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Research Article
Specialist Children's Obesity Management Services: What Makes a Difference in Outcomes?

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Abstract

Background and Objective: Evidence supports multi-component behavioural interventions of greater than 26 h to improve weight status in children and adolescents who are obese. It can be challenging for health systems to provide services at this intensity. This study aimed to determine the effectiveness of a pilot multidisciplinary specialist service provided to children and adolescents who were overweight or obese and living in Brisbane, Australia. **Materials and Methods:** All children referred over a one year period were eligible to participate. A retrospective analysis of electronic medical records and appointment records was conducted to collect demographic details, anthropometric measures and appointment details. Semi-structured interviews were used to gather information regarding service perceptions and experiences. **Results:** 25 children and adolescents (52% male) ranging in age from 4.8-15.3 years participated. There was a statistically significant improvement in BMI z-score for all participants ($z = -2.814$, $p = 0.005$) and males showed greater improvements compared to females ($z = -2.432$, $p = 0.015$ vs. $z = -1.560$, $p = 0.119$, respectively). Discharged participants showed better outcomes compared to those who withdrew. Measures of success were achieved on average in 3-5 h over 12 months, less than evidence-based recommendations. Results should be carefully considered at the systems level and questions regarding service length, setting, participant characteristics, attrition rates and measures of success require further consideration. **Conclusion:** The results generate important considerations regarding specialist obesity management services from a service delivery and systems perspective. Additional large scale pragmatic, implementation studies are required to help progress this agenda.

Key words: Paediatric obesity management, service delivery, obesity, healthcare system, BMI

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The provision of effective obesity services by the health care system is a key component when addressing the prevalence of child and adolescent obesity across the world[1]. The World Health Organization (WHO)[1] report on the Commission on Ending Childhood Obesity detailed 6 recommendations regarding a systems-based approach to global obesity prevention and treatment, one of which focused directly on weight management at the individual level. Recommendation 6 urges countries across the world to 'Provide family-based, multicomponent, lifestyle weight management services for children and young people who are obese' as part of Universal Health Coverage[1]. Whilst this recommendation is based on a comprehensive review of the available evidence, what remains unclear for those wishing to implement this is the required intensity and duration of services to offer.

In Australia, recent statistics indicate that 27.4% of children and adolescents are overweight (20.2%) or obese (7.2%)[2]. This can be compared with the USA, where 33.4% of all children and adolescents are overweight (16.4%) or obese (17%)[3,4]. Most children in the USA do not receive evidence-based care for obesity[5] and this is likely to be the case in Australia also. The long term negative health outcomes of childhood obesity are well documented[6]. Obesity is a complex issue that places a major cost burden on public healthcare systems[5,7-9]. It is essential, therefore, that effective, evidence-based care is provided in a timely manner.

Current clinical practice guidelines provide some recommendations regarding the management of paediatric obesity. The United States Preventive Services Task Force (USPSTF) recommends that clinicians refer children who are obese and aged 6 years and older to intensive, multicomponent behavioural interventions of greater than 26 contact h over 2-12 months to improve weight status[10,11]. In Australia, the National Health and Medical Research Council (NHMRC) provides recommendations regarding the use of multicomponent lifestyle interventions for all ages but is silent on intervention intensity and frequency[12]. Conclusions from two recent systematic reviews of randomised controlled trials indicate that multicomponent, behaviour-changing interventions that incorporate diet, physical activity and behaviour change may be beneficial in achieving small, short-term reductions in body mass index (BMI) and BMI z-scores in children and adolescents[13,14]. Authors noted that due to the heterogeneity of studies and limited long term outcomes, additional research from other forms of enquiry is required[13,14].

While the recommendations from the USPSTF[10] can be considered the 'gold standard' for management, the ability of any health system to provide such intensive services can be challenging. Increasing services and frequency of contact is likely to have significant resource and cost implications, particularly when services would have to disinvest in low value services or increase capacity for services, when obesity management is not core business. The question of what is considered to be 'enough' or 'effective' when providing multicomponent behavioural interventions is then raised. Pragmatic studies, using realistic and practical components of existing services and addressing real-world questions of relevance are useful in exploring these constructs. The aim of this study, therefore, was to determine the effectiveness of a pilot multidisciplinary specialist service provided to children and adolescents who were overweight or obese and living in Brisbane, Queensland, Australia.

