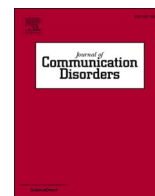


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Stuttering interventions for children, adolescents, and adults: a systematic review as a part of clinical guidelines

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ABSTRACT

Introduction: Stuttering may have a holistic effect on the quality of life of a person who stutters by limiting participation in social situations, resulting in feelings of isolation and frustration, leading to difficulties in education and employment and increasing the likelihood of mental health problems. Even young children who stutter may have negative experiences of speaking. Therefore, it is important to treat stuttering behavior effectively in both children and adults. The purpose of this paper was to systematically review group and case studies about the effectiveness of behavioral stuttering interventions to provide evidence-based guidelines for clinicians.

Methods: Systematic data retrieval was conducted in four electronic databases (PsycINFO, CINAHL, PubMed, Cochrane). The assessment of search results was conducted according to predetermined inclusion and exclusion criteria by two independent judges. The methodological quality of each paper was assessed using strict criteria to include only high-quality research.

Results: The search revealed 2293 results, and 38 papers (systematic reviews N=3, group design studies N=21 and case studies N=14) with acceptable methodological quality were included. The data show that there is most evidence about the treatment of early childhood stuttering, very little evidence about school-aged children and some evidence about adults. The most convincing evidence is about the Lidcombe Program in the treatment of young children who stutter, but also other methods have promising evidence. Our data imply that in the treatment of adults who stutter, holistic treatments may influence speech fluency and overall experience of stuttering behavior. Speech restructuring treatments may have a positive effect on overt characteristics of stuttering, but not on covert stuttering behavior.

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Conclusions: The results of this review agree with earlier reviews about the treatment of young children. However, due to different inclusion criteria, this review also shows the benefits of holistic treatment approaches with adults and adolescents.

1. Introduction

Stuttering is characterized by repetitions or prolongations of sounds, syllables, or words, or by hesitations or pauses that disrupt the rhythm of speech, according to the International Classification of Diseases 10 (ICD-10; [World Health Organization, WHO, 2016](#)). The forthcoming ICD-11 includes a more comprehensive description of stuttering ([WHO, 2019](#)), that resembles the definition in the Diagnostic and Statistical Manual of Mental disorders fifth edition (DSM-5). In DSM-5 the definition of a childhood-onset fluency disorder (315.35) also includes blocking and avoidance or substitution of words. Furthermore, it recognizes the effects of stuttering on social communication, personal, family, educational, occupational, or other important areas of functioning ([American Psychiatric Association, 2013](#)). Moreover, the International Classification of Functioning, Disability and Health (ICF) provides a more holistic description of stuttering compared to the ICD-10 and considers the structures and functions of the body, how individual and environmental factors affect stuttering and how these factors influence activity and participation ([WHO, 2001](#); [Yaruss & Quesal, 2004](#); [Yaruss, 2007](#)).

Recent studies on the effects of stuttering have revealed the multifaceted nature of stuttering more deeply (see e.g., [Gerlach et al., 2018](#); [Iverach, Jones et al., 2009, 2009b, 2010](#); [Iverach & Rapee, 2014](#)). As early as at the age of three years, a child may have more negative experiences around speaking than fluent peers ([Vanryckeghem et al., 2005](#)) and in preschool stuttering has the potential to provoke negative peer responses ([Langevin et al., 2009](#)). Adolescents who stutter have reported being teased or bullied and having communication competence below average ([Erickson & Block, 2013](#)). Parents of children who stutter experience feelings of helplessness, uncertainty, fear, and difficulties managing their child's frustration, have concerns about academic performance, and feel empathy for their child ([Erickson & Block, 2013](#); [Plexico & Burrus, 2012](#)). Even before an overt dysfluency of speech occurs, a person who stutters (PWS) may feel stuck or helpless ([Tichenor & Yaruss, 2018, 2019](#)), and start to avoid speaking because of stuttering ([Lowe et al., 2017](#)). Thus, stuttering may limit a speaker's ability to participate in conversations, result in feelings of loneliness and isolation, lead to problems in social interaction, create a sense of helplessness, and be accompanied by social anxiety (see e.g., [Iverach et al., 2017](#); [Manning & DiLollo, 2018, 188–189](#); [Yaruss, 2007](#)). For adults who stutter, communicative participation is predicted by self-esteem, self-efficacy, and social support in addition to the severity of speech disfluencies ([Boyle et al., 2018](#)). In fact, self-efficacy is a positive predictor of the quality of life for PWS, while a high frequency of stuttering, on the other hand, is a negative predictor of self-efficacy ([Carter et al., 2017](#)). Moreover, speech fluency and self-confidence have been reported to be inextricably related ([Carter et al., 2019](#)). Therefore, stuttering may have a profound negative emotional, behavioral, and cognitive impact on a speaker's life regardless of the age of the PWS ([Carter et al., 2017](#); [Guttormsen et al., 2021](#); [Tichenor & Yaruss, 2018, 2019](#); [Werle et al., 2021](#); [Yaruss, 2007](#)).

Because of the multifaceted aspects of stuttering, the assessment and, more importantly, the treatment of stuttering, cannot focus solely on the overt aspects of stuttering behavior. A comprehensive description of assessment is outside the scope of this review. In brief, experienced clinicians suggest that the assessment of stuttering should include the speaker's reactions, as well as reactions by people in the speaker's environment, adverse impact caused by stuttering, stuttering-related background information, speech, language and temperament development, and speech fluency ([Brundage et al., 2021](#)). The goals of the treatment may relate to speech fluency, emotional functioning, activity and participation, and understanding one's stuttering, as described by PWS themselves ([Sønsterud, Feragen, Kirmess, Halvorsen & Ward, 2019](#)).

The treatment of stuttering has a long and innovative history, as multiple methods have sought to help PWS. During the past one hundred years, numerous different therapy methods have been developed, and some are still widely used today, such as Van Riper's Iowa Method (e.g., [Boberg & Kully, 1989](#)). However, to date, no gold standard treatment approach exists for all PWS. The lack of a consensus on treatment and limited education about stuttering, together with the fact that they seldom encounter PWS may contribute to some clinicians having low levels of knowledge about stuttering ([Quesal & Yaruss, 2010](#); [Yaruss et al., 2017](#)). Moreover, clinicians may have negative attitudes toward PWS ([Crichton-Smith et al., 2003](#); [Walden et al., 2020](#)), uncertainty about suitable treatment approaches ([Crichton-Smith et al., 2003](#); [Kelly et al., 2020](#); see also [Quesal & Yaruss, 2010](#)) and moderate levels of self-efficacy in conducting holistic treatments targeting overt and covert stuttering and the counseling environment ([Beita-Ell & Boyle, 2020](#)). Many clinicians in different countries could benefit from treatment guidelines, but to our knowledge, only a few guidelines have been published internationally ([Neumann et al., 2017](#); [Pertjts et al., 2014](#); [Starkweather et al., 1993](#); [Taylor-Goh, 2005](#)). Unfortunately, some of them are outdated, some are not available to all clinicians or not peer-reviewed, and some suffer from methodological weaknesses. This review could provide clinicians a compact first aid kit for stuttering treatment by summarizing the effectiveness of behavioral stuttering interventions and, in addition, increasing confidence in choosing among different treatment approaches.

