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Journal

Journal of Eating Disorders, 12(1)

ISSN

2050-2974

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Publication Date

2024-12-19

DOI

10.1186/s40337-024-01175-w

Peer reviewed

Journal of Eating Disorders

RESEARCH

Open Access

Delivering evidence-based treatment via telehealth for Anorexia Nervosa in rural health settings: a multi-site feasibility implementation study

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Abstract

Background Access to evidence-based treatments such as family-based therapy (FBT) is difficult for adolescents diagnosed with Anorexia Nervosa (AN) living in rural or regional areas due to a limited trained workforce, high staff turnover and inconsistent treatment fidelity. Telehealth offers a potential access solution by facilitating care irrespective of family or service location. The disruption to the health system caused by COVID-19 amplified an existing need and increased the use of telehealth to deliver FBT before its efficacy and safety was fully evaluated. This study aimed to evaluate the feasibility, acceptability and preliminary efficacy of telehealth-FBT delivered by community-based clinicians within rural services directly into the home to reduce the eating disorder symptoms of adolescents diagnosed with AN.

Methods A pre- and post-implementation multi-site case series delivered up to 20 sessions of telehealth-FBT to 28 adolescents (89.29% female, $M = 14.68 \pm 1.58$ years) living in rural or regional Australia. The RE-AIM framework guided the evaluation, with Reach (treatment uptake and completion); Efficacy (change in weight, global eating disorder symptoms, and remission from baseline to end of treatment and six-month follow-up); Adoption (patient characteristics and drop out); Implementation (intervention fidelity) and Maintenance (outcomes and intervention during the follow-up period) used to assess the feasibility and preliminary efficacy of telehealth-FBT.

Results There was a high level of interest in telehealth-FBT, with two-thirds of eligible families consenting to participate. Both treatment engagement and completion rates were over 60%, and treatment was delivered with acceptable fidelity. Twenty adolescents (71.43%) met the diagnostic criteria for AN (baseline 86.03%mBMI ± 7.14), and eight (28.57%) for Atypical AN (baseline 101.34%mBMI ± 8.28), with an overall mean duration of illness of 8.53 months ($SD = 5.39$, range 2–24 months). There was a significant increase in %mBMI at the end of treatment compared to the baseline ($p = 0.007$, 95%CI: 1.04–6.65), with over 68% of adolescents weight restored and 36.8% of these achieving both weight and psychological remission criteria. Weight remained significantly improved at six-month follow-up

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($p = 0.005$, 95%CI: 1.57–8.65). Also, there was a decrease in adolescents' global eating disorder symptoms, as rated by their parents, at the end of treatment compared to the baseline of 0.735 ($p = 0.028$, 95%CI: 0.079–1.385).

Conclusions Telehealth-FBT was feasibly implemented into rural services and delivered by community clinicians with reach, adoption, preliminary efficacy, and fidelity scores comparable to those reported by specialist studies.

Trial registration The study was conducted according to the HREC-approved protocol (HREC 2020/ETH00186) and registered with the Australian and New Zealand Clinical Trials Registry (ANZCTR # 12620001107910).

Plain English summary

Families living in rural and regional locations face additional challenges accessing healthcare, and in particular quality evidence-based treatment for conditions needing specialist knowledge or treatment. For young people in these areas with anorexia nervosa, accessing Family Based Treatment (FBT) is difficult compared to their urban counterparts. This study evaluated the feasibility and preliminary efficacy of telehealth-FBT delivered by local community-based clinicians to 28 families living in rural Australia. Results showed that telehealth-FBT was well-received, with high engagement and completion rates. Most adolescents experienced significant weight gain and improvement in eating disorder symptoms by the end of treatment, with continued benefits observed at a six-month follow-up. The study found that telehealth-FBT could be effectively implemented in rural health services, achieving outcomes similar to those from specialised academic clinical settings.

Keywords Anorexia nervosa, Family-based treatment, Effectiveness, Implementation, Rural health, Outcomes

Background

Anorexia Nervosa (AN) confers severe psychological and physical consequences [1–3]. Frequently onset in the vulnerable adolescent period, evidence suggests that after 10 years of AN, only 30% of individuals have recovered [4]. Family-based Treatment (FBT) is an efficacious treatment [5] recommended by international guidelines [6, 7] as the first-line outpatient treatment for adolescents with AN [8–10]. FBT emphasises parental responsibility for the adolescent's weight recovery as the primary mechanism in the treatment of AN [11]. Given the seriousness of the disorder, and that remission rates are most promising when FBT is delivered early in illness course [10, 12, 13], treatment must be delivered efficiently and effectively.

Yet, in many parts of the world, families living in rural areas face significant treatment access inequities, with a shortage of health professionals, significant distances between homes and services [14, 15] and care ratios as high as 6000:1 [16]. Attending FBT is particularly difficult for rural families as it requires whole family attendance and regular appointments each week, at least for the first few months of treatment [17]. Evidence suggests that when rural adolescents with AN are referred to specialist services in urban areas, they are often more medically compromised due to delays in identification and treatment, require higher levels of care than their urban counterparts [18] and are more likely to require hospital readmissions [19], further exacerbating the health disparity for rural adolescents.

Implementing evidence-based eating disorder (ED) treatments in community settings is challenged by a low concordance between provider diagnoses and patient symptom profiles, and significant treatment manual deviations. For example, a recent Australian study examined practitioner skills and knowledge to treat EDs within a regional community-based health service [20]. While weight monitoring is an essential component and outcome measurement of evidence-based treatments for AN, only 35% of cases receiving treatment from the service had a baseline weight recorded. Despite introducing micro-skill training sessions, weight omissions and diagnostic inaccuracies, particularly false-negative AN diagnoses, remained high [20]. Although clinicians were initially trained in FBT, the treatment model was later removed from the program due to a change in funding which directed individuals with AN to other specialist services [20]. Consequently, the feasibility, acceptability and effectiveness of implementing FBT in rural and regional non-specialist treatment settings remains unclear.

In addition to inequalities in geographical access, rural areas are more vulnerable to natural disasters and climate change impacts [21, 22], which have significant consequences for mental health [23], service delivery, and workforce availability [21]. Telehealth may reduce the impact of these challenges by facilitating the continuity of care when face-to-face treatment is not safe or practicable. Although research conducted prior to the COVID-19 pandemic suggested telehealth was a feasible mode to deliver FBT [11, 24] the adoption of telehealth in rural Australia was relatively slow [25].

The COVID-19 pandemic and associated public health measures forced the sudden shift from in-person care to telehealth [26, 27], emphasised an already recognised need for increased access to FBT [8] and triggered an increase in research examining the outcomes [28–32] and experience of [33–36] telehealth-delivered FBT. A

recent study explored the outcomes of FBT+ (telehealth-FBT with lived experience peer and family mentors) delivered by clinicians in the community and found that adolescents achieved weight restoration and a decrease in eating disorder symptoms, comorbid depression and anxiety following up to 12 months of treatment [30]. The authors noted further research is needed to examine the feasibility, process and outcomes of telehealth-FBT delivered by community-based services. This gap is particularly pertinent for rural services, which must act as a 'one-stop-shop' for families who require a flexible yet evidence-informed treatment approach [37].

