The effectiveness of telepractice for speech-language pathology intervention with children younger than 12 years: A meta-analysis

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Data can be obtained by contacting the first author of the study.

ABSTRACT

Background: Since COVID-19, telepractice delivery has become increasingly integrated in the standard practice of speech-language pathologists and audiologists. It is therefore important to synthesize existing knowledge on this intervention modality. However, limited evidence exists regarding its use in children. This meta-analysis evaluated evidence on the effectiveness of telepractice compared to in-person intervention for children aged ≤ 12 years.

Method: A systematic search was conducted for systematic reviews, meta-analyses and randomized controlled trials comparing telepractice and in-person intervention for children ≤12 years. Eight databases were searched: PsychINFO, Linguistics and Language Behavior Abstracts (LLBA), Education Resources Information Center (ERIC), Web of Sciences, PubMed, Embase, the Joanna Briggs Institute (JBI) database, and Cumulative Index to Nursing and Allied Health Literature (CINAHL).

Results: Seven studies on speech-language pathology intervention met the inclusion criteria; no audiology studies could be included. Effect sizes were calculated for 31 outcomes reported across both conditions (telepractice and in-person intervention). Eight effect sizes were inverted, allowing all positive values to indicate favorable intervention outcomes. Overall, interventions resulted in moderate to high effects, with telepractice intervention resulting in equal or larger effect sizes compared to in-person intervention.

Conclusion: Telepractice intervention demonstrated outcomes comparable or better than in-person intervention across speech-language pathology subdomains. This applies to both child-related and caregiver-related outcomes, as well as for child-directed (typically for children ≥ 4

years) and caregiver-mediated approaches, where caregivers are trained to implement the strategies at home with their child. These findings suggest that telepractice intervention is an effective alternative to in-person intervention.

Key words: telepractice intervention, speech-language pathology, children

INTRODUCTION

Telepractice is an overarching term to define healthcare services provided through technology (1). Telepractice is most often implemented synchronously, involving real-time interactions between client, caregiver and clinician through audio or video connections (2,3). Asynchronous applications also exist, where client data are transmitted to the clinician for interpretation or exercises are provided for the client to complete independently. A combination of these methods, or a combination of in-person and telepractice intervention is referred to as hybrid telepractice.

During the COVID-19 pandemic, telepractice use expanded dramatically, requiring rapid adoption by both clinicians and clients (4). This rapid adoption was essential to ensure continuation of care under the exceptional circumstances. Beyond the pandemic, telepractice delivery has potential as a sustainable care delivery model, but its implementation requires a thorough understanding of the modality and supporting scientific evidence. It is also crucial to identify the populations for which telepractice intervention is appropriate. For example, its delivery differs for adults, adolescents and children, as each group has specific needs and requires tailored, age-appropriate care.

This study focuses on telepractice intervention for speech, language, swallowing and hearing problems in children up to 12 years of age. This age limit allows examination of challenges specific to telepractice intervention in a pediatric population, including intensive caregiver involvement and age-adjusted methods, e.g., shorter, more varied activities. Children represent a substantial proportion of speech-language pathology caseloads. The choice of 12 years coincides with a meaningful developmental and educational transition in the educational context (from primary to secondary education), often accompanied by increased independence

in learning and technology use. Adolescents typically demonstrate more autonomy and technologically proficiency, enabling participation in telepractice sessions with minimal adult support.

Furthermore, intervention goals and formats differ substantially between adults and children, with pediatric interventions relying heavily on play-based and behaviorally supported methods. The central role of caregivers in pediatric telepractice intervention, ethical considerations surrounding remote engagement with younger children (e.g., attention span, self-regulation), and the limited child-specific evidence underscore the need to examine this population separately.

Telepractice delivery offers several important advantages (5–8). Some interventions can be delivered more cost-effectively through telepractice compared to in-person intervention (9) although the difference is not always significant (10). While costs are not always clearly defined, telepractice intervention can reduce time spent on health care, session cancelations, costly transportation and unnecessary home visits (8). Another important advantage is improved access to specialized care, often cited as the main benefit of telepractice intervention (8). Since distance is not a barrier, clients can consult clinicians with specific expertise regardless of location. Clinicians also report enhanced collaboration with other professionals involved in the intervention (e.g., teachers) and stronger relationships with caregivers, who gain skills during telepractice intervention (5). Additionally, telepractice intervention provides tailored support within the child's home environment. This helps caregivers to effectively implement the intervention strategies at home.

Overall, caregivers of young children report high satisfaction with telepractice intervention (1,11–14). Some even prefer it over in-person intervention, citing greater convenience, reduced travel time, and better accommodation to family schedules (15,16). Respecting client preferences is a core principle of evidence-based practice (17). Clinicians who routinely offer clients the choice between in-person and telepractice intervention can better tailor intervention to the needs of their clients.