Stuttering therapy may be indirect or direct (see e.g., [Bernstein Ratner, 2018](#); [Shenker & Santayana, 2018](#)). Indirect treatment for children who stutter targets working with the parents without demanding the child modifies their speech, whereas direct treatment focuses on working with the child. The RESTART-DCM treatment aims to achieve a balance between the communication demands and the child's motoric, linguistic, socio-emotional, and/or cognitive skills and capacities ([Franken & Laroes, 2021](#)). This is established by both working with the parents by lowering demands and increasing the child's capacities. The Palin PCI treatment aims at reducing a child's stuttering with interaction strategies (such as following the child's lead, balancing the parent's speech rate to the child's rate,

pausing, establishing eye contact) and family strategies (such as special times, openness about stuttering, turn-taking, building confidence; Kelman & Nicholas, 2017). It is also possible to combine indirect and direct components of treatment based on individual needs. For example, in the later stages of the Palin PCI, child strategies (such as easy onsets, rate reduction and pausing) are included (Kelman & Nicholas, 2017). In addition, Yaruss et al., and Hammer (2006) describe a family-focused treatment approach for preschool children. This treatment is both indirect and direct including parent communication modifications, parent and child understanding, and acceptance of stuttering and child communication modification.

Direct treatments have been developed for PWS of all ages and they may focus on, for example, the modification of speech fluency, or the perceptions, acceptance, or emotions related to stuttering. Several methods for young children aim at fluent speech and focus on overt stuttering. The extensively studied Lidcombe Program (LP, Onslow et al., 2020) is a direct, operant stuttering treatment, where the child's parents are guided to give verbal contingencies according to the fluency of the child's speech. Extended length of utterance (Ingham, 1999) or a gradual increase in the length and complexity of utterance (Ryan & Van Kirk, 1978) establish fluent speech by systematically increasing the length of the utterance. Syllable timed speech or the Westmead Program (Trajkovski et al., 2009; Trajkovski, 2012) aims for fluency by producing each syllable in a rhythm. Treatments may also use elements such as speech rate, easy onset, breathing, pausing, and phrasing to improve fluency (e.g., Reitzes, 2006; fluency rules for children, Runyan & Runyan, 1986).

Direct, speech restructuring treatments for adults mainly target speech fluency. The Camperdown Program increases fluency by modifying speech rate (O'Brian et al., 2018) as well as different other variations of prolonged/smooth speech (see e.g., Onslow et al., 1996). Other methods improve fluency by modifying phonetic intervals (see Ingham et al., 2015), or altering the auditory feedback of a speaker's own speech by using devices designed for this (see e.g., Van Borsel et al., 2003). In contrast, the multifaceted nature of stuttering behavior is addressed in several treatment programs that integrate elements of improving fluency and modifying stuttering, and may also include problem-solving skills, cognitive or cognitive behavioral therapy or other methods addressing psychological effects of stuttering (e.g. Fry et al., 2009, 2014; comprehensive stuttering program, Langevin et al., 2006; Lee et al., 2015; multidimensional individualized stuttering therapy, Sønsterud et al., 2020; Van Riper's method, Van Riper, 1973). These integrative, holistic therapy methods are also used with children (Fourlas & Marousos, 2015; Kelman & Nicholas, 2017; Murphy, Yaruss & Quesal, 2007; Shields, 2018; Yaruss et al., 2006, 2012). Direct methods can also target solely the psychological effects of stuttering, and psychotherapeutic approaches have been applied to the treatment of stuttering: cognitive behavioral treatment (CBT) aims to reduce tension or anxiety related to stuttering and improve the acceptance of stuttering and is used with PWS of all ages (Menzies et al., 2009). Also, acceptance and commitment therapy, inquiry-based stress reduction and mindfulness have been applied in stuttering therapy (see e.g., Beilby et al., 2012; Boyle, 2011; Feldman et al., 2021; Scott & Jaime, 2013).

Regardless of the method, stuttering treatment should be based on high-quality empirical data. There are, however, many challenges in conducting effectiveness studies, especially about stuttering. First, the spontaneous recovery of stuttering for children is common, and the majority (65–91%) of them outgrow stuttering with or without treatment (Kefalianos et al., 2017; Maguire et al., 2012; Yairi & Ambrose, 2013). Second, stuttering varies depending on the context, and speech fluency in a clinical setting does not necessarily represent speech fluency outside the clinic, or the experience the PWS has of stuttering. Third, not every individual responds to treatment in the same way, because many factors may affect treatment outcomes, such as motivation, stage of change, willingness to commit to therapy, and mental health issues (see e.g., Floyd et al., 2007; Iverach, Jones et al., 2009, 2009b, 2010; Prochaska & DiClemente, 1986; Prochaska et al., 1992; Zebrowski et al., 2021). On top of these specific challenges, many studies are limited by methodological weaknesses, such as a small number of participants, lack of usage of statistical analyses, inadequate baseline measurements, or lack of a control group, which lowers the level of the evidence provided. This makes it essential to critically evaluate the methodological quality of a study when learning about the effectiveness of treatment. Moreover, the primary measure of the studies is too often the percentage of syllables stuttered (%SS), which reflects only the overt aspects of stuttering in a specific situation, not the speaker's experience of stuttering. For PWS, the holistic experience and treatment of stuttering may be more important than the exact amount of overt stuttering (see e.g., Karimi et al., 2018; Rodgers & Gerlach, 2021). It is important to include both the results of effectiveness research and experience-based knowledge, ethical factors, contextual factors, and clients' perceptions to build a total evidence and knowledge approach (McCurtin et al., 2019).

This review presents intervention studies, systematic reviews, and meta-analyses published 2000–2018. After our data search, a few reviews or meta-analyses about the treatment of stuttering have been published. Brignell et al. (2020) included eight randomized controlled studies (RCT) and systematic reviews about adults who stutter in their paper. They identified that speech restructuring treatments and transcranial direct current stimulation treatments were used with adults who stutter, and that they reduced stuttering by 50–57% and 22–27% on average, respectively. Brignell et al. (2021) published another systematic review of interventions in children and adolescents and included systematic reviews, registered trials and RCTs (N=20). They aimed at identifying and describing empirical evidence on interventions designed to reduce stuttering in children. Brignell et al. (2021) found that evidence is concentrated on interventions for preschool children who stutter, and that the best available evidence is about the LP. The RESTART-DCM was found to have similar outcomes to the LP, but there were fewer studies of it. Connery et al., and McCurtin (2021) examined the evidence for effective nonpharmacological interventions for adults who stutter. They included nine RCTs in their review and conducted a meta-analysis of seven of them. They found in pooled analysis that interventions for speech restructuring, interventions with brain stimulating techniques and interventions targeting anxiety did not demonstrate statistically significant differences between the intervention group and comparator/control group. However, two independent studies examining brain stimulation and speech restructuring demonstrated a favorable effect on speech fluency. None of the studies demonstrated an effect on overall experience of stuttering or quality of life. In the Cochrane review of four studies about the LP, the authors stressed that none of the included studies reported stuttering severity, communication attitudes, emotional, cognitive, or psychosocial domains, or adverse reactions, but mainly reported stuttering frequency as the primary outcome (Sjøstrand et al., 2021). In yet another review, the LP was also found to be

effective with preschoolers and young school-age children also in non-English-speaking countries, but they may require more time compared to conducting therapy in English (Subasi et al., 2021).