To this end, the present study aimed to evaluate the feasibility as well as establish the preliminary efficacy of telehealth-FBT implemented in a rural health system to reduce the core eating disorder symptoms of adolescents diagnosed with AN or Atypical Anorexia Nervosa (AAN). We hypothesised that telehealth-FBT would be feasible with recruitment, retention and completion rates similar to those reported in face-to-face studies. Secondly, based on the results of previous studies [11, 29–32, 38], we hypothesised that adolescents with AN and AAN would experience a significant and clinically meaningful increase in weight and decrease in global eating disorder symptomology from baseline to end of treatment and from baseline to six-month follow-up.

Method

Study design

The pre- and post-implementation case series utilised the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework [39] to evaluate the feasibility and preliminary efficacy of telehealth-FBT. Reporting was informed by the Standards for Reporting Implementation Studies (Supplementary Table 1) [40, 41]. The study was conducted in accordance with the published protocol [42] approved by Human Research Ethics Review Board (HREC#2020/ETH00186). The study was pre-registered with the Australian and New Zealand Clinical Trials Registry (ANZCTR#12620001107910.

Setting

The study was conducted in the health system of New South Wales (NSW), Australia's most populated state. The state-funded and governed public health system is geographically divided into fifteen health districts, nine covering rural and regional NSW (see Maguire and Maloney [43] for a comprehensive review of eating disorder services in the Australian health care system). Five rural districts received management approval and enrolled in the study. Participating districts ranged from 246,676 square kilometres (km^2, 95,242.14 square miles) to 20,732km^2 (8004.67 square miles) in size.

Most mental health care in NSW is delivered by community-based Child and Adolescent Mental Health Services (CAMHS) geographically dispersed around the health district, often in a major town or population hub. Before the statewide rollout of a comprehensive workforce training initiative, clinician expertise and the availability of in-person FBT varied, with rural areas often facing notable gaps in experience [43]. Although CAMHS aim to provide localised care, some families in rural districts face travel times exceeding two hours to reach services.

Each district employed an Eating Disorder Coordinator (EDC) whose role was to develop and coordinate services for people with eating disorders. In the context of this study, the EDC was responsible for the local implementation of the study, such as assisting with ethics processes and recruitment strategies, working with local services to identify potential participants, attending investigator meetings, and supporting study clinicians with cases.

The study was designed in 2019, prior to most health districts using telehealth to deliver care. However, implementation was delayed until April 2020 as the participating districts were particularly overwhelmed by the 2019/2020 'Black Summer' bushfire crisis and COVID-19 impacts. These events increased demand for mental health services and reduced service staff, with many clinicians placed on secondment to crisis response roles or resigning from health services. In the second year of implementation, a sixth study site, the 'InsideOut Institute (IOI) Hub' was added to the study to increase recruitment capacity due to rural sites being significantly overwhelmed and under-resourced. The IOI Hub was facilitated by a university-based eating disorder research centre for families from any area of regional or rural NSW or those unable to access treatment locally.

Participants

Participants were recruited between April 2020 and December 2022, and final treatment follow-up data were collected in January 2024. Three groups of participants were recruited; (1) adolescents diagnosed with AN/AAN, (2) parents/guardians and (3) treating clinicians. The published protocol manuscript details recruitment strategies [42].

Adolescents

Adolescents were eligible to participate if they were aged between 12 and 18 years (inclusive), met the diagnostic criteria for AN or AAN as defined by the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5 [44]), were located within a participating health district and had access to a device with sufficient internet connection, audio and video capabilities. Adolescents needed to be medically stable for outpatient

treatment. As the IOI hub was entirely virtual and not able to provide medical monitoring or management, participants at this site required written medical clearance from their medical practitioner to enter treatment. A comprehensive guide to medical monitoring, guidelines for inpatient admission and links to online upskilling training modules delivered by IOI were included in the medical clearance paperwork. Additionally, the medical practitioner had to provide medical monitoring and continue contact with the IOI Hub therapist throughout the duration of telehealth-FBT. A medical practitioner employed at the IOI Hub was available as a consultant should the community-based medical practitioners require clinical guidance or support. Exclusion criteria for adolescent participants included concurrent psychological treatment for AN, active acute suicidality, current pregnancy or being under compulsory treatment orders.

Parents, guardians and siblings

While preference was for all guardians responsible for the care of the adolescent to participate in the treatment, at least one guardian was required to commit to FBT. All family members who participated in the treatment contributed to research tasks detailed in the Assessment section. Siblings younger than 12 years of age could participate in FBT but consent was not obtained from them to contribute to the research tasks.

Study clinicians

Study clinicians were employed by the CAMHS in general clinical roles with varying levels of experience treating AN with FBT (ranging from zero to over ten years). Study clinicians at the IOI hub site ($N=2$) were employed by the specialist ED clinical and research centre. One of the IOI hub clinicians had five years of FBT experience, and the second had never treated AN with FBT before. To participate, all clinicians were required to obtain management support and attend a two-day workshop facilitated by DLG, who also provided weekly online supervision throughout the study.

Procedure

Potential participants were identified by the EDC, study clinicians or CAMHS service intake and triage staff. After receiving psychoeducation about FBT and that this was the recommended treatment for their child. Families were given the option of the telehealth study or 'treatment as usual', which may have been in-person FBT if there was an available trained clinician, but it could also include being placed on a waitlist with medical monitoring and supportive psychotherapy. If a family wanted to know more about the study, they were then contacted by a member of the research team, who then initiated the consent process.

FBT was delivered via the approved telehealth platform of the respective health service. Based on previous studies, it was anticipated that most families would require between 16 and 20 sessions to reach Phase 3. However, families were not required to complete FBT in 20 sessions if it was not clinically appropriate. Session 20 marked the maximum point that the end-of-treatment data was collected (or earlier if families completed treatment before session 20). Telehealth-FBT followed the same structure and principles described in the FBT manual [17], including externalising the ED, obtaining patient weights each session, providing an opportunity to independently speak with the adolescent each session, reviewing a weight graph for the patient with their family, and conducting a family meal. Manual modifications for telehealth included the parents or medical practitioner taking the adolescent's weight before each session, flexibility with sibling attendance, and at what timepoint the family meal session was completed (at least by session five). The sibling attendance modification was made following feedback from therapists that enforcing sibling attendance was an engagement barrier and logistically difficult for some families with limited physical space to include all family members in the webcam view. Most therapists encouraged sibling attendance at the beginning of treatment, for the family meal session, and when clinically indicated. Additionally, therapists advised that due to baseline assessments taking place with the research team, they needed more time via a "session zero" [45] to establish a preliminary formulation, explore and manage potential barriers to treatment implementation, set up and ensure the technology was working sufficiently, build rapport and engagement with the family, and discuss expectations for the treatment process within the study.

