Clinical Approach

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Obese and Overweight Children and Adolescents: An Algorithmic Clinical Approach

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Abstract

Obesity in children and adolescents is a hot issue throughout the world. Numerous complications are related to childhood obesity, such as cardiovascular disease, diabetes, insulin resistance and psychological problems. Therefore, identification and treatment of this problem have an important role in the health system. In this clinical approach, we have provided a general overview of the assessment and management of obesity in children and adolescents, including definitions, history-taking, physical examinations, and laboratory testing for general practitioners and pediatricians. Furthermore, conventional therapies (physical activity, eating habits and behavioral modification) and non-conventional treatments (drugs and surgery options) have been discussed.

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Introduction

Over the past three decades, the prevalence of obesity among children and adolescents in most developed countries, and more recently in developing countries, has significantly increased[1-2]. In 2010, World Health Organization (WHO) estimated that 43 million preschool-aged children (that is 35 million in the developing world) were overweight or obese, and the worldwide prevalence has risen from 4.2% (95% CI 3.2–5.2%) in 1990 to 6.7% (95% CI 5.6–7.7%) in 2010[3]. In a 2010 systematic review, it has been shown that the prevalence of overweight and obesity in children and adolescents in Western Europe, the USA, Japan and Australia reached a plateau, although many developing countries are still encountered with a rising prevalence rate[4]. Based on an Iranian national survey in 2007, the prevalence of overweight and obesity in school age children was 10.1% and 4.79% respectively, according to the national cut-offs[5]. In another study in 2011, the prevalence of overweight and obesity among Iranian school children was 9.27% and 3.22% respectively[6]. Mirhosseini et al in 2012, reported prevalence of overweight and obesity in adolescent Iranian girls, 14.6% and 3.4% respectively[7].

Not only is obesity the most common cause of insulin resistance in children, but also it is related to dyslipidemia, type 2 diabetes, and long-term vascular complications[8]. In one study about cardiovascular risk factors and body fat distribution in Iranian girls, adiposity, particularly truncal adiposity, was related to metabolic

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problems such as blood pressure and triglyceride abnormalities and consequently cardiovascular problems[7]. As we know during recent years, the prevalence of these chronic diseases has increased among children[9]. On the other hand, the risk of morbidity from coronary artery disease and arthritis in adulthood is higher in overweight adolescents, even if they have normal weight as adults[10]. In addition, childhood obesity increases the same risk in adulthood[11] and as obese parents would reproduce overweight offspring, these children will become parents to overweight children consecutively[12]. These long-term serious consequences of overweight and obesity along with short-term psychosocial problems, such as eating disorders, emphasize the real need to develop effective prevention and treatment strategies. This review presents an algorithmic approach to assessment and treatment of overweight and obese children and adolescents.

Definition of overweight and obese children

Based on definitions, obesity means having a body mass index (BMI) at or above the 95th percentile and a BMI at the 85th to 94th percentile for gender and age is considered as overweight. It has been suggested to use the 99th BMI percentile as the cut-off point for severe obesity[13].

In comparison with international reference data, using national BMI reference data to categorize children's BMI provides a safe, practical, and evidence-based approach[14]. In 1999, Hosseini et al presented BMI percentile curves for Iranian children and compared them with those of the US national reference. This study revealed that the US reference data were not appropriate for nutritional assessment of Iranian children[15]. Furthermore, in another study in 2011, the BMI percentile curves of 25 to 60-month Iranian boys and girls were estimated and the