The purpose of this paper is to review the effectiveness of behavioral stuttering interventions systematically and critically in all age groups to provide evidence-based knowledge for Finnish clinical guidelines. The paper was commissioned by the Finnish Association of Speech and Language Therapists. The results of this review report the current treatments available and the effect they have on both speech fluency and overall experience of stuttering in particular. Moreover, we suggest treatment guidelines for every age group, and discuss holistic treatment approaches and measures.

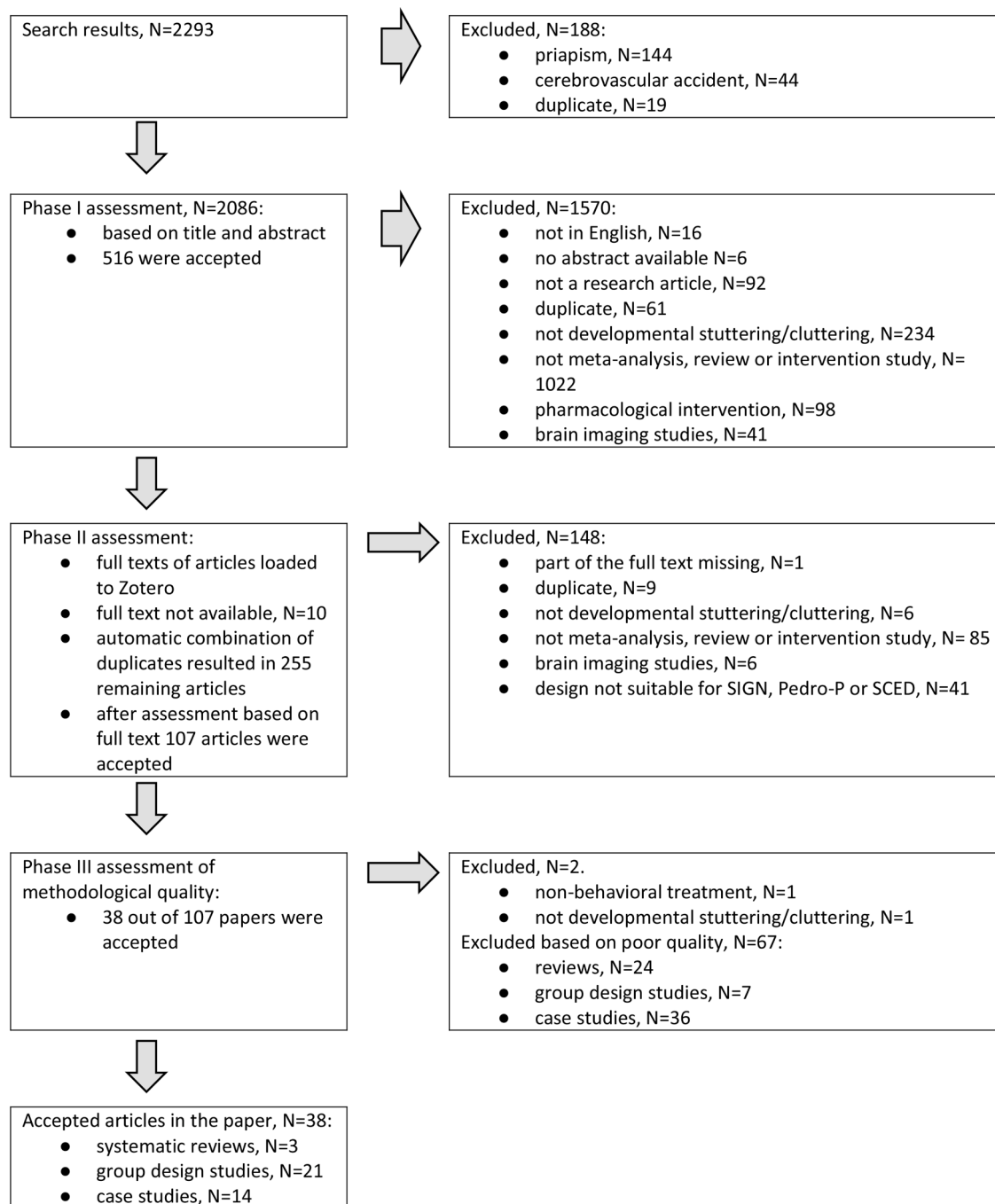


Fig. 1. The search and selection process of the data published in 2000–2018.

Table 1

The methodological quality of accepted reviews and meta-analysis using SIGN.

	Quality of the article	Research question clearly defined; inclusion/exclusion criteria listed	A comprehensive literature search carried out	At least two people selected the studies	At least two people extracted the data	Status of publication not an inclusion criterion	The excluded studies listed	The relevant characteristics of the included studies provided	The quality of the included studies assessed and reported	The scientific quality of the studies used appropriately	Appropriate methods used to combine individual study results	The likelihood of publication bias assessed appropriately	Conflicts of interests declared
Baxter et al. (2016)	acc*	yes	yes	yes	yes	yes	yes	yes	yes	yes	NA**	no	no
McGill et al. (2018)	acc*	yes	yes	yes	yes	no	no	yes	yes	yes	NA**	no	no
Nye et al. (2013)	acc*	yes	yes	yes	yes	no	no	yes	yes	yes	yes	no	no

* quality of the article acceptable

** not applicable

Table 2
The methodological quality of accepted group design studies using Pedro-P.

	Pedro-P points (max.10)	Eligibility criteria specified	Subjects randomly allocated	Allocation concealed	The groups similar at baseline	Blinding of all subjects	Blinding of all therapists	Blinding of all assessors	Measures obtained from more than 85% of the subjects	Intention to treat analysis (ITT)	Statistic comparisons reported	Point and variability measures provided
Lidcombe Program in the treatment of early childhood stuttering												
Arnott et al. (2014)	4	1	1	0	0	0	0	1	0	0	1	1
Bridgman et al. (2016)	5	1	1	1	0	0	0	1	0	0	1	1
Donaghy et al. (2015)	6	1	1	1	0	0	0	1	1	0	1	1
Ferdinands and Bridgman (2018)	6	1	1	1	1	0	0	1	0	0	1	1
Harris et al. (2002)	5	1	1	1	0	0	0	1	0	0	1	1
Harrison et al. (2004)	5	1	1	0	0	0	0	1	1	0	1	1
Jones et al. (2008)	5	1	1	0	1	0	0	1	0	0	1	1
Jones et al. (2005)	8	1	1	1	1	0	0	1	1	1	1	1
Lattermann et al. (2008)	5	1	1	0	0	0	0	1	1	0	1	1
Lewis et al. (2008)	6	1	1	1	0	0	0	1	0	1	1	1
Other therapy methods in the treatment of early childhood stuttering												
de Sonnevile-Koedoot et al. (2015)	7	1	1	1	1	0	0	1	1	0	1	1
Franken et al. (2005)	5	1	1	1	0	0	0	1	0	0	1	1
Riley and Ingham (2000)	6	1	1	0	1	0	0	0	1	1	1	1
Treatment of stuttering in children aged 7–12 years												
Nejati et al. (2013)	5	1	1	0	1	0	0	0	1	0	1	1
Treatment of stuttering in adolescents and adults												
Carey et al. (2010)	7	1	1	1	0	0	0	1	1	1	1	1
Cream et al. (2010)	8	1	1	1	0	0	1	1	1	1	1	1
Ingham et al. (2015)	4	1	1	0	0	0	0	1	0	0	1	1
Lee et al. (2015)	4	1	0	0	0	0	0	1	1	0	1	1
McAllister et al. (2017)	7	1	1	1	0	1	1	0	0	1	1	1
Menzies et al. (2008)	6	1	1	1	0	0	1	1	0	0	1	1
Ritto et al. (2016)	5	0	1	0	1	0	0	0	1	0	1	1