MATERIALS AND METHODS

Study area and population: This retrospective, cross-sectional study was part of a larger project investigating the expansion, evaluation and sustainability of paediatric multidisciplinary obesity services provided by the specialist Children's Hospital in Queensland, Australia. All activities involved in this study were conducted between January, 2016 and December, 2018. Ethical approval was obtained from the Human Research Ethics Committee at both the Children's Health Queensland Hospital and Health Service (CHQ) and Bellberry Limited[15]. Written, informed consent was provided by all parents/guardians and participants where appropriate. The study was registered under the Australia New Zealand Clinical Trials Registry (ID: ACTRN12616000101482).

All children and adolescents and their parents/guardians who attended their first appointment at the weight management clinic at the Lady Cilento Children's Hospital (LCCH) between May, 2015 and June, 2016 were invited to participate in the study. Inclusion criteria were: (i) Referred by a paediatrician and aged between 0 and 18 years and (ii) For participants less than 2 years of age being above the 97th percentile on the WHO weight-for-age growth charts[16] and gaining weight rapidly or assessed by a paediatrician as having weight concerns and above the healthy weight range, participants older than 2 years of age were required to have a body mass index (BMI) >85th percentile on the United States Centers for Disease Control and Prevention (US-CDC) charts[17]or the WHO charts[18]. Participants and their parent/guardian were excluded if they could not understand English well and an interpreter was not available. The service

included consultations with a combination of a dietitian, psychologist and paediatrician, according to clinical indication. All advice given was personalised and evidence-based[12]. There was no pre-determined total time allowance for each individual-discharge occurred when deemed clinically appropriate. Current recommendations regarding intensity of services[10] was not followed as this was not achievable in the context. No control group was possible as this was deemed unethical, so a pragmatic approach of a before-and-after study was implemented.

Data collection methods: Data collection occurred between July, 2016 and July, 2018 and involved a retrospective analysis of individual electronic medical records as well as healthcare service appointment records, combined with semi-structured interviews completed with parents/guardians and participants (where appropriate) by telephone or in person. Data collected from the electronic records included: demographic details (age and gender of the child/adolescent), anthropometric data (any recorded measures of height and weight at each clinic appointment to determine changes in weight, height and body mass index (BMI, kg m^{-2}). BMI z-score for age and gender was then determined via the US-CDC z-score data files)[17], appointment details (how many appointments were attended and over what time frame, how many appointments were cancelled, which clinicians the appointments were with (paediatrician, dietitian, psychologist or a combination) and withdrawal and discharge details (including any reasons given)). Semi-structured interviews were conducted with parents/guardians and children/adolescents (where appropriate) to gain an understanding about their perceptions and experiences of the clinic. The interview was composed of 16 questions and was developed by Skelton and colleagues for use with children and parents enrolled in a family-based obesity management program delivered by a Children's Hospital in North Carolina, USA[19]. These questions were used with author permission with some word modification to suit the clinic context. Questions were patient-centred, aimed to understand parent and child experiences in the program, explored all aspects of treatment (including clinic readiness, clinic impacts and thoughts on the clinic) and allowed for exploration of areas of satisfaction and dissatisfaction[19]. Interviews took an average of 20 min to complete.

Statistical analysis: Statistical analysis for quantitative data were performed using the Statistical Package for the Social Sciences version 25 (IBM SPSS Statistics 25.0). Standard tests for normality were performed and descriptive statistics were calculated. Statistical significance for all tests was set at an value of 0.05 and all tests were 2-tailed. Participants were grouped according to gender, clinic completion status (discharged or withdrew/failed to attend (FTA)) and type of multidisciplinary care received. Differences in variables between groups were assessed using either t-tests, Wilcoxon Signed Rank Tests, Mann Whitney U-tests, one-way ANOVA with *post-hoc* Tukey tests or Kruskal Wallis tests with *post-hoc* Mann-Whitney U tests. Thematic analysis was used to explore the qualitative data collected from the semi-structured interviews. The 6 phases as described by Braun and Clarke[20], were used: data familiarisation, generation of initial codes, searching for themes, reviewing themes, defining and naming themes and producing findings. Due to the sample size, open coding was completed without the use of specialised software. Responses were detailed according to themes and sub-themes, with positive and negative responses distinguished and detailed by participant clinic completion status (discharged or withdrew/FTA).

