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Adapting pediatric obesity care to better suit adolescent patients: Design of a treatment platform and results compared with standard care in the national patient quality register

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Abstract

Background: Obesity constitutes a critical risk for adolescent health. This study aimed at identifying youth-friendly components of obesity treatment.

Methods: In this feasibility study, an adolescent obesity treatment platform was implemented at two Pediatric outpatient clinics in Sweden. Body mass index (BMI), BMI *z*-score, and the category of obesity (International Obesity Task Force) were compared before and after the intervention and with data on standard care from the Swedish Childhood Obesity Treatment Register.

Results: The study included 99 participants (49 females) aged 13–18 years from 1 September 2014, to 31 December 2016. A pediatric nurse met the participants on average 6.5 times in the average inclusion period of 15 months. Physical activity sessions attracted 63 participants. Acceptance Commitment Therapy and *In Real Life* groups attracted 24 participants. At inclusion, 62 participants had obesity and 37 severe obesity, and 71/99 (72%) remained in the same category. The mean BMI increased from 32.0 to 33.4 kg/m^2 ($p < 0.01$), but 56/94 (60%) participants lowered their BMI or increased less than 1 kg/m^2 and 73% stayed to the end of the study. Participants who were new to treatment and participants coming for more than eight visits to the nurse did not increase in BMI. BMI did not change for the 221 out of 641 register patients who had two recordings of BMI in the study period.

Conclusions: The platform was successful in increasing retention, and 60% of participants lowered or maintained their BMI. Still, seven out of ten adolescents with obesity or severe obesity remained in the same weight category.

KEYWORDS
adolescent health, bariatric surgery, developmentally appropriate health care, neuropsychiatric disorders, obesity treatment, youth-friendly care

1 | INTRODUCTION

One in five adolescents in the world lives with overweight or obesity,[1] and obesity constitutes one of the most critical risks for adolescent health.[2-4] The risk of an adolescent patient to remain with obesity in adulthood is around 80%.[5] Interventions promoting lifestyle modification are most commonly used, but have been less successful for adolescent patients than for younger children.[6-8] Pharmacotherapy is rarely used outside investigational trials, and few medications have indications for patients below 18 years of age. Emerging anti-obesity drugs may become an option for adolescent patients.[9,10] Bariatric surgery is increasingly suggested for adolescents with severe obesity but remains controversial and underutilized.[11,12] Apart from remaining a cornerstone of treatment, promoting healthy behaviors, such as physical exercise and non-smoking, can help to mitigate the complications of obesity.[13]

Adolescence is a unique period in life, and, importantly, the influence of family will decrease. *Developmentally Appropriate Health care* has been suggested as a term for adapting health care to the young person's social, psychological, and biological age, "youth-friendly" care.[14] Although treatment for younger children is often family-based or even addressing just the parents,[7] the role of the parents in supporting their adolescents with obesity is not clear. A randomized study showed no advantage of improving parent–adolescent communication in treating adolescent patients with obesity, and there was a trend favoring a greater decrease in body mass index (BMI) for adolescents whose parents were minimally involved in their weight control efforts.[15] Analyzing 15 qualitative studies, Jones et al. showed that although adolescents said that they benefited from positive family support; sometimes, parents created a barrier to weight loss. This lack of family support appeared more common in adolescents reporting no success.[16]

In a meta-analysis of 28 randomized controlled studies on patients of 12–17 years of age in treatment for obesity, Al-Khudairy et al. showed a reduction of the BMI *z*-score of 0.13 units in the intervention compared with the control groups. For the six studies with 18–24 months follow-up, the BMI *z*-score was reduced by 0.36 units. There were no differences between interventions with or without parental involvement.[6] In another review, parents of children and adolescents with obesity were described as ambivalent in their attitudes, caught between the desire to do something about their child's overweight and fear to harm or add to the child's burden.[17] This balancing act may become even more difficult with the increasing age of the child.

A long-term relationship with the health care provider has been important for treating other chronic diseases such as type-1 diabetes mellitus.[18] Analyzing the prominent domain of support, Jones et al. noted that professional support appeared to be highly valued than support from peers and family. There was a general desire from adolescents to work more closely with professionals.[16] The need for highly specialized multi-disciplinary teams may be challenging for smaller units, and networking with external providers, such as dieticians or physiotherapists, may be an option.

In treatments for children with obesity, attrition is high at 30%–80%.[19] A Regional Roadmap for Obesity in the Stockholm region was developed and ratified by the health care and political authorities.[20] The Roadmap clarified the rights of patients of all ages to find obesity treatment, provided the terms of reference for health care providers, and mapped the referral links. In other contexts, the primary health care providers treat obesity,[21,22] but the Roadmap stated that children with International Obesity Task Force (IOTF)-BMI 30 should be referred to second line treatment at Pediatric outpatient clinics. The primary health care providers, school health care, and child-well clinics should identify children with overweight and provide essential advice to prevent a progression to obesity and refer children with obesity to the Pediatric outpatient clinics.

For this study, a multi-professional reference group collaborated in the design, and two Pediatric outpatient clinics were the targets of the intervention. A relationship with a designated health care provider was suggested to be meaningful and visits to the selected pediatric study nurses were to be the core of the project. The nurses aimed to assist the participants in their increasing autonomy and the natural process of diminishing parental support.

The rationale of this study was to address one of the identified gaps in the health care system: the observed poor results for treatments of obesity in adolescent patients. The main objective of the treatment platform was to upgrade the existing pediatric care to improve the coverage of care and treatment results for adolescents with obesity. The specific objectives were to (1) design and implement a new treatment platform; (2) increase the number of adolescents of both sexes with obesity coming to the Pediatric outpatient clinics; (3) involve providers of health care outside the Pediatric outpatient clinics; (4) use modern technology for communication with the participants; and (5) compare results with standard care for adolescent patients in the Swedish Childhood Obesity Treatment Register. The hypothesis of this study was that a youth-friendly treatment platform would increase the retention in obesity treatment and contribute to better treatment results for adolescent patients.

2 | METHODS

2.1 | Study area and study objects

The Stockholm Region in Sweden provides health care for a population of over 2 million people. By far, most health care is financed by public funding. For this study, two public Pediatric outpatient clinics were purposively selected for geographic location and previous work on obesity.[23] The Pediatric outpatient clinics constituted the second line of health care for children below 18 years of age for pediatric consultations, including obesity. They were staffed with pediatricians and pediatric nurses, and to a varying degree, other staff categories. Almost exclusively, children were referred from primary care general practitioners, school health physicians, or child-well clinics.

