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Research Article

Effectiveness of Stuttering Modification Treatment in School-Age Children Who Stutter: A Randomized Clinical Trial

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ABSTRACT

Purpose: This study investigated the effectiveness of the stuttering modification intervention Kinder Dürfen Stottern (KIDS) in school-age children who stutter.
Method: Seventy-three children who stutter were included in this multicenter, two-group parallel, randomized, wait-list controlled trial with a follow-up of 12 months. Children aged 7–11 years were recruited from 34 centers for speech therapy and randomized to either the immediate-treatment group or the 3 months delayed-treatment group. KIDS was provided by 26 clinicians who followed a treatment manual. Although the primary outcome measure was the impact of stuttering (Overall Assessment of the Speaker's Experience of Stuttering–School-Age [OASES-S]), the secondary outcomes included objective and subjective data on stuttering severity.
Results: At 3 months postrandomization, the mean score changes of the OASES-S differed significantly between the experimental (n = 33) and control group (n = 29; p = .026). Furthermore, treatment outcomes up to 12 months were analyzed (n = 59), indicating large effects of time on the OASES-S score (p < .001, partial η^2 = .324). This was paralleled by significant improvements in parental ratings and objective ratings (stuttering severity, frequency, and physical concomitants).
Conclusions: The significant short-term treatment effects in the OASES-S are in line with the (initial) focus of KIDS on cognitive and affective aspects of stuttering. Over 12 months, these changes were maintained and accompanied by behavioral improvements. The results suggest that individual treatment with KIDS is an adequate treatment option for this age group.
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School-age children who stutter differ from their preschool-age counterparts in several ways (Yaruss et al., 2022). Along with their cognitive, behavioral and emotional development, they communicate more independently in an increasing number of different situations, whereas their chance of recovery from stuttering decreases (Bloodstein et al., 2021; Neumann et al., 2016). Contextualizing stuttering of this age group into the framework of the International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001) illustrates its complexity and heterogeneity. Impairment of stuttering is often characterized by more tensed core behaviors (e.g., blocks) that result in escape behaviors (e.g., eye blinking; Guitar, 2019). At school, children who stutter often experience negative emotions (Daniels et al., 2012) that limit their activities and participation both inside and outside the classroom. Attitudes toward communication tend to become less positive with increasing age (Logan & Arnold, 2022) and a longer course of stuttering influences self-identity (Yaruss et al., 2022; personal context). Compared to children who do not stutter, children

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who stutter have a higher risk of being victims of bullying (Blood & Blood, 2016; environmental context). In summary, stuttering affects school-age children in different ways, which should be considered during treatment.

Two main behavioral treatment approaches are frequently applied to people who stutter (Guitar, 2019; Sidavi & Fabus, 2010). Fluency shaping, also referred to as *speech restructuring*, aims to establish fluent speech by teaching a new speaking pattern (e.g., prolonged speech, smooth speech, and rhythmic speech). Clients learn to use this speaking pattern at a gradually increasing rate and practice to obtain naturally sounding, controlled fluency in everyday speaking situations. In some fluency shaping treatments, feelings and reactions to stuttering are not explicitly addressed (Sidavi & Fabus, 2010). Stuttering modification, also referred to as *Van Riper treatment*, aims to achieve easier forms of stuttering by desensitizing children to their stuttering-related fears and teaching them to modify stuttering moments. Typically, the Van Riper treatment consists of four phases: (a) identification (of one's own stuttering behavior), (b) desensitization (of negative feelings toward the disorder), (c) modification (of core symptoms through preparatory set, pullout, and cancelation techniques), and (d) stabilization (of fluent stuttering through self-monitoring; Van Riper, 1973). Today, many clinicians use an integrated approach that combines both teaching strategies of stuttering modification and principles of fluency shaping (Zebrowski et al., 2022).

Evidence Base for Behavioral Stuttering Treatment in School-Age Children

Current systematic reviews provide evidence of the efficacy and effectiveness of stuttering treatment in preschool children and adults (Brignell et al., 2021; Neumann et al., 2016; Sjøstrand et al., 2021). By contrast, little is known about the effectiveness of stuttering treatment in school children aged between 6 and 13 years. Brignell et al. (2021) recently published a systematic review that did not identify any randomized controlled trial for this age group. In an earlier systematic review, Baxter et al. (2015) also included quasi-experimental and observational study designs and found 26 trials addressing school-age children up to the age of 11 years. Although the authors concluded that these studies indicated the benefits of treatment for at least some children who stutter, they also reported a high risk of bias for two thirds of all included papers. Interestingly, existing evidence mostly refers to intensive treatment in a group format (e.g., Baumeister et al., 2003; Laiho & Klippi, 2007; Rosenberger, 2007; von Gudenberg, 2006), raising the question of whether individual treatment in a less-intensive format is also effective.

Kinder Dürfen Stottern: Stuttering Modification Treatment for School-Age Children Who Stutter

In Germany, approximately 45,000 children aged between 7 and 11 years have a stutter (Neumann et al., 2016; Statista GmbH, 2023). For this age group, treatment is covered by health insurance and is typically offered as outpatient treatment in private practice. In 2018, the first author conducted an online survey on treatment interventions, formats, caseloads, treatment experience, and training regarding individuals within different age groups who stutter in Germany. Nationwide, 72 ambulatory clinicians responded to the survey. Results showed a dominant use of stuttering modification interventions for all age groups and clinicians reported to feel most competent in delivering stuttering modification treatment (Kohmäscher, 2019). In the treatment of school-age children who stutter, 89% of the clinicians reported providing stuttering modification therapy Kinder Dürfen Stottern (KIDS; "children are allowed to stutter"; Sandrieser & Schneider, 2015).

KIDS was developed in 2001 by two German speech-language pathologists and has been frequently reported to be taught in education as a method in the treatment of childhood stuttering. Based on the stuttering modification approach for adults (Van Riper, 1973) and children (Dell, 2000) who stutter, two versions for preschool children (Mini KIDS) and school-age children (School KIDS) were developed. Because recovery from stuttering becomes less likely with increasing age, KIDS for school-age children aims to (a) reduce socially disapproved secondary behavior and negative psychological reactions to stuttering, (b) improve quality of life and resilience, (c) expand the ability to provide information on stuttering, and (d) create a supportive environment (Schneider et al., 2023). Sandrieser and Schneider (2015) postulated that speech fluency improves and the probability of recovery increases if these goals are achieved.

KIDS includes five sequential phases that may be adjusted according to a child's needs: information and contract, desensitization, identification, modification, and generalization. Each phase contributes to the achievement of the abovementioned goals; the information and contract phase serves the education of the child and the environment, as well as the establishment of an agreement (contract) concerning treatment goals, activities, and mutual responsibilities.