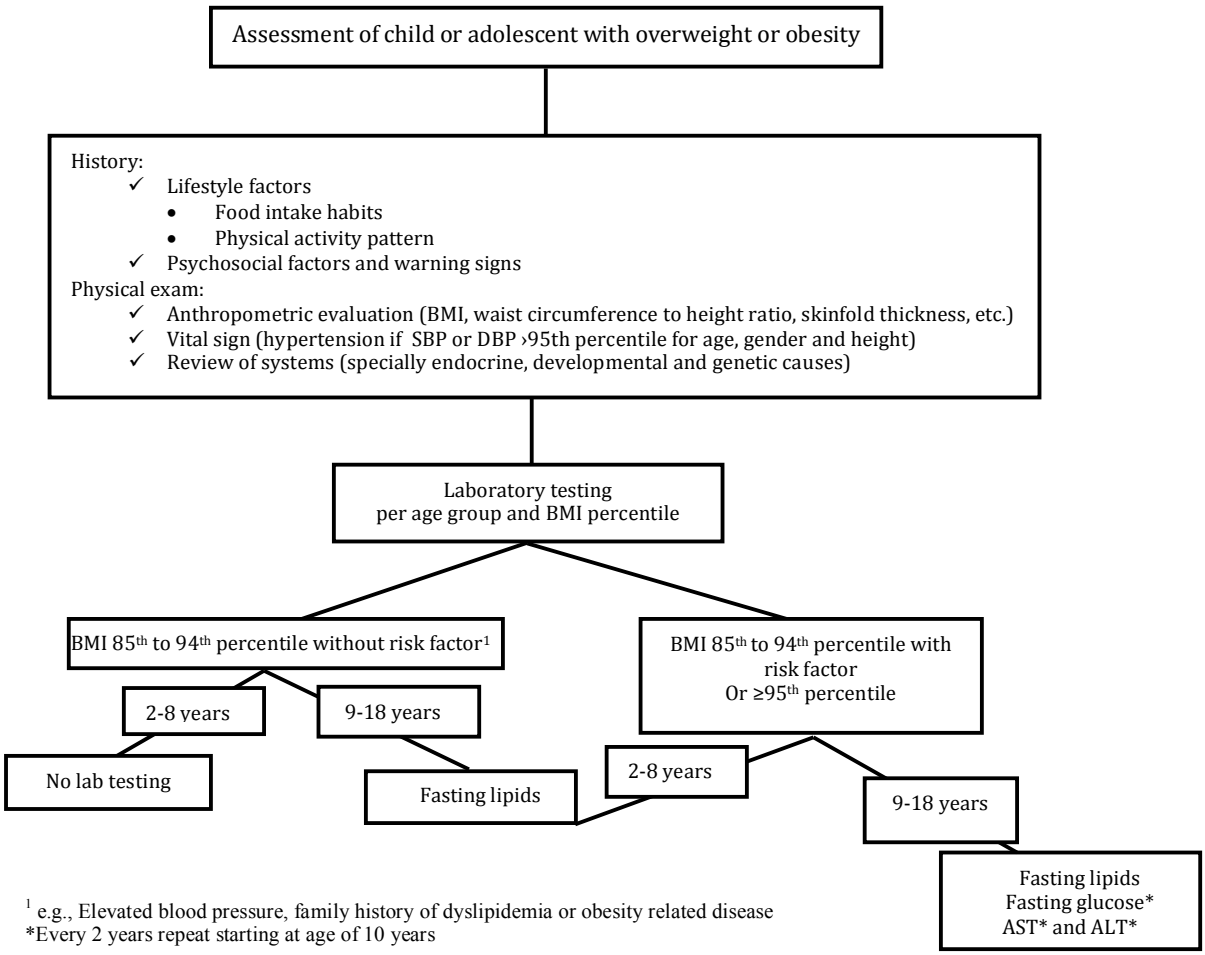

Fig. 1: Algorithmic approach to assessment of child or adolescent obesity

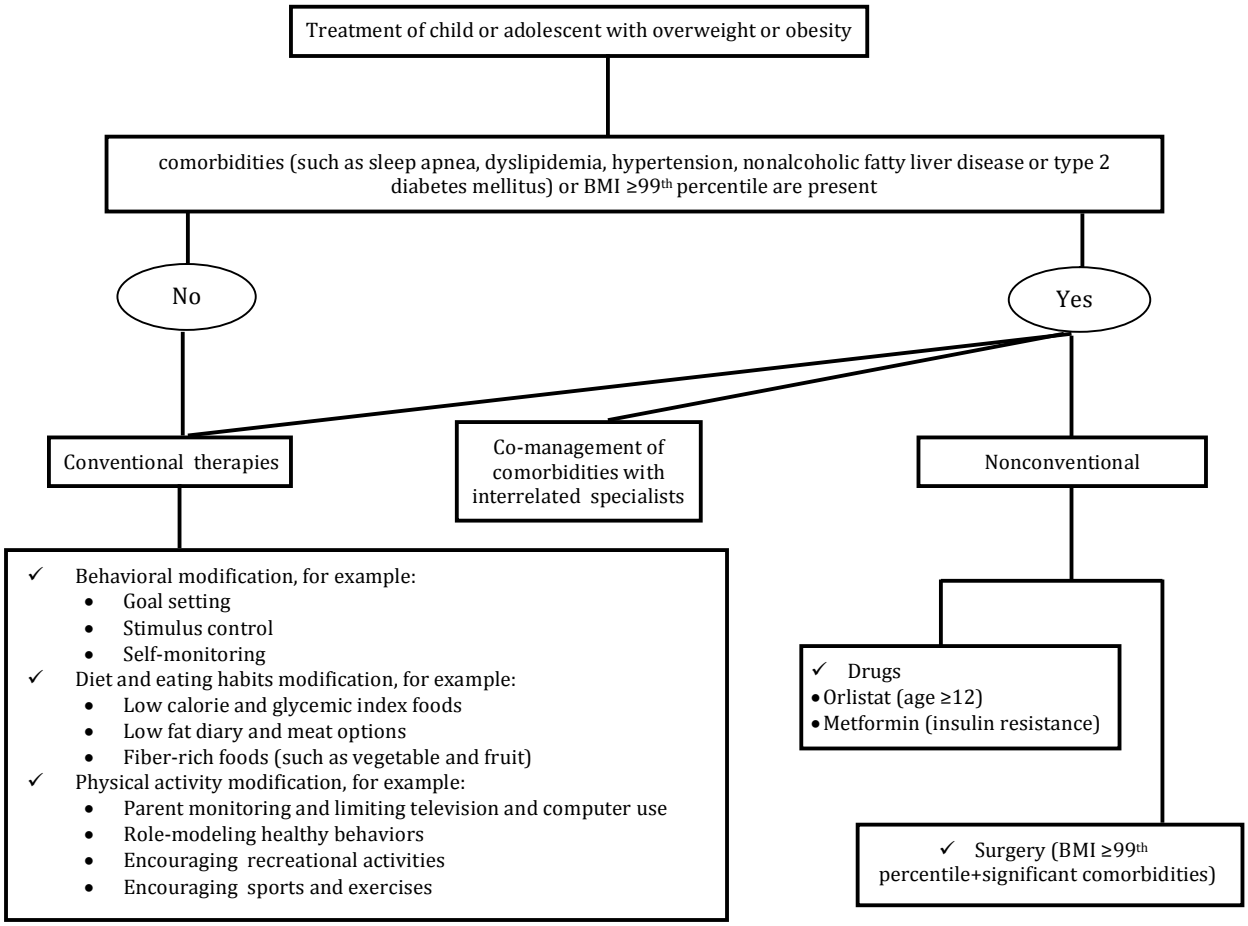

Fig. 2: Algorithmic approach to treatment of child or adolescent obesity

authors concluded that the prepared charts were different from the global reference charts[16].

Clinical Assessment

The algorithmic clinical approach to obese and overweight children is summarized in Fig 1 and 2, and described as follows.

History

Taking a clinical history is crucial to the assessment of a child's or adolescent's health status. Evaluating lifestyle factors need to include both sides of the energy balance equation. On one-side stands food intake history that should involve evaluation of one's eating pattern (for example, having breakfast regularly, attending family meal-time routines, and snacking habits). On the other side, there is the assessing of physical activity including both organized sports and daily activities such as walking to school, helping with chores, and playing[17]. In addition, it is deemed significant to find out the time spent watching television and using computers as it is regarded as an independent risk factor for childhood obesity[18].

A careful psychosocial history-taking and assessment is essential as psychological disturbances including depression, body dissatisfaction, loss-of-control eating, unhealthy and extreme weight control behaviors, impaired social relationships, and decreased health-related quality of life are among the more common obesity-associated complications[2,19-20]. Some warning signs that should raise suspicions of eating disorders such as bulimia nervosa and binge-eating disorder include eating large amounts of food, excessive concern about weight, bathroom visits after meals (which may raise concerns over compensatory behavior such as self-induced vomiting), strict dieting followed by

eating binges, and increased criticism of one's body[21].