Synthesizing evidence across speech-language pathology subdomains can support clinicians in making evidence-based decisions about the use of telepractice intervention. Clinicians generally consider the implementation of evidence-based practice favorable when they feel adequately trained in its principles (18), but the translation of evidence into clinical practice is challenging when evidence is lacking or not immediately applicable to a specific client (19). Current research on the effectiveness of telepractice intervention in speech-language pathology largely focuses on the adult population (e.g., Scott et al., 2024) (20). Applying telepractice intervention to younger populations introduces unique challenges that limit the relevance of findings derived from adults. For instance, young children often require substantial support from their caregivers (parents) during telepractice intervention, and their engagement depends heavily on developmental and contextual factors (e.g., attention span, play-based interaction). In addition, consulting and applying existing evidence is time-consuming, and particularly challenging in clinical settings, where time constraints are common (19,20). Summarizing the existing evidence on telepractice intervention can help clinicians quickly find evidence applicable to their client or see broader trends, facilitating the integration of evidence into daily clinical practice.

This systematic review and meta-analysis are part of a larger project aimed at developing governmental guidelines for the efficient and optimal implementation of telepractice intervention in speech-language pathology and audiology for children up to 12 years (21). While the guideline provides detailed recommendations for specific interventions within this population, the current meta-analysis focuses on quantitatively synthesizing existing evidence on the effectiveness of telepractice intervention compared to in-person intervention for children ≤ 12 years.

METHODS

Search procedure

The systematic review process followed the *Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)* flowchart (22). A comprehensive systematic search was conducted across eight electronic databases to identify publications on the effectiveness of telepractice in children : 1) PsychINFO, 2) Linguistics and Language Behavior Abstracts (LLBA), 3) Education Resources Information Center (ERIC), 4) Web of Science, 5) PubMed, 6) Embase, 7) the Joanna Briggs Institute (JBI) database and 8) Cumulative Index to Nursing and Allied Health Literature (CINAHL) database. Search strings were tailored for each database (Appendix A), incorporating relevant MeSH terms where applicable and free-text terms limited to the title and abstract fields. If the database allowed for it, searches were restricted to English, French or Dutch and to peer-reviewed publications. Grey literature was also reviewed and relevant studies were included.

Inclusion and exclusion criteria

Eligible studies had to meet the following inclusion criteria: a) the study described the use of telepractice for intervention procedures in a speech-language pathology subdomain or

audiology, b) the study compared telepractice with in-person intervention, c) the study employed a randomized controlled trial design or were a systematic reviews or meta-analyses of randomized controlled trials, d) the study delivered telepractice intervention (at least partly) through real-time client-clinician interaction (synchronous or hybrid), e) the study targeted children ≤ 12 years of age, f) the study reported outcomes related to the effectiveness (e.g., improvement of the condition, quality of life, functioning and participation to society), g) the study involved audiologists or speech-language pathologists as care providers, h) the study is written in English, Dutch, or French, and i) published in a peer-reviewed journal, j) between January 1st, 2002 and December 8th, 2022. We chose the time frame of the past two decennia because telepractice intervention has been increasingly adopted globally during this period. Studies were excluded if they only focused on caregiver training without child involvement, applied only asynchronous telepractice intervention, described telepractice intervention for training health professionals, were non-peer reviewed (e.g., editorial letters, unpublished theses), and lacked empirical data (e.g., narrative reviews). Figure 1 provides an overview of exclusion reasons and the number of studies that were excluded per criterion.

Study selection

Several steps were undertaken to select eligible studies. The initial search resulted in a total of 17 404 studies. After removing duplicates using the *Zotero* software package (23), 11 518 studies remained. A two-step screening process was then applied. In the first step, titles and abstracts were independently screened by at least two raters using the Rayyan web application. (24). One co-author (main rater) screened all studies, while three other co-authors and two undergraduate speech-language students each blindly screened a proportion of studies. The first 10 studies were screened jointly for training purposes. Subsequently, the five raters screened their first 1,000 studies independently. Disagreements with the main rater were

resolved through discussion until consensus was reached. Inter-rater reliability reached 90% for each pair (Table 1). The remaining 5,898 studies were divided among the five raters, with all also screened by the main rater. Disagreements were discussed within pairs. In the second step, the 1,089 remaining studies were screened on the full text. The main rater screened all studies. Three secondary raters collectively screened 45% of the studies, leaving 55% screened only by the main rater. Doubts were resolved through discussion. The main exclusion reasons were absence of telepractice intervention and lack of efficacy outcomes. Other exclusion reasons are detailed in the PRISMA flowchart (Figure 1). An additional step was conducted due to uncertainties identified by the main rater during full-text screening on the portion that was not screened by two raters. Discussion between the main rater and the first and last authors led to the exclusion of studies with incorrect design and low quality. Ultimately, nine studies were considered eligible for quality appraisal. Figure 1 provides a detailed overview of this process.

Table 1.

Inter-rater reliability of the title and abstract screening phase

Raters	Articles (N)	Conflicts (N)	Percentage of conflicts (%)	IRR (%)
MR – ER1	1035	63	6	94
MR – ER2	1031	75	7	93
MR – ER3	1035	58	6	94
MR – ER4	1265	126	10	90
MR – ER5	1244	122	10	90

Note. MR = Main Rater. ER1 – ER5 = Extra rater 1 – Extra rater 5.