Assessment

Feasibility and acceptability

The feasibility and acceptability of the telehealth-FBT were assessed by the reach and adoption arms of RE-AIM. This included: (a) the number of families eligible for the study (i.e., an indicator of reach); (b) the number of families that expressed interest in participating in the study; (c) the number of families enrolled in the study (i.e., an indicator of treatment uptake); (c) the number of families that completed at least 10 sessions (i.e., an indicator of treatment engagement and acceptability); and (d) the number of families reaching the end of treatment (i.e., an indicator of treatment retention).

General eating disorder and clinical assessment

Outcomes were obtained from clinical and semi-structured interviews, parent and medical provider reports

(including weight measurement) and online self-report surveys. Before the first session, demographic and clinical background information was collected via an initial assessment session (called session zero [45]) with the study clinician and Eating Disorder Examination interviews with a research officer (EDE Version 15; [46] and Parent EDE Version 2.0, PEDE [47]). Once the first telehealth-FBT was scheduled, participants were sent a link to an online survey that collected the remaining baseline data (see Table 1). This survey was repeated at session nine, at the end-of-treatment and at six-month follow-up.

Preliminary efficacy

The change in the adolescent's percent median Body Mass Index (%mBMI [58]), and global eating disorder symptomology as determined by the PEDE-Q [59] from baseline to end of treatment and baseline to six-month follow-up was used to establish the preliminary efficacy of telehealth-FBT. The adolescent's weight was measured in kilograms on calibrated digital scales by either the adolescent's parents or medical provider before every treatment session. The adolescent's height was collected at baseline, session nine, end of treatment and at six months follow-up.

We note that the published protocol [42] defined the primary outcome as an increase in %mBMI greater than 85% as an indicator of remission. However, to reduce access inequities and meet service demands, the inclusion criteria were expanded to include adolescents with AAN given the effectiveness of FBT with this group [60, 61]. To account for the higher %mBMI, the indicators of remission will be explored as the proportion of adolescents who achieve weight (≥95%mBMI) and/or psychological (global PEDE-Q score≤1.73 [59]) criteria. This higher weight threshold has been found to predict longer-term recovery [62, 63]. Further, recent psychometric assessments of the PEDE-Q have found that it is a more useful measure (compared to the EDE-Q) to identify and accurately assess adolescent AN [59].

Table 1 Assessment battery presented via the online survey

Adolescent	Parent / Guardian
EDE-Q [48]	PEDE-Q [47]
CIA [49]	PVA [50]
CET [51]	RCADS-P [52]
RCADS [53]	MFAD [54]
RSE [55]	*EQ-5D-5 L* [56]
MFAD [54]	
EQ-5D-5 L [56] / *EQ-5D-Y* [57]	

Note Psychometric citation in brackets. EDE-Q=Eating Disorder Examination Questionnaire, CIA=Clinical Impairment Assessment, CET=Compulsive Exercise Test, RCADS=Revised Children's Anxiety and Depression Scale, RSE=Rosenberg Self Esteem Scale, MFAD=McMaster Family Assessment Device, PEDE-Q=Parent Eating Disorder Examination Questionnaire; PVA=Parents Versus Anorexia Scale, RCADS-P=Revised Children's Anxiety and Depression Scale Parent Version. See Hambleton, Le Grange [42] for details regarding the psychometric properties of the assessments

FBT fidelity

Treatment fidelity was assessed each session using the FBT-FACT, a self-report questionnaire initially developed by treatment manual co-authors Lock & Le Grange [64]. The 25-item questionnaire has been used in previous FBT implementation studies [65, 66], including a recent investigation of FBT delivered via videoconferencing [38] to assess the clinician's adherence to key interventions for each treatment phase. The FBT-FACT uses a 7-point Likert scale (1=Not at all, 7=Very much), and acceptable fidelity is determined by the minimum threshold of 4/7. Fidelity was further managed via bi-weekly virtual supervision with co-investigator, FBT expert and treatment manual co-author Le Grange, with supervision focus dependent on the needs of the clinicians and the progress of study cases. Clinicians were encouraged to present treatment progress updates regularly, case presentations following session one or the family meal session, mid-treatment and towards the end of treatment as a minimum.

Analysis

Power analysis

A sample size calculation with a medium effect size using Cohen's criteria [60], alpha of 0.05 and a power of 0.8 was used to calculate a sample size estimate of $N=31$. The effect size of %mBMI was based on data from Anderson, Byrne [11], comparing the effectiveness of FBT via telemedicine at baseline to the end of treatment.

Statistical analysis

Data was analysed using STATA Version 15 [67] and SPSS Version 29 [68]. Initial exploratory and descriptive analyses were conducted, including differences in baseline characteristics were assessed using chi-square tests for categorical variables (e.g., gender at birth) and one-way analysis of variances (ANOVAs) for continuous variables (e.g., age, illness duration). Greater than 10% of missing data were considered significant and analysed with appropriate statistical models based on missingness assumptions that fit the data (missing at random) and with intention to treat principles. A generalised linear mixed model (with inverse variance weighting) was chosen for analysis, modelling the primary outcomes of %mBMI and PEDE-Q global scores over time. An alpha of 0.05 was considered statistically significant.

Results

The feasibility, acceptability and effectiveness results are reported using the RE-AIM framework; however, they are reported in a modified order to enhance readability

and present results consistent with our study aims (i.e., participant characteristics, as part of the adoption assessment, is presented first, and the implementation data will be presented prior to efficacy).

RE-AIM: reach

Uptake

Data relating to the uptake of and referral to FBT in rural health services prior to this implementation study were not available for comparison. The EDCs documented that 130 adolescents were referred to a rural health service with suspected or diagnosed AN/AAN during the study period. FBT was the recommended treatment for 86 families (66.2%), and 52 of those (60.5%) were referred to the study for further intake and eligibility assessment (please see Supplementary Table 2 for breakdown by each rural district). The EDCs advised that the primary reasons families were not referred to the telehealth-FBT study was not wanting to participate in research and/or wanting to receive FBT in person within the service. Of those 52 families assessed by the researcher, 19 did not proceed to consent, with 36.84% not wanting to receive treatment via telehealth ($n=7$), 21.05% meeting the study exclusion criteria such as acute medical instability or a correction in diagnosis ($n=4$), 15.79% not wanting to receive FBT ($n=3$), 15.79% preferring to access care from the private system ($n=3$) and losing contact with 10.53% of families ($n=2$). Figure 1 presents the CONSORT diagram detailing participant enrolment and flow through the study.

