The Friends Project: A randomised controlled trial investigating the PEERS® social skills group program for adolescents with brain injury

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The Friends Project: A randomised controlled trial investigating the PEERS® social skills group program for adolescents with brain injury


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Abbreviations:

ADHD: Attention Deficit Hyperactivity Disorder
ABI: Acquired Brain Injury
ASD: Autism Spectrum Disorder
BRIEF: Behaviour Rating Inventory of Executive Function
CASS: Contextual Assessment of Social Skills
CP: Cerebral Palsy
EMD: Estimated Mean Difference
GSSIs: Group Social Skills Interventions
IQ: Intelligence Quotient
IQR: Interquartile Range
IRR: Incidence Rate Ratio
MD: Mean Difference
PEERS®: Program for the Education and Enrichment of Relation Skills
QSQ: Quality of Socialization Questionnaire
RCT: Randomized Controlled Trial
RoB2: Cochrane Risk of Bias (version 2) tool
SMD: Standardized Mean Difference
SRS: Social Responsiveness Scale
SSIS-RS: Social Skills Improvement System-Rating Scale
SSRS: Social Skills Rating Scale
TASSK: Test of Adolescent Social Skills Knowledge
TBI: Traumatic Brain Injury
Abstract

**Aim:** To test the efficacy of a group social skills intervention on social functioning in adolescents with brain injury.

**Method:** Thirty-six adolescents (mean 14y, SD 1y8m; 18 females) with acquired brain injury (≥12 months post; n=19) or cerebral palsy (n=17) were randomly allocated to Program for the Educational Enrichment of Relational Skills PEERS® or usual care. The primary outcome was the Social Skills Improvement System Rating Scales (SSIS-RS). Secondary outcomes were scores derived from the Test of Adolescent Social Skills Knowledge-Revised (TASSK), Social Responsiveness Scale-2nd Edition and Quality of Socialization Questionnaire. Between group differences post-intervention and 26 weeks were compared using linear mixed modelling for continuous outcomes and Poisson regression for count data.

**Results:** There were no between group differences on the primary outcome, SSIS-RS. Exploring secondary outcomes, the PEERS®-exposed group achieved significantly greater improvements on the TASSK (mean difference (MD) 6.8, 95%CI 4.8, 8.8; p<0.001) which were maintained at 26 weeks (MD 8.1, 95%CI 6.0, 10.2; p<0.001). PEERS® was also associated with a significant increase in parent-reported invited get-togethers at 26 weeks (Incidence Rate Ratio 4.0, 95%CI 1.0, 16.0; p=0.05).

**Interpretation:** Adolescents with brain injury who completed PEERS®, learned and retained social knowledge and increased social participation.

**Shortened Title:** PEERS® for adolescents with brain injury.
What this paper adds:

- Adolescents with brain injury can learn and retain social knowledge.
- PEERS® can improve social participation in adolescents with brain injury.
- PEERS® is able to be adapted for Australian adolescents with brain injury.

Acknowledgements:

The Friends Project group includes: Sarah Goodman\textsuperscript{a}, Kirsten Quinn\textsuperscript{d} and Isabelle Balde\textsuperscript{d}. The authors acknowledge the support of Jack Calderan and Shaneen Leishman in social coaching adolescent groups; Kate Hooke, Honnie Gorry, Ingrid Honan and Alana English in facilitating group sessions, Bianca Van Ginkel and Anne-Marie Sarandrea in contributing to protocol development, Sara Coombes in contributing to protocol development and facilitating a focus group, Megan Kentish and Mary-Clare Waugh for organisational support at the Queensland and New South Wales sites respectively. The authors acknowledge the contribution from Dr Syeda Farah Zahir for statistical support received through the Children’s Health Queensland Hospital provided by QCIF Facility for Advanced Bioinformatics (QFAB).
Adolescents with an acquired brain injury (ABI) or cerebral palsy (CP) can experience challenges with many aspects of social functioning, such as social problem solving, pragmatic language and speech difficulties, interpreting emotions of others and regulating their own emotional responses.\textsuperscript{1-3} These difficulties, along with often reduced social opportunities, motor and sensory impairments and persisting physical symptoms such as pain and fatigue can result in social isolation, reduced social participation or rejection by peers.\textsuperscript{3} Prevalence rates for difficulties with social functioning in these populations are emerging with studies reporting 23-50\% of children with traumatic brain injury (TBI)\textsuperscript{4-6} and 33-45\% of children with CP\textsuperscript{3, 7} experiencing problems with social functioning which can increase over time and persist into adulthood.\textsuperscript{3, 7, 8}