Table 3

The methodological quality of accepted case design studies using SCED.

	SCED points (max.10)	Clinical history specified	Specified measures of target behavior	Design: A-B-A or multiple baseline	Baseline measurements at least three times	Measurements during intervention at least three times	Raw data points reported	Inter-rater reliability at least .80	Independence of assessors	Statistical analysis	Replication of subjects, settings, or therapist at least four times	Evidence of generalization
Lidcombe Program in the treatment of early childhood stuttering												
Wilson et al. (2004)	6	1	1	0	1	0	1	1	0	0	1	1
Other therapy methods in the treatment of early childhood stuttering												
Jones and Ryan (2001)	8	1	1	1	1	1	1	1	0	1	0	1
Millard et al. (2009)	9	1	1	1	1	1	1	1	1	1	1	0
Trajkovski et al. (2009)	6	1	1	1	1	1	1	1	0	0	0	0
Treatment of stuttering in children aged 7–12 years												
Smits-Bandstra and Yovetich (2003)	9	1	1	1	1	1	1	1	1	1	1	0
Wood and Ryan (2000)	7	1	1	1	1	1	1	1	0	0	0	1
Treatment of stuttering in adolescents and adults												
Fry et al. (2009)	8	1	1	1	1	1	1	1	1	1	0	0
Fry et al., and Botterill (2014)	8	1	1	1	1	1	1	1	1	1	0	0
Harasym et al. (2015)	6	1	1	0	1	1	1	1	0	1	0	0
Hewat et al. (2001)	6	1	1	0	1	1	1	1	1	0	0	0
Ingham et al. (2001)	7	1	1	1	1	1	1	1	0	0	1	0
Monteagudo et al. (2017)	8	1	1	1	1	1	1	1	1	0	1	0
Pollard et al. (2009)	7	1	1	1	1	1	1	1	0	0	1	0
Schulte and Walach (2006)	4	1	1	0	1	1	0	0	0	1	0	0

2. Methods

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Moher et al., 2009). We did not, however, perform any numerical synthesis of the results.

2.1. Data retrieval

Four databases (PsycINFO, CINAHL, PubMed and Cochrane) were searched for relevant research articles, meta-analyses, and reviews. We used the search terms *stuttering*, *stammering*, *fluency disorder*, *speech dysfluency* or *speech disfluency* and *speech language therapy*, *speech language pathology*, *speech therapy*, *rehabilitation*, *intervention*, or *treatment*. The results were connected to the search terms *effect**, *outcome*, *efficiency*, or *efficacy*. The PsycINFO search included papers between 1.1.2000–21.9.2018, PubMed between 1.1.2000–8.10.2018, CINAHL between 1.1.2000–8/2018 and Cochrane between 1.1.2000–21.9.2018.

2.2. Inclusion criteria

Studies fulfilling the following inclusion criteria were included: 1) addresses the treatment of stuttering, 2) is an intervention study, meta-analysis, or systematic review, 3) the treatment focuses on speech fluency, attitudes or overall experience of stuttering, 4) suitable to be assessed either by SIGN, Pedro-P or SCED (see 2.4.), 5) published between 2000–2018 and 6) written in English. Studies were excluded if 1) stuttering was a part of a broader diagnosis (e.g., autism spectrum, Parkinson, Tourette's or Down's syndrome), 2) it was about neurogenic stuttering, 3) the study was about a pharmacological or other non-behavioral treatment, 4) effectiveness of treatment was reported only in brain functions, not in behavior or 5) the full text was not available.

2.3. Study selection

The search revealed a total of 2293 results and they were loaded into the RefWorks reference management program. After the removal of articles about stuttering priapism and stroke as well as automatic exclusion of duplicates, the remaining 2086 articles were screened by two independent judges in three phases. First, the articles were screened and compared to the inclusion criteria based on their title and abstract. The remaining 506 articles were loaded into the reference management software Zotero, which automatically combines duplicates, so 255 different articles remained in the data. In the second phase, the articles were compared to the inclusion criteria based on the full text. In phase three, the methodological quality of the articles was evaluated. In the case of differences in the evaluations, they were discussed, and a consensus reported. Altogether, 38 studies were accepted. The data selection is presented in Fig. 1.

2.4. Assessment of methodological quality

The scientific quality of reviews and meta-analyses were assessed by the [Scottish Intercollegiate Guidelines Network checklist SIGN \(2012\)](#) (2012). The checklist includes 12 criteria, presented in [Table 1](#). Based on the checklist, the quality of the article may be classified as high, acceptable, low or unacceptable. Each of the 28 reviews was assessed and 3 were accepted. The accepted articles and qualitative assessments are shown in [Table 1](#).

The methodological quality of the randomized and non-randomized controlled trials was assessed using a Pedro-P rating scale ([PEDro scale, 1999](#) PEDro scale, 1999). In Pedro-P, eleven criteria are scored (see [Table 2](#)), but only the points from criteria 2–11 are summed up for the total score.

A total of 21 out of 34 Pedro-P scored articles were accepted. These scores of the accepted articles are presented in [Table 2](#). There are no guidelines in Pedro-P to define a study of high or low quality, so the authors decided to accept papers scoring four points or more. Some of the criteria are not very suitable for speech therapy. For example, it is almost impossible to blind subjects or therapists to the intervention. A total of 4–5 points was considered as moderate quality, 6 or more as high quality. In general, the accepted articles were of moderate quality (Pedro-P points mean 5.7, median 5, range 4–8).

Single and multiple case studies were assessed using a single-case experimental design (SCED) scale ([Tate et al., 2008](#)), which can be used for both types of case studies. In SCED, eleven criteria are scored (see [Table 3](#)), but only the points from criteria 2–11 are summed up for the total score. The authors decided to accept papers with at least four points. In addition, an accepted article needed to score a point from criterion four, which assesses baseline measurements and is essential in demonstrating any changes happening due to the intervention. A total of 4–5 points were considered as moderate quality, 6 or more as high quality. In general, the accepted articles were of high quality (SCED points mean 7.1, median 7, range 4–9).