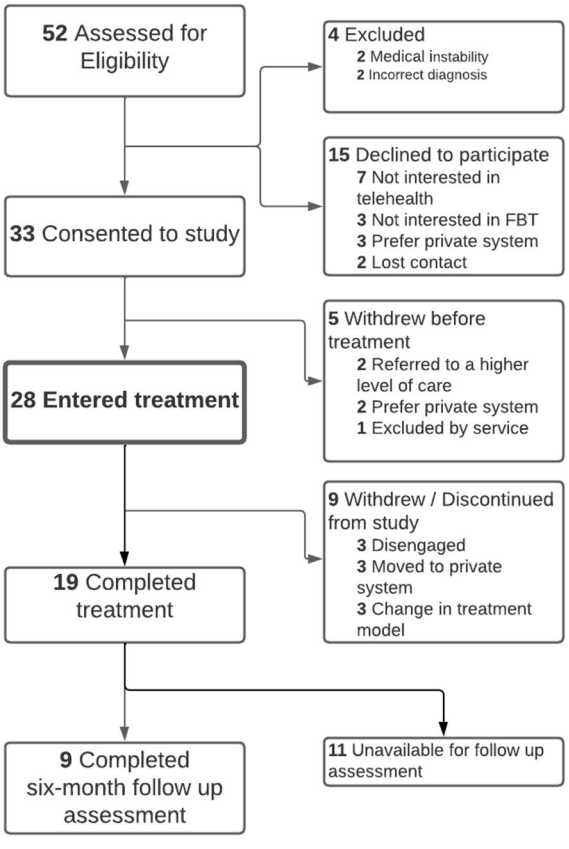

Fig. 1 Consort flowchart of participants

Treatment completion

Informed consent was obtained from 33 families; however, five withdrew from the study before completing baseline measures or commencing treatment. Two families were referred to a higher level of care due to the adolescent physically deteriorating rapidly, two families opted to seek care from the private system and one family was discharged by their service due to moving out of area. Thus, 28 adolescents (89.29% female, average age 14.68±1.58 years) and their parents/guardians entered treatment.

The overall average number of sessions was 11.62 ($SD=7.5$, range 1–20) over 19.17 weeks ($SD=14.42$ weeks, range 0.86–47.29), however this includes families who withdrew from the study. The nineteen families who met the criterion for treatment engagement (10 sessions) attended an average of 16.68 sessions ($SD=2.85$, range 10–20) over 28.1 weeks ($SD=8.77$, range 9.86–47.29). These nineteen families went on to complete the full course of allocated sessions. At the end of the study treatment period, one family was still in Phase 1, seven families were in Phase 2 and eleven families were in Phase 3 (see Fig. 2 for the progress of families through FBT phases).

Two participants required an inpatient admission during phase 1 of FBT. For one of these participants, a seven-day admission was required due to risk of harm concerns relating to comorbid depression. The second participant required a ten-day admission for medical stabilisation after refusing food and fluids for over 24 h. Both participants returned to the study following discharge.

RE-AIM: adoption

Participants

The characteristics of the 28 adolescents who entered treatment are presented in Table 2 (see Supplementary Table 3 for further baseline clinical demographics reported by the adolescent and their parent/guardian). According to information obtained from clinical assessment and the EDE and PEDE interviews, twenty adolescents met the diagnostic criteria for AN (71.43%), and eight for AAN (28.57%). The overall mean duration of illness was 8.53 months ($SD=5.39$, range 2–24 months) and baseline %mBMI was 90.4%mBMI ($SD=10.16$). Eight adolescents had an inpatient admission for medical stabilisation before entering the study. The global eating disorder symptoms measured by the baseline EDE and PEDE interviews were 3.33 ($SD=1.52$) and 2.39 ($SD=1.29$), respectively.