2.2 | Design and content of the treatment platform

A broadly selected reference group of 23 persons representing different aspects of adolescent health and obesity, and a patient and parent organization, met twice in half-day workshops. The reference group helped in problem formulation and suggested issues on the project design. It was suggested to focus on the participant's attachment to the health care provider and retention in treatment, allowing a large degree of flexibility in choice of activities and timing so that the adolescent could be supported to achieve a stability or reduction in BMI and BMI *z*-score.

A steering committee that consisted of the authors, two additional health professionals, and one representative from the Stockholm Region met 19 times during the study period and on-demand with three pediatric study nurses. Training in adolescent health was provided by senior members of the Swedish Association of Adolescent Medicine,[24] a member organization of the International Association for Adolescent Health. The training was adapted for the treatment of chronic diseases, including obesity.

All facility staff received and discussed literature on adolescent medicine from textbooks and articles, attended a workshop on speech methodology and lectures on adolescent medicine. The treatment platform was designed with a set of components selected by convenience, from which the participant and the pediatric study nurse would choose (Table 1).

The physical activity was individual session with a physiotherapist or group activities in a gym or pool. The *In Real Life* group was based on the theory of "Sense of Coherence," in which predictability and a sense of meaning are the important contributors to health.[25] The pediatric study nurses, who lead the groups, worked with the groups' participants and used techniques such as role-plays and exercises on perceptions and values. The aim was to create hope and interest in making changes in lifestyle by empowering the participants, increase self-awareness and the ability to reflect on health and health-related behavior. The group sessions also provided basic information on issues like sleep and physical activity. The Acceptance Commitment Therapy group was headed by psychologists who used strategies based on Cognitive Behavioral Therapy for handling emotions such as motivation, hope, guilt, shame, and disturbed eating patterns; addressing participants' goals to guide the process of behavior change; and increase psychological flexibility.[26]

At the first visit, the pediatric study nurse introduced the components of the platform. The participant and the nurse agreed on an individualized written treatment plan stating frequency and type of visits, and goals for the treatment. The aim was to meet the study nurse approximately once a month. This plan could be revised as needed. The design was chosen, despite the highly flexible design making the evaluation more difficult. Measuring the participants' height and weight was encouraged at all visits to the pediatric study nurse in a neutral way: "to see if you are on track." Health professionals aimed at to reduce the participant's feelings of failure and guilt and identify positive changes to encourage continued efforts. The physical environment of the clinic was critically revised to be more attractive for adolescents. Telephone and SMS were used for communication, but the web applications were not finalized due to issues that were technical and related to protecting the integrity of the electronic patient records, and obstacles in the procurements of web applications.

2.3 | Participants

Inclusion criteria were obesity or severe obesity according to the IOTF,[27] age 13–18 years, and a wish to participate in the platform (Table 2). Severe mental retardation and inability to understand basic Swedish were exclusion criteria. Patients already undergoing care at either of the two Pediatric outpatient clinics were offered to join the program, and to recruit new patients for participation in the study, information on the program was distributed in the professional networks and school health services in the area.

Inclusion was continuous for the study period of 28 months. The pediatrician introduced the option of joining the treatment platform at a regular visit. For each participant, the date of inclusion was the following first meeting with the pediatric nurse. The study finished on 31 December 2016, or when the participant chose to leave. Participants who turned 18 years could decide to remain in the program until 31 December 2016, or be referred to adult care. For BMI and BMI *z*-score, the measurements at the inclusion visit were compared

TABLE 1 Components of the treatment platform and provider's association with the Pediatric outpatient clinic. Nurse visits were the core component and the participants could choose among the remaining components

Component	Comment
Nurse visits	At start, a pediatric study nurse was linked to each patient at the Pediatric outpatient clinic. Individual goal setting and individual written treatment plan, height and weight
Curator or psychologist	Individual, external providers
Physical training	Swimming and gym training, groups and individual, external providers
Dietary advise by dietician	Individual, external providers
Acceptance and Commitment Therapy (ACT)-group	Group, at the Pediatric outpatient clinic. Led by psychologists
In Real Life group therapy	Groups, at the Pediatric outpatient clinic. Led by the pediatric study nurses

TABLE 2 Patient characteristics

	Study participants	Register patients
Number of patients (female)	94 (49)	221 (104)
Number of new patients (female)	27 (15)	221 (104)
Number of patients in previous treatment (female)	67 (34)	0
Mean age at inclusion, years [SD]	14.9 [1.3]	14.8 [1.1]
Mean age at inclusion, female, years [SD]	14.9 [1.4]	14.9 [1.1]
Mean age at inclusion, male, years [SD]	14.9 [1.2]	14.8 [1.1]
Median weight at inclusion (kg) {IQR}	89.1 {78.9–101.5}	-
Median weight at inclusion, female (kg) {IQR}	85.0 {78.0–98.3}	-
Median weight at inclusion, male (kg) {IQR}	98.0 {82.5–109.0}	-
Weight at inclusion, range, female (kg)	60.0–128.5	-
Weight at inclusion, range, male (kg)	69.7–144.4	-
Median BMI at inclusion (kg/m^2) {med}	32.0 {30.4–35.3}	31.5 {29.7–34.1}
Median BMI at inclusion, female (kg/m^2) {IQR}	32.1 {30.7–35.2}	32.0 {30.7–34.9}
Median BMI at inclusion, male (kg/m^2) {IQR}	31.8 {30.4–35.4}	31.5 {29.7–34.1}
BMI at inclusion range, female (kg/m^2)	28.5–45.3	28.3–44.3
BMI at inclusion range, male (kg/m^2)	27.8–47.2	27.3–50.1
Mean IOTF BMI *z*-score at inclusion [SD]	2.8 [0.4]	2.7 [0.3]
Mean IOTF BMI *z*-score at inclusion, female [SD]	2.7 [0.4]	2.7 [0.3]
Mean IOTF BMI *z*-score at inclusion, male [SD]	2.9 [0.4]	2.8 [0.3]

Abbreviations: IOTF, International Obesity Task Force; {IQR}, intraquartile range; kg, kilogram; [SD], standard deviation.

to the last measurement, including measurements made up to 31 January 2017.