A total of 14 out of 51 SCED scored articles were accepted. The scores of the accepted articles are presented in [Table 3](#).

A list of papers excluded based on methodological quality is available from the corresponding author upon request, and the quality assessment scores are included.

3. Results

The results of this paper describe multiple different treatment methods. A comprehensive description of each therapy method is outside the scope of this review. However, the main characteristics of the treatments are described in Supplementary material,

Tables A–E. We present the results first for the reviews, then for the treatment of young children and school-aged children and lastly for the adolescents and adults.

3.1. Reviews

After the careful examination of the methodological quality using SIGN scoring, only three reviews were accepted. The main characteristics of the reviews are presented in Supplementary material Table A. The first review, by [Baxter et al. \(2016\)](#), reported the effectiveness of interventions in the stuttering treatment and how PWS and professionals experience the treatment of stuttering. The treatment methods in the 137 included studies were divided into categories, out of which only two types of interventions were conducted with preschool children, i.e., behavioral modification interventions (LP) and speech motor interventions. LP was also used with school-aged children. Behavioral modification, speech motor interventions, altered auditory feedback, combined speech motor and cognitive, and multiple-component interventions had been used in the studies with school-aged children, adolescents, and adults. Cognitive interventions (CBT, personal construct psychology, hypnosis and mindfulness-based stress reduction) aiming at psychological change were methods reported with adults only. The authors concluded that at least some of the participants benefited from any intervention, but none of the interventions was suitable for every participant. In addition, there was a large variability in the results. That may be because the treatment time varied in the studies between 10 and over 75 hours. [Baxter et al. \(2016\)](#) also noticed that the improvement in the percentage of syllables stuttered (%SS) did not necessarily influence the PWS ability to participate in their everyday life. They included 137 studies in the review but discussed that the risk of bias was high in three-quarters of the included studies. We assessed the quality of the [Baxter et al. \(2016\)](#) review to be acceptable. The review was carefully conducted but many of the included studies were of quite low quality.

The second review by [Nye et al. \(2013\)](#) evaluated the effectiveness of behavioral treatments of childhood stuttering. The review was carefully conducted but there were only nine studies included. We assessed the quality of the [Nye et al. \(2013\)](#) review to be acceptable. According to [Nye et al. \(2013\)](#), when using %SS as a sole measurement, children benefit from the therapy. Those who did not receive therapy did not progress as much. This result was based mainly on the studies about the LP. When two or more treatments were compared, there were no differences found in favor of any treatment. [Nye et al. \(2013\)](#) categorized the treatment methods of the included nine studies to delayed auditory feedback, gradual increase in length and complexity of utterance, speech motor training, extended length of utterance, electromyographic feedback, smooth speech, and the LP, and stated that the strongest evidence is about the LP. However, the LP is most suitable only for children under six years of age.

The third included review by [McGill et al., and Siegel \(2018\)](#) wanted to guide professionals in the development and implementation of livestream, video telepractice services, and to identify areas for future research related to telepractice and stuttering. Their review was carefully done but included only seven studies, in which the Camperdown Program, LP, or integrated treatment involving a combination of widely accepted stuttering treatments (e.g., fluency shaping, stuttering modification, and avoidance reduction approaches) via telepractice were used as treatment methods with different age groups. We assessed the quality of the [McGill et al. \(2018\)](#) review to be acceptable. Based on the results, video telepractice services are a suitable possibility in the treatment of stuttering. Telehealth services may be cost-effective, save time and be easy to arrange, and help clients to find a speech therapist specialized in the treatment of stuttering.

3.2. Treatment for young children who stutter

Seventeen studies about early childhood stuttering were included in this review, of which 13 were group design studies and four were case studies. Eleven group design studies and one case study were about the LP and included 421 participants. The LP studies are described in detail in Supplementary material Table B. In this age group, there were also three group design studies and three case studies about other treatment methods. These studies including 263 participants are described in Supplementary material Table C. Based on the data in this review, intervention methods used with young children were 1) the Lidcombe Program, 2) indirect interventions, and 3) other direct interventions than the LP.

The main finding of the LP studies was that the LP reduces stuttering in children under the age of 6 years ([Harris et al., 2002](#); [Jones et al., 2005](#); [Lattermann et al., 2008](#)). Stuttering was reduced significantly more in children who received the LP than in the control children ([Harris et al., 2002](#); [Jones et al., 2005](#); [Lattermann et al., 2008](#)). The effectiveness of the LP required parental verbal contingencies ([Harrison et al., 2004](#)). [Donaghy et al. \(2015\)](#) stated that children and parents are known to find one type of verbal contingency, a request for self-correction, aversive. Therefore, they wanted to study the importance of this type of verbal contingency. Removing the request for self-correction did not interfere with the duration of the LP ([Donaghy et al., 2015](#)). However, the parents still provided one contingency, acknowledgment, for stuttering. The LP was as effective in group therapy as in individual therapy ([Arnott et al., 2014](#)). Group delivery of the LP may be cost-effective, because it requires less contact time from the speech therapist for an individual child ([Arnott et al., 2014](#)). In addition, there were no differences in the effectiveness of the LP between face-to-face and telepractice treatments ([Bridgman et al., 2016](#); [Ferdinands & Bridgman, 2018](#); [Lewis et al., 2008](#); [Wilson et al., 2004](#)). The results of the LP were stable for 3.5–7 years after the intervention ([Jones et al., 2008](#)).

Indirect treatment was used in four studies with 239 participants. The largest study (N=198) compared the indirect RESTART-DCM (the Rotterdam Evaluation Study of Stuttering Therapy in preschool children, a Randomized Trial-Demands and Capacities Model) treatment to the LP ([de Sonnevile-Koedoot et al., 2015](#)). There were no differences between the groups 18 months after the intervention. However, three months after the beginning of the intervention, the %SS was slightly lower in children in the LP group than in the RESTART-DCM group. Another, earlier study, compared the DCM treatment and the LP ([Franken et al., 2005](#)). In that study, both

groups progressed during treatments and there were no differences between the groups. The Palin Parent-Child Interaction (Palin PCI), also an indirect treatment, has been studied in a multi-case study (Millard et al., 2009). Four of the six children in the treatment reduced stuttering significantly. The experiences of the parents participating in the Palin PCI were that their child was more fluent, stuttering had less impact on the child or to themselves and they had gained more information and confidence in treating stuttering. The language skills of the children developed normally during treatment (Millard et al., 2009). The complex relationship between stuttering and speech rate became evident in a case study of one parent-child dyad (Jones & Ryan, 2001). The mother's slower speech rate also caused the child to slow down the speech. However, when speaking slower, the child's stuttering was reduced, and this enabled the child to speak more words than before, therefore the difference in the speech rate was difficult to monitor (Jones & Ryan, 2001).

There were only two studies (24 participants) where childhood stuttering was treated with some other direct method than the LP. Riley and Ingham (2000) compared Speech Motor Training and Extended Length of Utterance methods and noticed that speech became 64% more fluent in the Extended Length of Utterance group and 37% more fluent in the motor training group. Trajkovski et al. (2009) used the Syllable Timed Speech method with three children and noticed that it may increase fluency.