A number of systematic reviews of group social skills interventions (GSSIs) exist for adolescents with Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD).\textsuperscript{9-13} A recent systematic review and meta-analysis of group social skills intervention for adolescents with congenital, acquired or developmental disabilities included 16 randomised controlled trials (RCTs) of seven social skills programs (Gilmore et al. 2021, under review). Of the 16 RCTs, 15 comprised adolescents with ASD, and one focused on brain tumour survivors.\textsuperscript{14} Meta-analyses found that group social skills interventions compared to waitlist usual care led to significantly improved social responsiveness, social skills, social functioning and social knowledge (Gilmore et al. 2021, under review). The most commonly evaluated group social skills program was the Program for the Educational Enrichment of Relational Skills (PEERS®).\textsuperscript{15} There is evidence that PEERS® may be effective for youth with other diagnoses such as ADHD\textsuperscript{16}. As both ADHD and ASD are common amongst adolescents with brain injury, it was hypothesised that PEERS® might be an effective intervention to improve social functioning in this group.
The aim of this RCT was to determine the efficacy of PEERS® to improve social competence and friendship skills of adolescents with a brain injury. It was hypothesised that adolescents receiving PEERS® would achieve significantly greater gains in self and caregiver reported social skills, improved social knowledge, a reduction in caregiver reported social impairments and an increase in social participation compared to waitlist usual care.

**Method**

The study design for this waitlist RCT has been described in the study protocol. The study took place in Brisbane and Sydney, Australia between August 2017 and December 2019. Ethical approval was given by the Medical Research Ethics Committee of The University of Queensland (2017000864), the Children’s Health Queensland Hospital and Health Service Human Research Ethics Committee (HREC/17/QRCH/87) and the Cerebral Palsy Alliance Ethics Committee (20170802/HREC:EC00402). Written consent was obtained from caregivers and verbal assent was given by all adolescent participants. The trial was registered with the Australian New Zealand Clinical Trial Registry (ACTRN12617000723381).

**Participants**

Adolescents aged 11-17 years with a diagnosis of ABI (at least 12 months post injury) or CP and self and caregiver-reported difficulty in making and keeping friends were invited to participate. To be eligible for inclusion, participants were required to: (i) be enrolled in high school (home schooling included); (ii) be motivated to improve friendship skills; (iii) be able to attend a 14-week group program including homework tasks; (iv) have a verbal IQ>70 measured on the Wechsler Abbreviated Scale of Intelligence second edition (WASI-II); (v)
be able to verbally communicate in English and complete pre- and post-assessments.

Caregivers were also required to be able to verbally communicate in English, commit to participation in the 14-week group program and support homework completion. Adolescents were excluded if they had uncontrolled epilepsy, severe visual or auditory impairment or were non-verbal. Including a mix of young people with CP and ABI was decided on based on research evidence and the authors’ clinical and research experience with both groups and the similarities in presentation of social functioning difficulties that often occur.

**Study procedure**

Participants were randomly allocated to the 14-week PEERS® intervention or waitlist usual care. Allocation was conducted by a statistician not involved with conducting the intervention, with access only to a participant’s identification number and (for balancing purposes) site, gender and diagnosis. Opaque envelopes were used to conceal group allocation until baseline assessments were completed. Blinding of participants and therapists was not possible due to the nature of the group program.

**Intervention and Comparison**

The intervention comprised one 90-minute group session per week for adolescent participants and a separate 90-minute group session per week for their caregivers (conducted simultaneously) over a 14-week period. Group sessions comprised 4-6 participants. Sessions were conducted at the Centre for Children’s Health Research in Brisbane and the Cerebral Palsy Alliance in Sydney. Sessions were led by occupational therapists, speech pathologists, clinical/neuropsychologists, social workers and youth workers experienced in facilitating groups. Two group leaders conducted the adolescent group and one facilitator led the caregiver group. A social coach who had lived experience assisted in the adolescent group.
At least one group leader was a certified PEERS® instructor who had completed the three-day training program. Group leaders not trained in the program used the treatment manual and received guidance by certified practitioners to assist in running the groups. Both the treatment group and waitlist group continued with usual care throughout the program, which included a range of therapies such as physiotherapy, occupational therapy, speech pathology and psychology. A full description of the PEERS® intervention, including the intake procedures is detailed in the protocol paper.¹⁷