School KIDS is typically provided as an outpatient, individualized treatment with one or two treatment sessions of 45 min per week. The duration of treatment depends on the achievement of the abovementioned goals. Although goals are determined for each treatment phase,

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clinicians may need to adapt the duration as well as order and overlap of phases to the child's needs. The end of treatment is discussed and agreed upon between the child, parents, and clinicians when the following criteria are met: (a) the child stutters mildly (symptoms last less than half a second and are without associated struggle behaviors) or not at all; (b) the child has a positive self-efficacy in coping with stuttering symptoms, difficult speech situations, and negative listener reactions related to stuttering; and (c) adequate reactions in the environment toward stuttering prevail.

This Study

This prospective randomized clinical trial, PMS KIDS (Prospective Multicenter Study on the effectiveness of outpatient stuttering treatment with the stuttering modification therapy KIDS) examined the effectiveness of an outpatient, extended treatment for school-age children who stutter to improve cognitive, affective, and behavioral aspects of stuttering within a period of 12 months. Because of the prevalent use of KIDS in Germany, we opted against a superiority study and implemented a wait-list control group for the first 3 months. Based on the study design, we formulated the following hypotheses:

(1) At 3 months postrandomization, only the impact of stuttering (Overall Assessment of the Speaker's Experience of Stuttering–School-Age [OASES-S]) would be significantly reduced in the immediate-treatment group compared to the delayed-treatment group (wait-list control).

(2) At 6 and 12 months postonset of treatment, stuttering severity (Stuttering Severity Instrument–Fourth Edition [SSI-4]) would be significantly reduced compared to baseline in both groups.

(3) At 3, 6, and 12 months postonset of treatment, subjective parental ratings would decrease for stuttering severity and increase for satisfaction with communication in both groups.

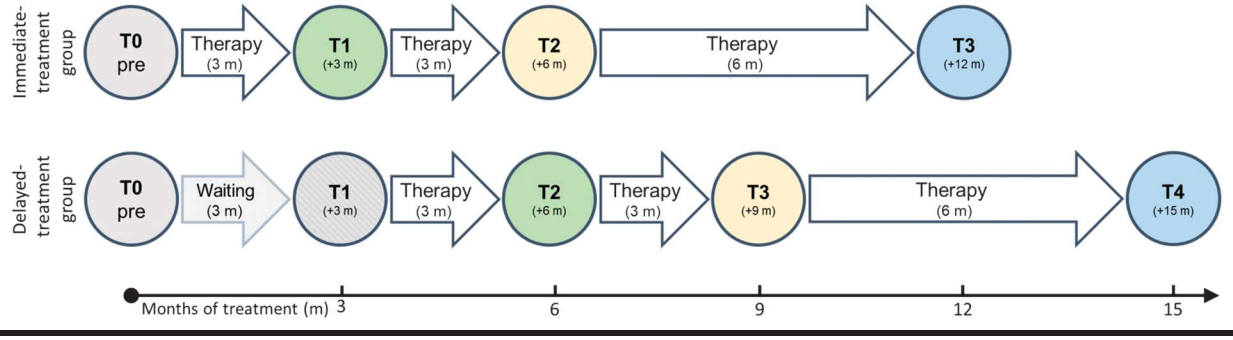
Method

Study Design

PMS KIDS was designed as a multicenter, two-group parallel, randomized, wait-list controlled, and open-label trial (Kohmäscher & Heim, 2018). All procedures were carried out in accordance with the European Guideline for Good Clinical Practice (European Medicines Agency, 2016). Verbal and written informed consent was obtained from all participating children, their parents, and clinicians. The study was approved by the ethics committees of the German Association of Academic Speech-Language Therapy (dbs e.V.; 18–10032-LA-KSp) as well as the RWTH Aachen University (Medical Faculty, EK 299/18). The study protocol was registered at the German Clinical Trials Register (www.drks.de) under registry number DRKS00015851 (date of registration 2018/11/07; see Supplemental Material S4 for more details on the research protocol). The reporting follows the Consolidated Standards of Reporting Trials with the extension for pragmatic trials (see Supplemental Material S3 for Consort Checklist).

Since we evaluated the effectiveness of KIDS, the children in the immediate-treatment group began their treatment directly after enrollment, whereas the children in the delayed-treatment group waited 3 months before starting the treatment (see Figure 1). We considered a waiting period of 3 months ethically justifiable, considering an age group where stuttering is usually present for at least a year or longer (Guitar, 2019). Our design allows between-group comparisons at baseline (T0) and after 3 months of intervention versus no intervention (T1), the latter being a typical point of time to decide whether a chosen intervention makes a sufficient impact (de Sonneville-Koedoot et al., 2015; Harris et al., 2002). In addition, we followed the treatment course for each participant for 12 months. As the duration of treatment cannot

Figure 1. Study design. T0–T4 refer to the assessment time points. T0 = pre-assessment; T1 = 3 months after the pre-assessment; T2 = 6 months after the pre-assessment; T3 = 12 months after the pre-assessment; T4 = 15 months after the pre-assessment.



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be predetermined in individual treatments, assessments at 3, 6, and 12 months after randomization were undertaken, regardless of whether or not treatment was ongoing.

Participants

Physicians diagnosed and referred all children for stuttering therapy; subsequently, parents consulted one of the 34 participating centers offering outpatient stuttering treatment. The following inclusion criteria were applied: (a) children who stutter aged between 7.0 and 11.0 years; (b) at least a mild-to-moderate impact, measured by the OASES-S total score; and (c) sufficient language abilities in German for treatment with KIDS. We excluded all children who stutter from the trial who had additional neurological, linguistic, emotional, or behavior-related impairments that prevented the implementation of stuttering therapy according to KIDS. In total, 73 children who stutter were followed over a course of 12 months.

Clinicians were recruited via public relations directed to different organizations for speech-language therapy and specialized stuttering treatment. Of the 37 clinicians who consented to participate in the trial, 26 actually provided treatment. The other clinicians did not receive any referral from a child who stutters in this age group, or the referred children were not eligible or willing to participate. The actively involved clinicians worked in outpatient centers throughout Germany. All clinicians were familiar with KIDS in their professional training and had treated at least two school-age children who stutter within the past 2 years. The clinicians differed in age, gender, and experience with (stuttering) treatment.

Randomization and Blinding

We used a blinded stratified randomization method to allocate the children to the immediate-treatment or delayed-treatment group. Stratification variables were age (< 9.0 years and ≥ 9.0 years) and sex with literature-based prevalence ratios of 4:1 (boys/girls). Block randomization ensured that the participants from the same strata were equally allocated to each group in the study. Prior to the beginning of the trial, the last author generated subsequent randomization codes for younger girls (< 9.0 years), older girls (≥ 9.0 years), younger boys (< 9.0 years), and older boys (≥ 9.0 years). After obtaining written informed consent from the parents and their children, the first author entered the appropriate code into an Excel spreadsheet and obtained the result of randomization: immediate- or delayed-treatment group. Directly after randomization, the second author informed the clinicians, parents, and children about their group assignment. After all speech samples had been collected, the second author coded these samples so that, during outcome analyses, the first, third, and fourth authors were blinded to group allocation and measurement time points (0, 3, 6, and 12 months).