RESULTS

A total of 25 children and adolescents (52% male) ranging in age from 4 years 10 months to 15 years 4 months and their parents/guardians consented to participate in the study. The participants attended the clinic between May, 2015 and May, 2018. At baseline, 4% (n = 1) of participants were classified as overweight, 20% (n = 5) as obese and 76% (n = 19) as morbidly obese according to the International Obesity Task Force (IOTF) classification for BMI for age and gender. BMI was unable to be calculated for one participant at the final appointment due to missing data. Participant and clinic characteristics and changes in BMI z-score as assessed at baseline and the final appointment are detailed in Table 1. Children/adolescents and their families attended on average a total of 5 ($\pm$2) appointments with the service over a time frame of 12.4 months ($\pm$6.6 months). There was a statistically significant improvement in BMI z-score for all participants ($z = -2.814$, $p = 0.005$). This overall group improvement can be attributed to the male participants, who experienced a significant improvement in their BMI z-score ($z = -2.432$, $p = 0.015$), whereas females did not ($z = -1.560$, $p = 0.119$).

In Table 2 participants have been grouped according to their status at the final appointment. Participants were either discharged from the service as clinically indicated (hence achieved their goals or completed the appropriate clinical intervention), withdrew (initiated by the parent/guardian and/or child/adolescent) or were classified as FTA after failing to attend 3 consecutive appointments. There was a statistically and clinically significant improvement between

Table 1: Participant and clinic characteristics and changes in BMI z-score as assessed at baseline and final appointments

Clinic characteristics	Total (n = 25)	Male (n = 13)	Female (n = 12)
Age at baseline (years)	10.4±4.0	10.4+4.5	10.5±3.7
Time in clinic (months)	12.4±6.6	14.6±6.2	9.9±6.5
Number of appointments	5.0±2.0	5.5±1.7	4.5±2.3
Participant baseline characteristics	Total (n = 25)	Male (n = 13)	Female (n = 12)
BMI z-score	2.54 (0.54)	2.49 (0.75)	2.61 (0.37)
Overweight as per IOTF (n)	1	1	0
Obese as per IOTF (n)	5	4	1
Morbidly obese as per IOTF (n)	19	8	11
Participant final characteristics	Total (n = 24)	Male (n = 13)	Female (n = 11)
BMI z-score	2.45 (0.54)*[z = -2.814, p = 0.005]	2.24 (0.76)*[z = -2.432, p = 0.015]	2.59 (0.39) [z = -1.560, p = 0.119]
Overweight as per IOTF (n)	2	2	0
Obese as per IOTF (n)	4	3	1
Morbidly obese as per IOTF (n)	18	8	10
Change in baseline and final measures	Total (n = 24)	Male (n = 13)	Female (n = 11)
BMI z-score	-0.09 (0.31)	-0.23 (0.67)	-0.03 (0.11)

Data presented as Mean±SD or median (IQR), *Significantly difference from baseline BMI z-score (p<0.05) via Wilcoxon signed-rank test, BMI: Body mass index, IOTF: International obesity task force classifications

Table 2: Participant and clinic characteristics and changes in BMI z-score according to the status at the final appointment

Variables	Status at final appointment (n of participants)	Outcome	p-value
Age at baseline (years)	Discharged (n = 11)	9.8±4.7	0.486
	Withdrew/FTA (n = 14)	10.9±3.5	
Time in clinic (months)	Discharged (n = 11)	12.6±7.0	0.858
	Withdrew/FTA (n = 14)	12.1±6.6	
Number of appointments	Discharged (n = 11)	5.7±1.7	0.108
	Withdrew/FTA (n = 14)	4.4±2.1	
BMI z-score baseline	Discharged (n = 11)	2.41 (0.77)	0.584
	Withdrew/FTA (n = 14)	2.61 (0.27)	
BMI z-score final	Discharged (n = 11)	2.10 (0.68)	0.060
	Withdrew/FTA (n = 13)	2.59 (0.41)	
BMI z-score baseline	Discharged (n = 11)	2.41 (0.77)	0.005* [z = -2.803]
BMI z-score final	Discharged (n = 11)	2.10 (0.68)	
BMI z-score baseline	Withdrew/FTA (n = 14)	2.61 (0.27)	0.806
BMI z-score final	Withdrew/FTA (n = 13)	2.59 (0.41)	
Change in BMI z-score	Discharged (n = 11)	-0.29 (0.88)	0.001^[z = -3.275]
	Withdrew/FTA (n = 13)	-0.01 (0.11)	