The PEERS® commercially available treatment manual was used to guide treatment sessions and included topics such as conversational skills, electronic communication, choosing appropriate friends, using humour, entering and exiting conversations, hosting and attending get-togethers, good sportsmanship, handling teasing and embarrassing feedback and bullying, changing a bad reputation and handling disagreements, rumours and gossip. Each adolescent session included a homework review, didactic lesson with modelling, role play and behavioural rehearsal and socialisation activity. The caregiver group comprised problem solving regarding social coaching of adolescents, review of the adolescent’s didactic lesson for the week, homework assignment and reunification with the adolescents. Minor tailoring of weekly sessions to adjust content for adolescents with brain injury incorporated provision of written cue cards to support working memory and learning of new social rules and behaviours. The session which focused on choosing appropriate friends was adjusted to include social groups relevant to Australian adolescents and some minor wording changes were adjusted to suit the cultural context. Fidelity checklists were completed after each session ensuring all manual content was covered each week.

Screening and outcome measures
Data were collected at baseline (T1), immediately post intervention at 14 weeks (T2) and at 26 weeks for 3-month retention (T3). A neuropsychologist at each site administered the WASI-II\textsuperscript{18} screener, with the verbal composite score used to determine eligibility for the trial. The Behaviour Rating Inventory of Executive Function (BRIEF, first edition)\textsuperscript{19} and Conners-3\textsuperscript{20} were completed by caregivers at the screening assessment to assess executive function behaviours. Primary outcome measures of social competence were the social and problem behaviour subscales of the Social Skills Improvement System-Rating Scales\textsuperscript{21} (SSIS-RS) which were completed separately by the adolescents and caregivers. Standard scores were obtained with higher scores reflecting increased frequency of behaviour (mean 100, SD 15). Secondary outcomes, for which the study was not powered, included the Quality of Socialization Questionnaire\textsuperscript{22} (QSQ), which measured the frequency (count data) of hosted and invited get-togethers in the previous month and was completed independently by caregivers and adolescents. This study reported separate results for hosted and invited get-togethers. The conflict score was not calculated as many adolescents could not complete this part of the assessment due to not attending or hosting any get-togethers in the previous month. Social impairment was measured by the caregiver reported Social Responsiveness Scale second edition\textsuperscript{23} (SRS-2) with higher scores indicating increased levels of social impairment. Raw scores were used for the SRS-2 in keeping with recommendations for research.\textsuperscript{23} The Test of Adolescent Social Skills Knowledge-Revised\textsuperscript{24} (TASSK-R) is a 30 point questionnaire completed by adolescents to assess social knowledge. See the protocol paper for a full description of measures, including validity and reliability data.\textsuperscript{17}

**Statistical analysis**

A sample size of 38 participants was estimated to give 80% power based on data from previous PEERS® studies to detect a 10 point mean difference on the parent reported SSIS-RS social composite score.
RS (assuming SD of 10.5 and α=0.05). Linear mixed modelling, adjusting for baseline, sex and diagnosis, on an intention to treat basis was used to analyse between group differences on the continuous outcomes: SSIS-RS, TASSK and SRS-2. STATA (version 16.1) was used to analyse results with the significance level set at p<0.05 for all outcome measures. No adjustment for multiple comparisons was performed. Poisson regression was used to analyse the count data generated by the QSQ. Pre-post data from the intervention and waitlist group participants who completed PEERS® were pooled and analysed using paired t-tests.

Results

Thirty-six adolescent-caregiver dyads consented to participate in the study and were randomized into the PEERS® intervention (n=18) or waitlist care as usual group (n=18). Baseline characteristics are presented in Table 1 with a mean age of the sample of 14 years and an almost even gender divide. A number of subscales on the BRIEF (see supplementary online table 5) and Conners-3 were elevated in our sample, indicating more difficulties with attention, working memory, executive functioning and learning than published normative data from age-matched peers. Scores for peer relations difficulties on the Conners-3 were particularly elevated.