Quality appraisal

The nine eligible studies were all randomized controlled trials comparing telepractice intervention with in-person intervention. Quality appraisal was established with the randomized controlled trial checklist of the Joanna Briggs Institute (25,26) which consists of 13

closed-ended questions evaluating scientific rigor of a study. Studies with a positive evaluation on more than half of the items were included in this meta-analysis.

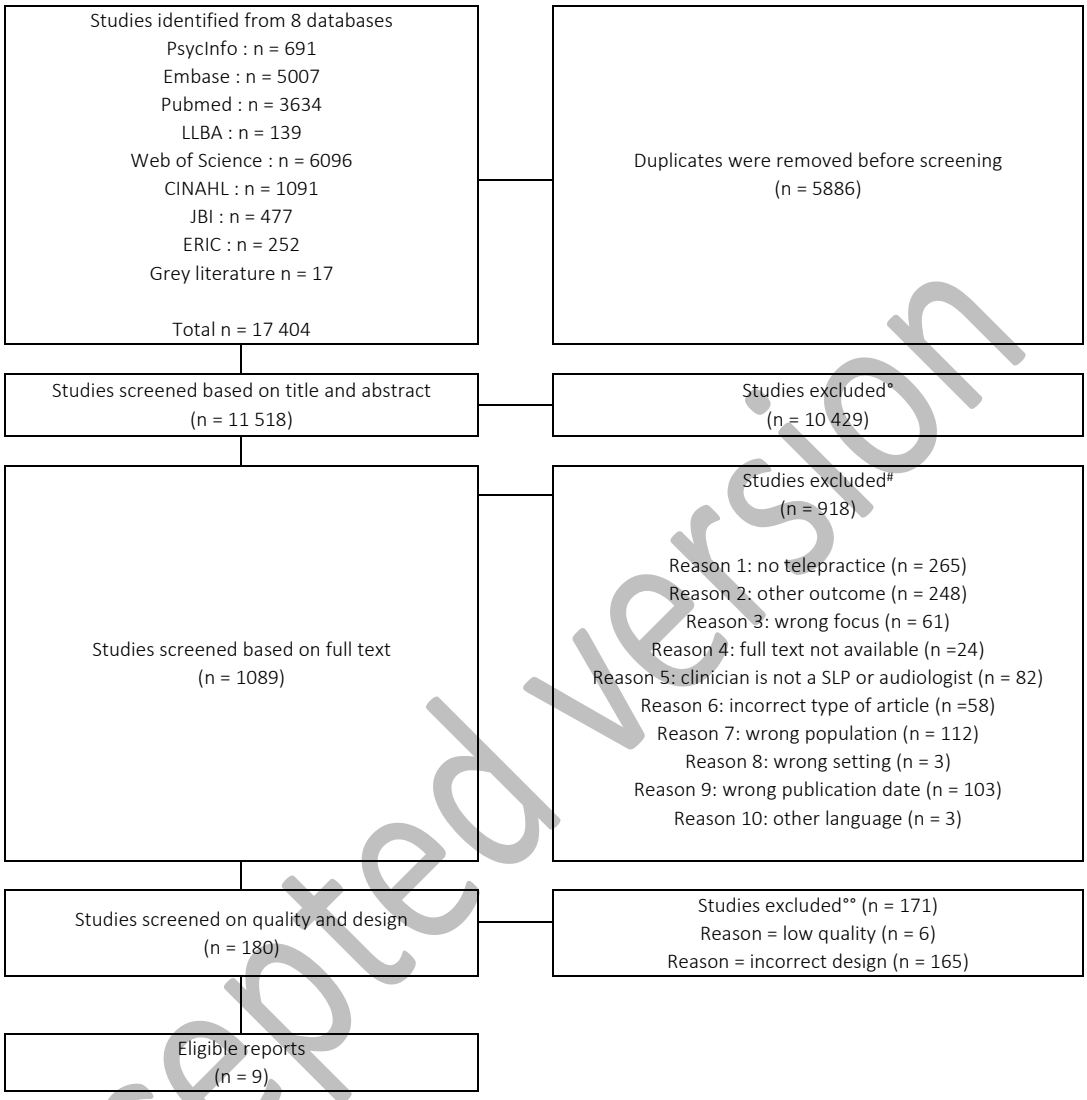
The second, third and last author performed the appraisal. The main appraiser (second author) evaluated all studies while the third and last author each appraised half of the records. Each study was independently evaluated by the main appraiser and one secondary appraiser. Disagreements were resolved through discussion until consensus was reached for each item on the checklist. When necessary, a third appraiser (first author) was consulted. No studies were excluded because of poor quality appraisal, resulting in nine eligible studies for data extraction.

Data extraction and coding

Data extraction was performed by the second, third and last author. The following study characteristics were extracted from each study: title, author, year of publication, research design, age of participants, sample size, type of population receiving care, country of study, person providing care, control condition, telepractice intervention details, intervention dosage, trial duration, drop-out rate, and findings related to effectiveness. Authors of five studies were contacted to obtain missing data or to require clarify procedure. Two studies were excluded at this stage, because the requested data could not be provided or authors did not respond, leaving seven randomized control trials in speech-language pathology subdomains for inclusion in the meta-analysis. Relevant characteristics of these seven studies are presented in Table 2. Across these studies, effect sizes for 31 outcome measures were extracted for in-person intervention and for telepractice intervention. The number of effect sizes per study ranged from one to eight. Details of the 31 outcome measures are presented in Table 2.