Outcome data presented as Mean±SD or median (IQR), * Significant difference via Wilcoxon signed-rank test, ^Significant difference via Mann-Whitney U test, BMI: Body mass index, FTA: Failed to attend

the baseline and final BMI z-score for all participants who were discharged from the clinic (z = -2.803, p = 0.005). These participants also experienced a greater change in their BMI z-score over time when compared to those who withdrew or FTA (z = -3.275, p = 0.001), despite no significant difference in the number of appointments attended or total time spent in clinic. Those who withdrew from the clinic or were classified as FTA did not experience any significant increase in BMI z-score over the clinic time period (p = 0.806).

Table 3 details changes in BMI z-score according to the type of multidisciplinary care. The majority of participants were seen by more than one clinician, with 5 participants seeing a dietician only. Those who received care from all 3 clinicians (dietician, psychologist and doctor) were the only group that showed a statistically significant improvement between their baseline and final BMI z-score (z = -1.960, p = 0.05), despite no differences in the number of appointments attended. There was a trend toward greater improvements in BMI z-score when a psychologist was involved.

The overall attrition rate was 56%, with 44% of participants who commenced the clinic being discharged from the service after reaching their goals or completing the appropriate clinical intervention (Table 4).Withdrawal usually commenced between the 2nd and 3rd appointments, after approximately 3.5 months. Discharge from the service commenced after a time period of approximately 6.5 months, between the 3rd and 4th appointments.

A total of 18 parents/guardians of participants (72%) and 4 children/adolescents (16%) completed the semi-structured interviews. Three themes and 11 corresponding sub-themes were identified from the interview data, a summary of

Table 3: Participant and clinic characteristics and BMI z-score according to the type of multidisciplinary care received

Variables	Multidisciplinary care received (n of participants)	Outcome	p-value
Participants discharged	Dt or Dt and Psych (n = 4)		
	Dt and Dr (n = 2)		
	Dt, Psych and Dr (n = 5)		
Participants	Dt or Dt and Psych (n = 4)		
Withdrew/FTA	Dt and Dr (n = 6)		
	Dt, Psych and Dr (n = 4)		
Age at baseline (years)	Dt or Dt and Psych (n = 8)	11.8±3.6	0.448
	Dt and Dr (n = 8)	10.3±4.4	
	Dt, Psych and Dr (n = 9)	9.3±4.1	
Number of appointments	Dt or Dt and Psych (n = 8)	4.6±2.2	0.822
	Dt and Dr (n = 8)	5.1±2.3	
	Dt, Psych and Dr (n = 9)	5.2±1.7	
BMI z-score baseline	Dt or Dt and Psych (n = 8)	2.38 (0.43)	0.318
	Dt and Dr (n = 8)	2.64 (0.38)	
	Dt, Psych and Dr (n = 9)	2.54 (0.75)	
BMI z-score final	Dt or Dt and Psych (n = 8)	2.21 (0.61)	0.082
	Dt and Dr (n = 8)	2.64 (0.31)	
	Dt, Psych and Dr (n = 8)	2.20 (0.63)	
BMI z-score baseline	Dt or Dt and Psych (n = 8)	2.38 (0.43)	0.069
BMI z-score final		2.21 (0.61)	
BMI z-score baseline	Dt and Dr (n = 8)	2.64 (0.38)	0.621
BMI z-score final		2.64 (0.31)	
BMI z-score baseline	Dt, Psych and Dr (n = 8)	2.54 (0.75)	0.050* [z = 1.960]
BMI z-score final		2.20 (0.63)	
Change in BMI z-score	Dt or Dt and Psych (n = 8)	-0.12 (0.28)	0.323
	Dt and Dr (n = 8)	-0.01 (0.14)	
	Dt, Psych and Dr (n = 8)	-0.17 (0.82)	