The number of days of inclusion and visits were determined for the period between date of inclusion and until 31 December 2016, or earlier if the participant chose to leave the study. Height and weight were measured at the visits to the Pediatric outpatient clinics using the standard equipment (digital scale and height measurer) of the facility. Weighing was performed with the participant in light underwear, but if participants did not want to undress, the clothes' approximate weight was deducted. BMI was calculated using weight in kg and height in meters (kg/m^2). To compare across ages and sexes, BMI *z*-score was calculated using the IOTF.[27] For categorization of obesity, the IOTF BMI < 24.9 for normal weight, 25–29.9 for overweight, 30–34.9 for obesity, and IOTF BMI 35 for severe obesity were used.[27,28] Data were entered into the medical records and the Swedish Childhood Obesity Treatment Register (BORIS). Two participants objected to the inclusion in the register, and their data were collected separately. Number of visits were calculated using all visits in the platform framework, and categorized into low (<1 visit/month), medium (1–2 visits/month) or high (>2 visits/month) activity in the platform.

Seven participants had overweight at the first visit and were excluded from all analyses. Two participants started in the program before age 13 years and were included at their first visit after 13 years. Seven participants objected to weighing at inclusion but had weight and height recorded within 2 months before inclusion, and the last observation carried forward was used to determine BMI at inclusion. Two patients had no weight at inclusion, or within 2 months before inclusion, and were excluded (Figure 1). The last BMI *z*-score before 18.5 years was used as the final BMI *z*-score for participants who stayed in the program after 18 years of age. Five participants (all male) had only one measurement, and therefore, no final weight was included. Using intention-to-treat, these five participants were included in the weight category analysis ($n = 99$), but not in the further investigations of visits, BMI and BMI *z*-score ($n = 94$).

2.4 | Standard care from the national treatment register

All children of age 13–18 years in Sweden who had the first visit for obesity in the Swedish Childhood Obesity Treatment Register at the same level of care (Pediatric outpatient clinic) for the period of the study, excluding the two clinics in the study, were identified. Data on age, sex, BMI, and BMI *z*-score were extracted for these 645 patients. Two patients with clearly erroneous reporting (one patient with BMI 4 and one patient with BMI 64 followed by a new recording of BMI 26) and three patients with a lack of data on weight and height at the first visit were excluded. Patients who did

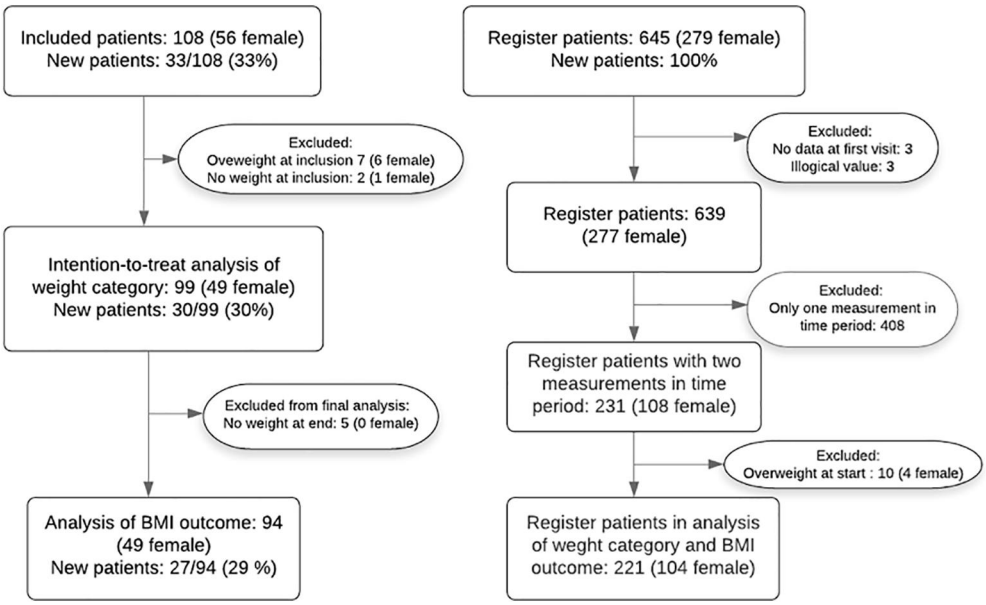

FIGURE 1 Flow of study participants (left) and the patients from the Swedish Childhood Obesity Treatment Register (right) used for comparison. BMI, body mass index

not have two or more registrations in the study period and patients with overweight, but not obesity, at inclusion, were excluded. Finally, data from 221 patients in standard care in the national treatment register were included in the analysis of changes in the BMI and IOTF category of obesity. The first and the last recorded visits in the study period were used for the comparison (Table 2 and Figure 1).

2.5 | Staff

Three experienced pediatric nurses working at the Pediatric outpatient clinics were recruited as pediatric study nurses. The available psychologists, dieticians, and providers of physical activity outside the clinics were mapped, and collaborations were established. The pediatricians and other staff of the Pediatric outpatient clinics attended teaching sessions on adolescent medicine and information meetings.

2.6 | Statistical analysis

For this feasibility study, mainly descriptive statistics were used. An intention-to-treat–approach was used. For BMI and BMI *z*-score, the distribution was skewed, and the mean value and interquartile range with the first and third quartile were shown. To further illustrate the span, the range was shown for each sex for weight and BMI. Student's paired *t*-test in Microsoft Excel was used for comparing BMI at the first and last visit. For changes in the IOTF category of obesity, the category at the inclusion (obesity or severe obesity) and end of study (normal weight, overweight, obesity, or severe obesity) was assessed. Visits were calculated from the participant's records with mean and visits per included month.

2.7 | Ethics

The study was approved by the Swedish Ethical Review Authority, 2019-02506. All participants gave their consent to participating before joining the project.

3 | RESULTS

3.1 | Resource allocation, collaborations, and technical development

The resource allocation at the Pediatric outpatient clinics consisted of one extra nurse. The Pediatric outpatient clinics and the external providers claimed routine per-capita revenues from the public financing of health care. The participants paid no fees. Patient conferences were held with external providers within the health system, but not with external providers outside the health care system.

Mobile phones were used for communicating with participants over phone or via SMS. The objective of adding technical web applications to the platform was not fulfilled. Issues on procurements and budget for designing new web applications; the ability to use existing commercial applications, software and equipment for video-visits; issues on protecting the integrity of the electronic patient records; and the legal aspects of documentation of interactions in the patient's electronic medical files were not solved.

3.2 | Staff training and feasibility aspects

The pediatric study nurses attended courses for 4 days in adolescent health, and all involved staff attended 2 days of training in adolescent health. Staff members studied literature on adolescent health[29] and met in several meetings, training on speech methodology workshops and lectures amounting to a total of 5–7 days of capacity building.