Figure 1.

PRISMA flowchart



° Exclusion based on irrelevant content; # Sum is more than total N as some studies were excluded based on more than 1 reason; °° This step was taken due to uncertainties of the main rater during full-text screening. General note: the numbers reported in this PRISMA flowchart differ slightly from those in the guideline because this meta-analysis includes only a subset of the studies.

Based on: Page M. J. et al., (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. British Medical Journal, n71. https://doi.org/ 10.1136/bmj.n71

Statistical analysis

The DerSimonian-Laird random-effects model (27) was used for meta-analyzing the Standardized Mean Difference (SMD) effect sizes, using the JAMOVI statistical software package (28). Cook's distances were examined to detect overly influential effect sizes, i.e., defined as

values exceeded the median plus six times the interquartile range of the Cook's distance. Outliers were further assessed using studentized residuals. A study was considered an outlier if its studentized residual was larger than the 100 x (1 - .05/(2 x k))th percentile range of a standard normal distribution. Effect sizes for 31 outcome measures across both conditions (telepractice intervention and in-person intervention) were analyzed, resulting in 62 effect sizes. Eight of these effect sizes were inversed to align with the other 23 effect sizes, so that positive values indicated favorable intervention outcomes. Funnel plot asymmetry was tested by Egger's regression to visualize the relationship between individual study effect sizes and their precision and therefore detecting potential publication bias. If funnel plot asymmetry was observed, the analyses were re-run after removing the studies contributing most to this asymmetry to investigate its impact.

The overall intervention effect was first evaluated by pooling all 62 effect sizes. Then, as mentioned previously, intervention modality was examined by adding it as a categorical variable (two levels: telepractice intervention and in-person intervention). Subsequently, the intervention effects were analyzed separately for each modality.

RESULTS

Results for the overall intervention effect sizes are presented first, followed by results for effect sizes by modality (i.e., telepractice versus in-person intervention). Characteristics of the individual studies, including the 62 outcomes measures included in the meta-analysis, are provided in Table 2.

Overall intervention effect

The overall effect of the 62 outcome measures (combining both telepractice and in-person intervention) was investigated. The random-effects model indicated a Standardized Mean Difference (SMD) of = 0.717 (z = 9.220, $p < .001$, SE = 0.078, 95% CI: 0.565 to 0.870), with 95% of effect sizes being positive, indicating an overall moderate positive intervention effect. Substantial heterogeneity was observed (I^2 = 63.75%; Q = 168.30, $p < .001$), with moderate between-study variance ($\tau^2 = 0.23$). No funnel plot asymmetry was detected ($p = .093$).