Physical Examination

A thorough physical examination with special focus on findings suggestive of *endocrine*, *developmental* or *genetic causes* is essential for any child presented with obesity[22]. Important signs that must be highlighted in physical examination are mentioned below[13,23]. Vital signs must be assessed (e.g. hypertension is diagnosed if systolic or diastolic blood pressure falls over 95th percentile for age, gender and height in at least 3 occasions)[13]. In addition, endocrine problems must be considered carefully with greater focus on signs of hypothyroidism (goiter), insulin resistance (acanthosis nigricans), polycystic ovary syndrom (hirsutism, excessive acne), and Cushing syndrom (violaceous striae, moon face)[13,23]. Further, reproductive system and tanner stage disturbance, for example premature puberty (age <7 years in white girls, age <6 years in black girls, and age <9 years in boys), apparent micropenis (but normal penis may be hidden in fat), undescended testis/micropenis (Prader Willi syndrome), etc must be evaluated[13,23]. If headache is present, optic discs needs to be examined for optic edema due to pseudo tumor cerebri[23]. Other signs and symptoms, including respiratory problems (asthma, sleep apnea), hepatomegaly or abdominal pain (gastroesophagial reflux, nonalcoholic fatty liver), musculoskeletal problems (slipped capital femoral epiphysis, Blount disease), and psychological disorders (depression, bulimia nervosa) must be taken into account too[13,23], although in more than 95% of cases, the cause of obesity is idiopathic[22].

Anthropometric measurement is an important part of the first visit and it should be repeated in follow-up visits to evaluate the effectiveness of the treatment. BMI (weight/height^2) has been recommended by many experts as the preferred index for routine clinical measurement of overweight and obesity in children and adolescents over 2 years of age[13,24-27]. It correlates closely with total body adiposity[28] and is a fairly specific index for defining overweight and obesity[28-29]. Nationally recommended BMI-for-age charts, such as those presented by Hosseini et al for Iranian children, should be used to determine the appropriate BMI[15,30].

In a recent study, some anthropometric measurements such as weight-for-height (WH), body mass index-for-age (BMI) and mid-upper arm circumference-for-age (MUAC) were compared in Iranian schoolchildren and adolescents[31]. The results showed that WH and BMI could be used for obesity detection in different pubertal stages. In addition, in pre-pubertal stage, MUAC could be used instead of BMI for obesity classification[31].

Other indexes, for example CDC growth charts for 2 to 18-year-old children and adolescents and WHO growth curves for those younger than 2 years should be used for children obesity evaluation[13]. Other measurement devices such as bioelectrical bio impedance analysis could be used for detection of obesity instead of BMI[32].

There is also an association between central fat distribution and increased cardiometabolic risk in children as in adults[7,33]. Central adiposity can be recognized using waist circumference to height ratio. A ratio of more than 0.5 is associated with cardiovascular and metabolic risk in normal and overweight or obese school-aged children[34-35]. However, waist circumference measurements alone are not recommended for clinical use in children because reference values are not available for children[13,36].

Skinfold thickness measurements can present information about body fat if performed by an experienced person using body points and formulas validated for children. However, they are not recommended as a routine part of screening or management of obesity in children and adolescents, because they are hard to perform[13,37]. Although in the US reference data for subscapular and triceps skinfold thickness of children and adolescents are available[38], in Iran only triceps skinfold thickness chart of an urban sample of 6 to 11-year-old children has been presented[39].

It seems that a single anthropometric measurement index may not produce accurate classification in obese and overweight children, we should use multiple indexes for this purpose[31].

Laboratory Testing

Routine laboratory tests, which depend on BMI and other risk factors, are recommended to assess

obesity in children (at age 2 and above)[23,40]. Based on the 2007 US Expert Committee's recommendation, overweight children (BMI 85–94th percentile) need to have a fasting lipid-screening test and, if risk factors coexist, measurement of serum levels of fasting glucose, alanine aminotransferase (ALT), and aspartate aminotransferase (AST) is necessary every 2 years (high levels of ALT and AST indicate the possibility of non-alcoholic fatty liver disease)[13]. Risk factors include increased blood pressure or hypertension, dyslipidemia and family history of diabetes[23,40]. The recommendation for those who are obese (BMI ≥95th percentile) consists of measuring serum levels of fasting lipids, glucose, ALT, and AST every 2 years, regardless of risk factors[13]. However, institute for clinical systems improvement (ISCI) guideline in 2013, based on Krebs et al study, reported that children 2 to 6 years of age without risk factors do not need laboratory tests. Fig 1 shows the ISCI approach[36,41].