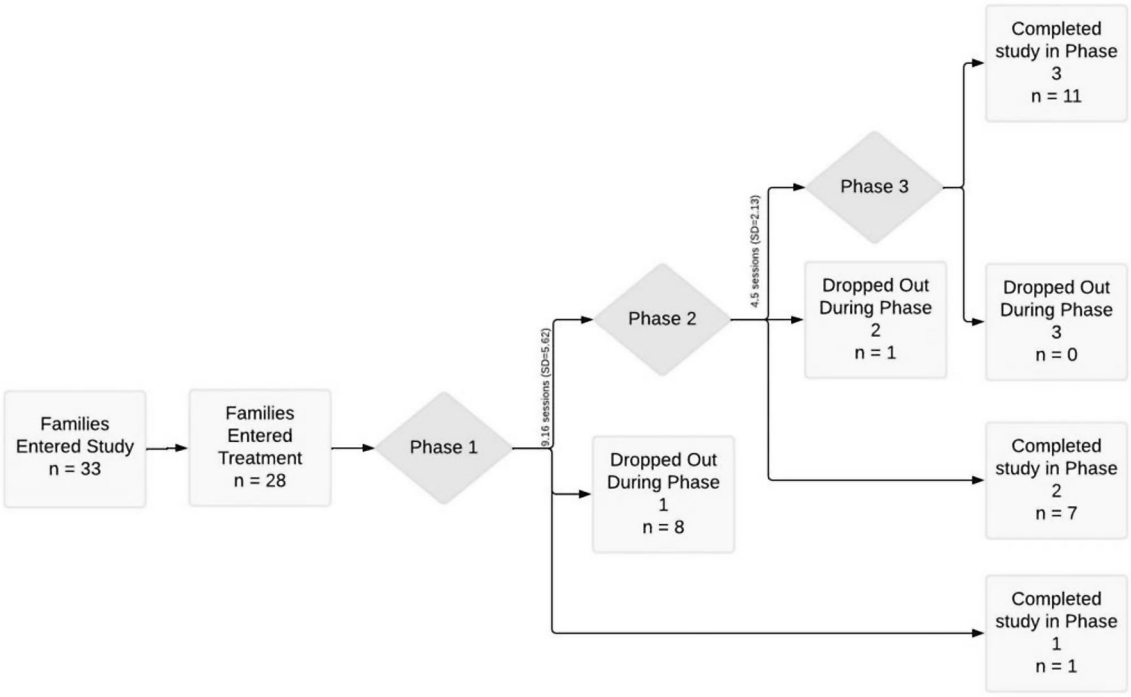

Fig. 2 The progress of families through telehealth-FBT treatment phases

Table 2 Baseline characteristics of adolescents who entered treatment

Characteristic	R1 (*N* = 12)	R2 (*N* = 4)	R3 (*N* = 1)	IOI Hub (*N* = 11)	Total sample (*N* = 28)
Female, *N*(%)	10 (83.33%)	4 (100%)	1 (100%)	10 (90.91%)	25 (89.29%)
Age					
Mean (*SD*), y	14.58 (1.56)	15.5 (1.73)	14 (-)	14.54 (1.57)	14.68 (1.58)
Range, y	12–17	13–17	-	12–16	12–17
Residing with both primary carers, *N*(%)	7(58.33%)	3(75%)	1(100%)	7(63.63%)	18 (64.29%)
Diagnosis					
AN, *N*(%)	9 (75%)	3 (75%)	-	8 (72.72%)	20(71.43%)
AAN, *N*(%)	3 (25%)	1 (25%)	1 (100%)	3 (27.27%)	8(28.57%)
Illness duration in months, Mean(SD)	7.45 (4.63)	6 (3)	4 (-)	10.72 (6.23)	8.53 (5.39)
Medical admission prior to entering study, *N*(%)	3 (25%)	1 (25%)	0	4 (36.36%)	8 (28.57%)
%mBMI, Mean(*SD*)	88.63 (9.81)	91.65 (14.03)	97.14 (-)	91.26 (10.2)	90.4 (10.16)
AN, Mean(SD)	84.66(6.25)	85.23(6.95)	-	87.03(8.57)	86.03(7.14)
AAN, Mean(SD)	100.57 (9.39)	110.9(-)	97.14 (-)	100.31(9.74)	101.34(8.28)
EDE					
Global Mean(*SD*)	3.27 (1.03)	4.83 (0.16)	2.76 (-)	2.98 (1.95)	3.33 (1.52)
Restraint Mean(*SD*)	2.87 (1.8)	4.8 (0.69)	1.6 (-)	3.22 (2.11)	3.21 (1.89)
Eating Mean(*SD*)	2.8 (1.39)	4 (0.4)	2.8 (-)	2.34 (1.85)	2.76 (1.55)
Shape Mean(*SD*)	4.17 (1.01)	5.33 (0.58)	4.86 (-)	3.42 (2.06)	4.02 (1.61)
Weight Mean(*SD*)	3.2 (1.19)	5.2 (0.2)	1.8 (-)	2.96 (2.07)	3.33 (1.71)
PEDE					
Global Mean(*SD*)	2.52 (0.79)	4.05 (0.58)	0.28 (-)	1.82 (1.39)	2.39 (1.29)
Restraint Mean(*SD*)	2.74 (1.10)	4.35 (0.66)	0.2 (-)	1.98 (1.36)	2.59 (1.42)
Eating Mean(*SD*)	2.01 (1.01)	3.4 (1.05)	0.4 (-)	1.13 (1.23)	1.81 (1.31)
Shape Mean(*SD*)	2.77 (1.51)	4.16 (0.76)	0.13 (-)	1.98 (1.92)	2.57 (1.76)
Weight Mean(SD)	2.09 (1.3)	4.3 (0.5)	0.4 (-)	1.18 (2.12)	2.37 (1.75)

Abbreviations R1-R3 = Rural Districts 1 to 3; IOI Hub = InsideOut Institute Hub; AN = Anorexia nervosa; AAN = Atypical Anorexia Nervosa; SD = Standard deviation; y = years; EDE = Eating Disorder Examination; PEDE = Parent Eating Disorder Examination

Table 3 Number of study cases per study clinician and health district

District	Clinician	Study cases *N*(%)
R1		
	C1	5(17.9%)
	C2	3(10.7%)
	C3	3(10.7%)
	C4	1(3.6%)
R2		
	C5	3(10.7%)
	C6	1(3.6%)
R3		
	C7	1(3.6%)
IOI Hub		
	C8	7(25%)
	C9	4(14.3%)

Note R1-R3 refers to the three participating rural districts who recruited to the study; IOI Hub = InsideOut Institute Hub; C1-C9 refers to each study clinician

Withdrawal

Eight of the nine families who withdrew from the study did so in Phase 1 and before session four. One family withdrew following their fifth session. Three families disengaged from the service and so were withdrawn from the study, three families opted for care via the private health system mostly due to scheduling challenges with health service operating hours, and three families requested a change in treatment model.

Clinicians

Initially, 15 clinicians were trained in FBT and entered the study. However, due to the impact of natural disasters (2019/2020 'Black Summer crisis, Northern NSW flood emergency) and the COVID-19 pandemic and associated public health measures on the workforce, several of these trained clinicians withdrew from the study. One rural health district had to withdraw entirely from the study as all their trained FBT clinicians left the district. Another health district could not recruit anyone to the study via their services as their only remaining FBT-trained clinician was removed from their clinical post and placed in a crisis response role indefinitely. Therefore, nine study clinicians delivered telehealth-FBT (see Table 3), including the two IOI hub-based clinicians who joined the study in the second year of treatment delivery when local workforce issues prevailed.

RE-A*I*M: implementation

Fidelity

Descriptive statistics for each item of the fidelity measure FBT-FACT [64] are presented in Table 4. A total of 336 sessions were conducted and although the checklist was presented after every session, clinicians provided self rated their fidelity for 138 of those sessions (41.07% completion rate). Acceptable fidelity (mean score of ≥4.0/7.0) was achieved for 19 of the 25 items (76%). The proportion of items having scores ≥4.0 varied for each phase, with 76% of items in Phase 1 (10/13), 66.67% of items in Phase 2 (4/6) and 83.33% of items in Phase 3 (5/6). The highest-rated item for Phases 1 and 2 was *externalising AN from the young person* (M=6.02, SD=0.71 and M=5.11, SD=0.88). The highest-rated item for in Phase 3 was *managing termination* (M=5.17, SD=1.26).

Table 4 Self-rated FBT-FACT treatment fidelity scores (scale of 1 to 7)

Phase and fidelity domain	Mean	SD
Phase 1		
Session 1 (N=23)		
Greet family in sincere but grave manner	4.86	1.02
Take a history that engages family	5.12	0.91
Externalise AN from the young person	6.02	0.71
Orchestrate an intense scene	5.25	1.01
Charge parents with the task of refeeding	5.77	0.83
Session 2: Family Meal (N=15)		
Take a history and observe family patterns around food and eating	4.55	1.49
Help parents convince young person to eat one more mouthful	4.65	1.58
Align young person with siblings	3	2.59
Remainder of Phase 1 (N=63)		
Focus therapeutic discussion on food and eating behaviours	5.01	0.98
Help parental dyad achieve refeeding	4.64	1.54
Discuss and support sibling alignment	2.31	2.13
Modify parental and sibling criticisms (if present)	3.89	1.76
Continue to externalise AN from young person	5.12	1.42
Phase 2 (N=24)		
Continue to support parents in management of symptoms	4.95	1.08
Assist parents to negotiate transition of control	4.47	1.19
Explore relationship between adolescent issues and AN	4.16	1.21
Support sibling efforts	3.48	1.79
Modify parental and sibling criticisms (if present)	2.4	1.85
Continue to externalise AN from young person	5.11	0.88
Phase 3 (N=13)		
Review adolescent issues with family to model problem solving	4.49	1.04
Involve family in the review of issues	4.78	1.08
Check in on parent dyad	3.35	2.12
Explore adolescent themes	4.78	0.99
Plan for future issues	4.67	1.93
Manage termination	5.17	1.26

RE-A*I*M: maintenance

Remission

At the end of treatment, 26.3% (N=5) of adolescents achieved full remission (both weight and psychological). A further 31.6% (N=6) of adolescents achieved partial remission (weight only), meaning 57.9% of the total