Table 2.
Study characteristics

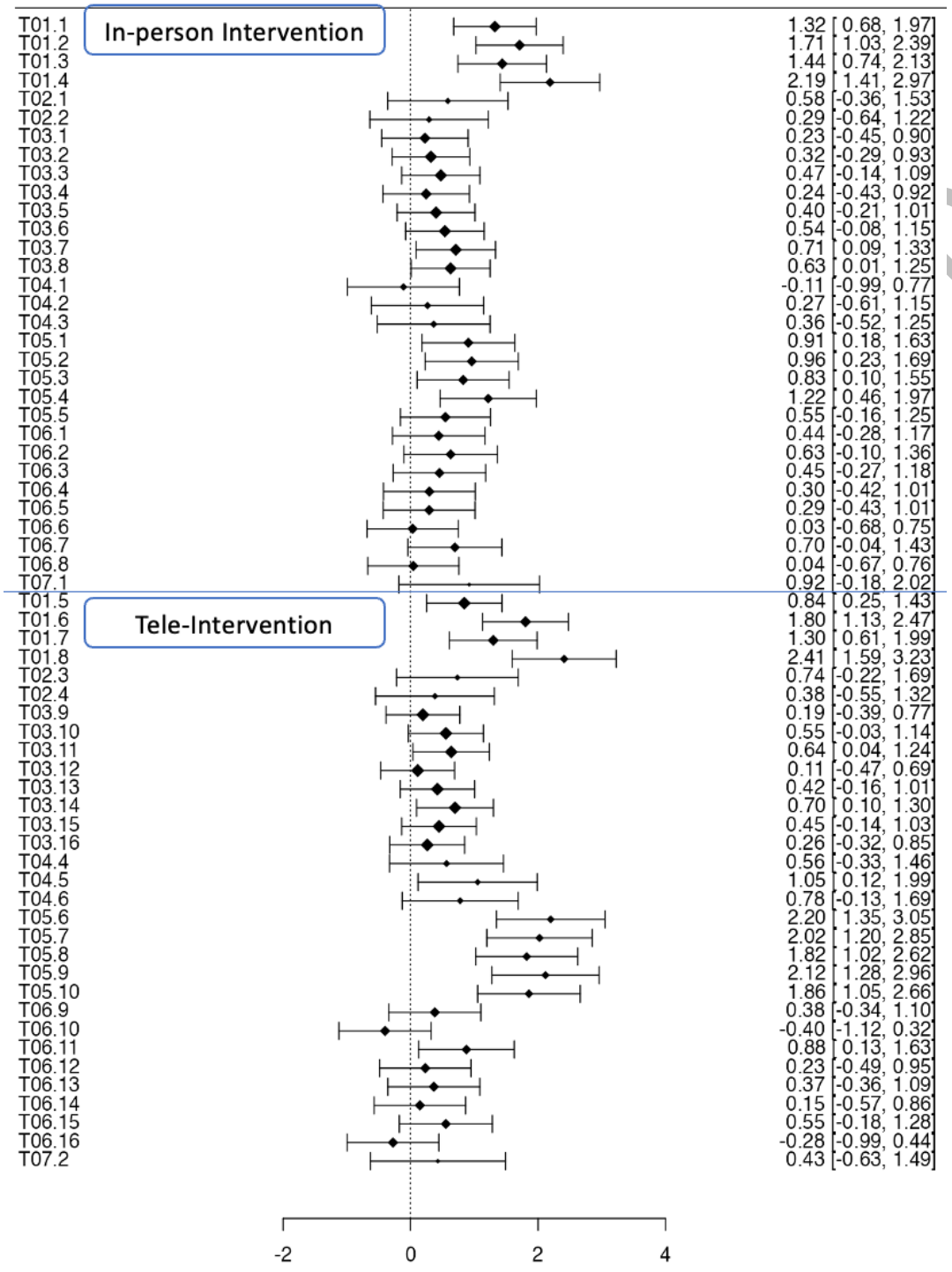
Authors	Design study	Participants	Number of participants	Objectives	Effect outcomes, moment of assessment (post-randomization), direction of scores and statistical results
Bridgman et al., 2016 (9) (T01)	Randomised controlled trial, parent-mediated	Parents and preschool age children who stutter (3-5 years 11 months)	N = 49 Telepractice (n = 25), in-person (n = 24)	This study compared the standard Lidcombe Program intervention with the experimental webcam Lidcombe Program.	Child outcome 1: %Syllables Stuttered at 9 months (lower is better)[#] IP: SMD = 1.32, 95% CI [0.68 to 1.97] – TP: SMD = 0.84, 95% CI [0.25 to 1.43] Child outcome 2: Severity Rating at 9 months (lower is better)[#] IP: SMD = 1.71, 95% CI [1.03 to 2.39] – TP: SMD = 1.80, 95% CI [1.13 to 2.47] Child outcome 3: %Syllables Stuttered at 18 months (lower is better)[#] IP: SMD = 1.44, 95% CI [0.74 to 2.13] – TP: SMD = 1.30, 95% CI [0.61-1.99] Child outcome 4: Severity Rating at 18 months (lower is better)[#] IP: SMD = 2.19, 95% CI [1.41 to 2.97] – TP: SMD = 2.41, 95% CI [1.59-3.23]
Lau et al., 2022(28) (T02)	Randomised controlled trial, parent-mediated	Parent and children with ASD or other developmental disorders, the average age of the children was 4.4 years (SD = 1.4; range = 2–7).	N = 34, ELearning (n = 9), telepractice (n = 7), in-person (n = 9), wait-list control (n = 9).	This study explored the acceptability and feasibility of the World Health Organization's Caregiver Skills Training Programme in alternative delivery modes during and post COVID-19 period.	Only the outcomes of the videoconferencing and in-person group were included in the meta-analysis. Child outcome 1: Strengths and Difficulties Questionnaire – Difficulties at 10 weeks (lower is better)[#] IP: SMD = 0.58, 95% CI [-0.36 to 1.53] – TP: SMD = 0.74, 95% CI [-0.22 to 1.69] Child outcome 2: Strengths and Difficulties Questionnaire – Prosocial Scale at 10 weeks (higher is better) IP: SMD = 0.29, 95% CI [-0.64 to 1.22] – TP: SMD = 0.38, 95% CI [-0.55 to 1.32]
Sweeney et al., 2020(29) (T03)	Randomised controlled trial, parent-mediated	Parents and pre-school children with cleft palate	N = 44, Telepractice (n = 23), in-person (n = 21)	Parents, in the parent-trained group (n=23), attended 2 days' training, received a detailed speech therapy program, and undertook intervention over 12 weeks supported by the cleft specialist SLT using FaceTime and one in-person session. In the control arm (n=21), parent–child dyads received six therapy sessions over 12 weeks with a research SLT, comparable with usual care. Speech recordings were undertaken pre- and post-intervention.	Child outcome 1: Percent Consonants Correct in words at 6 weeks (higher is better) IP: SMD = 0.23, 95% CI [-0.45 to 0.90] – TP: SMD = 0.19, 95% CI [-0.39 to 0.77] Child outcome 2: Percent Consonants Correct in words at 12 weeks (higher is better) IP: SMD = 0.32, 95% CI [-0.29 to 0.93] – TP: SMD = 0.55, 95% CI [-0.03 to 1.14] Child outcome 3: Percent Consonants Correct in words at 2 months post-intervention (higher is better) IP: SMD = 0.47, 95% CI [-0.14 to 1.09] – TP: SMD = 0.64, 95% CI [0.04 to 1.24] Child outcome 4: Percent Consonants Correct in phrases at 6 weeks (higher is better) IP: SMD = 0.24, 95% CI [-0.43 to 0.92] – TP: SMD = 0.11, 95% CI [-0.47 to 0.69] Child outcome 5: Percent Consonants Correct in phrases at 12 weeks (higher is better) IP: SMD = 0.40, 95% CI [-0.21 to 1.01] – TP: SMD = 0.42, 95% CI [-0.16 to 1.01] Child outcome 6: Percent Consonants Correct in phrases at 2 months post-intervention (higher is better) IP: SMD = 0.54, 95% CI [-0.08 to 1.15] – TP: SMD = 0.70, 95% CI [0.10 to 1.30] Child outcome 7: Intelligibility in Context Scale (ICS) at 12 weeks (higher is better) IP: SMD = 0.71, 95% CI [0.09 to 1.33] – TP: SMD = 0.45, 95% CI [-0.14 to 1.03] Child outcome 8: Focus on the Outcomes of Communication Under Six (FOCUS) at 12 weeks (higher is better) IP: SMD = 0.63, 95% CI [0.01 to 1.25] – TP: SMD = 0.26, 95% CI [-0.32 to 0.85]
Wainer et al., 2021(30) (T04)	Randomised controlled trial,	Parents and young children with ASD, between 18-60 months, mean 40.10	N = 20 Telepractice (n = 10), in-person (n = 10)	Comparison between digital parent mediated intervention online reciprocal imitation training (RIT; a naturalistic developmental behavioral	Parent outcome 1: Early Intervention Parenting Self-Efficacy Scale (EIPSES) at 15 weeks (higher is better) IP: SMD = -0.11, 95% CI [-0.99 to 0.77] – TP: SMD = 0.56, 95% CI [-0.33 to 1.46]