Groups were similar at baseline for demographic and baseline measures (Table 1) for most variables. Exceptions were a higher number of caregiver reported hosted get-togethers in the waitlist control group (median 1, interquartile range (IQR) 0-2.0) than the intervention group (median 0, IQR 0-0.8) and the intervention group reporting a higher number of adolescents with a co-diagnosis of ADHD (n=7, 39%) and epilepsy (n=4, 22%) than the waitlist control (ADHD: n=1, 6%; epilepsy n=1, 6%). Fourteen of the waitlist control caregivers reported an
annual income greater than $100,000 Australian dollars compared to eight of the intervention
group. The higher number of adolescents with a co-diagnosis in the intervention group,
along with fewer family financial resources in this group were imbalances that occurred by
chance. If they had any impact on outcomes, they could potentially contribute to an
underestimation of the effect of the intervention. Adjusting for high income (> $100,000) in
the linear mixed model made a negligible difference to the intervention effect for every
outcome.

One hundred percent of the intervention group completed the program and were reassessed at
14 weeks (T2; see Fig.1 Participant flow diagram). Three dyads from the waitlist care as
usual group withdrew before T2 as they no longer wished to participate. At three months
retention (T3), 17 dyads from the intervention group (94%) and 12 from the waitlist care as
usual group (67%) completed outcome measures. Ten dyads from the waitlist care as usual
group went on to complete PEERS®. Average attendance for the intervention group was
82%. Fidelity checklists confirmed 100% compliance with delivery of the content of
PEERS®. No significant adverse events were reported during the trial.

**Primary and secondary outcomes**

Primary and secondary outcomes are reported in Table 2. No between group differences on
the caregiver or adolescent SSIS-RS (social skills or problem behaviour subscales) were
detected immediately post-intervention or at 3-month follow-up after controlling for baseline,
gender and diagnosis. Immediately post-intervention, the PEERS® group had increased
social knowledge on the TASSK compared to the waitlist control group (mean difference
(MD) 6.8, 95%CI 4.8, 8.8; p<0.001) and this was maintained at 26 weeks (MD 8.1, 95%CI
6.0, 10.2; p<0.001). No significant differences were detected in caregiver reported invited
get-togethers on the QSQ immediately post intervention, however, compared to the control group, the PEERS® group had a borderline significant increase in caregiver reported invited get-togethers on the QSQ at 26 weeks (Incidence Rate Ratio IRR 4.0, 95%CI 1.0, 16.0; p=0.05). There were no statistically significant between group differences in the adolescent reported invited and hosted get-togethers on the QSQ or the caregiver reported SRS2.

**Post hoc analyses**

For each outcome, post hoc analyses were conducted on the pooled pre and pooled post data (Pre: T1 for intervention group and T3 for control group; Post: T2 for intervention group and T4 for control group (Table 3). Significant changes from baseline were found on the primary outcome measure of the SSIS-RS caregiver reported social subscale (MD 4.5, 95% CI 0.5, 8.6, p=0.03) and the secondary outcome measures of the TASSK (MD 7.5, 95%CI 5.8, 9.1, p<0.001), SRS2 (MD -12.1, 95%CI -20.9, -3.3, p=0.009), QSQ adolescent reported invited get-togethers (MD 0.7, 95%CI 0.2, 1.2, p=0.009), QSQ caregiver reported invited get-togethers (MD 0.6, 95%CI 0.2, 1.1, p=0.004) and QSQ caregiver reported hosted get-togethers (MD 0.9, 95%CI 0.4, 1.5, p=0.002). Some changes were found for the SSIS-RS caregiver reported problem behaviour scale, adolescent reported SSIS-RS social and problem behaviour scales and QSQ hosted get-togethers, but none were statistically significant.

**Discussion**

This study found no difference between PEERS® and waitlist groups on caregiver or adolescent reported social competence. Secondary outcome measures demonstrated that adolescents with ABI and CP who participated in PEERS® gained social knowledge and were able to retain this new knowledge three months after completion of the program, despite reported functional challenges with working memory and learning. Improved social
participation was also seen with an increased number of invited get-togethers at the three months follow-up. Caregiver reported hosted get-togethers, adolescent reported hosted and invited get-togethers and caregiver reported social impairment did not show significant between group differences. Analysis of pooled pre-post data from all adolescents who completed PEERS® found significant improvements in caregiver reported social skills, adolescent social knowledge, adolescent reported invited get-togethers, caregiver reported invited and hosted get-togethers as well as reduced caregiver reported social impairment.