The collaborative work in the reference group workshops and steering group generated a number of "problem areas" that helped design the project and set the study objectives. On completing the project, the steering committee suggested recommendations for the future work to the Stockholm region as per Table 3.

3.3 | Participants

In total, 99 patients (49 female) were included, 57 and 42 at each Pediatric outpatient clinic, respectively. A third[30] were new patients referred to the clinics for joining this program. A concomitant disease was common with 22 (7 female) having neuropsychiatric or psychiatric diagnoses. One participant had hepatosteatosis, and one had Type 2 diabetes mellitus. No participant was taking anti-obesity drugs. The average inclusion time was 452 days (15 months, range 74–842 days). In total, 82/99 participants had more than four visits to a nurse or a pediatrician. For the 94 participants that were included in the final analysis, the total number of visits was 1682. The average number of visits to the focal nurse was 6.5 (range 1–14), with female participants coming for 6.7 visits and male participants for 6.3 visits. Average visits to the pediatrician were 1.2 per participant. A total of 22 participants met a dietician at least once, and 14 participants met a psychologist at least once during the inclusion period. The frequency of visits varied, and 51/94 (54%) came at least once a month to any of the activities in the platform.

The interest in group activities varied. In terms of participation, physical activity in groups was the most successful with 63 adolescents participating at least once and on average 11 times. The 24 (16 female) participants who came for physical activity more than 10 times attended on average 21 times. The participants clearly appreciated the opportunities for non-competitive physical activity, practical guidance on how to handle the equipment in a public gym, and social interactions in the gym and changing rooms. A total of 18 adolescents signed up for a therapeutic group activity *In Real Life* and were divided into two groups of nine. The Acceptance and Commitment Therapy group attracted six participants. Attendance in all the groups varied along the way and effort was needed to keep the groups going. Issues were related to practical problems of fitting the activities into several participants' schedules, but also to ambivalence among the participants who stated that they found the groups helpful, appreciated meeting others in the same situation but also that they were hesitant to join and expose themselves to others. Groups and meetings for parents were canceled because of limited interest.

At the end of the study period, 61/99 participants were still included. Of the 38 not participating to the end of the study, 21 (9 female) expressed a wish to leave the study, 16 finished because of age, and one moved from the area. Disregarding participants who wished to leave because of age (18 years and above), the retention rate was 61/83 (73%).

3.4 | Weight measurements

Of all participants, 71/99 (72%) remained in the same IOTF category of obesity, 13% decreased their BMI enough to go from a higher to a lower IOTF category of obesity whereas 10% increased their weight category from obesity to severe obesity. For five participants, there was no final weight. Six participants ended the study in the overweight category (Figure 2A). Among the 221/645 patients in standard care in the national treatment register who had two visits in the study period, 157/221 (71%) remained in the same weight category and 21% decreased the weight category (Figure 2B). Of the study participants, 56/94 (60%) either lowered or increased their BMI by less than 1 kg/m^2 (Figure 3A), and 83/94 (88%) lowered or increased less than 0.3 unit in their BMI *z*-score (Figure 3B). The results were similar or slightly better for patients in standard care (Figure 3C,D).

For the study participants, the mean BMI on inclusion was 32.0 kg/m^2 and increased to 33.2 kg/m^2 ($p < 0.001$) (Figure 4A), and for the patients in the national treatment register, the BMI went from 31.4 to 32.1 kg/m^2 which was not significant ($p = 0.58$). The median BMI was similar between sexes (Figure 4B female, Figure 4C male) for the study participants, but the range was wider for male participants and both sexes increased BMI ($p < 0.01$). BMI results were analyzed for the study participants who were new or previously in treatment, participated more often in physical activity or came more often to the focal nurse, or had a low, medium or high frequency of visits per month. Only for three of these analyses, the median BMI was similar at the start and end of the program; being a new patient without previous treatment (Figure 4D, $p = 0.60$), visited eight times or more to the focal nurse (Figure 4I, $p = 0.0521$), or 1–2 times per month (Figure 4K, $p = 0.10$). For all others, the median BMI increased significantly (Figure 4).

4 | DISCUSSION

In this study, 99 adolescents with obesity or severe obesity were included in a new adolescent obesity treatment platform. The retention rate was over 70%, the average inclusion time 15 months, and 30 new patients were included. The participants increased in BMI, but six out of ten study participants lowered or kept their BMI increase less than 1 kg/m^2. The patients in standard care in the national treatment register used for comparison did not increase in BMI; however, only a third of the register patients had two measurements in the study period. The results of the platform in terms of

TABLE 3 Feasibility aspects of the adolescent obesity treatment platform: Problem formulation, strategy, results, and suggestions. Obesity including severe obesity

Problem formulation	Strategy	Results	Suggestions
Results of obesity treatments are poor for adolescents	Provide youth-friendly care close to home	An adolescent obesity treatment platform was designed and implemented at two existing pediatric outpatient clinics and attracted 99 patients	Provide staff training in adolescent medicine and individualize care
	Use existing evidence on adolescent medicine and obesity treatment		Set goals, promote retention and healthy lifestyle (consider the option of being better positioned for later bariatric surgery or pharmacological obesity treatment)
	Monitor weight		Monitor weight status at all appointments; weight stability may be an achievable goal
	Promote retention and limit dropouts		Promote "do", e.g., physical activity rather than discussing physical activity
			Accept flexibility in appointments, cancellations and activities
			Adapt the physical environment of the clinic to the needs and wishes of adolescent patients
Few adolescents with obesity are in active treatment	Increase coverage by cooperation with the school health service	30 new patients were recruited to the platform	Use school health service providers to identify and recommend adolescents to seek care for obesity
The significance of attachment to a designated health care provider in adolescent obesity treatment is not clear	Promote the bonding to a specified health care provider (here: a pediatric nurse)	More than 8 meetings with the pediatric nurse were associated with better outcome	Promote a personal relation between the health care provider and the patient
Parents' role and ability to participate in adolescent obesity treatment is not clear	Enable for parents to participate but focus on the adolescent patient	Activities targeting parents were canceled due to lack of interest	Target the adolescent patient
			Connect with social services for the families that need support
All categories needed for a multi-professional team were not available at the Pediatric outpatient clinics.	Join with providers outside the Pediatric outpatient clinics	Physical training in groups was the most used component in the platform (the most active quartile of patients came on average 21 times)	Map and cooperate with fitness centers and dieticians outside the Pediatric outpatient clinic
Poor psychological health and concomitant psychiatric disease is common in adolescents with obesity	Establish cooperation with psychiatric care	14 patients had at least one appointment with a psychologist in the platform	Cooperate with psychiatric and school health care for patients with suspected or confirmed psychiatric or neuropsychiatric disorders
The effect of group treatment is not clear for adolescents with obesity	Provide group activities with therapeutic agendas	24 patients participated in therapeutic group activities. Groups were appreciated by the participants but it was a challenge to match participants and their schedules to make groups work over time	Offer group activities and plan for a high need of staff involvement
			Qualitative research is needed to evaluate the effect of groups with therapeutic agendas
The role of Internet support for treatment of adolescents with obesity is unclear	Add components of web-based interventions to obesity care	The Internet applications aimed for in the platform were not established due to technical and patient integrity issues	Modes for patient communication, monitoring weight, and virtual consultations over the Internet for cooperation with adolescent patients need to be further developed and investigated in research