As mentioned before, measurement of serum levels of fasting glucose is necessary for overweight and obese children because impaired glucose tolerance and diabetes are also relevant to pediatric obesity[42]. If the result of fasting glucose screen test is more than 126 mg/dL, counseling and repeating test is necessary[23]. In addition, pediatric obesity can lead to impaired glucose tolerance[42]. The study suggests that an $HbA1_c$ value of 40 mmol/mol (5.8%) is an appropriate screening tool for diagnosing impaired glucose tolerance[42].

The undesirable lipid profile is common among obese children[43]. If total cholesterol level is on the borderline (170-200 mg/dl), the screen test should be repeated after one year and if it is elevated (≥200 mg/dl), cardiac referral may be needed[23].

Some expert committees recommend measurement of blood urea nitrogen and creatinine levels for those who are obese (BMI ≥95th percentile) in order to detect renal dysfunction[40].

Some endocrine abnormalities are associated with pediatric obesity[44]. For example, hypothyroidism and polycystic ovarian syndrome are some endocrine diseases reported to be associated with obesity[40]. Although the mechanism of thyroid hormonal changes is not yet known, it seems that children's obesity is associated with increasing TSH concentrations[45]. However, routine screening for thyroid hormones are not seen in assessment recommendations for obese or overweight children.

Some other investigations, including high-sensitivity tests for C-reactive protein and other markers of low-grade inflammation, could be valuable in evaluating childhood obesity, but they are not still recommended by national clinical practice guidelines as routine measures[46].

Results of recent studies suggest that obesity can be one of the risk factors for vitamin D deficiency[47] and the increasing risk for type 2 diabetes in obese children is associated with 25-OH-vitamin D serum level[48].

Treatment

In general, recommended weight loss for 2 to 5 year-old children is 1 pound per month and average weight loss in 6-18 year-olds is 2 pounds per week[41].

On comparing the existing treatments, a systematic review on the treatment of pediatric obesity in 2008 concluded that drugs (sibutramin and orlistat) had a short-term effect on BMI, physical activity had a moderate treatment effect on adiposity but not on BMI, and a combination of lifestyle modifications had small to moderate treatment efficacy on BMI[49].

However, a Cochrane Review on the treatment of pediatric obesity in 2009, which evaluated 64 randomized controlled trials (RCTs), recommended no specific treatment program over another[50]. Another systematic review in 2012 suggested that lifestyle modification including diet plus exercise and/or behavioral intervention was an effective treatment for childhood obesity and also could improve cardio-metabolic outcomes at least up to one year. It concluded that more research was required to obtain "the optimal length, intensity, and long-term effectiveness of lifestyle modification"[51]. Bariatric surgery leads to long-term and clinically significant outcomes in obese children[52].

It is of paramount importance to manage effectively obesity-associated comorbidities such as sleep apnea, dyslipidemia, hypertension, nonalcoholic fatty liver disease or type 2 diabetes mellitus. Ideally, patients should be co-managed in

an organized manner by interrelated specialists. Effective weight reduction is one of the key elements in the prevention and treatment of co-morbidities[17]. In the following, we describe and discuss important factors involved in the treatment of obese and overweight children including accepted conventional and nonconventional therapies.

Conventional Therapies

In order to plan a developmentally appropriate approach, it is essential to consider the developmental age of the patient, and the resultant level of parental engagement that will be required. Usually, the approaches used for preadolescent children and adolescents are not the same[17]. In preadolescent children, a parent-based program, without direct engagement of the child, might be more appropriate than a child-centered approach[53-54]. Based on these studies, involvement of parents in therapy sessions with or without presence of the child could be the most effective method in treating preadolescent children with obesity. Evidence for the treatment of adolescent obesity is more limited than that for younger children. Most studies have suggested separate sessions for adolescents and their parents.