Intervention

To ensure uniform application of KIDS by the participating clinicians, a treatment manual was developed by the authors of KIDS (Schneider & Sandrieser, 2018; see Supplemental Material S5 for more details on the intervention KIDS). Typically, treatment with KIDS started with the information and contract phase, in which parents and children were educated and compliance for treatment was established (Schneider et al., 2023). In the following phase desensitization, clinicians focused on removing taboo from stuttering and desensitized against stuttering symptoms as well as listener reactions. During identification, the children learned to perceive and describe their symptoms objectively. Speech techniques, such as preparatory set and pullout, were acquired and practiced in the subsequent phase modification. The phase generalization included activities outside the clinic and constituted the last phase of treatment in which the children learned to become more independent from the clinician. If necessary, treatment was supplemented by framework therapy, in which certain skills, such as problem-solving behavior, were trained. The treatment ended with a follow-up phase, during which refresher sessions were conducted. Based on clinical reasoning, clinicians were allowed to change the order of the treatment phases and omit phases, such as modification, if this met the children's needs.

For each phase, the treatment manual detailed the premises, goals, procedures, and troubleshooting (Schneider & Kohmäscher, 2022). Case descriptions, notes for guidance, background information, checklists, and an extensive collection of materials (exercise suggestions, illustrations, and documentation sheets) supported the clinician in clinical reasoning considerations and enabled individualized planning of treatment sessions and course. Although the clinicians were familiar with KIDS, all completed a 1-day training course using the manual. During this training, eligible variations in treatment practices were discussed and mandatory treatment elements (e.g., participation of the family and desensitization outside the clinic) were explained. During the trial, each clinician documented the treatment elements that were used on a standardized form (e.g., desensitization against listener reactions) after each session. To monitor the treatment courses, every clinician participated in two half-day group supervision events with the first and second authors.

The intensity of treatment was prescribed for the first 3 months with 45 min per week and at least 10 sessions

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within this period. Subsequently, clinicians were allowed to decide on one or two treatment sessions per week. Despite KIDS being designed as a face-to-face treatment, some clinicians had to replace treatment sessions with video therapy due to COVID-19 regulations (see below).

Outcomes

We chose the impact of stuttering on everyday life, measured by the OASES (Yaruss et al., 2016), as the primary outcome. This self-report measure is recommended in the literature (Brundage et al., 2021; Neumann et al., 2016) and is suitable to assess treatment outcomes. Specifically, we used the OASES-S, which is a version for school-age children between 7 and 12 years that has been validated and translated into German (Euler, Kohmäscher, et al., 2016; Kohmäscher, 2017).

The secondary outcomes included parental ratings. At each assessment time point, the parents judged their subjective impression of their child's stuttering severity, as well as their satisfaction with the child's ability to communicate on a 10-point rating scale. The parental rating on satisfaction with communication was added to the study protocol later, but before the first data collection. Objective secondary outcomes included data on speech fluency and stuttering in various situations. Each child was videotaped in the treatment center during a 15-min conversation with the third or fourth author (not their clinician) and asked to read an age-appropriate text aloud if reading competencies were sufficient. These speech samples were analyzed with respect to (a) the frequency of syllables stuttered, using an online syllable counter (Natke, 2019); (b) the duration of the three longest stuttering moments, using software Praat that allows analysis of spectrograms (Boersma & Weenink, 2021); and (c) physical concomitants. These concomitants included distracting sounds, facial grimaces, head movements, and movements of the extremities and were judged using the 5-point rating scale of the SSI-4 (Riley, 2009). Additionally, we calculated the total score for stuttering severity according to the manual of the SSI-4 by combining data on stuttering frequency, duration, and physical concomitants.

As stuttering is highly variable across different speaking tasks and settings (Constantino et al., 2016), we obtained additional audio speech samples from each child talking to one parent and to an unrelated adult outside the treatment center. The parents collected these speech samples using a voice recorder or an app that had been designed for this study. The latter allows simple recording of the conversations via a smartphone and immediate, data-secured, and encoded transfer of the files to the research team. These audio files were analyzed with respect to stuttering frequency and duration.

To ensure the reliability of the data, the first author, who has extensive experience in the analysis of speech samples with stuttering (Alpermann et al., 2010, 2012), trained the third and fourth authors in determining frequency, duration, and physical concomitants. Subsequently, each rater analyzed all existing speech samples of a given child (0, 3, 6, 12, and also 15 months in the delayed-treatment group).

Beginning with the first COVID-19 lockdown in March 2021 and subsequent travel restrictions, face-to-face assessments in the participating centers had to be replaced with video consultations, with only a few exceptions (Zava Sprechstunde Online GmbH, 2021). The research team sent reading texts as well as the rating scales of the OASES-S and parental ratings to the participants prior to the assessments, enabling the examiner to maintain the procedures of face-to-face assessments. To ensure data privacy, the examiner videotaped the computer screen instead of recording the sessions online.

Data Analysis

A Priori Power Analysis and Determination of Sample Size

To determine the required sample size, a priori power calculation using the program G*Power (Faul et al., 2009) was carried out. Alpha was set at .05, and power (1-β) was determined at .8. In accordance with earlier studies (Euler, Anders, et al., 2016; Zang et al., 2010), a medium effect of $f = 0.2$ (reduction by 0.5 points) was expected for the change in the OASES score after 3 months of treatment (primary hypothesis). This resulted in a total sample size of 52 children in both groups of the study design. Due to reports in comparable trials (Andrews et al., 2016; Franken et al., 2005; Onslow et al., 1994) and initial experiences with randomization, we estimated a dropout rate of up to 30% and, thus, aimed to include 75 children who stutter in the study.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics (Version 27). All outcomes were assessed using intention-to-treat analysis. In the case of participant attrition or missing data, last-observation-carried-forward was implemented by replacing missing scores on any outcome with the participant's score of that outcome on the previous assessment occasion. First, we executed the descriptive statistics to summarize demographic and clinical characteristics of those children who were included in the comparison from baseline to 3 months. The comparability of the treatment groups at baseline was analyzed with Pearson's chi-square tests for categorical data and independent samples t tests for continuous data. Descriptive data for

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the whole group and the entire duration of the trial were calculated for all available outcomes at a given assessment time point (see Supplemental Material S1).

The initial effects of treatment were explored by comparing the mean change score (T0–T1 difference per group) of the experimental (immediate treatment) group with the control (delayed treatment) group by means of an independent-sample t test (one tailed) per outcome measure. We corrected the p values for multiple testing using the Bonferroni–Holm procedure.[1] Corresponding effect sizes (Cohen's d) were interpreted as small for $0.2 \leq d \leq 0.49$, medium for $0.5 \leq d \leq 0.79$, and large for $d \geq 0.8$.