	parent-mediated	months in telepractice group, 35.40 in in-person group.		intervention) and a treatment as usual (TAU) control on parent and child outcomes. The acceptability and feasibility of TAU RIT and the Online RIT digital intervention were rated highly.	Child outcome 1: Social Communication Checklist (SCC) at 15 weeks (higher is better) IP: SMD = 0.27, 95% CI [-0.61 to 1.15] – TP: SMD = 1.05, 95% CI [0.12 to 1.99] Child outcome 2: Unstructured Imitation Assessment (UIA) at 15 weeks (higher is better) IP: SMD = 0.36, 95% CI [-0.52 to 1.25] – TP: SMD = 0.78, 95% CI [-0.13 to 1.69]
Cameron & Hutchison, 2009(31) (T05)	Randomised controlled trial, child-directed	Typically developing children, from Kindergarten/grade 1: 5.68 years (SD = 0.62) range: 4.75 – 6.67 years and from Grade 2: 7.14 years (SD = 0.37) range: 6.75 – 8.08 years	N = 33 Telepractice (n = 16), in-person (n = 17)	This study investigated the effects of an intensive telephone training on oral narratives compared to in-person interchanges.	Child outcome 1: Number of utterances at 4 weeks (higher is better) IP: SMD = 0.91, 95% CI [0.18 to 1.63] – TP: SMD = 2.20, 95% CI [1.35- to 3.05] Child outcome 2: Number of words at 4 weeks (higher is better) IP: SMD = 0.96, 95% CI [0.23 to 1.69] – TP: SMD = 2.02, 95% CI [1.20 to 2.85] Child outcome 3: Number of different words at 4 weeks (higher is better) IP: SMD = 0.83, 95% CI [0.10 to 1.55] – TP: SMD = 1.82, 95% CI [1.02 to 2.62] Child outcome 4: Narrativity at 4 weeks (higher is better) IP: SMD = 1.22, 95% CI [0.46 to 1.97] – TP: SMD = 2.12, 95% CI [1.28 to 2.96] Child outcome 5: Goal-directed content at 4 weeks (higher is better) IP: SMD = 0.55, 95% CI [-0.16 to 1.25] – TP: SMD = 1.86, 95% CI [1.05 to 2.66]
Cancer et al., 2021(32) (T06)	Randomised controlled trial, child-directed	Children with specific reading disorder, aged between 8 and 13 years (M = 9.89; SD = 1.31;)	N = 30 Telepractice (n = 15), in-person (n = 15)	RCT with 2 groups of children with reading disability. Both children received the same intervention program on a computer, with in the in-person group the therapist sitting with the child facing the same screen and in the case of the telepractice group, the child and therapist connecting through videoconferencing and the therapist sharing her screen with the child.	Child outcome 1: Word reading accuracy at 10 weeks (higher is better) IP: SMD = 0.44, 95% CI [-0.28 to 1.17] – TP: SMD = 0.38, 95% CI [-0.34 to 1.10] Child outcome 2: Word reading speed at 10 weeks (lower is better)[#] IP: SMD = 0.63, 95% CI [-0.10 to 1.36] – TP: SMD = -0.40, 95% CI [-1.12 to 0.32] Child outcome 3: Nonword reading accuracy at 10 weeks (higher is better) IP: SMD = 0.45, 95% CI [-0.27 to 1.18] – TP: SMD = 0.88, 95% CI [0.13 to 1.63] Child outcome 4: Nonword reading speed at 10 weeks (lower is better)[#] IP: SMD = 0.30, 95% CI [-0.42 to 1.01] – TP: SMD = 0.23, 95% CI [-0.49 to 0.95] Child outcome 5: Text reading accuracy at 10 weeks (higher is better) IP: SMD = 0.29, 95% CI [-0.43 to 1.01] – TP: SMD = 0.37, 95% CI [-0.36 to 1.09] Child outcome 6: Text reading speed at 10 weeks (lower is better)[#] IP: SMD = 0.03, 95% CI [-0.68 to 0.75] – TP: SMD = 0.15, 95% CI [-0.57 to 0.86] Child outcome 7: Rapid automatized naming in seconds at 10 weeks (higher is better) IP: SMD = 0.70, 95% CI [-0.04 to 1.43] – TP: SMD = 0.55, 95% CI [-0.18 to 1.28] Child outcome 8: Rapid automatized naming in number of errors at 10 weeks (lower is better)[#] IP: SMD = 0.04, 95% CI [-0.67 to 0.76] – TP: SMD = -0.28, 95% CI [-0.99 to 0.44]
Grogan-Johnson et al., 2013(33) (T07)	Randomised controlled trial, child-directed	Children with speech sound disorders, 6-10 years, with a mean age for the participants in the telepractice group of 8.4 years with a range of 6.4 to 9.9 years, and 9.0 years with a range of 7.9 to 10.0 years in the in-person group.	N = 14 Telepractice (n = 7), in-person (n = 7)	This study explored the effects of a 5-week speech sound intervention delivered in-person with therapy delivered via telepractice in school-aged children with speech-sound disorders. Moreover, video and audio quality as well as intervention fidelity was assessed.	Child outcome 1: Goldman-Fristoe Test of Articulation (GFTA-2) at 5 weeks (higher is better) IP: SMD = 0.92, 95% CI [-0.18 to 2.02] – TP: SMD = 0.43, 95% CI [-0.63 to 1.49]