Behavioral Modification

Behavioral and emotional problems in overweight and obese Iranian girls are greater than in normal-weight girls[55]. On the other hand, behavioral modification strategy has a large effect on decreasing BMI[56]. The set of techniques employed to change thought processes and actions associated with eating, physical activity, and sedentary behaviors are said to be the components of behavioral modification[57]. In the 2009 Cochrane review, goal setting, stimulus control, and self-monitoring are the three key behavior modification techniques, which were used in most of the studies[50].

Performance goals, such as changing behaviors related to eating or activity, or outcome goals, like specific weight loss, can be included in goal setting. As an example, a well-specified goal for a parent would be: "I will not buy any cookies, chocolates or other high-fat foods during the weekly shopping. In order to make this easier, I will leave the children at home and shop on my own. If the children ask for junk food, then I will offer yoghurt or fruit instead." Considerable session time is required to set and review strategies for behavior change with families and young people[58].

Diet and Eating Habits Modification

Specific dietary interventions to treat childhood or adolescent obesity were assessed in a 2006 systematic review of RCTs of pediatric obesity[59]. In spite of the fact that lack of high-quality studies and the heterogeneous characteristics of the studies identified meant that direct conclusions could not be drawn, interventions including a dietary component were efficient in attaining relative weight loss[17].

Dietary interventions should pursue national nutrition guidelines which have an emphasis on regular meals, eating together as a family, choosing nutrient-rich foods that are lower in energy and glycemic index, low-fat diary, increased intake of fiber-rich foods such as vegetable and fruit, healthier snack food options, decreased portion sizes, promotion of water as the main beverage, and a reduction in sugary drink intake[13,17,25]. It is important to involve the whole family in making the changes into a healthy lifestyle[17].

Physical Activity Modification

Low cardio-respiratory and physical fitness has been seen in overweight and obese children[60,61]. On the other hand, sedentary lifestyle is related to increasing BMI[60]. Greater reductions in percentage overweight was observed in obese children who participated in a lifestyle program (walking, running, cycling or swimming, based on the family's preference) at 6 months and 17 months when compared with a program of isocaloric programmed aerobic exercise[62].

A similar study, but including a third control group involved in calisthenics and with follow-up for 10 years, demonstrated that the programs geared to lifestyle and aerobic exercise were superior considering percentage overweight reduction to the calisthenics control group[63].

A systematic review and meta-analysis of

exercise interventions in 2006 among overweight children and adolescents pointed out that 155–180 minutes of supervised moderate-to-high intensity physical activity per week (with or without a concomitant dietary intervention) was helpful in decreasing body fat (standardized mean difference was –0.4% (range –0.7 to –0.1), although the effects on body weight and abdominal adiposity were inconclusive[64]. In ISCI guideline in 2013, at least 60 min of physical activity per day was recommended for children aged 6 years and older[41]. In younger children, free play activities were stressed[41].

Parents' involvement is essential to raise the level of physical activity or decrease sedentary behaviors, including monitoring and limiting television use, role-modeling healthy behaviors, and encouraging recreational activities[65].

Nonconventional Therapies

The evidence of other forms of treatment, such as very-low-energy diets (VLEDs), pharmacological therapy or bariatric surgery, in severe obesity in the pediatric subject is more limited than that of behavioral interventions. Generally, such therapies should be applied along with a program of behavioral weight management and be constrained to specialist centers with expertise in managing severe obesity[17].

Very Low Energy Diets (VLEDs)

VLEDs dietary planning provides nutritional requirements together with <800 calories per day. To date, there are no RCTs that have examined the effectiveness of a weight-management program integrating initial VLED management in obese adolescents. The US Expert Committee recommended using VLEDs with severely obese patients managed by a multidisciplinary team in a tertiary care setting[26]; however, these diets are not appropriate for use in young children[13].

Drugs

As previously mentioned, behavioral treatment, diet modification, and physical activity are recommended by the Expert Committee as principles to prevent or treat childhood obesity[49], since such lifestyle modification interventions cannot produce significant success in body weight reduction among severely obese children[50]. Hence, there is noticeable interest in incorporating these modifications to drastic strategies such as pharmacotherapy[66].