Medium-term outcomes up to 12 months were analyzed for all children by aligning and pooling data from the two treatment groups for the four time points, pre (immediately before therapy onset) and 3, 6, and 12 months post therapy onset. Corresponding effect sizes (partial η^2) were interpreted as small for $\eta^2 < .06$, medium for $.06 \leq \eta^2 \leq .14$, and large for $\eta^2 > .14$. Subsequently, a series of planned pairwise contrasts were run by means of dependent-sample t tests, comparing the baseline with each subsequent assessment and changes between all assessment occasions.

To establish interrater agreement, all three raters analyzed one randomly chosen speech sample from each child. This resulted in 65 speech samples (i.e., a total of 9%). In addition, each rater re-analyzed these samples after 1 month to monitor intrarater agreement. Krippendorff's alpha (Hughes, 2021), including the macro of Hayes for ordinal and interval data (Hayes & Krippendorff, 2007), allowed calculation of inter- and intrarater agreement for frequency and duration (interval scale) as well as physical concomitants (ordinal scale).

Results

Enrollment of the children took place between December 2018 and June 2021. Of 121 children who were referred for the stuttering treatment, 73 were randomized and allocated to the treatment or wait-list control group (see Figure 2). For between-group comparisons after 3 months, the data of 62 children ($n = 33$, $n = 29$) were available. In the delayed-treatment group, 10 of the 36 children allocated to the group did not receive delayed treatment for various reasons, resulting in 26 children for the 12-month comparison. Despite four dropouts, all 33 children in the immediate-treatment group could be analyzed for the 12-month comparison. Thus, in total, 59 children were included in the 12-month comparison.

The baseline demographic characteristics of the children were highly comparable between the groups (see Table 1). Clinical characteristics showed a slightly higher stuttering severity, frequency of stuttering, and impact of stuttering in the immediate-treatment group; however, t tests were nonsignificant for all outcome measures at T0 except for the subscale OASES-S Quality of Life (with higher scores for the immediate-treatment group).

The average number of treatment sessions for the immediate-treatment group was 11 ($SD = 2$) in the first 3 months. Over the period of 12 months, 59 children who were included in the statistical analysis participated, received an average of 26 treatment sessions ($SD = 9$) that were stretched over 39 weeks ($SD = 14$). From all children with complete follow-up data, three treatments (6%) were completed 3 months after the beginning of therapy and another six treatments (12%) were completed between 3 and 6 months postbeginning of therapy. Thirty-two children (62%) completed their treatment within 12 months, whereas 11 (21%) continued their treatment after the trial. In 27 cases (47%), video therapy was combined with regular treatment sessions in person. The average of video therapy sessions was 16%, ranging from 4% to 67% in individual cases.

Except for six children, at least one external audio speech sample could be analyzed per child. In the delayed-treatment group, 245 within clinic speech samples and 146 beyond clinic speech samples were available for analysis. In the immediate-treatment group (with one assessment point less), there were 216 internal speech samples and 111 external audio samples. Due to age-related, insufficient reading competencies, reading samples were scarce, were only analyzed descriptively, and were used for the calculation of the total SSI-4 score (see Supplemental Material S1).

Interrater agreement of objective outcome measures can be judged as near-perfect according to the interpretation of Hayes and Krippendorff (2007; stuttering frequency: .969, duration: .889, physical concomitants: .899). The intrarater agreement of the three raters also exceeded near-perfect agreement (rater 1: .942, rater 2: .934, and rater 3: .876).

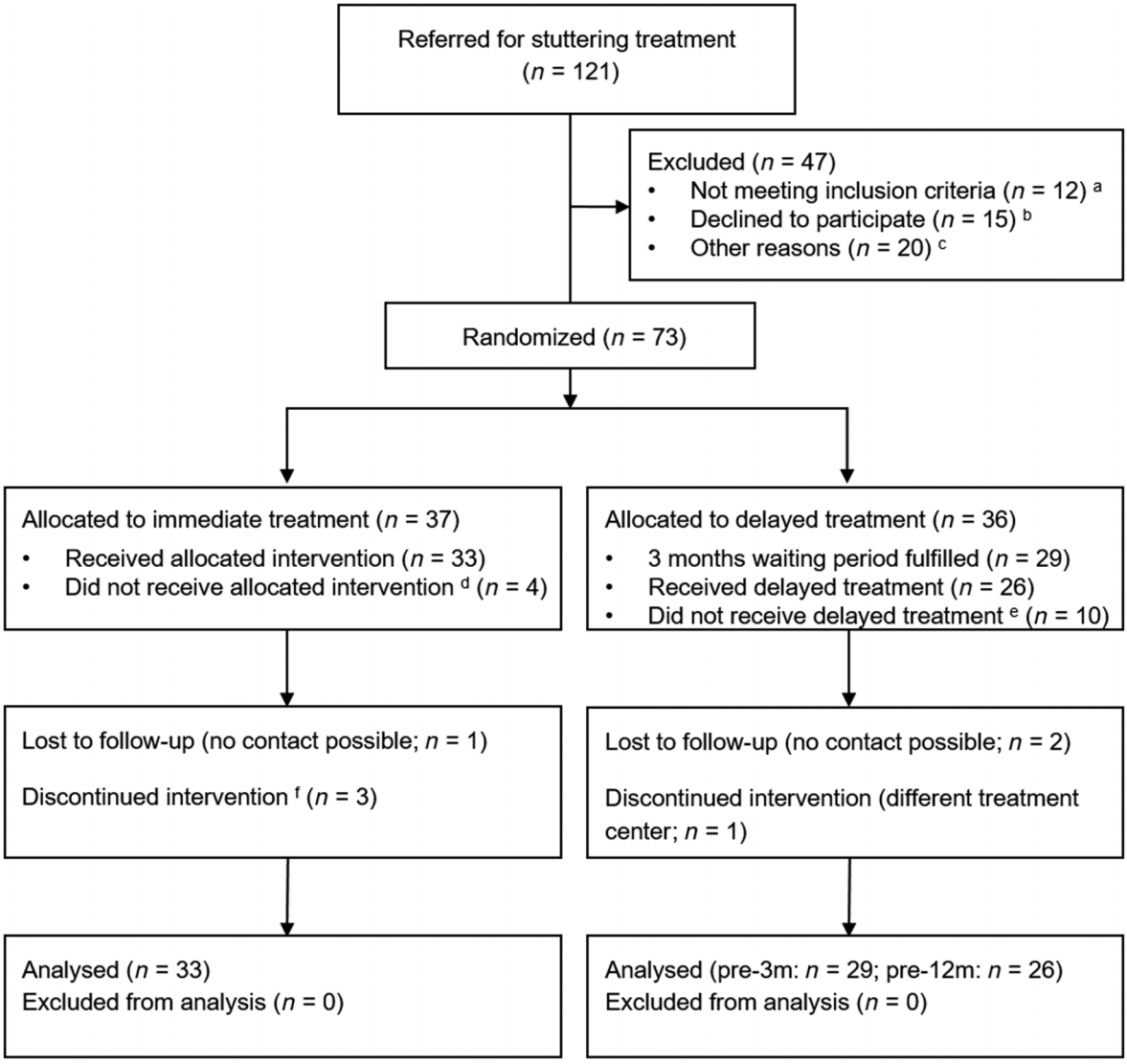
Treatment Effects After 3 Months

At T1 (see Figure 1), 3 months postrandomization, the OASES-S total score (primary outcome) had decreased

[1]First, the smallest p value is multiplied by the total number of statistical comparisons (n). If this corrected p value is below the critical statistical threshold (i.e., .05), the next larger p value is multiplied by the number of remaining comparisons ($n = 1$) and so forth. The procedure terminates when one corrected p value exceeds the critical statistical threshold. All remaining p values are then considered as nonsignificant (cf., https://en.wikipedia.org/wiki/Holm%E2%80%93Bonferroni_method).