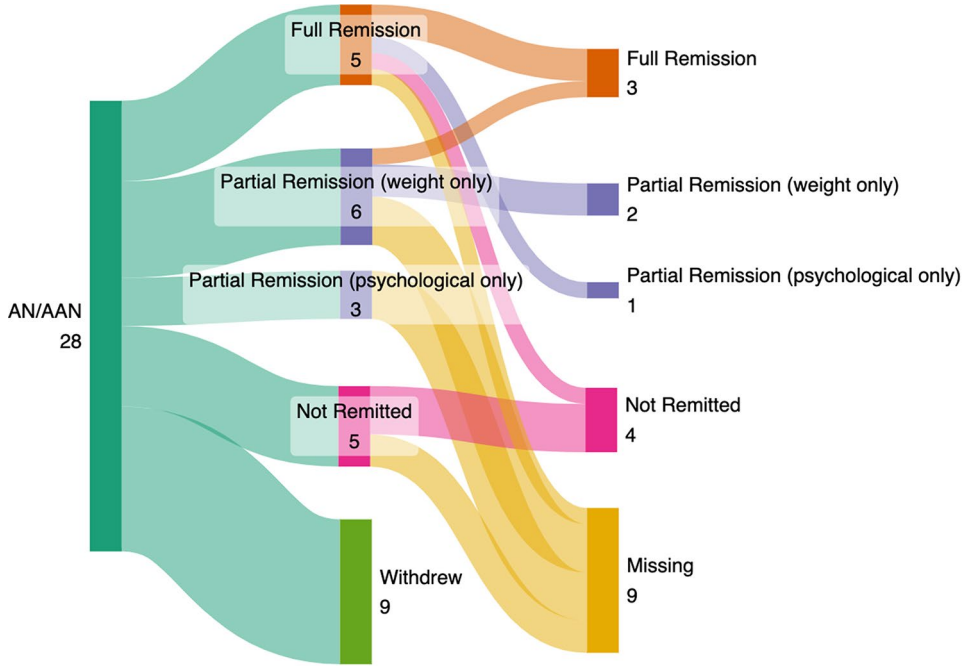

Fig. 3 Sankey Chart Displaying Change in Remission Status Across Timepoints. **Note**: Six participants did not complete the PEDE-Q at end of treatment. Five of these were classified as achieving partial remission (weight only) and one participant was classified as not remitted as their psychological status was unknown. Two participants did not complete the PEDE-Q at the six-month follow-up and were classified as achieving partial remission (weight only) as their psychological status was unknown. Full Remission = both criteria (≥ 95%mBMI and global PEDE-Q score ≤ 1.73). Partial Remission (weight only) = ≥ 95%mBMI but PEDE-Q > 1.73 or missing. Partial Remission (psychological only) = Global PEDE-Q score ≤ 1.73 but < 95%mBMI. Not Remitted = Did not meet either criteria. Missing = %mBMI and global PEDE-Q data not provided

Table 5 Frequencies of those who accessed treatment following the telehealth-FBT study

Treatment following FBT-telehealth	*N* (%)
Accessed further treatment*	15 (53.6%)
Did not access further treatment	5 (17.9%)
Unknown	8 (28.6%)

Note * Includes participants who withdrew from the study and continued to receive treatment outside of the study (such as individual therapy or non-specific family therapy)

sample achieved ≥ 95%mBMI at the end of treatment. Of note, five of these six adolescents did not complete the PEDE-Q at the end of treatment, so we are unable to determine if they met both remission criteria. Three participants (15.78%) achieved partial remission (psychological only), but their weight remained below the remission cut-off. Of the 19 adolescents who completed treatment, 26.3% ($n=5$) did not obtain either remission criteria. Figure 3 details the change in remission status across the study timepoints.

At the six-month follow-up, eleven families provided data for weight or PEDE-Q, or both (the six-month follow-up data for nine families (47.4%) was not returned). Two adolescents met both weight and psychological remission criteria. Two further adolescents achieved weight restoration but their psychological data was missing, and two participants achieved the psychological criteria, but their weight was just below the threshold.

Further treatment

Over half of the participants (53.6%) continued to receive mental health treatment - for either AN or a comorbid condition during the six-month follow-up period (see Table 5). Details regarding the specifics of the treatment were not collected in the follow-up survey. Qualitatively, some participants advised that they continued with FBT with their therapist, changed to an individual therapy approach, and other families accessed treatment from different providers (such as a dietitian or social worker).

Preliminary efficacy

Change in weight

For the total sample ($N=28$), there was a trend of increasing weight over the course of telehealth-FBT and to six-month follow-up. There was a significant increase of 3.84%mBMI from baseline to the end-of-treatment ($p=0.007$, 95%CI 1.04—6.65%). This increase in weight was maintained at follow-up, with %mBMI at six months follow-up being 5.11% higher than baseline ($p=0.005$, 90%CI 1.57–8.65%). The %mBMI for adolescents with AAN was 13.22%mBMI higher over time than adolescents with AN ($p=0.003$, 95%CI 4.45 – 22.22%) (Table 6).

Table 6 Results of Generalised Linear Mixed model analysis of change in weight over time

	Marginal Means (SE)	b(SE)	z	*p*	95% CI
Time	-				
Baseline	88.98 (1.99)	-	-	-	-
End of Treatment	92.82 (2.04)	3.84(1.43)	2.68	**0.007**	(1.04 to 6.65)
Follow Up	94.09 (2.31)	5.11(1.81)	2.83	**0.005**	(1.57 to 8.65)
Treatment Duration (weeks)	-	-0.07(0.17)	-0.39	0.695	(-0.40 to 0.27)
Illness Duration (months)	-	0.03(0.44)	0.07	0.941	(-0.83 to 0.89)
Diagnosis	-				
AN	-	-	-	-	-
AAN	-	13.33(4.53)	2.94	**0.003**	(4.45 to 22.22)
RCADS Obsess(Baseline)	-	0.27(0.21)	1.24	0.214	(-0.15 to 0.69)

Table 7 Results of Generalised Linear Mixed model analysis of change in PEDE-Q score over time

	Marginal Means (SE)	B(SE)	z	*p*	95% CI
Time	-				
Baseline	2.434 (0.26)	-	-	-	-
End of Treatment	1.702 (0.32)	-0.73(0.33)	-2.20	**0.028**	(-1.385 to -0.079)
Follow Up	2.022 (0.39)	-0.41(0.40)	-1.03	0.305	(-1.201 to 0.375)
Treatment Duration (weeks)	-	0.02(0.02)	0.95	0.344	(-0.021 to 0.061)
Illness Duration (months)	-	0.00(0.05)	-0.07	0.946	(-0.107 to 0.100)
Diagnosis	-				
AN	-	-	-	-	-
AAN	-	-0.26(0.57)	-0.45	0.65	(-1.375 to 0.858)
RCADS Obsess (Baseline)	-	0.05(0.03)	2.07	**0.039**	(0.003 to 0.104)

Change in eating disorder symptoms

For the total sample ($N=28$), there was a significant decrease of 0.73 in the PEDE-Q scores from baseline to the end of treatment ($p=0.028$, 95%CI 0.079–1.385). There was no significant difference in PEDE-Q scores between baseline and six-month follow-up. There was a significant increase of 0.05 PEDE-Q scores for every unit increase in RCADS obsessive compulsive score ($p=0.039$, 95%CI 0.003–0.104) (see Table 7).