The adolescents with brain injury in our study had difficulties with executive functioning, in line with the extensive literature indicating executive difficulties following childhood brain injury.\textsuperscript{27, 28} Despite these difficulties in executive functioning, improvements in social knowledge were comparable with other trials of PEERS® (Gilmore et al. 2021, under review). The current study’s increase of 6.8 (95%CI 4.8, 8.8) is in keeping with a recent meta-analysis of five studies that demonstrated improved social knowledge on the TASSK with a MD of 7.4 points (95%CI 5.4 to 9.5) compared to waitlist control group (Gilmore et al. 2021, under review). These results suggest that adolescents with brain injury can make similar gains with adequate support.

PEERS® was designed for adolescents with ASD and without intellectual impairment. Although our sample had an average verbal IQ, adjustments were made to support difficulties in executive functioning associated with brain injury. Social rule cards listing the rules related to the weekly topic were provided to each participant. These cards were intended to provide explicit scaffolding of the information, prompt memory and assist with rehearsal of homework tasks before performing tasks in the home and school environment. The core components of role play, repetition and homework in PEERS® also provided structure to
enhance new learning and memory. Clinically, PEERS® is now delivered over 16 weeks at The University of California, Los Angeles, where the program originated. Other GSSIs, such as KONTAKT, have been delivered over 16 to 24 weeks with large effect sizes for the longer intervention. A longer PEERS® programs for adolescents with brain injury would offer more opportunity for repetition and reinforcing of new learning potentially increasing the effectiveness of the intervention. However, this would need to be balanced against with the feasibility of a longer course for participants and health service providers. To the authors’ knowledge, no head-to-head comparisons of longer and shorter programs of any GSSIs in a RCT have been conducted, few studies have explored the feasibility and acceptability of participation and no health economic evaluation detail the costs involved.

Translation of social knowledge into gains with social functioning in an adolescent’s own community is a key goal of GSSIs. The primary outcomes of caregiver and adolescent rated social skills and problem behaviours on the SSIS-RS in the current study did not capture translation of knowledge into social functioning. Data from previous RCTs of PEERS® with adolescents with ASD have largely shown significant between group differences on the caregiver rated SSIS-RS. Few studies report adolescent self-rated SSIS-RS and previous systematic reviews of outcome measures highlight concerns about the validity of these results in relation to an adolescent’s potential vulnerability to social desirability and dependence on an individual’s ability to follow instructions. Similar concerns have been raised by authors in the brain injury field, recommending self-report not be used as a primary approach to measurement. Findings from our study support this recommendation with the adolescents rating themselves in the average range for social skills and problem behaviours, which contrasted with caregivers’ ratings of increased difficulties with social skills and problem behaviours. While reduced insight may account for a lack of change on adolescent ratings,
failure to detect change on the parent primary outcome measures may reflect a lack of power, a real absence of treatment effect or indicate that the measure itself may not have captured change in individual goals, such as whether they had a friend to sit with at lunch at school. Adding an individualised goal setting measure to the outcome measures, such as the Goal Attainment Scale (GAS) may better capture change in what is most important to adolescents and their caregivers in their own home, school and community.

Results of this study must be interpreted with consideration of design limitations. Three participants in the waitlist group did not complete post-intervention assessments as they no longer wished to participate in the trial. A further two waitlist participants dropped out before the 26-week retention timepoint and one was lost to follow up. Although common in longer trials of GSSIs, with large time commitments involved from families and difficulties with conflicting schedules impacting participation in trials, this loss of information may have influenced results. Lack of information on minimal important change for any of the questionnaire measures makes interpreting results difficult. In addition, all outcome measures were self, or caregiver reported introducing potential bias through lack of blinding to the intervention. The absence of an individualised goal setting outcome measure is also acknowledged. The potential for differing outcomes in adolescents with ABI and CP after participation in PEERS® is acknowledged, however this study is probably too small to determine these effects.

Research testing the efficacy of GSSIs with adolescents with brain injury is in its early stages with many questions to explore in future research. High quality clinical trials testing different programs with validated and reliable measures sensitive to change is of key importance. Future studies should consider the addition of other established and emerging...
assessments to provide more objective measures of social skills, such as the Contextual Assessment of Social Skills (CASS) \textsuperscript{32}, the Paediatric Evaluation of Emotions, Relationships, and Socialisation (PEERS) \textsuperscript{36} and a means of measuring individualised social participating goals \textsuperscript{35}. Additionally, embedding a qualitative evaluation would provide more in depth understanding of the impact of these studies on social functioning in this population. Focus group data collected during the current study will be analysed and contribute to knowledge regarding acceptability and feasibility of the intervention. Ensuring input from teenagers and families with lived experience in the planning stage of future trials will also help focus studies on outcomes that are important to participants. Homework compliance was not formally measured in this study and so it remains unknown as to whether homework completion was a potential mediator of translation of social knowledge to changes in social functioning.