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Figure 2. Participant flow. [a]Insufficient language abilities in German for treatment with Kinder Dürfen Stottern (n = 8), (suspected) neurological, linguistic, emotional, or behavior-related impairment(s) that prevent(s) the implementation of stuttering therapy according to KIDS (n = 4). [b]Preference for different clinician or treatment center (n = 5), fear of study-related, negative impact on stuttering (n = 2), immediate treatment preferred without information about study (n = 2), parents refusing randomization (n = 5), and unknown reasons (n = 1). [c]No timely treatment capacity (n = 2), refreshment of former treatment (n = 4), treatment not required (n = 2), potential waiting period not reasonable (n = 6), organizational, and other reasons (n = 6). [d]Inclusion criterion of at least mild–moderate impairment in Overall Assessment of the Speaker's Experience of Stuttering–School-Age not fulfilled (n = 3), preference for different treatment center (n = 1). [e]Withdrawal from study after randomization (n = 2), pregnancy-related absence of clinician (n = 2), treatment not required after waiting period (n = 4), withdrawal without given reason (n = 2). [f]Treatment changed to cluttering treatment after T2 (n = 1); treatment discontinued after a few sessions due to a different indication (n = 1) and the parents' wishes (n = 1).



in both the experimental, immediate-treatment group and the control, delayed-treatment group (see Figure 3). The mean OASES-S total score of M = 2.55 in the immediate-treatment group before therapy corresponded to a moderate impact of stuttering, whereas the score after 3 months (M = 2.17) was equivalent to a mild–moderate impact of stuttering. Changes in the delayed-treatment group were similar but less pronounced with M = 2.35 at the first assessment and M = 2.23 after 3 months.

Comparison of the OASES-S mean changes in both groups revealed that the mean decrease in the experimental, immediate-treatment group significantly exceeded the mean decrease in the control, delayed-treatment group (p = .026, medium effect; see Table 2). Regarding the subscales of the OASES-S, only mean changes in General Information (large effect) and Quality of Life (medium effect) were significantly larger for the immediate-treatment group than for the delayed-treatment group (see

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Table 1. Baseline demographic and clinical characteristics.

Characteristic	Immediate-treatment group	Delayed-treatment group	Group comparison *p* value
Age (*M* ± *SD*)	8.33 ± 1.14	8.31 ± 1.11	.879
Sex			
Male	28 (85%)	26 (90%)	.510
Female	5 (15%)	3 (10%)	
Bilingualism (*n* + %)	12[a] (39%)	8[b] (28%)	.413
OASES-S total score (*M* ± *SD*)	2.55 ± 0.52	2.35 ± 0.44	.086
SSI-4 total score (*M* ± *SD*, severity equivalent)	19 ± 8.6 mild	16 ± 7.6 mild	.177
Stuttering frequency (%)	6.0 ± 5.1	4.6 ± 4.0	.165
Family history of stuttering	11[c] (36%)	15[d] (52%)	.176
Earlier treatments[e]			
None	19 (63%)	14 (52%)	.527
One	5 (17%)	9 (33%)	
Two	4 (13%)	3 (11%)	
Three	2 (7%)	1 (4%)	

Note. OASES-S = Overall Assessment of the Speaker's Experience of Stuttering–School-Age; SSI-4 = Stuttering Severity Instrument–Fourth Edition. [a]*n* = 30. [b]*n* = 27. [c]*n* = 28. [d]*n* = 26. [e]*n* = 30 in immediate-treatment group, *n* = 28 in delayed-treatment group.

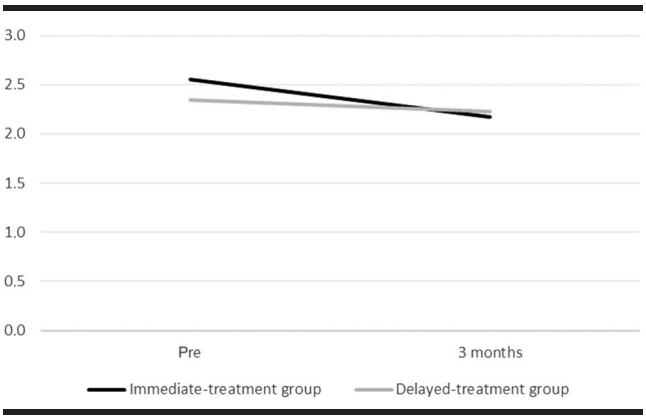
Table 2). No other comparisons of the secondary outcomes reached statistical significance.

Trajectories 12 Months Postonset of Treatment (Combined Groups)

Changes up to 12 months refer to within-clinic outcome measures for 59 children. The trajectory of the primary outcome OASES-S showed that the initial improvements in the first 3 months remained stable up to 12 months (see Figure 4, Supplemental Material S1).

The repeated-measures analysis of variance (see Table 3) revealed a significant change with large effect sizes for the OASES-S total score ($p < .001$, partial $\eta^2 = .324$) and the subscales General Information ($p < .001$, partial $\eta^2 = .430$), Reactions to Stuttering ($p < .001$, partial $\eta^2 = .195$), and Quality of Life ($p < .001$, partial $\eta^2 = .223$). Medium effects were found for the OASES-S subscale Communication in Daily Situations ($p = .007$, partial $\eta^2 = .082$).

Figure 3. Within- and between-group comparison after 3 months for the primary outcome Overall Assessment of the Speaker's Experience of Stuttering–School-Age.



For all secondary outcomes, changes between baseline and 12 months postonset of treatment, except the mean duration of the three longest moments of stuttering were significant (see Table 3). Effect sizes were large for parental rating of subjective stuttering severity (partial $\eta^2 = .144$) and medium for parental rating of satisfaction with communication (partial $\eta^2 = .087$), as well as SSI-4 total score (partial $\eta^2 = .100$) and stuttering frequency (partial $\eta^2 = .085$). Changes in the subscale physical concomitants of the SSI-4 amounted to a small effect (partial $\eta^2 = .048$).