Discussion

Rural health services across the world experience workforce challenges and shortages, and this is particularly true in the Australian setting. In terms of treatment for AN, most report experiencing a paucity of trained and experienced FBT practitioners, and rural families often need to travel lengthy distances to access evidence-based eating disorder care. Telehealth can potentially reduce geographical inequities by facilitating the delivery of FBT directly into the rural family home. To this end, this study aimed to evaluate the feasibility, acceptability, and preliminary efficacy of telehealth-FBT delivered by generalist clinicians to reduce the core eating disorder symptoms of rural adolescents diagnosed with AN and AAN accessing care from real-world, community-based public health treatment settings.

Our findings extend the emerging evidence supporting the feasibility of manual modifications to deliver telehealth-FBT [28, 30, 38] by demonstrating a real-world multi-site implementation in a complex public health system. Rural family interest in telehealth-FBT was high. Two-thirds of the families referred to the study consented to participate. Similarly, the adoption of telehealth-FBT by rural families was good, with a dropout rate (32.14%) comparable to previous FBT implementation studies [69, 70]. The reasons for dropout were similar to those reported by Chew, Kelly [70], with families opting for an individual therapy approach that did not require parents to take charge and challenges with scheduling or the time commitment required by FBT.

As was expected, there was a significant improvement in %mBMI and a significant reduction in parent-rated global eating disorder psychopathology from baseline to the end of telehealth-FBT. Almost three-quarters of the sample (71.43%) were diagnosed with AN. Adolescents with AN began treatment at a lower weight (86.03%mBMI, $SD=7.14$) than those with AAN (101.34%mBMI, $SD=8.28$). After accounting for these weight differences, there was an increase of 3.84%mBMI ($p=0.007$, 95%CI 1.04 −6.65%) by the end of telehealth-FBT. Adolescents' weight continued to improve post-treatment, with a significant difference from baseline also noted at the six-month follow-up. The significant decrease in global PEDE-Q score from baseline to end of treatment ($p=0.028$, 95%CI -1.39—0.08) was relatively weak, and overall there was no significant difference

in PEDE-Q score at six-month follow-up. This is likely reflective of the missing data and small sample size. Importantly, the restuls demonstrate the global eating disorder symptoms (as rated by the adolescents' parents) were not worse, demonstrating non-inferiority and efficacy of telehealth-FBT.

Although weight improvement is critical given the potential consequences of malnutrition and low weight, we recognise that AN recovery is best operationalised by improvements in physical, behavioural and psychological well-being [71, 72]. While stricter remission criteria are associated with lower remission rates [71], research suggests that including both weight and psychological symptom change is necessary to ensure treatment effectiveness is not overstated. In this study, 36.8% of adolescents could be classified as having achieved remission at the end of treatment. A further 31.6% of adolescents achieved the weight-only criterion (≥95%mBMI), meaning 68.4% were weight restored following telehealth-FBT. It may be that the number of adolescents that actually achieved full remission was in fact higher, as five out of six adolescents who achieved the weight-only criterion did not return their psychological measure at post, meaning we could not determine their status. Of note, one of these adolescents did return their psychological measure at follow-up and did meet both criteria for remission at that point. Overall, these remission rates are fairly consistent with those reported in dissemination [70, 73, 74] and telehealth FBT [29, 38] studies.

The overall duration of telehealth-FBT was shorter (M=27.1 weeks, SD=9.64) than the 12-month duration described in face-to-face studies [37, 75, 76]. We set no mandates for the number of sessions families received, although the end of treatment data was collected at session 20 if they hadn't completed treatment before then. Nor were families required to reach Phase 3 by the end of the study treatment period. For this reason, we had one family in Phase 1, seven in Phase 2 and eleven in Phase 3 when they completed the end of treatment measures. Our literature review did not reveal any prior studies reporting the FBT phase reached by families at the end of the study treatment period. Presumably, this is due to the use of dose (number of sessions) and time (duration of treatment) to define the end of treatment but not necessarily the point at which the patient reached the clinical change required to conclude the delivery of FBT. Participants had similar levels of illness severity to those in other trials, however, without the above information from other studies, it is difficult to discern whether the families in our study progressed through treatment differently or if the telehealth delivery or rurality had an impact. This would be an interesting matter for investigation in future trials.

Several modifications to FBT were required to adapt the intervention to telehealth, such as parents measuring the adolescent's weight each session rather than the FBT clinician and completing the family meal session in the home environment. The initial challenge of this shift in responsibility was described by parents in a recent qualitative study that explored the experience of telehealth-FBT during COVID-19 [33]. The parents noted that weighing their child got easier as treatment progressed and the intensity of AN lessened [33]. Families described the family meal session as uncomfortable and awkward but assumed this was the case irrespective of session location (at home via telehealth or in a clinic) [33]. While parental weighing of the adolescent may have introduced variability in the reliability and validity of weight data, the overall results suggest that these modifications to allow for telehealth delivery are generally accepted by families and can be feasibly completed within the home without negatively impacting overall treatment outcomes.

This study highlighted the challenges regional, rural and remote health settings face, such as workforce transience and variable clinician skills when implementing telehealth solutions to treatment gaps exacerbated by geography [77]. Research conducted in real-world clinical practice has found that generalist clinicians often practice with lower levels of treatment fidelity [20, 78, 79]. Conversely, in the current study, all clinicians completed key components of FBT, and fidelity ratings were similar to those reported in face-to-face [65] and telehealth studies conducted in specialist FBT research settings [38]. Perhaps the improved adherence observed in the generalist rural therapists engaged in this trial can be attributed in part to the fact they were participating in a trial rather than being observed in their regular practice, and aware their practice was being monitored [38] via frequent structured supervision and the fidelity survey. Equally the high-quality training and supervision from a highly skilled world leader in the modality may have been causal. Importantly, the study demonstrates that with adequate training and supervision, generalist clinicians working in community health services can safely deliver FBT with equal fidelity and equal outcomes.

Limitations

When interpreting the results of this study, several limitations must be considered. This study aimed to assess the feasibility and effectiveness of telehealth-delivered FBT to a diverse clinical sample of Australian rural adolescents with AN or AAN. Recruitment faced significant challenges due to Australian- and rural-specific factors, such as high clinician-to-patient ratios, complex clinical cases, and reduced staffing levels exacerbated by the COVID-19 pandemic and natural disasters unexpectantly occurring during study period. For example, despite

having eight adolescents eligible for the study in R3, only one family was enrolled due to significant staff changes and shortages. To enhance recruitment, the IOI hub site was added, which successfully enrolled and treated nearly 40% of participants.

Another significant issue was the high amount of missing data, with only eight adolescents completing the baseline online survey. Six-month follow-up completion rates were similarly poor, with just eleven families providing weight information and nine families finishing the online survey despite several reminders. We note that the completion rate was higher for participants enrolled at the IOI Hub site (45.5%) compared to the rural sites (35.3%) and suspect this difference might be indicative of the IOI hub families having more interaction with researchers. For the rural sites, the research project was likely experienced as peripheral to their care. This challenge is common in FBT studies, with some families reporting that their child's completion of end-of-treatment and follow-up assessments was hindered by other conditions, such as depressive episodes, which made completing additional tasks difficult. Ultimately, the reasons for the poor response rate are unknown. Consequently, the generalisability of the results is limited and may be subject to selection bias effects favouring those who experienced improvements.