Outcome data presented as Mean±SD or median (IQR), *Significant difference via Wilcoxon signed-rank test, BMI: Body mass index, Dt: Dietitian, Dr: Doctor, FTA: Failed to attend, Psych: Psychologist

Table 4: Clinic attrition and discharge details for all participants

Appointment number (n)	Time between appointments (weeks, Mean±SD)	Active participants		Attrition		Discharged participants	
		Number	Percentage	Number	Percentage	Number	Percentage
1	-	25	100	0	0	0	0
2	13.93±12.19	25	100	0	0	0	0
3	12.15±8.00	21	84	4	16	0	0
4	10.93±5.66	19	76	5	20	1	4
5	18.46±12.43	16	64	7	28	2	8
6	13.04±5.31	9	36	10	40	6	24
7	12.47±12.94	6	24	11	44	8	32
8	13.00±8.19	3	12	13	52	9	36
9	10.00±0.00	1	4	14	56	10	40
10	-	0		14	56	11	44

which is displayed in Fig. 1. Example responses from parents/guardians and children/adolescents are detailed in Table 5. When asked about their perceptions of and experiences at the clinic, those who were discharged from the clinic were more likely to report positive responses, over all seemed more motivated (particularly regarding readiness to start and commitment) and were less likely to report negative responses when compared to those who withdrew or were classified as FTA.

For theme 1, starting the weight management clinic and specifically subtheme 1a, readiness to start, 10 negative responses were recorded under the topic: not ready, didn't think we needed it, feel too late, with the majority (n = 8) coming from those who were classified as withdrew/FTA. When focusing on theme 2, the clinic itself, 9 positive responses referred to the clinic staff (Subtheme 2c), under the topic: staffs were friendly, helpful, supportive, honest, caring and knowledgeable. Subtheme 3a, Lessons learnt (part of theme 3, the impacts of the clinic), was the result of a number of responses from participants, particularly positive responses regarding the topics: portion sizes, meal ideas, family support, principles of healthy eating, reinforced what we knew (n = 10