3.3. Treatment of stuttering in children aged 7–12 years

After the assessment of the methodological quality using Pedro-P and SCED scoring, only three studies about children aged 7-12 years fulfilled the predetermined criteria of acceptability. These three studies included 26 participants: one was a group design study and two were case studies. The study characteristics are described in Supplementary material Table D. Each of the studies used a different approach to treat stuttering. Nejadi et al., and Bahrami (2013) focused on improving attention using a computer-based program. They noticed that the intervention improved the fluency of children who stutter in clinic-based conversations. Smits-Bandstra and Yovetich (2003) reported results of a multi-case study of five children. The treatment combined elements of cognitive behavioral therapy and speech modification. This improved speech fluency and normalized communication attitudes (Smits-Bandstra & Yovetich, 2003). The third included paper was a case study of one child. When the child reduced speech rate, it improved fluency in the clinic. The generalization of this more fluent speech was established with parental feedback (Wood & Ryan, 2000).

3.4. Treatment of stuttering in adolescents and adults

Fifteen research articles about the treatment of stuttering in adolescents and adults were accepted in this review. Seven group design studies and eight case studies included 293 participants. The articles are described in detail in Supplementary material Table E. Based on these data, the main categories of the intervention studies were 1) speech restructuring treatments, 2) cognitive/cognitive-behavioral therapy combined with speech restructuring, 3) altered auditory feedback, 4) maintenance of treatment results, and 5) other separate methods.

In general, speech restructuring treatments decreased stuttering. The Camperdown Program was as effective in clinical visits as in telepractice treatment (Carey et al., 2010). In both groups, stuttering decreased at least 50% when comparing results pre-treatment and 9 months post-treatment (Carey et al., 2010). Ingham et al. (2015) compared prolonged speech treatment and Modified Phonetic Interval treatment and found no differences between the treatment groups (see also Ingham et al., 2001). Hewat et al., and Packman (2001) studied the effects of self-imposed timeout after stuttering. The timeout reduced stuttering and finally ended it in this case study of one participant.

It has been reported that two-thirds of adults who stutter may be diagnosed with social anxiety disorder before the therapy (Menzies et al., 2008). When PWS were treated with speech restructuring or a combination of CBT and speech restructuring, it was noticed one year after the treatment that those who were treated with CBT could no longer be diagnosed with social anxiety disorder. Of those participants who received only speech restructuring treatment, 53% were still diagnosed with social anxiety disorder (Menzies et al., 2008). CBT alone in the treatment of stuttering did not affect speech fluency (Menzies et al., 2008). Lee et al. (2015) combined in the therapy seven cognitive and behavioral components, addressing both speech behavior and affective reactions. They found that this treatment significantly reduced stuttering and changed the participants' experiences of stuttering. After the intervention, the participants felt they were more capable of modifying their speech and that life events were not so affected by stuttering (Lee et al., 2015). The case studies in this data supported the result that integrating CBT, fluency and communication skills training may reduce stuttering and change the perception PWS have about themselves (Fry et al., 2009, 2014).

Speaking in a chorus enhances fluency and altered auditory feedback treatment simulates the chorus effect by modifying either the frequency or timing of the auditory feedback from own speech. SpeechEasy is one of the devices that has been developed to alter auditory feedback. Ritto et al., and de Andrade (2016) compared SpeechEasy treatment (N=11) and speech modification treatment (N=7). Speech modification included e.g. negative practice, smooth speech, self-observation and systematic cognitive and attitudinal intervention. They found that stuttering was reduced in both groups equally in clinic-based speech samples. SpeechEasy did not benefit every participant, but every participant in the speech modification treatment benefited from the treatment (Ritto et al., 2016). It has also been found that SpeechEasy may make oral reading more fluent (Pollard et al., 2009).

Maintenance programs aim at maintaining achieved therapy results and avoiding possible relapse after the therapy. Cream et al. (2010) studied the maintenance of therapy results with 89 PWS. They asked PWS (N=44) to watch video recordings where they spoke fluently or used speech modification techniques in addition to a standard 7-week maintenance program after the treatment. They found that video self-modeling had no effect in maintaining treatment results compared to a group of adults who attended only the standard maintenance program (N=45). However, Harasym et al., and Kully (2015) found in a case study of three PWS that video

self-modeling had a positive effect on stuttering, when the PWS had participated in stuttering treatment within the previous 6 years. While Cream et al. (2010) included everyone in their maintenance program, Harasym et al. (2015) used video self-modeling only when participants felt they needed additional help with stuttering.

We included in this review two methodologically carefully conducted studies using alternative methods in the treatment of stuttering. Monteagudo et al., and Sivek-Eskra (2017) utilized active relaxation, proprioceptive/awareness, and airflow/regulation of breath training of the Linklater voice method to treat stuttering in their case study of three persons. The Linklater voice method was originally developed for actors to increase the consciousness and potential of primarily the speaking voice (reviewed in Linklater, 2018). In the other case study of two people, the Alexander Technique was applied to stuttering (Schulte & Walach, 2006). This self-help method aims via the guidance of professionals to recognize and change self-damaging movement habits which affect one's posture or muscle tension, but scientific evidence of its effectiveness is still scarce (Ernst & Canter, 2003). Both methods reduced stuttering, but there was no evidence of generalization or maintenance of the effect, and no follow-up studies have been conducted.

4. Discussion

This review describes the effects of behavioral stuttering therapy interventions. The methodological quality of the included studies was assessed carefully and only studies with acceptable quality were included. A total of 19 different therapy methods were used in the included group and case studies, even more when reviews are included. This demonstrates the great variability of the treatment options that a clinician needs to choose from. The mixture of different treatments, doses and results in the literature may be confusing, especially if the clinician is not very familiar with stuttering.

In light of our review, the most evidence is available about the treatment of early childhood stuttering and especially about the LP. In the eleven included research papers about the LP, convergent results were reported, which suggests that the LP is effective in the treatment of early childhood stuttering. The LP aims at speech fluency and requires that the parent conducts therapy with the child almost daily, which may not be possible in every family. It seems that other methods may be as effective as the LP (de Sonneville-Koedoot et al., 2015; Franken et al., 2005; see also Millard et al., 2009). These methods (DCM, Palin PCI) are more holistic and focus on building a communication environment that supports the child's fluency, and also gives parents possibilities to express their feelings and concerns about stuttering. RESTART-DCM and Palin PCI also require active parental involvement, as much as the LP, from five to fifteen minutes daily or several times a week. At the moment, the evidence for these methods is promising, but further research is needed. Our results are in perfect agreement with the recent review by Brignell et al. (2021). Because all the effective therapy methods for young children reviewed in this study include almost daily parental involvement, the question raises how to implement treatment in this age group if active parental involvement is not possible (for example, in some families, children are in preschool daily up to ten hours, and sometimes family resources are limited for many different reasons). In these situations, it might be helpful to work with preschool teachers more systematically to support children's communication skills and speech fluency. More research about this topic is needed. We found that there are several effective options for clinical guidelines for the treatment of early childhood stuttering. The strongest evidence is around the LP, and, in addition, there is promising evidence about the RESTART-DCM and Palin PCI. We also think that before the beginning of a treatment program a holistic assessment of stuttering and counseling of the family (e. g., giving information and working with parental concerns, emotions, and reactions) is required (Laiho et al., 2021).