**Conclusion**

This first RCT using PEERS\textsuperscript{®} with adolescents with brain injury showed that with minor adjustments to the manualised intervention, adolescents were able to gain and retain social knowledge in a similar way to adolescents with ASD. Increases in invited get-togethers with friends at follow-up was also an encouraging indication of the potential for this program to increase social participation. No evidence of change to social competence on parent and adolescent reported questionnaire data was found. Future research is required to test the efficacy of PEERS\textsuperscript{®} in a larger sample of adolescents with brain injury and needs to consider additional measures of individual social participation goals as well as objective observational measures of change in social skills. Other options, such as peer support and increasing the length of the intervention could also be considered. Further exploration of the acceptability
and feasibility of this intervention remains crucial during this initial testing of efficacy in this population.
Figure 1. Participant flow diagram.

Assessed for eligibility (n=272)

Screening interview/assessment (n=46)

Baseline assessment (n=36; T1)

Randomized (n=36)

PEERS® (n=18)
• Received allocated intervention (n=18)

14 week post-intervention assessment (n=18, 100%; T2)

26 week retention assessment (n=17, 94%; T3)
• 1 withdrew (no longer wished to participate)

Analysis (Maximum cases available 0-14 wk)
 n=18; 0-26 wk n=17

Control waitlist (n=18)

14 week post-intervention assessment (n=15, 83%; T2)
• 3 withdrew (no longer wished to participate)

26 week retention assessment (n=12, 67%; T3)
• 2 withdrew (no longer wished to participate)

Control waitlist participated in PEERS® (n=10, 56%)

40 week assessment (n=10, 56%; T4)
 Waitlist only

Analysis (Maximum cases available 0-14 wk)
 n=15; 0-26 wk n=12

Declined or not eligible (n=228)
**Reasons for ineligibility:**
Not in high school
Verbal IQ < 70
Lived too far from centre
No social skill concerns

Declined (n=5)
Not eligible (n=5)
**Reasons for ineligibility:**
Verbal IQ<70

Baseline assessment (n=36; T1)

Screening interview/assessment (n=46)

Randomized (n=36)

PEERS® (n=18)
• Received allocated intervention (n=18)

14 week post-intervention assessment (n=18, 100%; T2)

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Lived too far from centre
No social skill concerns

Declined (n=5)
Not eligible (n=5)
**Reasons for ineligibility:**
Verbal IQ<70
Table 1. Demographic and screening variables for treatment and waitlist control group.

<table>
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<th>Group</th>
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<th>Waitlist control n=18</th>
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<td>Mean age, years (SD)</td>
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<td>2 (11)</td>
</tr>
<tr>
<td>Home Schooling</td>
<td></td>
<td>-</td>
<td>1 (6)</td>
</tr>
<tr>
<td>WASI-II (Verbal composite), M (SD)</td>
<td></td>
<td>91.8 (15.1)</td>
<td>93.0 (17.3)</td>
</tr>
<tr>
<td>BRIEF (Global executive composite), M (SD)</td>
<td></td>
<td>68.8 (11.0)</td>
<td>63.3 (9.4)</td>
</tr>
<tr>
<td><strong>CONNERS-3, M (SD)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inattention (T-score)</td>
<td></td>
<td>75.0 (14.0)</td>
<td>63.4 (9.4)</td>
</tr>
<tr>
<td>Hyperactivity/Impulsivity (T-score)</td>
<td></td>
<td>69.4 (15.1)</td>
<td>58.2 (14.5)</td>
</tr>
<tr>
<td>Learning Problems (T-score)</td>
<td></td>
<td>67.8 (14.2)</td>
<td>67.4 (14.9)</td>
</tr>
<tr>
<td>Executive Functioning (T-score)</td>
<td></td>
<td>66.5 (13.9)</td>
<td>62.1 (10.9)</td>
</tr>
<tr>
<td>Defiance/Aggression (T-score)</td>
<td></td>
<td>57.8 (11.2)</td>
<td>51.6 (12.9)</td>
</tr>
<tr>
<td>Peer Relations (T-score)</td>
<td></td>
<td>85.3 (10.0)</td>
<td>81.6 (12.6)</td>
</tr>
<tr>
<td><strong>Annual income, n(%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$AUD 50,000</td>
<td></td>
<td>2 (12)</td>
<td>2 (11)</td>
</tr>
<tr>
<td>AUD 50,000-100,000</td>
<td></td>
<td>7 (41)</td>
<td>2 (11)</td>
</tr>
<tr>
<td>AUD 100,000-150,000</td>
<td></td>
<td>2 (12)</td>
<td>4 (22)</td>
</tr>
<tr>
<td>&gt;$AUD 150,000</td>
<td></td>
<td>6 (35)</td>
<td>10 (56)</td>
</tr>
</tbody>
</table>