(Continues)

TABLE 3 (Continued)

Problem formulation	Strategy	Results	Suggestions
Research on treatment of obesity in adolescents is limited and the prevalence of obesity is unknown	Use the patient quality register to evaluate multi-component programs like this platform	Two patients objected to being included in the childhood obesity treatment register and their results were added outside the register	Use school health service data to establish the prevalence of obesity in the population Evaluate treatments in the childhood obesity treatment register

BMI may be viewed in relation to the higher retention. The increase in BMI among participants who had a high frequency of visits, more than two times a month, may indicate that the platform attracted adolescents who perceived a need to stay in treatment despite not decreasing the BMI.

A better outcome on BMI was observed for study participants who were new to obesity treatment and those who met the designated pediatric study nurse eight times or more, and for those who attended 1–2 times per month. The overall impression was that, despite being active in an obesity treatment program, seven out of ten adolescents with obesity or severe obesity remained in their respective IOTF weight category, illustrating the chronicity of the disease.[13]

Weight stability may constitute an achievable goal for adolescents with obesity or severe obesity. To help the adolescent patient set reasonable expectations, reduce the risk of failure, and promote self-esteem without neglecting the risks of persistent obesity are the challenges for the health service provider.[13] Also, other treatments may become a possibility for adolescent patients. New anti-obesity drugs are promising, particularly when combined with lifestyle modification interventions.[10] Increasing evidence shows that obesity surgery is an emerging treatment option for young adults and adolescents. Notably, the level of obesity at the time of surgery will affect the outcome, with patients losing, on average, around 30% of their initial weight.[11,30] Therefore, weight management strategies and weight stability are essential also for those adolescents with severe obesity and complications who may opt for surgery in adolescence or early adulthood.

One advantage of the study was the capacity building and training of staff in adolescent medicine in this study that was likely to benefit also patients with other diagnoses. The study prompted collaborations with regional authorities and service providers outside the facility. The major limitation of this study was the lack of matched controls. The comparison data from the Swedish Childhood Obesity Treatment Register were from patients who were new in treatment and only a third had two measurements to enable a before and after comparison. A selection bias may have affected the register patients in both directions. However, patients new to treatment and patients staying in treatment could be assumed to perform better. The registered patients used for comparison were likely to be affected by a selection bias for better results. Notably, the number of visits for the registered patients could also be the consequence of different registration routines. Also, the use of medications for neuropsychiatric disease among participants was not investigated. Due to the design, the time of inclusion varied between participants. Physical activities outside the study were not registered.

This study indicates that the bonding with a health care provider was important and associated with a better outcome in BMI. The role of the professional support, here a designated study nurse, was the one of our topics of investigation. A skilled health professional can adapt and individualize the way she or he supports a patient. Also, the physical activity sessions were the most attractive, and our interpretation was that "doing things" for an adolescent patient may be more attractive than just talking about issues. These observations were in line with previous qualitative research in adolescents in obesity treatment,[16] but more research is needed.

Interestingly, a similar number of female and male participants were included in this study, but more male participants left the study. More male participants had neuropsychiatric diagnoses. The prevalence of neuropsychiatric problems is high among adolescents with obesity, despite patients not always having the diagnosis.[31] In our study, female participants were among the most frequent participants in physical activity sessions, and female participants came slightly more often to the nurse. Comprehensive data from the Swedish Childhood Obesity Treatment Register show that girls come for obesity treatment earlier than boys.[32] Although this study had a better gender balance than many studies on obesity, health care providers need to find ways to keep male patients with severe obesity in treatment.

Group activities have proved useful, for example, in the treatment of substance abuse. The experience from this work was that the participants appreciated the groups and that the attention and success of group activities varied. A high level of staff involvement was needed to get the groups going and for the participants to fit the group activities into their schedules. The impression was that the groups were hard to establish but working well once they were formed.

Using web-based applications as an add-on to treatment programs may be especially interesting for adolescent patients.[16,33] Unfortunately, the objective of introducing new technology could not be fulfilled. Recently, the Covid-19 pandemic has rapidly improved the use of modern web-based technology in health care.[34] The significance of a personal contact with a health professional for adolescent patients, as opposed to, for example, web-based interventions, needs to be further elucidated, but, so far, this has mostly been studied for younger children.[33,35-37]