[#] These scores were inversed in the meta-analysis to have the same direction as the other outcomes; IP = in-person intervention; TP = Telepractice intervention.

Figure 2.

Standardized Mean Difference effect sizes for all extracted outcomes both in-person and telepractice intervention in a random effects model



Note: The left column refers to the specific study (e.g., T01) and the different outcomes within each study (e.g., the two outcomes T01.1 and T01.2 for study T01). Table 2 lists the specific outcome labels. The right column refers to the Standardized Mean Difference effect size per outcome measure, and its confidence interval. The dotted vertical line represents the line of no effect (effect size = 0). Points and confidence intervals positioned to the right suggest a positive effect; those to the left suggest a negative effect. The size of each diamond reflects the weight assigned to the study in the meta-analysis, with larger diamonds indicating greater weight.

Effect of intervention by modality

The random-effects model indicated that intervention modality had a significant effect on outcomes, with a SMD of 0.150 (z = 0.961, $p < .001$, SE = 0.157, 95% CI: -0.156 to 0.457). Telepractice intervention resulted overall in larger effect sizes, although the 95% CI includes a negative lower bound. A negative bound indicates that the effect could be slightly negative, favoring in-person over telepractice intervention, or zero, demonstrating no difference between both modalities. So, although the difference was small, the effect sizes for telepractice intervention seemed to be significantly larger than the effect sizes for in-person intervention. The 95% CI negative lower bound, however, indicates that the evidence is not strong despite its statistical significance. Driven by these results, in addition to the observed heterogeneity between the studies, the intervention effects were further investigated within each modality.

For in-person intervention intervention, the meta-analysis showed a moderate effect size with a SMD of 0.643 (z = 7.159, $p < .001$, SE = 0.090, 95% CI: 0.467 to 0.819), with 97% of estimates positive. Outcomes were heterogeneous ($I^2 = 45.41\%$; $\tau^2 = 0.11$; Q = 54.96, $p = .003$). One effect size was overly influential according to Cook's distances. Removing this effect size did not change results but decreased heterogeneity ($I^2 = 26.61$ and $\tau^2 = 0.05$; SMD = 0.598, $p < .001$). Overall, interventions delivered in-person resulted in a noticeable improvement in outcome measures, indicating reasonable effectiveness.

For telepractice intervention, a large effect size was observed (SMD = 0.801; z = 6.262, $p < .001$, SE = 0.128, 95% CI: 0.550 to 1.051) with 94% of estimates positive. Heterogeneity and between-study variance were substantial ($I^2 = 73.30\%$; $\tau^2 = 0.36$; Q = 112.37, $p < .001$). Overall, telepractice intervention demonstrated a strong improvement in outcome measures.