AUD, Australian dollars
Table 2. Results and analysis of primary and secondary outcomes.

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Intervention Group</th>
<th>Waitlist control group</th>
<th>Adjusted* between-group difference (Intervention – Control) at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>T2 Mean difference (95% CI); p</td>
</tr>
<tr>
<td>**Baseline (T1)</td>
<td></td>
<td></td>
<td>T3 Mean difference (95% CI); p</td>
</tr>
<tr>
<td>Caregiver reported Social Skills</td>
<td>83.4 (15.1)</td>
<td>89.7 (15.6)</td>
<td>3.5 (-2.7 to 9.8); p=0.26</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=18</td>
<td>1.8 (-4.8 to 8.4); p=0.59</td>
</tr>
<tr>
<td>Caregiver reported Problem Behavioursb</td>
<td>120.9 (13.6)</td>
<td>116.3 (15.6)</td>
<td>-3.3 (-10.4 to 3.8); p=0.36</td>
</tr>
<tr>
<td></td>
<td>n=17</td>
<td>n=18</td>
<td>0.1 (-7.5 to 7.6); p=0.99</td>
</tr>
<tr>
<td>Adolescent reported Social Skills</td>
<td>94.4 (16.2)</td>
<td>100.9 (12.8)</td>
<td>6.2 (-1.3 to 13.7); p=0.10</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=15</td>
<td>-2.8 (-10.8 to 5.2); p=0.49</td>
</tr>
<tr>
<td>Pension Behavioursb</td>
<td>107.6 (13.9)</td>
<td>101.8 (11.3)</td>
<td>-1.1 (-6.3 to 4.1); p=0.68</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=12</td>
<td>-3.8 (-9.5 to 1.8); p=0.18</td>
</tr>
<tr>
<td>TASSK*</td>
<td>14.8 (1.8)</td>
<td>14.0 (3.3)</td>
<td>6.8 (4.8 to 8.8); p&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=18</td>
<td>8.1 (6.0 to 10.2); p&lt;0.001</td>
</tr>
<tr>
<td>SRS2*</td>
<td>86.0 (28.9)</td>
<td>75.2 (27.3)</td>
<td>-7.7 (-19.3 to 3.9); p=0.19</td>
</tr>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>79.1 (23.1)</td>
<td>-2.6 (-15.0 to 9.7); p=0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>72.6 (25.4)</td>
<td></td>
</tr>
<tr>
<td>Triage hosted</td>
<td>0 (0-0.8)</td>
<td>1.0 (0-1.0)</td>
<td>1.9 (0.8 to 4.2); p=0.11</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=15</td>
<td>1.1 (0.4 to 3.1); p=0.79</td>
</tr>
<tr>
<td>Triage invited</td>
<td>0 (0-1.0)</td>
<td>1.0 (0-1.0)</td>
<td>2.2 (0.9 to 5.5); p=0.09</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=12</td>
<td>4.0 (1.0 to 16.0); p=0.05</td>
</tr>
<tr>
<td>Adolescent hosted</td>
<td>0 (0-0.8)</td>
<td>0.5 (0-1.8)</td>
<td>2.4 (0.9 to 6.0); p=0.07</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=10</td>
<td>2.0 (0.8 to 4.9); p=0.13</td>
</tr>
<tr>
<td>Adolescent invited</td>
<td>0 (0-1.0)</td>
<td>1.0 (0-1.0)</td>
<td>1.2 (0.5 to 3.1); p=0.69</td>
</tr>
<tr>
<td></td>
<td>n=18</td>
<td>n=8</td>
<td>1.6 (0.6 to 4.8); p=0.39</td>
</tr>
</tbody>
</table>

a, adjusted for baseline, gender and diagnosis; SD, standard deviation; CI, confidence interval; SSIS-RS, Social Skills Improvement System – Rating Scale; *, linear mixed modelling analyses b, lower scores indicate improvement; TASSK, Test of Adolescent Social Skills Knowledge; SRS2, Social Responsiveness Scale (second edition); QSQ, Quality of Socialization Questionnaire; #, Poisson regression analyses; IQR, Interquartile range.
Table 3. Post-hoc results of primary and secondary outcomes.