As this was a real-world study, services utilised a flexible approach to care. While study clinicians made every effort to maintain fidelity, many adolescents were concurrently receiving additional interventions such as school counselling, private therapy for comorbid conditions, and psychotropic medications. Over half of the participants continued to receive care for eating disorder or related comorbidities that required ongoing support from the CAMHS or private providers during the six-month follow-up period. This study is not sufficiently powered to analyse the potential moderating effects of continued intervention on the improvements in %mBMI observed at the six-month follow-up. Despite coaching parents on accurate weight measurement, variability and measurement error may still exist as the weights were self-reported by parents rather than independently assessed by study clinicians.

Finally, there may have been some risk of allegiance bias [80]. The first author who was the study coordinator and a clinician for the IOI Hub site treated 25% of the study cases. To mitigate this potential bias, a standardised set of procedures were followed in relation to the research and treatment. For example, research assistants conducted interviews and de-identified data prior to entry and analyses. Using the FBT manual and weekly supervision further ensured control over treatment fidelity.

Future research

While the overall interest and engagement rates for telehealth-FBT were consistent with published in-person studies, we note that 40% of families offered the telehealth study declined to receive further information, and 27% of participants withdrew from the study after consenting. We were not provided the reasons families declined beyond 'not interested in telehealth'. Future, potentially qualitative, explorations of the families not interested in telehealth would help clinicians understand who is likely to engage in this delivery mode. Further, telehealth is not a panacea for all access challenges, and ongoing innovation is required to help bridge gaps for isolated families who do not want to engage in telehealth treatment.

Relatedly, previous studies have noted a family preference for a hybrid model that combines in-person and telehealth sessions [33]. However, this preference assumes that families and services have the option to choose their treatment delivery mode. In our study, some families could only access FBT through telehealth due to local providers having lengthy waitlists or geographic impracticalities. These families were highly motivated for treatment and pro-telehealth. Future studies could explore the impact of this context and potential selection bias by comparing the outcomes of families who have the choice of in-person care and those who do not.

Frequent expert supervision within community-based rural health services is likely unsustainable outside of study contexts where costs are largely subsidised by research funding. Future naturalistic studies with a larger sample size could examine the outcomes of telehealth-FBT in real-world settings, beyond controlled research conditions where perhaps there is less supervision and monitoring. Such a study would provide valuable insight into the effectiveness of telehealth-FBT amid multiple uncontrolled confounding factors typical of real-world practice.

Conclusions

This study extends the evidence base for FBT in the real world by demonstrating the successful implementation of telehealth-FBT for adolescents with AN/AAN accessing care from rural health services. Importantly, there were clinically and statistically significant improvements in weight and eating disorder symptoms at the end of telehealth-FBT for the sample that were maintained at follow-up. The rates and magnitude of clinical improvements reported here, broadly match those observed in other implementation studies of FBT delivered directly or via telehealth. Further, this study showed that with appropriate training and some support, community-based clinicians working in general mental health teams can deliver FBT with fidelity achieving comparable levels of clinical response, providing hope for the future

of treatment for these illnesses in areas with low or no access to specialist services.

Abbreviations

AAN	Atypical Anorexia Nervosa
AN	Anorexia Nervosa
CAMHS	Child and Adolescent Mental Health Service
CET	Compulsive Exercise Test
CIA	Clinical Impairment Assessment
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
ED	Eating Disorder
EDC	Eating Disorder Coordinator
EDE	Eating Disorder Examination
EDE-Q	Eating Disorder Examination Questionnaire
HREC	Human Research Ethics Committee
MFAD	McMaster Family Assessment Device
NSW	New South Wales
PEDE	Parent Eating Disorder Examination
PEDE-Q	Parent Eating Disorder Examination Questionnaire
PVA	Parents Versus Anorexia Scale
RCADS	Revised Children's Anxiety and Depression Scale
RCADS-P	Revised Children's Anxiety and Depression Scale Parent Version
RSE	Rosenberg Self Esteem Scale
SD	Standard Deviation
%mBMI	Percent Median Body Mass Index

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40337-024-01175-w.

Supplementary Material 1

Acknowledgements

We recognise and pay respect to the First Nations Elders and communities—past, present, and emerging—of the lands that the University of Sydney's campuses stand on. For thousands of years, they have shared and exchanged knowledge across innumerable generations for the benefit of all. We would like to recognise the Charles Warman Foundation Pty Ltd for project funding. We also recognise the Graduate Women NSW Foundation support of AH's doctoral studies. We thank the Faculty of Science, University of Sydney, and the InsideOut Institute for Eating Disorders, a partnership between the Faculty of Medicine and Health, University of Sydney, and Sydney Local Health District, for supporting this research. We would also like to thank the eating disorder coordinators Angela Farrell, Belinda Green, Dr Deanna Bowen, Marcellinus Kim, Meg Vickery, and Ute Morris, the therapists and service staff from the participating health districts for participating and supporting this study. We would also like to acknowledge the following individuals who contributed to the design and development of telehealth-FBT and supported the project throughout: Dr Andrew Wallis, Dr Ang Li, Dr Michelle Cunich, and Dr Sloane Madden. Finally, we would like to thank all adolescents, families, and supports for their willingness to be involved in the research and share their lived experiences. Without them, this research would not be possible.

Author contributions

SM, JMW, DLG and AH contributed to study conception and design. AH was the trial coordinator and was the lead in managing ethics approval, recruitment, data collection and storage, and implementation at trial sites. MK and AH conducted the statistical analyses. AH, DLG, MK, JMW, ST and SM attended investigator meetings and provided input regarding study design and progress. SM was the lead investigator, obtained funding and supervised the study. DLG consulted to the study as a trainer and clinical supervisor. AH wrote the first draft of the manuscript and all co-authors revised the manuscript. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication. All authors have seen and approved the final version of the manuscript being submitted.

Funding

The study was funded by philanthropic funds donated by the Charles Warman Foundation Pty Ltd. Funding was managed by Prof Sarah Maguire (co-author) who is appointed within the University of Sydney.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted according to the study protocol approved by the Sydney Local Health District Human Research Ethics Review Board (HREC #2020/ETH00186).

Consent for publication

Not applicable.

Competing interests

Co-author Professor Stephen Touyz has affiliations and conflicts of interest to disclose. Professor Touyz is co-editor in Chief of the Journal of Eating Disorders. He has received research grant funding, travel grants and honoraria for public speaking and commissioned works from Takeda. He also chairs the Australasian Clinical Advisory Board for Binge Eating Disorder. He has received royalties from McGraw Hill, Hogrefe and Huber and Taylor and Francis for books/chapters. Co-author Prof Grange has affiliations to disclose. Prof Le Grange receives Royalties from Guilford Press and Routledge and is Co-Director of the Training Institute for Child and Adolescent Eating Disorders, LLC.

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Received: 26 August 2024 / Accepted: 6 December 2024
Published online: 19 December 2024

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