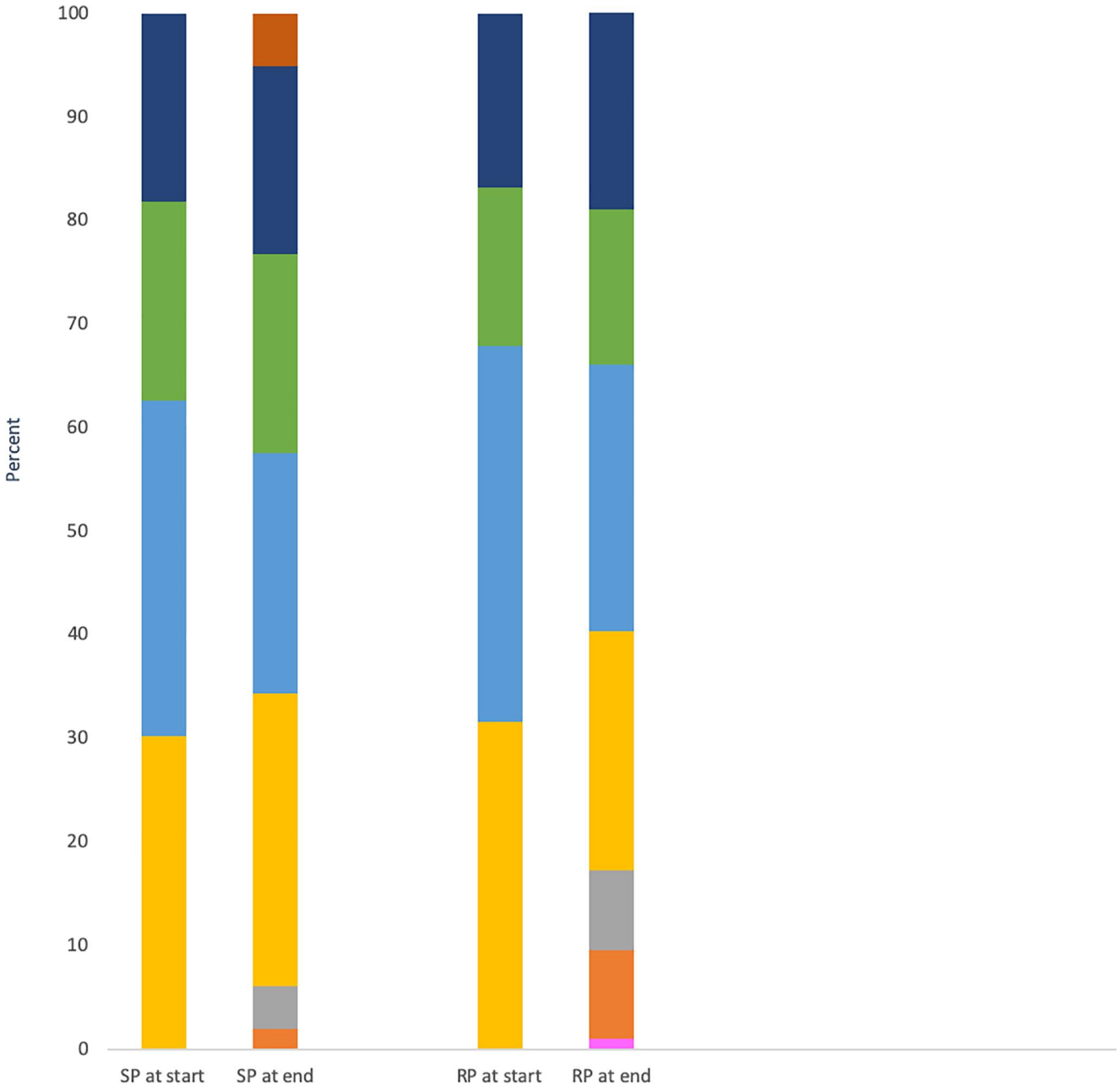

FIGURE 2 Distribution of International Obesity Task Force (IOTF) weight categories for female (yellow) and male (blue) adolescents with obesity, and female (green) and male (navy blue) adolescents with severe obesity. To the left, weight categories for 99 (49 female) study participants (SP) at start and end of participation in the Adolescent Obesity Treatment Platform. In total 71/99 (72%) patients remained in the same weight category, 13/99 (13%) participants decreased and 10/99 (10%) participants increased their weight category, and five (brown) were not measured at the end. Two female (orange) and four male (gray) participants ended in the overweight category. To the right, weight categories for 221 out of 641 (104 female) patients in standard care from the Swedish Childhood Obesity Treatment Register (RP) who had two measurements within the study period. The period between start and end varied between patients. In total, 158/221 (71%) patients remained in the same weight category, 47/221 (21%) decreased, and 16/221 (7%) increased the weight category. Of all, 36 patients ended in the overweight category. One female patient (pink) had a normal weight at the end

In this study, the participants' parents were not attracted by the activities offered, and most adolescents participated independently. Previous research has not shown an effect of parent involvement or been inconclusive.[6,16] More qualitative research is needed to clarify the role of parents and the interactions between parents and adolescents with obesity. This study indicated that treatment can be directed to the adolescent patient.

Due to the challenge of the increasing prevalence of obesity, treatment programs must be scalable, and collaborations with providers outside the health care facility may be a way forward. The

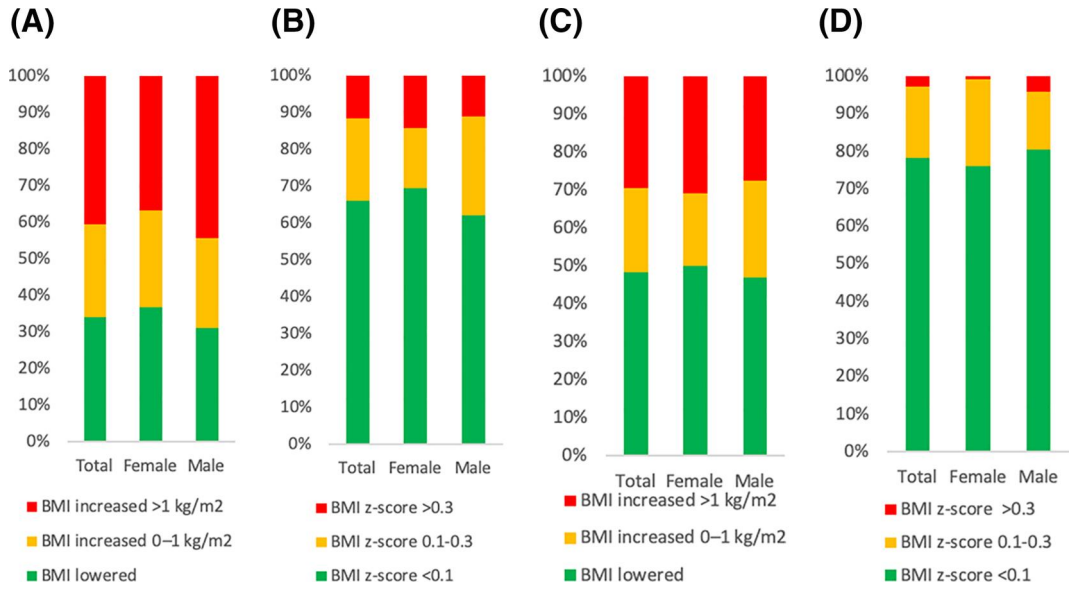

FIGURE 3 (A,B) Proportion of 94 study participants (49 female) that lowered their (A) body mass index (BMI) or (B) BMI *z*-score (green), kept BMI and BMI *z*-score within a narrow range (yellow), or increased in BMI or BMI *z*-score (red); (C,D) Proportion of 221 patients from the Swedish Childhood Obesity Treatment Register (104 female) that lowered their (C) BMI or (D) BMI *z*-score (green), kept BMI and BMI *z*-score within a narrow range (yellow), or increased in BMI or BMI *z*-score (red)