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Pre-intervention Mean (SD)</th>
<th>Post-intervention Mean (SD)</th>
<th>Difference (Post-Pre)* Mean (95% CI); $p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSIS-RS</td>
<td>$n=28$</td>
<td>$n=28$</td>
<td>4.5 (0.47 to 8.53), $p=0.03$</td>
</tr>
<tr>
<td>Parent reported Social Skills</td>
<td>86.6 (15.0)</td>
<td>91.1 (15.9)</td>
<td>-3.7 (-7.8 to 0.4), $p=0.08$</td>
</tr>
<tr>
<td>Parent reported Problem Behaviours</td>
<td>118.7 (13.1)</td>
<td>115.0 (15.1)</td>
<td>1.5 (-2.6 to 5.6), $p=0.46$</td>
</tr>
<tr>
<td>Adolescent reported Social Skills</td>
<td>97.6 (16.6)</td>
<td>99.1 (15.8)</td>
<td>-12.1 (-20.9 to -3.3), $p=0.009$</td>
</tr>
<tr>
<td>Adolescent reported Problem Behaviours</td>
<td>105.8 (12.4)$^a$</td>
<td>105.8 (11.2)</td>
<td>0.5 (-0.1 to 1.1), $p=0.12$</td>
</tr>
<tr>
<td>TASSK</td>
<td>14.3 (2.3)</td>
<td>21.7 (3.7)</td>
<td>7.5 (5.8 to 9.1), $p&lt;0.001$</td>
</tr>
<tr>
<td>SRS2</td>
<td>80.5 (28.9)</td>
<td>68.5 (31.7)</td>
<td>0.7 (0.2 to 1.2), $p=0.009$</td>
</tr>
<tr>
<td>QSQ</td>
<td>Median (interquartile range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent hosted</td>
<td>0.0 (0.0-1.0)</td>
<td>2 (0-2.3)</td>
<td>0.9 (0.4 to 1.5), $p=0.002$</td>
</tr>
<tr>
<td>Parent invited</td>
<td>0.0 (0-1.0)</td>
<td>1.0 (0.0-2.0)</td>
<td>0.6 (0.2 to 1.1), $p=0.004$</td>
</tr>
<tr>
<td>Adolescent hosted</td>
<td>0.0 (0.0-1.0)</td>
<td>1.0 (0.0-2.0)$^a$</td>
<td>0.5 (-0.1 to 1.1), $p=0.12$</td>
</tr>
<tr>
<td>Adolescent invited</td>
<td>0.0 (0.0-0.0)$^a$</td>
<td>1.0 (0.0-1.0)</td>
<td>0.7 (0.2 to 1.2), $p=0.009$</td>
</tr>
</tbody>
</table>

$^a n=27$; $^b n=26$, *paired t-tests


Table 5. BRIEF Score Summary Table for whole sample

<table>
<thead>
<tr>
<th>Index/Scale</th>
<th>Mean T Score (SD) n=36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibit</td>
<td>59 (12)</td>
</tr>
<tr>
<td>Shift</td>
<td>67 (13)</td>
</tr>
<tr>
<td>Emotional Control</td>
<td>61 (14)</td>
</tr>
<tr>
<td>Behavioural Regulation Index (BRI)</td>
<td>63 (13)</td>
</tr>
<tr>
<td>Initiate</td>
<td>67 (11)</td>
</tr>
<tr>
<td>Working Memory</td>
<td>68 (12)</td>
</tr>
<tr>
<td>Plan/Organize</td>
<td>64 (11)</td>
</tr>
<tr>
<td>Organization of Materials</td>
<td>57 (10)</td>
</tr>
<tr>
<td>Monitor</td>
<td>62 (12)</td>
</tr>
<tr>
<td>Metacognition Index</td>
<td>66 (11)</td>
</tr>
<tr>
<td>Global Executive Composite</td>
<td>66 (10)</td>
</tr>
</tbody>
</table>