There is hardly any research fulfilling our inclusion criteria about treatment effectiveness of school-aged children who stutter. The same was evident in the review by Brignell et al. (2021). Nye et al. (2013), on the other hand, also included studies about school-aged children in their review, and reported a positive treatment outcome compared to control children when %SS was a primary outcome measure. The therapy methods for school-aged children were delayed auditory feedback, gradual increase in length and complexity of utterance, electromyographic feedback and smooth speech. The results strongly supported use of the LP for children under six years of age, but did not favor any treatment method for school-aged children. Despite the lack of high-quality research, it is equally important to provide treatment for the children in this age group. At this age, a child begins to form perceptions of themselves as a speaker and therefore it is necessary to assess stuttering in a holistic way, using tools like ICF. For school-aged children, it is crucial to gain positive experiences about participating in social situations and communicating verbally, to accept stuttering as a part of themselves and to learn to be open about it, so that a positive attitude toward speaking can grow. In clinical practice, it has been recognized that school-aged children may benefit from group interventions and, therefore, stuttering therapy groups are organized widely (see e.g., Boberg & Kully, 1994; Byrd et al., 2016, 2018; Craig et al., 1996, 1998). Both individual and group therapy can address overt and covert aspects of stuttering, and in speech therapy children learn strategies to minimize overt stuttering and ways to cope with residual stuttering (Yaruss, 2010). In addition, addressing bullying (Murphy, Yaruss & Quesal, 2007) and neutralizing attitudes of classmates and the environment toward stuttering (Kathard et al., 2014) are important topics. These could be goals in the treatment of stuttering in school-aged children, and they may prevent stuttering-related problems, such as difficulties in education, employment, or mental health, later in life. It is not clear why there is a lack of research in this age group. Maybe it is related to treatment programs, since many of them target early childhood stuttering or persistent stuttering in adults. There is a need for further research with school-aged children. As a clinical guideline for the therapy interventions with school-aged children, we need to rely mainly on the research conducted with younger children and adolescents/adults. Based on the individual situation and age of the child, it is perhaps necessary to combine research results from other age groups, as noted also by Blomgren (2013). The individual situation of the child needs to be assessed in a holistic way with the child, the parents, and the teacher.

There is growing evidence about treating multidimensional aspects of stuttering in adults. Treatment of stuttering may include CBT as well as speech restructuring tools, and it may be that neither approach alone is effective enough for the PWS (see e.g., Menzies et al., 2008). Brignell et al. (2020) found that speech restructuring reduces stuttering in adults by 50–57% on average. Most often, however,

focusing only on speech fluency is not enough to change the perceptions the PWS has of themselves as a speaker. It is crucial for clinicians to note, for example, the high rate of social anxiety among PWS (see e.g., Iverach & Rapee, 2014), and to formulate a treatment plan based on multiple aspects of stuttering behavior. Several papers in this review (Fry et al., 2009, 2014; Lee et al., 2015; Menzies et al., 2008) support holistic treatment that addresses the whole stuttering behavior. The literature about the impact of stuttering on self-esteem, self-efficacy, quality of life, and communication attitudes support holistic approaches as well (Boyle et al., 2018; Carter et al., 2017, 2019; Gerlach et al., 2018). There is still a need for further intervention research, especially with adolescents, who represent a minority of the participants in this combined age group.

The inclusion criteria in this article resulted in a higher number of papers, and concluded slightly different results in adults who stutter, compared to recently published reviews or meta-analysis (Brignell et al., 2020, 2021; Connery et al., 2021). We have, however, excluded studies where the main purpose was to study the effects of treatment on brain functions (see e.g., Lu et al., 2012, 2017; Neumann et al., 2003) and neuromodulation treatments (see e.g., Chesters et al., 2017), because these types of treatments are not widely available, and this work aimed at writing an overview for clinicians. The goal of Brignell et al. (2020, 2021) was to show reductions in overt stuttering, and they demonstrated that speech restructuring reduced stuttering by 50–57% and transcranial direct current stimulation by 22–27% in adults. The strongest effectiveness evidence for young children involved the LP and some evidence about the RESTART-DCM. Connery et al. (2021), interestingly, wanted to show that stuttering therapy for adults has effects on fluency and on communication and psychosocial functioning as well. Therefore, they found that speech restructuring and brain stimulation increase fluency, but they found no treatment effect on overall experience of stuttering or quality of life. We suggest, in contrast to Connery et al. (2021), that some stuttering interventions may influence multidimensional aspects of stuttering. Compared to these recent reports, our data include research results on how interventions affect both speech fluency and overall experience of stuttering in adults (e.g., feelings, attitudes, locus of control, anxiety, quality of life; see Fry et al., 2009, 2014; Lee et al., 2015; Menzies et al., 2008; Millard et al., 2009). Based on the articles in this review, our guideline for clinical practice with adults suggests that most often stuttering therapy needs to be holistic and focus both on overall experience of stuttering and on speech fluency. Treatment needs to be individualized to speakers' personal goals, and it may be necessary to integrate different therapy methods, since one method may target speech fluency only.

The use of evidence from the effectiveness studies is challenging when the treatment needs to be fitted to the local resources. At least in Finland, there is a generally recognized shortage of speech therapists in all areas of speech, language, and communication disorders. There are treatments for young children with a reasonable number of sessions, but in this review the times used in therapy with adults who stutter varied between 10 to 560 hours. Sommer et al., and Strzelczyk (2021) reported that children insured by the statutory German health insurance receive a mean of 13.5 therapy sessions during the first year of diagnosis. In clinical practice, it is not always possible to use these treatments as described in the studies, and this leaves the clinicians unsure whether to start the treatment according to studies with a limited number of sessions, and whether the treatment provided will be effective. This also raises a need for practice-based evidence. When working with limited resources, one option is group therapy, which may save speech therapy resources (see Arnott et al., 2014). In future research it would be interesting to compare individual and group therapy delivery and to study whether PWS in fact gain more benefits from group therapy compared to individual therapy. In our data there were no studies about this. Research often studies how a specific intervention affects PWS. It is also valuable to study how the individual needs of PWS are considered in the treatment and how the therapy is tailored to meet these needs (Sønsterud et al., 2020). The evidence supports several therapy options, but it is still unclear what treatment will suit each client (see e.g., Franken et al., 2005; Nye et al., 2013; Sønsterud et al., 2020). There is a need to individualize therapy, and this leads us to conclude that not only are therapy guidelines needed, but guidelines for assessing and understanding stuttering behavior are also important (Brundage et al., 2021).