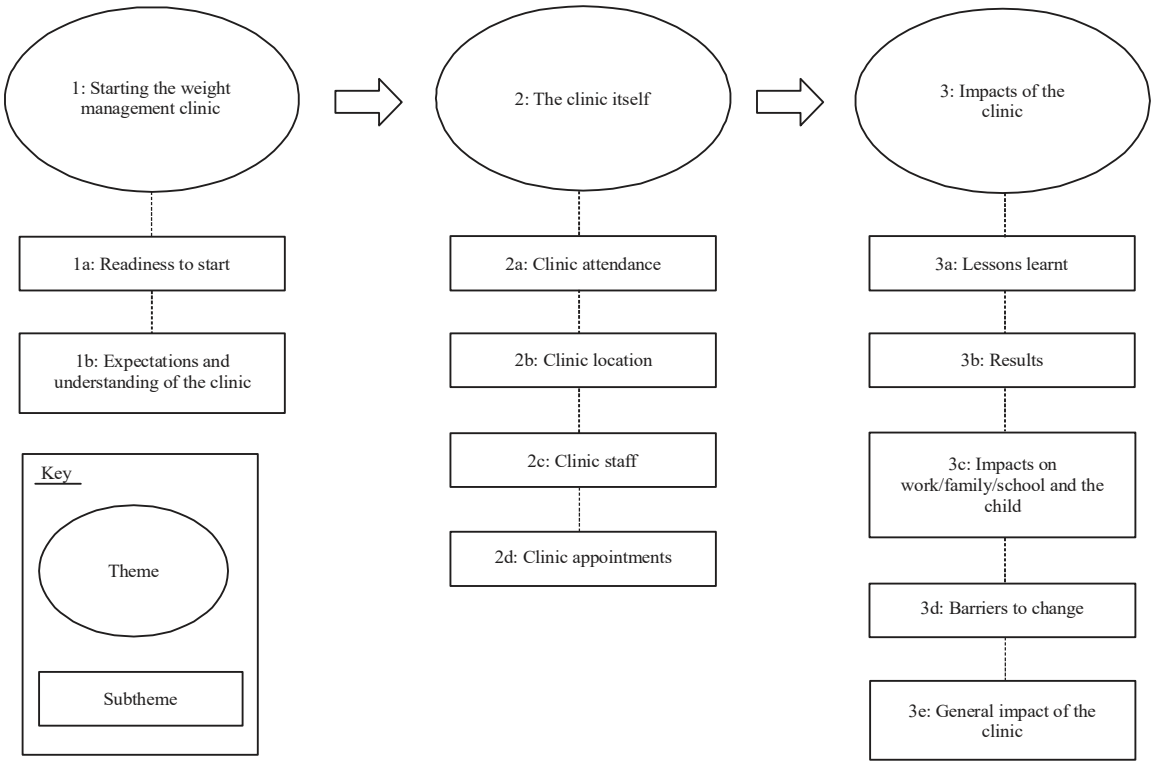

Fig. 1: Summary of thematic analysis of interview data collected from parents/guardians and children/adolescent who attended the weight management clinic

responses) and whole family needs to be involved, supportive environment, meal planning (n = 9 responses). These responses were equally distributed across those who completed and were discharged from the clinic and those who were classified as withdrew or FTA (Fig. 1 and Table 5).

DISCUSSION

Despite the small number of participants and the fact that the service intensity did not reflect current recommendations, results showed that there was a significant improvement in BMI z-score for all participants, with males doing better than females (despite no differences in the number of appointments or length of time spent in clinic). The improvement in BMI z-score for males was deemed to be clinically significant as the median value reflects proposed cut-offs for clinically meaningful changes as suggested in the literature (reductions of 0.2-0.25)[10,11,21-24].

Effective outcome measures for obesity in children and adolescents continue to be discussed. At a recent international meeting, consensus was that "the primary indicator of success should be the stabilisation or reduction of relative weight measures (e.g., BMI, BMI z-score, percentage weight above the 95th percentile) depending in the child's age and obesity status, with a focus on achieving clinically significant weight changes"[5]. Whilst all participants in our clinic achieved either a reduction or stabilisation in BMI z-score, it was only males that demonstrated clinically meaningful changes. Those participants who were discharged from the service showed better outcomes when compared to those who withdrew or were classified as FTA, despite no differences in the time spent in clinic or the number of appointments attended. Multidisciplinary care also resulted in better clinical outcomes and the importance of the inclusion of a psychologist was highlighted. Those who were discharged were more positive about the clinic and their experiences, particularly regarding their readiness to start the clinic. They were more likely to see improvements, were happier with the results and indicated that the clinic staff was supportive and considerate.

Overall, the measures of success were achieved, on average, in 5 appointments over 12 months, which equates to an approximate total treatment time of 3-5 h, depending on the combination of clinicians seen. This is significantly less than the USPSTF recommendations of greater than 26 contact h over 2-12 months[10]. On initial reflection, the results seem positive and the contact time achievable for the healthcare

Table 5: Thematic analysis of semi-structured interviews-number of positive and negative responses and examples from parents/guardians and participants who were discharged (D) and those who withdrew/failed to attend (W) grouped by themes and subthemes