DISCUSSION

As telepractice intervention becomes increasingly integrated into daily practice as an alternative to in-person intervention, the necessity emerged to consolidate existing evidence on its use with children in the subdomains of speech-language pathology and audiology. This study quantitatively synthesized evidence on the effectiveness of telepractice intervention compared to in-person intervention in pediatric populations. No audiology studies could be included.

The seven included studies demonstrated positive intervention effects with moderate effect sizes overall, regardless of modality (telepractice or in-person intervention) and across various outcomes and intervention durations. This finding is expected, as targeted interventions typically improve outcome measure. Given the scarcity of meta-analyses in speech-language pathology, the overall intervention results are noteworthy.

When comparing modalities, telepractice intervention showed a large effect size, significantly greater than in-person intervention. Most individual studies, however, reported no significant difference between speech pathology interventions delivered via telepractice compared to in-person interventions (9,29–31,33,34). These studies were conducted across speech-language pathology subdomains and assessed different outcomes with varying levels of evidence, from proof-of-concept trials where modalities were not directly comparable (31), to rigorous randomized controlled trials with highly comparable conditions. (33,34)

The study by Cameron and Hutchison (32) reported highly favorable outcomes for telepractice intervention delivered through telephone. Even though this was the only study using audio rather than video interaction, it was included because telepractice intervention is defined as (also) including audio-based interactions (2). In this study, children were trained to perform successive approximations of detached expression either in-person or by telephone. The results

may suggest that this skill set is particularly suitable to telepractice intervention since decontextualization occurs more naturally when visual cues (e.g. non-verbal signs of the clinician) are absent. Interestingly, when performing the analysis without this study, similar findings were still observed.

One study compared a hybrid approach with an in-person–intervention (30). In the hybrid approach, parent received a two-day training in-person, followed by telepractice intervention. This was the only study using a hybrid approach, combining in-person and telepractice intervention.

Overall, the positive outcomes of telepractice intervention reported in the individual studies, yielding results that are comparable to or better than in-person intervention, were confirmed in this meta-analysis. While in this study only randomized controlled trials were included, these results align with results from non-randomized controlled trials and numerous other studies investigating telepractice intervention in children, which have similarly reported promising findings (35–39). This meta-analysis covered treatment intervention across speech-language pathology subdomains, including *caregiver-mediated* approaches for stuttering (T01), speech sound training in children with cleft palate (T03), and language and communication in children with ASD (T02-4). It also included studies focusing on *child-directed* approaches for oral narrative training (T05), reading (T06) and speech sound training (T07). Outcome measures included both child-related and caregiver-related outcomes. It is likely that the observed trend of telepractice intervention resulting in similar or better results than in-person intervention can be generalized to other treatment approaches beyond those included in this meta-analysis.

The careful conclusion that telepractice intervention in pediatric speech-language pathology generally results in outcomes at least similar to, and potentially better than, in-person

intervention can support clinicians in making evidence-based decisions about intervention modality, particularly when exact matching evidence for a specific client is lacking. Fulcher-Rood et al. (19) noted that clinicians often find it challenging to bridge the evidence-to-practice gap. Stating this, clinical judgement remains essential in determining when and for whom telepractice intervention can be proposed as an alternative to in-person intervention. In addition, client preference about intervention modality should be respected. (29) Integrating these considerations aligns with the three pillars of evidence-based practice: research evidence, clinical expertise and client values. (40)

The previously developed guideline on telepractice intervention with children by the authors of this paper (21) addresses broader clinical questions beyond the research question of this meta-analysis, i.e. whether telepractice intervention is an effective alternative to in-person intervention. While this meta-analysis provides a more detailed answer to that specific question, the guideline offers practical recommendations for clinical implementation. Clinicians can download the guideline free of charge in English, French or Dutch to consult these recommendations.

This meta-analysis is the first to synthesize speech-language pathology studies comparing telepractice and in-person intervention in children. By exclusively including randomized controlled trials, systematic comparison of the two modalities for each outcome measure was ensured.

This meta-analysis has its limitations. Combining outcomes from different speech-language pathology subdomains with a relatively small number of effect sizes (n = 31 per modality), introduced heterogeneity in the true effect. Final results, however, were not impacted by outliers. This heterogeneity likely reflects differences in study populations, subdomains and

outcome measures, of which some focused on the child and some on the caregivers. Given the broad scope of this study, such heterogeneity was expected.

Future research should explore modality effects within specific subdomains of speech-language pathology and audiology. The need is particularly present in audiology, as eligible audiology studies were excluded due to missing data. Continued randomized controlled trials comparing in-person and telepractice intervention are essential to confirm the cautious conclusion drawn in this study. Finally, while this study highlights the potential of telepractice intervention, its role in assessments and diagnostics remains to be determined.

CONCLUSION

This meta-analysis systematically compared telepractice and in-person intervention in pediatric populations, yielding promising findings. Across speech-language pathology subdomains, telepractice intervention in children demonstrated outcomes similar to or surpassing outcomes of in-person intervention, positioning it as an effective alternative to in-person intervention in several speech-language pathology subdomains. This trend suggests that telepractice intervention may have broader applicability beyond the subdomains included in this review. Clinicians should, however, apply clinical judgement and consider client preferences when deciding whether to offer telepractice intervention as an option alongside in-person intervention.

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