The planned pairwise comparisons showed the following patterns. The OASES-S (total) score did not decrease significantly between 3 and 6 months ($p_{corr} = .071$) but did decrease from 6 to 12 months ($p_{corr} = .036$; see Supplemental Material S2). Comparisons of the scores at 3, 6, and 12 months with the scores before starting therapy were all significant (see Table 4). Interestingly, scores on all subscales decreased steadily, except for the subscale General Information. For this scale, scores decreased significantly in the first 3 months but increased significantly between 3 and 6 months (see Supplemental Material S2). Concerning parental ratings, subjective stuttering severity decreased significantly from pre to 3 months ($p_{corr} = .012$) and from 3 to 6 months ($p_{corr} = .018$). In addition, the scores at 6 and

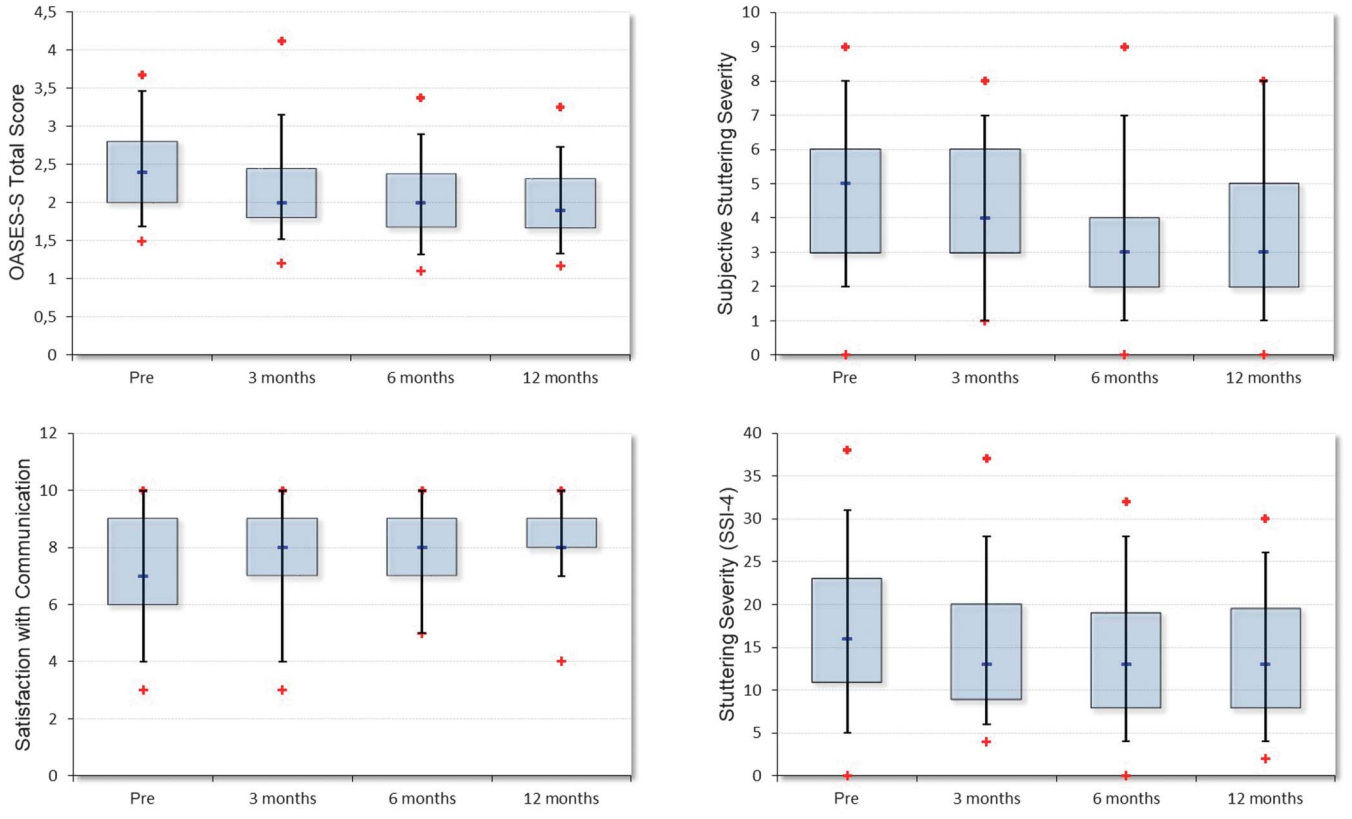
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Table 2. Score changes of the immediate-treatment group in comparison to the delayed-treatment wait-list control group.

Outcome	*t* (60)	*p*		Effect size *d*	95% CI	
		Uncorr	Corr		Lower	Upper
Impact of stuttering: OASES-S						
Total score	2.451	.009	**.026**	0.624	−1.132	−0.110
General Information	3.369	.001	**.003**	0.858	−1.376	−0.333
Reactions to Stuttering	0.463	.261	.261	0.164	−0.663	0.337
Communication in Daily Situations	0.914	.182	.182	0.233	−0.732	0.269
Quality of Life	2.790	.004	**.014**	0.710	−1.222	−0.193
Subjective parental ratings						
Subjective stuttering severity	0.461	.323	.323	−0.118	−0.616	0.382
Satisfaction with communication	0.002	.499	.499	< 0.001	−0.499	0.498
Objective stuttering severity: SSI-4						
Total	0.363	.359	.359	0.092	−0.407	0.591
Frequency spontaneous speech	0.320	.375	.375	0.082	−0.418	0.580
Duration	−0.596	.277	.277	−0.152	−0.651	0.348
Physical concomitants	0.373	.349	.349	0.095	−0.404	0.594

Note. *p* values are reported one tailed, uncorrected (Uncorr), and Bonferroni-Holm corrected (Corr) for the number of comparisons per test instrument. The *p* values indicating significance ($p < .05$) after correction are indicated by bold font. The effect size Cohen's *d* is interpreted as small for $0.2 \leq d \leq 0.49$, medium for $0.5 \leq d \leq 0.79$, and large for $d \geq 0.8$. CI = confidence interval; OASES-S = Overall Assessment of the Speaker's Experience of Stuttering–School-Age; SSI-4 = Stuttering Severity Instrument–Fourth Edition.

Figure 4. Changes over 12 months ($n = 59$) on the Overall Assessment of the Speaker's Experience of Stuttering–School-Age (OASES-S), satisfaction with communication, objective (Stuttering Severity Instrument–Fourth Edition [SSI-4]), and subjective stuttering severity.



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Table 3. Primary and secondary outcomes at 12 months as yielded by repeated measures analysis of variance.