	Example responses					
Topics	Positive	D	W	Negative	D	W
Theme 1: Starting the weight management clinic						
Subtheme 1a-Readiness to start						
Ready to start, requested it, prepared	"Yes was ready. Don't know why we didn't do it earlier" (D) "Yes was ready .. but child is a bit young" (W)	5	1	Not ready, didn't think we needed to, feels too late "Has been an ongoing issue for 8 years .. tried everything .. our last option" (D) I wasn't ready-I thought there was nothing I was doing wrong" (W)	2	8
Subtheme 1b-Expectations and understanding of the clinic						
No expectations	"no expectations-knew that they were there to help us with her weight management". (D)	1	0			
Better than expected	"I thought it would be different but it's pretty good". (D) "Expected very strict consultations, was very relaxed.. Very easy to talk to them" (W)	1	1			
Understanding	"yes understood, definitely after the first one after they'd explained everything". (W)	0	2			
Theme 2: The clinic itself						
Subtheme 2a: Clinic attendance						
Never miss appointments, doing best	"No we never miss appointments"(D) We've done lots of programs before.. I'm trying my best"(W)	1	3	Considered dropping out, stressful, no improvement, disappointed "Not seeing any results. Frustrated with the lack of results" (D) "Yes considered dropping out .. didn't feel done as well as could have " (W)	1	5
Dropping out was not an option	"Never considered dropping out but my daughter does. She is not happy sometimes. She says that we don't need to come" (D)	3	0			
Subtheme 2b: Clinic location						
				Disliked location, stressful driving "Location was what I liked least." (D) "Only stressful thing was driving in the city and money for parking" (W)	1	2
				Expensive parking, need car parks "Parking least favourite ... Got a fine!" (D) "need free parking" (W)	1	4
Subtheme 2c: Clinic staff						
Staff were friendly, helpful, supportive, honest, caring, knowledgeable	"The people there are the best thing – he's comfortable". (D) "I liked the care and consideration ... I think it's pretty good program." (W)	5	4	Staff were not genuine, uncaring, we didn't agree with advice "Didn't like the superficial nature of the previous dietitian-didn't feel right (W) "Didn't agree with the dietician's views i.e. was too focused on one aspect of food". (W)	0	3
Psychologist especially beneficial	"The psychologist was surprising...in a good way ... Shocked us that she was a part of it." (D) "Last sessions was the only session that they offered psychologist ...would've preferred for all the sessions" (W)	2	2			

Table 5: Continue

Topics	Example responses: Positive	D	W	Negative	D	W
Subtheme 2d: Clinic appointments						
Always on time, no waiting, appointment times were well accommodated	"Seen relatively quickly ... Unexpected and good... Very efficient". (D) "The clinic changed hours for me, no problem making it later in the afternoon" (W)	3	4	Long time between appointments, appointment too long, inconvenient times "Need more afternoon appointments so the whole family can come along" (D) "Might make it easier for families of younger children to attend if the appointments didn't run as long". (W)	1	3
Theme 3: Impacts of the clinic						
Subtheme 3a: Lessons learnt						
Portions sizes, meal ideas, family support, principles of healthy eating, reinforced what we knew	"To manage better ways to eat ...portion sizes has been the most helpful ... shopping." (D) "Portion size was the main thing ...will eat breakfast now ... trying new things" (W)	5	5	Learnt nothing new, not a lot changed, didn't meet our needs "I wanted more direction and to be given types of meals that are better for him ...a diet tailored for his conditions ... We got that with the first dietitian we ever saw (not LCCH) and it was great."(D) "Nothing much new ...already knew a lot of things... Would be better to get more structure...More meal planning... Not so general.. More specific advice." (W)	2	3
Whole family needs to be involved, supportive environment, meal planning	"Just to make things fun instead of being strict... do it together-everyone is involved" (D) "Making lunches, exchanging foods" (W)	5	4			
Subtheme 3b: Results						
Happy with the weight loss, happier child, improved relationships	"She was pretty proud of herself in the end"(D) "I think they did everything they could possibly do ...mostly saw the results I'd hoped to see ... Plateaued lately ... child feels better."(W)	4	2	No improvement, weight has increased "Haven't seen the results she's hoped to see.. but knew it was going to be hard" (D) "No ...her weight has continued to increase .. wanted to lose 5 kg but has increased weight by another 10 kg" (W) "Wasn't bad ... we've had so many appointments it hasn't made a difference" (W)	4	3
Some improvement in weight, slow improvement, some behaviour change	"Would've liked to see greater results ... has to do with a rare genetic condition" (D) "Didn't see results we'd hoped to see ...first couple of weeks she did lose some weight." (W)	4	3			
Subtheme 3c: Impacts on work/family/school and the child						
No impact or stress	"Had to take time off work ...not too much drama ... didn't affect her school performance" (D) "Hasn't affected family negatively or lead to stress .. didn't affect performance" (W)	5	4	Some stress for child and family "Quite overwhelming at times because of the nature of it ... Worried between appointments ... had we done enough? caused stress" (D) "did get anxious when she had to go back knowing she hadn't lost weight .. might disappoint staff (W)	5	4
Subtheme 3d: Barriers to change						
				Lack of support, resistant child "First couple of sessions child has been happy to come ... now not so happy" (D) "Hardest part is changing husband's mindset about food..." (W)	3	2
Subtheme 3e: General impact of the clinic						
Reassurance, support	" Liked the reassurance of someone saying that you are doing the right thing" (D) "Liked the guidance the most ...you blame yourself as a parent ... reassurance that it is not your fault is very helpful" (W)	1	3			

services to deliver, implying that this model of care could be implemented effectively elsewhere. These results, however, need to be carefully considered at the systems level, to further understand and determine what strategies are effective in supporting the management of paediatric obesity and what needs to change. From a service delivery perspective, the following factors need to be considered: the length of the service, the setting in which the service is delivered, the participants characteristics and attrition rates and the ability to define other measures of success.