The results of our review do not favor any specific treatment method for adults who stutter, and even with young children there are several treatment options. In psychotherapy research there is much discussion about the common factors of the therapy process. These include, for example, therapeutic alliance, collaboration, and the respect the therapist shows to the client (see e.g., Norcross & Wampold, 2011). In psychotherapy studies no clear difference has been found in the effectiveness of different approaches or in favor of any approach (see e.g., Wampold, 2001), nor that specific therapy techniques have a significant effect on recovery (see e.g., Norcross & Lambert, 2011). The explanation may rely on the common factors, which may explain approximately 30% of the therapy results (see e.g., Lambert, 2013). These factors may be involved in the speech therapy process as well (see e.g. Manning, 2010; Plexico et al., 2005, 2010). In a recent study, Sønsterud et al. (2019b) investigated the role of the working alliance in stuttering therapy and found that an alliance between the PWS and the speech therapist is an important factor affecting the treatment outcome, especially in dimensions related to the task and goal of the treatment.

An important question in stuttering therapy research is what to measure and how to report the therapy effects. The primary measure in almost all effectiveness studies in this review was %SS. In many studies it remains unclear how well the %SS in a speech sample represents speech fluency in natural situations, or how it is related to perceptions PWS have about themselves as speakers. The %SS reflects only a narrow part of stuttering: it may over- or underestimate the amount of stuttering in everyday situations, and a major part of the gain of the treatment may remain unreported. This may be the case even when the treatment has been holistic and focused on the speaker's experiences of stuttering as well as on speech fluency. There are, in fact, several holistic treatments available, but unfortunately not all of them are presented in our data. There is a need for further research to study what, if any, effects the interventions have on the multidimensional aspects of stuttering. In some studies, these effects have been described more (see Fry et al., 2009, 2014; Lee et al., 2015; Menzies et al., 2008; Millard et al., 2009). All but one of these studies were excluded from the recent reviews. For example, Millard et al. (2009) reported in their multi-case study parents' and children's experiences of the Palin PCI treatment, and in addition to the changes in fluency, parents and children also gained, for example, self-agency in the treatment of stuttering. The multidimensional effects of the Palin PCI treatment were also reported in a study of 55 children who stutter by Millard

et al., and Kelman (2018). These effects included significant change in %SS, severity of stuttering, child's communication attitudes, parents' perception of the impact of stuttering on the child and on the parents, parents' knowledge of stuttering, and their confidence in managing it. Unfortunately, there was no control group in this study, so the paper was not included in our review. In addition, in our opinion, holistic treatment in young children also addresses parental concerns and anxiety and indirect ways to support fluency. One important aspect of treatment at any age may also be in supporting self-esteem and self-confidence and helping PWS to see stuttering only as a feature, not as a ruling characteristic of the self. Many PWS also find it helpful to meet other PWS and share experiences related to stuttering. All these aspects are important in the treatment of stuttering, but unfortunately the research does not yet measure effectiveness in all of them.

We used a systematic assessment of methodological quality of the papers by SIGN, Pedro-P or SCED. It is possible that the selection of these assessment tools, as well as the strict policy to demand a predetermined level of quality assessed by these tools, has excluded informative studies from the review. For example, there are many group design studies without a control group, and those studies were not included based on our criteria. Also, more qualitative studies were excluded, leaving out of the data for example experiences PWS have about the therapy. In addition, for the group studies, we decided to include only studies which scored more than four points in Pedro-P. A criterion of three or five points would have led to different results. The SIGN assesses the quality of reviews and meta-analysis. Sometimes a review may be carefully conducted but include many research papers of low quality. For example, Baxter et al. (2016) ambitiously included a very large number of studies in their review. This resulted in inclusion of also low-quality studies, where results may be unreliable, and therefore bias the conclusions. Some other reviews have included the best evidence available, e.g., RCTs, leading to less than 10 included papers (e.g., Brignell et al., 2020, 2021; Connery et al., 2021; McGill et al., 2018; Nye et al., 2013). By using a strict methodological quality threshold, we aimed to include only the most reliable studies and ended up with 38 studies with at least moderate methodological quality. Some previous reviews have focused on overt aspects of stuttering or speech fluency (e.g., McGill et al., 2018; Nye et al., 2013). In some reviews two-thirds of included studies were evaluated as having a high risk of bias, originating from inadequate sample size, blinding, randomizing, statistics, or missing control groups (Baxter et al., 2016), or included only few RCTs and systematic reviews (Brignell et al., 2020, 2021; Connery et al., 2021; McGill et al., 2018; Nye et al., 2013). In contrast, we included both group and case studies with moderate methodological quality. The latter were included because each individual responds differently to treatment.

We acknowledge several limitations in this review. Our data search was completed in September 2018, which inevitably leaves out the more recent articles. Moreover, we did not include papers published before 2000, which may have left some relevant studies out. We wanted to focus on the latest research, but also including earlier studies might have resulted in an even wider spectrum of treatment methods. We included only studies with behavioral treatments and measures, for example, all pharmacological treatments were excluded. We recognize that in half of the case studies there were no proper statistical methods used. Despite this, we found results similar to other reviews regarding children and adolescents who stutter. The similarities include, for example, a wide range of treatment options, agreement about the evidence and treatments with young children who stutter, lack of evidence in school-aged children and adolescents, and a tendency to measure and report results in terms of overt characteristics of stuttering. Our results for the treatment of adults who stutter broaden the results of earlier reviews, and the value of this review is in the data of non-randomized group studies and case studies, that bring in light holistic treatment approaches. More high-quality research is needed about interventions that are clinically available, where the intervention is properly described, and the primary results include holistic measures. We also recognize that there is a need for randomized, controlled trials as well as more qualitative studies, where the therapy process and the common factors of the therapeutic interaction are studied.

5. Conclusions

Our results indicate that there are several effective treatment options for young children who stutter. Most evidence is available about the LP, which solely targets reducing %SS. Other treatments targeting multidimensional aspects of stuttering have shown promising results, especially the RESTART-DCM. These results agree with an earlier review (Brignell et al., 2021). The data from the case studies also support Palin PCI therapy. For adults, there are several treatment options available. Speech restructuring treatments reduce stuttering, when measured with %SS. However, they do not reduce covert aspects of stuttering, such as social anxiety. Because of the different inclusion criteria than in earlier reviews or meta-analyses (Brignell et al., 2020; Connery et al., 2021), our data supports treatments that address the multifaceted nature of stuttering and include elements of both speech modification and methods targeting psychological and social effects of stuttering. There are not sufficient effectiveness studies available for school-aged children who stutter, so we need to rely on research about young children and adolescents/adults and perhaps combine elements of both based on the individual situation and the age of the child.

CRediT authorship contribution statement

Auli Laiho: Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Conceptualization. **Heli Elovaara:** Methodology, Formal analysis, Investigation, Writing – review & editing, Conceptualization. **Kirsi Kaisamatti:** Writing – review & editing, Conceptualization. **Katri Luhtalampi:** Formal analysis, Investigation, Writing – review & editing, Conceptualization. **Liisa Talaskivi:** Methodology, Formal analysis, Investigation, Writing – review & editing, Conceptualization. **Salla Pohja:** Formal analysis, Investigation, Writing – review & editing, Conceptualization. **Karin Routamo-Jaatelä:** Formal analysis, Investigation, Writing – review & editing, Conceptualization. **Elsa Vuorio:** Formal analysis, Investigation, Writing – review & editing, Conceptualization.

Declaration of Competing Interest

None.

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Supplementary materials

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