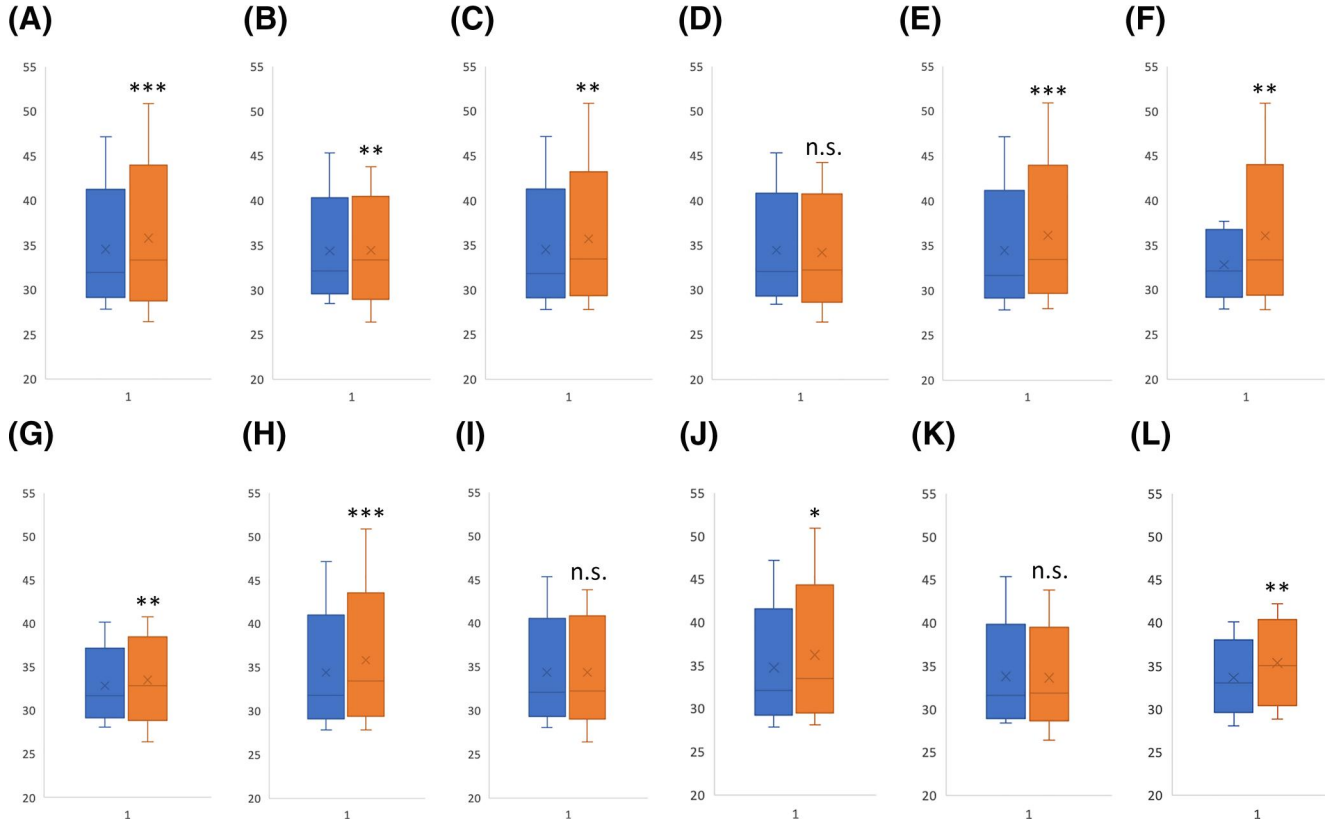

FIGURE 4 (A) Body mass index (BMI) at start (blue) and end (red) of treatment for all study participants ($n = 94$; 49 [52%]); (B,C) divided by sex (B female, C male); (D,E) divided whether the participant was a new (D not in previous treatment) or old patient (E had previous treatment); (F,G) divided by whether the participant attended fewer (F) or more than 10 visits (G) for physical training in the treatment period; (H,I) divided by whether the participant met the pediatric study nurse fewer than eight times (H) or eight times and more (I); and (J–L) divided by whether the patient came to visits in the program less than once an month (J), 1–2 times per month (K), or more often than twice a month (L). The time in treatment varied between participants

degree of support needed for a patient to develop a heathier lifestyle is variable, ranging from self-support to intense professional support. This variability makes flexibility desirable, and preferably, choices should be patient-driven.[13]

In conclusion, the new adolescent obesity treatment platform was feasible, kept more patients in treatment, and was well received among participants.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTIONS

Anna Bohlin, Annika Janson, Britt-Marie Johansson, Sven Klaesson, and Sofia Trygg-Lycke designed and conceptualized the study, wrote the study protocol and participated in the study steering committee with Fredrika Gauffin. Anna Bohlin, Britt-Marie Johansson, and Sofia Trygg-Lycke implemented the study in the clinic, collaborated with external providers, and recorded study data. Annika Janson wrote the ethical application, cleaned the data, and drafted the first and later manuscript versions. All authors contributed to the writing process and approved the final version.