Some studies suggest that combining weight-loss medications with lifestyle interventions leads to major weight reduction among children[67]. Yet obesity pharmacotherapy is recommended to those children who represent insulin resistance, obstructive sleep apnea, hypertension, dyslipidemia, and other obesity-related comorbidity[13,68], although at present time FDA-approved Orlistat is the only weight-loss medication that can be used in children aged 12-16 years[69].

Orlistat: Orlistat is prescribed for people aged ≥12 years[17]. A meta-analysis of two of the RCTs, evaluating 579 subjects, showed that Orlistat had an additional effect on BMI over placebo of –0.76 kg/m^2 (95% CI –1.07 to –0.44; P<0.00001)[50]. The most commonly reported adverse effects in the studies were gastrointestinal problems, such as fatty or oily stools, increased stool frequency, oily spotting, cramps, and abdominal pain[50,70]. However, the presence of these adverse effects along with lifestyle intervention can contribute to changes in dietary habits (that is, to a reduced-fat diet)[17].

Metformin: Through the past 5 years, studies have taken into account the use of Metformin versus placebo in obese adolescents with no diabetic hyperinsulinemia and with at least medium-term (6 months) improvement in body composition and metabolic parameters[71,72]. In another trial, 100 severely obese insulin-resistant children (6–12 years) were selected randomly to receive Metformin or placebo for 6 months and showed more decrease in BMI (–1.09 kg/m^2; 95% CI –1.87 to –0.31), plasma glucose level and homeostasis model assessment insulin resistance index in the treated group than the placebo group[73]. The most commonly reported adverse effects in these different studies were gastrointestinal symptoms[73].

New drugs:

Lorcaserin (Belviq): Lorcaserin is a selective 5-HT_{2C} (5-hydroxytryptamine) receptor agonist, which decreases energy intake by influencing

central nervous system and inhibiting feeding behavior[74]. Lorcaserin was approved by FDA in June 2012 as a drug for long-term weight management[69], despite the fact that consuming lorcaserin leads to major weight loss among obese adults and ameliorate maintenance of weight loss but no pediatric trials have been reported[69,75].

Qsymia: FDA, as another drug for long-term weight management, approves Qsymia (the trade name for the drug). It was approved in July 2012 for weight management in adults[69]. Qsymia is produced by combining Phentermine and Topiramate[69]. Phentermine is an appetite suppressant, which increases adrenergic tone, and Topiramate is a GABAergic anticonvulsant and clinical trials suggest that it can produce substantial weight loss[69,76].

Guidelines on pharmacological therapy: The present national guidelines or expert advice on overweight and obesity management in children and adolescents give only some clues on pharmacological therapy. Generally, in severely obese adolescents, drug therapy (mostly Orlistat), along with continued dietary and activity counseling, is suggested by a multidisciplinary care team[13,25,69].

Surgery

Increased health risks associated with severe obesity necessitates more aggressively therapeutic methods including surgery[77]. Some evidence is in favor of safety and effectiveness of obesity surgery in adolescents[78]. The Roux-en-Y gastric bypass, the sleeve gastrectomy, and the adjustable gastric band are three surgical approaches currently used for adolescents with severe obesity[22]. Many bariatric surgeons prefer gastric surgery due to the available long-term data and relative low rate of complications in adolescents[79]. Due to lack of post-surgery complications, the sleeve gastrectomy has become an attractive option[79]. A meta-analysis indicated that both laparoscopic adjustable gastric banding and Roux-en-Y gastric bypass caused sustained and clinically significant BMI reduction. Both these procedures had some possible complications, although more severe ones were reported following Roux-en-Y gastric bypass[52]. In 2011, FDA disapproved the adjustable gastric band method because of its unclear long-term outcomes and high reoperation rate[22].

Bariatric surgery should only be saved for severely obese adolescents (BMI at or above the 99th percentile) suffering from significant co-morbidities (e.g. type 2 diabetes mellitus, dyslipidemia, fatty liver, hypertension) who are emotionally mature. Before the surgery, the patient's compliance should be taken into account. A long-term follow-up program is necessary during adolescence, which later should convert into an adult program with supervision of an adult bariatric surgeon [22].

Conclusion

Childhood and adolescent obesity is a major health problem. Treatment largely focuses on sustained lifestyle changes with family involvement. Behavior therapy, healthy diet, and increasing physical activity are the great sections of obesity treatment.

Conflict of Interest: None

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