Outcome	*F* (*df*)	*p*	Partial η^2
Impact of stuttering: OASES-S			
Total score	27.795 (2.413; 139.940)	**< .001**	.324
General Information	43.830 (2.470; 143.281)	**< .001**	.430
Reactions to Stuttering	14.043 (2.118; 122.831)	**< .001**	.195
Communication in Daily Situations	5.203 (1.951; 113.182)	**.007**	.082
Quality of Life	16.651 (2.041; 118.375)	**< .001**	.223
Subjective parental ratings			
Subjective stuttering severity	9.748 (2.730; 158.349)	**< .001**	.144
Satisfaction with communication	5.540 (2.624; 152.220)	**.002**	.087
Objective stuttering severity: SSI-4			
Total score	6.323 (2.283; 130.114)	**.002**	.100
Frequency spontaneous speech	5.389 (2.877; 166.867)	**.002**	.085
Duration spontaneous speech	0.799 (2.420; 140.358)	.473	.014
Physical concomitants	2.895 (2.798; 162.274)	**.040**	.048

Note. Degrees of freedom (*df*) are Greenhouse–Geiser corrected. The *p* values indicating significance ($p < .05$) are printed in bold. Corresponding effect sizes (partial η^2) were interpreted as small for $\eta^2 < .06$, medium for $.06 \leq \eta^2 \leq .14$, and large for $\eta^2 > .14$. OASES-S = Experience of Stuttering–School-Age; SSI-4 = Stuttering Severity Instrument–Fourth Edition.

12 months were significantly lower than those at the beginning of therapy. Similarly, parents' ratings of satisfaction with communication were significantly higher at 6 months ($p_{corr} = .028$) and 12 months ($p_{corr} < .001$; mean score of 8: good) than before (mean score of 7: amply sufficient).

Stuttering severity in the SSI-4, a combined score of stuttering frequency, duration, and physical concomitants during spontaneous speech and reading (if available), was reduced on average by 2 points over 12 months. As shown in Figure 3, changes in the SSI-4 total scores were most prominent in the first 3 months and stabilized afterward until 12 months. For the whole group, improvements after 3, 6, and 12 months compared to the initial scores were significant (see Table 4). On the subscale stuttering frequency the percentage of stuttered syllables decreased from 4.80% to 3.64% after 12 months (for details see Supplemental Material S1). The reductions in physical concomitants were only statistically significant for the comparison of 12 months versus the beginning of therapy ($p_{corr} = .035$).

Discussion

This study evaluated the effectiveness of the stuttering modification treatment KIDS in school-age children who stutter under everyday conditions. Initial treatment effects after 3 months were measured in comparison to a delayed-treatment wait-list control group that served as the control. In addition, medium-term changes were analyzed for the entire group after 3, 6, and 12 months.

As expected in the primary hypothesis, after 3 months, the improvements concerning the impact of stuttering (OASES-S) in the immediate-treatment group significantly exceeded the changes in the delayed-treatment control group. In contrast, none of the changes in the secondary outcome measures were significantly larger in the immediate-treatment group for this time interval. The medium-term outcomes are in line with the secondary hypotheses. For the whole group, at 12 months post-KIDS therapy onset the impact of stuttering (OASES-S) was reduced significantly with a large effect. Parental ratings improved with medium to large effects. Moreover, secondary, the objective outcomes (SSI-4 total score, frequency of stuttering, and physical concomitants) decreased with medium effect sizes. Only the mean duration of stuttering moments had not significantly decreased at 12 months post-treatment onset compared to baseline.

Overall, the short-term results are in line with the rationale of KIDS, which focuses on the cognitive and affective aspects of stuttering before actively addressing stuttering behavior. The first treatment phase, information and contract, which includes intensive education on stuttering, is central at the beginning of the treatment and might explain the large effect on the subscale General Information after 3 months of treatment. Also, interventions in the first three months resulted in a significant increase in the subscale Quality of Life, which is important given the challenges school-age children who stutter experience in social interaction (Yaruss et al., 2022).

The medium-term changes of up to 12 months concern several components of the ICF framework. Changes in affective, behavioral, and cognitive aspects are reflected by significant changes on the OASES-S subscale Reactions to Stuttering and Communication in Daily Situations. Analyses of the treatment documentation revealed that

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Table 4. Planned pairwise comparisons for all outcomes.

Outcome	Changes compared to pretreatment								
	3 months versus pre			6 months versus pre			12 months versus pre		
	t(58)	p_{uncorr}	p_{corr}	*t*(58)	p_{uncorr}	p_{corr}	*t*(58)	p_{uncorr}	p_{corr}
Impact of stuttering: OASES-S									
Total score	5.822	**< .001**	**< .001**	6.251	**< .001**	**< .001**	7.495	**< .001**	**< .001**
General Information	6.403	**< .001**	**< .001**	7.798	**< .001**	**< .001**	9.245	**< .001**	**< .001**
Reactions to Stuttering	3.318	**.001**	**.003**	4.473	**< .001**	**< .001**	4.629	**< .001**	**< .001**
Communication in Daily Situations	1.211	.116	.116	3.264	**.001**	**.005**	3.055	**.002**	**.006**
Quality of Life	5.356	**< .001**	**< .001**	4.707	**< .001**	**< .001**	5.055	**< .001**	**< .001**
Subjective parental ratings									
Subjective stuttering severity	2.737	**.004**	**.012**	4.339	**< .001**	**< .001**	4.081	**< .001**	**< .001**
Satisfaction with communication	–1.135	.131	.131	–2.536	**.007**	**.028**	–4.037	**< .001**	**< .001**
Objective stuttering severity: SSI-4									
Total score	3.157	**.002**	**.006**	2.859	**.003**	**.009**	3.263	**.001**	**.005**
Frequency spontaneous speech	2.651	**.005**	**.015**	3.250	**.001**	**.005**	3.100	**.002**	**.006**
Duration	1.429	.079	.079	0.541	.296	.296	1.176	.122	.122
Physical concomitants	1.383	.086	.086	2.207	**.016**	.062	2.544	**.007**	**.035**

Note. *p* values are one sided and significances indicated in bold font. For each scale, the *p* value indicating significant results after Bonferroni correction for the five independent comparisons per scale is $p < .01$. Uncorr = uncorrected; corr = corrected; OASES-S = Overall Assessment of the Speaker's Experience of Stuttering–School-Age; SSI-4 = Stuttering Severity Instrument–Fourth Edition.

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interventions for desensitization constituted the largest amount of all KIDS interventions (Hillebrandt, 2022). It seems plausible that these activities improved personal reactions and resulted in increased participation. Environmental factors were captured only through parental ratings. Their ratings of subjective stuttering severity and satisfaction with communication changed significantly within 12 months. This is probably due to the positive changes of their children but might also be influenced by their active involvement in therapy and specific education on stuttering. At the impairment level, changes in stuttering behavior (SSI-4) began within the first 3 months but were more pronounced at 6 and 12 months after the beginning of treatment. Concerning the treatment rationale, this seems plausible as it takes time for the effects of desensitization to be noticeable and children usually learn modification techniques in a later phase of treatment. Interestingly, a similar pattern of changes was observed in the beyond clinic samples (see Supplemental Material S1), indicating that changes in stuttering behavior were transferred outside the clinics.

One subscale of the SSI-4, the mean duration of the three longest stuttering symptoms, was not reduced as expected. At least two reasons might explain this: (a) The mean duration at baseline was already low (M = 1.41 s) in comparison to normative data of the SSI-4, averaging 6.4 ± 3.2 s for school-age children, possibly resulting in floor effects, and (b) the manual of the SSI-4 does not specify which stuttering behavior needs to be included in the duration. We only measured the duration of primary symptoms such as blocks, prolongations, and repetitions, and excluded related starters and postponements (e.g., uhm, you know). KIDS might have reduced these secondary behaviors, but we did not capture them using our method of analysis. Subjectively, we found a qualitative change in symptoms in some children, such as an increase in full-word repetitions rather than part-word repetitions. This would result in higher means of durations, even though the child's speech develops toward normal disfluencies.