In regards to the length of the service, it needs to be determined if the time period over which the intervention is delivered could be shortened to provide a more intensive service for participants, which may result in outcomes being achieved more quickly. The time between appointments (Table 4) ranged from 10-18.5 weeks. It is unclear if this was due to the capacity of the service, family requests or based on subjective clinician decisions (which may not be evidence-based). This needs to be understood on a broader level so that effective service delivery models can be defined that manage the tension between services and clients.

The results raise the issue of the role of various levels of healthcare and more specifically, the setting in which the service is delivered. This clinic was delivered by a specialist children's service and it is unclear if it could be replicated in primary care or community settings and achieve the same outcomes. Literature suggests how clinicians themselves present a major barrier to changing service responsibilities. A recent, comprehensive review by Mihrshahi *et al.*[25], which focused on prevention and management approaches to paediatric obesity in Australia captures this challenge well "barriers to paediatric weight management experienced by medical practitioners include difficulties about raising the issue, uncertainty about advice to offer, lack of referral pathways, reduced local service capacity, a relative lack of confidence in managing patients with obesity and a need for further training"[25].

Another factor which can impact service delivery is the participant characteristics and attrition rates. This service worked well for those who were ready to start and who were more motivated overall. Those who withdrew or FTA reported that they were not ready to participate, did not see the intended results and did not learn anything new. Attrition rates were in the middle of ranges reported within the literature[19,26]. This reflects thoughts presented by Perez and Ball[27]-"The adherence paradox: those for whom greater adherence to behavioural advice is necessary to manage excess weight are the least likely to act accordingly" and "The attrition paradox: those who would potentially benefit the most from remaining in care longer are more likely to leave care prematurely"[27]. Perhaps better screening processes would ensure that participants are matched to services more appropriately.

The stabilization of weight outcomes, while in itself considered to be a measure of success[5], may also be accompanied by other changes in behaviour that can positively contribute to weight loss in the future and can be more meaningful for participants and their families in a shorter time frame. This may include measures such as quality of life, dietary behaviours, mental health and physical activity. There is potential for this to be linked back to attrition rates as those who see improvement in outcomes in addition to or other than weight may be more inclined to continue to attend services.

Overall the results, whilst very positive at an individual-level, generate a variety of important questions and considerations regarding paediatric obesity management in a service delivery and systems sense. The evidence regarding the need for targeted services for those children and adolescents who are already overweight or obese is clear[1], however the ongoing difficulty is how this can be effectively achieved in real-world settings. Further, large scale pragmatic, implementation studies in the context of health services research are required to help progress this agenda. A promising example is a recently published study protocol by Cohen *et al.*[28], which aims to determine the acceptability, effectiveness and impact of different models of care for paediatric weight management services across New South Wales, Australia. It is anticipated that outcomes from this type of research will assist countries in implementing effective management strategies that can impact prevalence rates of childhood overweight and obesity.

CONCLUSION

A significant improvement in BMI z-score was evident for all participants when attending a pilot multidisciplinary paediatric obesity service, despite the service intensity not reflecting current recommendations. The five appointments can be considered the minimum number of consultations offered to a child/adolescent and their family as part of a weight management service, in order to support the achievement of significant, positive outcomes. Further pragmatic studies are required to investigate these factors to ensure suitability and sustain ability of specialist clinical services.

SIGNIFICANCE STATEMENT

The study is unique in that it investigated both quantitative and qualitative outcomes for children and adolescents attending specialist obesity management services in a real-world setting and identified and discussed key factors contributing to success. This study will help researchers and clinicians to design and deliver effective weight management services, which in turn, has the potential to impact childhood obesity prevalence rates.

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