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REFERENCES

1. Ng M, Fleming T, Robinson M, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014;384(9945):766-781.
2. Azzopardi PS, Hearps SJC, Francis KL, et al. Progress in adolescent health and wellbeing: tracking 12 headline indicators for 195 countries and territories, 1990–2016. *Lancet*. 2019;393(10176):1101-1118.
3. Meyer JF, Larsen SB, Blond K, Damsgaard CT, Bjerregaard LG, Baker JL. Associations between body mass index and height during childhood and adolescence and the risk of coronary heart disease in adulthood: a systematic review and meta-analysis. *Obes Rev*. Published online May 7, 2021. https://doi.org/10.1111/obr.13276
4. Lindberg L, Danielsson P, Persson M, Marcus C, Hagman E. Association of childhood obesity with risk of early all-cause and cause-specific mortality: a Swedish prospective cohort study. *PLoS Med*. 2020;17(3):e1003078.
5. Simmonds M, Llewellyn A, Owen CG, Woolacott N. Simple tests for the diagnosis of childhood obesity: a systematic review and meta-analysis. *Obes Rev*. 2016;17(12):1301-1315.
6. Al-Khudairy L, Loveman E, Colquitt JL, et al. Diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years. *Cochrane Database Syst Rev*. 2017;6:Cd012691.
7. Ells LJ, Rees K, Brown T, et al. Interventions for treating children and adolescents with overweight and obesity: an overview of Cochrane reviews. *Int J Obes*. 2018;42(11):1823-1833.
8. Danielsson P, Kowalski J, Ekblom O, Marcus C. Response of severely obese children and adolescents to behavioral treatment. *Arch Pediatr Adolesc Med*. 2012;166(12):1103-1108.
9. Kelly AS, Auerbach P, Barrientos-Perez M, et al. A randomized, controlled trial of liraglutide for adolescents with obesity. *N Engl J Med*. 2020;382(22):2117-2128.
10. Wilding JPH, Batterham RL, Calanna S, et al. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med*. 2021;384:NEJMoa2032183.
11. Olbers T, Beamish AJ, Gronowitz E, et al. Laparoscopic Roux-en-Y gastric bypass in adolescents with severe obesity (AMOS): a prospective, 5-year, Swedish nationwide study. *Lancet Diabetes Endocrinol*. 2017;5(3):174-183.
12. Janson A, Järvholm K, Gronowitz E, et al. A randomized controlled trial comparing intensive non-surgical treatment with bariatric surgery in adolescents aged 13-16 years (AMOS2): rationale, study design and patient recruitment. *Contemp Clin Trials Comm*. 2020;19:100592. https://doi.org/10.1016/j.conctc.2020.100592
13. Cardel MI, Atkinson MA, Taveras EM, Holm J-C, Kelly AS. Obesity treatment among adolescents: a review of current evidence and future directions. *JAMA Pediatr*. 2020;174(6):609.
14. Farre A, Wood V, Rapley T, Parr JR, Reape D, McDonagh JE. Developmentally appropriate healthcare for young people: a scoping study. *Arch Dis Child*. 2015;100(2):144-151.
15. Jelalian E, Hadley W, Sato A, et al. Adolescent weight control: an intervention targeting parent communication and modeling compared with minimal parental involvement. *J Pediatr Psychol*. 2015;40(2):203-213.
16. Jones HM, Al-Khudairy L, Melendez-Torres GJ, Oyebode O. Viewpoints of adolescents with overweight and obesity attending lifestyle obesity treatment interventions: a qualitative systematic review. *Obes Rev*. 2019;20(1):156-169.
17. Lachal J, Orri M, Speranza M, et al. Qualitative studies among obese children and adolescents: a systematic review of the literature:

qualitative studies among obese children and adolescents. *Obes Rev*. 2013;14(5):351-368.
18. Wigert H, Wikström E. Organizing person-centred care in paediatric diabetes: multidisciplinary teams, long-term relationships and adequate documentation. *BMC Res Notes*. 2014;7(1):72.
19. Ball GDC, Sebastianski M, Wijesundera J, et al. Strategies to reduce attrition in managing paediatric obesity: a systematic review. *Pediatr Obes*. 2020;16(4):e12733. https://doi.org/10.1111/ijpo.12733
20. Roadmap Overweight and Obesity 2016-2020, Stockholm [In Swedish: Handlingsprogram övervikt och fetma 2016-2020]. Stockholm Regional administration. Downloaded February 14, 2021. www.vardguiden.se
21. Bhuyan SS, Chandak A, Smith P, Carlton EL, Duncan K, Gentry D. Integration of public health and primary care: a systematic review of the current literature in primary care physician mediated childhood obesity interventions. *Obes Res Clin Pract*. 2015;9(6):539-552.
22. Seburg EM, Olson-Bullis BA, Bredeson DM, Hayes MG, Sherwood NE. A review of primary care-based childhood obesity prevention and treatment interventions. *Curr Obes Rep*. 2015;4(2):157-173.
23. Danielsson P, Bohlin A, Bendito A, Svensson A, Klaesson S. Five-year outpatient programme that provided children with continuous behavioural obesity treatment enjoyed high success rate. *Acta Paediatr*. 2016;105(10):1181-1190.
24. Swedish Association of Adolescent Medicine [In Swedish: Svensk förening för ungdomsmedicin]. Downloaded February 14, 2021. https://sffu.barnlakarforeningen.se
25. Benz C, Bull T, Mittelmark M, Vaandrager L. Culture in salutogenesis: the scholarship of Aaron Antonovsky. *Glob Health Promot*. 2014;21(4):16-23.
26. A-Tjak JGL, Davis ML, Morina N, Powers MB, Smits JAJ, Emmelkamp PMG. A meta-analysis of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems. *Psychother Psychosom*. 2015;84(1):30-36.
27. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes*. 2012;7(4):284-294.
28. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244):1240.
29. Berg Kelly, K. *Youth health [In Swedish: Ungdomars hälsa]*. 1st ed. Lund, Sweden: Studentlitteratur; 2014.
30. Inge TH, Courcoulas AP, Jenkins TM, et al. Five-year outcomes of gastric bypass in adolescents as compared with adults. *N Engl J Med*. 2019;380(22):2136-2145.
31. Björk A, Dahlgren J, Gronowitz E, et al. High prevalence of neurodevelopmental problems in adolescents eligible for bariatric surgery for severe obesity. *Acta Paediatr*. 2020;110:1534-1540. https://doi.org/10.1111/apa.15702
32. Hagman E, Danielsson P, Lindberg L, Marcus C, on behalf of the BORIS Steering Committee. Paediatric obesity treatment during 14 years in Sweden: lessons from the Swedish Childhood Obesity Treatment Register—BORIS. *Pediatr Obes*. 2020;15(7):e12626. https://doi.org/10.1111/ijpo.12626
33. Thorén A, Janson A, Englund E, Silfverdal S. Development, implementation and early results of a 12-week web-based intervention targeting 51 children age 5–13 years and their families. *Obes Sci Pract*. 2020;6(5):516-523.
34. Keesara S, Jonas A, Schulman K. Covid'19 and health care's digital revolution. *N Engl J Med*. 2020;382(23):e82.
35. Thorén A, Janson A, Persson M. Now she prefers jeans, like everyone else" - parents´ experiences of group- and web-based treatment of children´s obesity. *Acta Paediatr*. 2021;110:1869-1879. https://doi.org/10.1111/apa.15798
36. Tripicchio GL, Ammerman AS, Neshteruk C, et al. Technology components as adjuncts to family-based pediatric obesity treatment in low-income minority youth. *Child Obes*. 2017;13(6):433-442.
37. Johansson L, Hagman E, Danielsson P. A novel interactive mobile health support system for pediatric obesity treatment: a randomized controlled feasibility trial. *BMC Pediatr*. 2020;20(1):447.

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