The extent of the improvement found in our study can be compared with the results of effectiveness studies in a group format. Laiho and Klippi (2007) reported for a stuttering modification group therapy, aimed at children between 6.8 and 14 years, a reduction of stuttering frequency from 4.4% to 2.7% immediately after the end of treatment, which is comparable to our change scores from 4.8% to 3.6% after 12 months. Although improvements to a less severe stuttering severity category were gained for 43% of the children in the Finnish study, 56% of the children in our study received a lower severity grading after 12 months and another 28% maintained a (very) mild stuttering severity. It should be noted that the number of treatment sessions in the Finnish trial varied between 35.5 and 52.5 hr (stretched over 2–3 weeks), while the average number of treatment sessions in PMS KIDS amounted to 26. Subjective changes in affective and emotional aspects can hardly be compared between the two studies, as Laiho and Klippi only reported subjective outcomes for the behavioral aspect avoidance behavior, which was significantly reduced. Comparing our results to a fluency shaping therapy in group format for 5- to 10-year-old children who stutter (Euler et al., 2021) reveals a larger reduction in stuttering frequency in fluency shaping, which is probably also due to higher initial scores (9.4% in fluency shaping, 4.8% in PMS KIDS). The mean 18-month posttreatment stuttering frequency scores in the fluency shaping study were higher (4.7%) than the scores after 12 months in our study (3.6%). Regarding the impact of stuttering, as measured with the OASES-S in both studies, the change after 12 months in PMS KIDS and 18 months in the fluency shaping study was comparable: A moderate stuttering impact at baseline changed to a mild–moderate impact. Comparisons must be interpreted cautiously as treatment in PMS KIDS was ongoing in some cases. Taking these findings together, it seems that individual extended stuttering modification therapy with KIDS results in outcomes comparable to those of intensive group treatment with a stuttering modification or fluency shaping approach. The fact that some participants do not appear to have profited from a given treatment method demonstrates the need for different treatment options. From a cost–benefit perspective, individual treatments such as KIDS seem to be efficient even with fewer treatment sessions (Sommer et al., 2021); however, group treatments address more children and usually have a shorter time interval.

Strengths and Limitations

This study was designed as a pragmatic trial to assess the effectiveness of KIDS in everyday conditions. Support for this methodological approach can be found in the number and broad selection of participating clinicians from various settings. Due to the desired heterogeneity in therapeutic expertise (with stuttering), we made considerable efforts to provide a treatment manual with detailed guidance for less experienced clinicians as well as enough flexibility for experts. The documentations on treatment fidelity as well as the supervision sessions indicate that clinicians adhered to the manual and the rationale of KIDS. However, we do not have insight and cannot determine if individual decisions during treatment courses were reasonable, effective, and efficient. Even if precise instructions on individual steps would have been helpful in replicating the effects found in this study, we still acknowledge that, overall, the individualized approach that is common in practice has heterogeneous implications. As is known from

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psychotherapy, an intervention itself only partly contributes to treatment outcomes (Zebrowski et al., 2022). Other common factors, such as the therapeutic alliance, the skills, abilities, constitutional factors of the client, environmental features, and the expectancy that change can happen probably play a major role in the extent of individual improvements.

The aim of reflecting common practice is also evident in the broad inclusion criteria. Baseline characteristics showed that more than one third of the participating children were bilingual and lived in a family with a migratory background. This proportion is representative of the German population (Federal Statistical Office of Germany, 2022). As we recruited participants from 34 different centers for speech therapy over 1.5 years, we assume that the study sample is representative. It should be noted that the results cannot be generalized to children with speech-language, neurological, emotional, or behavioral impairments that require treatment, as these were excluded from the study. Another strength of our study in terms of generalizability is the diverse experience and expertise of clinicians. Furthermore, it might be questioned whether the speech (behavior) in our samples is representative of children's speech in everyday conditions. The abovementioned beyond clinic audio samples indicate similar improvements; however, the data were too incomplete for statistical analyses. The OASES-S subscale Communication in Daily Situations confirmed improvements with medium effects, but these were lower than improvements on other subscales. Clinically, this stresses the difficulty of and need for specific transfer activities as described in the KIDS manual (Schneider & Kohmäscher, 2022).

A major limitation of this study was the COVID-19 pandemic, which forced clinicians to pause treatments for at least several weeks and to switch to video therapy without having prior experience. Recent research shows that video therapy can be effective in stuttering treatment in this age group but possibly requires more treatment sessions than treatment in the clinic (Lowe et al., 2014; Tomaiuoli et al., 2021). The abovementioned transfer activities were probably more difficult to arrange, because face-to-face conversations were limited due to COVID-19 restrictions. Regardless of the actual treatment, the pandemic has affected children who stutter in a specific way that is currently unknown. On the one hand, many challenging speaking situations, such as in school or sports, fell away during lockdowns or home schooling. On the other hand, those restrictions and isolation from peers compromised all children's mental health and well-being (Ravens-Sieberer et al., 2021; Vogel et al., 2021) and possibly lowered the quality of life of children who stutter. Moreover, data collection procedures during the study had to be adopted into video sessions, which are, at least for younger children, less common speaking situations.

Another limitation of this study was the lack of follow-up data after the end of treatment. Such data would provide evidence on the stability of treatment effects, which is especially important in this age group where recovery from stuttering is increasingly unlikely. Due to high data loss, the availability of beyond clinical data were also limited in our study. We learned that app-supported recordings are generally a convenient method, but some parents find it difficult to adhere to given time frames and others are challenged in eliciting spontaneous speech from a child. Finally, even standardized, objective assessments have limitations in capturing stuttering behavior and its changes, thus, influencing their validity. In terms of stuttering severity, the judgment of physical concomitants is error-prone due to movements of the extremities that are not visible on the video or that are difficult to distinguish from movements not related to stuttering. The OASES-S offers broad insight into the personal experience of stuttering, but some items are difficult to understand if children are less competent in the German language or have not dealt with their stuttering before.

Acknowledging the challenge of evaluating the complexity and heterogeneity of stuttering, we conclude that the interpretation of our data was facilitated by the availability of objective (SSI-4) and subjective measures (OASES-S, parental ratings), within and beyond clinic data as well as data from children and parents.

Conclusions

Individual, outpatient stuttering modification treatment with KIDS for school-age children who stutter effectively reduces the affective and cognitive aspects of stuttering within 3 months. In addition, clinically relevant improvements in the behavioral aspects of stuttering can be expected over the course of 12 months.

Data Availability Statement

Due to ethical concerns, supporting data cannot be made openly available. Further information regarding the data and conditions for access are available from the corresponding author.

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