Childhood Obesity

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Obesity is a chronic recurrent disease related to excessive fat tissue accumulation that presents a risk to health. The diagnosis of overweight, obesity, and severe obesity is usually based on the measurement of high and weight, calculation of weight-to-length ratio in children below the age of 5 years and body mass index (BMI) in older children.

obesity

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join statement

1. Introduction

Pediatric obesity is not a single nation problem, but it is one of the most important problems of public health ^{[1][2]}. Although healthy eating patterns and regular physical activity (PA) help people achieve and maintain a healthy weight starting at an early age and continuing throughout life, every nation has unique cultural, economical, and health-care system conditions that make difficult to implement some detailed universal guidelines. Therefore, there is a need to publish local guidelines that will be in concordance with international, universal recommendations. This is the first position statement of the Polish Society of Pediatrics, Polish Society for Pediatric Obesity, Polish Society of Pediatric Endocrinology and Diabetes, and Polish Association for the Study on Obesity. The Expert Panel's goal was to develop comprehensive evidence-based guidelines addressing to prevention, diagnosis and treatment of obesity and its complications in children and adolescents.

2. Obesity—Definition

Obesity is a chronic recurrent disease related to excessive fat tissue accumulation that presents a risk to health. The diagnosis of overweight, obesity, and severe obesity is usually based on the measurement of high and weight, calculation of weight-to-length ratio in children below the age of 5 years and body mass index (BMI) in older children ^{[3][4][5]}. Indexes are assessed using child growth standards for age and sex. The advantages of these indexes are simplicity, low cost, universality of measurement, and assessment. However, it should be noted that they are not perfect in assessing the amount and distribution of fat tissue accumulation causing the development of obesity complications. In addition, they should be used with caution in a particular situation, for example, in athletes with high muscle mass or children with significant posture defects (scoliosis) related to the decrease of height measurement.

3. Diagnostic Tools and Data Interpretation

According to the World Health Organization (WHO), in children under the age of 5 years, overweight should be diagnosed if the weight-to-length ratio is greater than 2SD above the median of the child growth standard and obesity when this ratio is greater than 3SD above the median ^{[3][5]}. In children aged 3–18 years, Polish BMI percentile charts should be used, where overweight is defined as BMI above the 85th percentile (>1SD) and obesity above the 97th percentile (>2SD) ^[6]. WHO standards for children aged 5–19 years can be also used, with the overweight and obesity definition in accordance with Polish charts ^{[7][8]}. It is also possible to use older BMI percentiles charts for Polish children, published in 1999 by Palczewska and Niedzwiecka ^[9], where overweight is defined as BMI above the 90th percentile and obesity above the 97th percentile. However, using them, researchers risk underestimation of the prevalence of overweight compared to WHO charts.

Due to the high risk of metabolic and cardiovascular complications development, severe obesity should be specified. There are few definitions of severe obesity in children. Researchers propose to use ONE, where severe obesity is diagnosed in children older than 5 years if BMI exceeds 3SD (99.9th centile) ^[5].

The accumulation of visceral fat tissue, which is an index of abdominal obesity related to a metabolic complication that can be used in children, is waist circumference ^[8]. It is measured at the level of the midpoint between the lowest rib and the iliac crest. For Polish children, centile charts for waist circumference for age and sex were developed within the OLA/OLAF project ^[10]. Up to the age of 16 years, waist circumference exceeding 90 percentile for age and sex defines abdominal obesity and is associated with increased cardiometabolic risk. In older adolescents, adult cut-off point values for abdominal obesity should be used (94 cm for men and 80 cm for females).

4. Treatment of Obesity

4.1. Weight Goal Reduction

Weight loss goals are determined by the age of the child and the severity of obesity and related comorbidities.

It has been suggested that in younger children with obesity the goal of treatment should be the stabilization of the body weight with successive BMI reduction. Maintenance of a stable weight for more than 1 year might be an appropriate goal for those children with overweight and mild obesity, because BMI will decrease as children gain height. In older children, weight loss is recommended to obtain the 85th percentile BMI. A weight loss of up to 1–2 kg/month is safe. Rapid weight loss is not recommended because of possible adverse effects on growth ^[11]. Bioelectrical impedance (BIA) is a useful method to assess the change in body composition in children ^{[12][13]}.

4.2. Effectiveness of Nutritional Interventions

A stepwise approach to weight control in children is recommended, taking into account the child's age, the severity of obesity, and the presence of obesity-related comorbidities ^{[14][15]}. Treatment of childhood obesity involves

adherence to a structured weight reduction program individualized for each child, along with the adoption of a healthy diet and lifestyle. Anti-obesity medications play a limited role in childhood and are not recommended in younger children. Bariatric surgery is reserved for morbidly obese older adolescents, but its long-term safety data are limited in this age group ^[16]. The combination of increased PA and improved nutrition has shown promise as an intervention to combat obesity in children and adolescents ^[17].

4.3. Eating Behaviors and Lifestyle Modifications

Obesity prevention and treatment should be a focus on diet, eating behaviors, and PA, and the reduction of body fat mass should be the summary effect of all this change.

Efforts should be made to permanently change the lifestyle of the whole family ^{[18][19]}. Nutritional behaviors such as avoiding breakfast, irregular eating, snacking between meals, insufficient eating vegetables, and fruits are proven predictors of obesity development as well as sedentary lifestyle ^{[20][21][22][23]}. Special attention should be paid to them in patient education. The diet and other lifestyle modifications recommended for the treatment of obesity are summarized in **Table 1**.

Interventions	
Interventions in eating behaviors	• Eating five structured meals per day (three main and two complementary) without snacking/eating meals
	• Every meal should contain protein, carbohydrates, and healthy fats
	• Eating at regular times every 3–4 h
	Avoid skipping breakfast and meals at school.
	 Eating fruits (2–3 portions a day), vegetables (at least 3 portions a day, green vegetables in plenty)
	• Eating dairy products (not sweetened) minimum 2–3 portions a day
	 Avoid consuming high-energy and low nutrient density foods (e.g., sweetened or energizing drinks, fast-food, high-energy snacks, e.g., chips, sticks, additives such as sauces, mayonnaise)
	Encouraging more water intake instead of sweetened beverages
	 Encouraging the reading of food labels, especially regarding added sugars

 Table 1. Dietary and other lifestyle modifications.

Interventions	
	Encouraging the family to eat meals together as much as possible
	Limiting eating out, especially in fast-food restaurants
	Adjusting portion sizes appropriately for age
	Avoiding watching television, tablets, and smartphones while eating
Physical activity	• Daily at least 60 min of moderate to vigorous aerobic PA vigorous intensity
	 Limitation of screen time outside of school to 1–2 h daily
	• Engaging in fun and age-specific exercise that is appropriate for the individual's abilities
Behavioral interventions	 Identifying disorders such as depression, eating disorders, body image problems, and anxiety

4.4. WELHOUS OF ITEALINETIC BY DIELALY WOULDCALION

Dietary modifications are essential in the treatment of obesity, but there is a lack of one validated dietary strategy for weight loss in children. Various dietary modifications are used in scientific research for weight loss in children with obesity. As shown by these studies, diets with modified carbohydrate intake, such as low glycemic index and low carbohydrate diets, have been as effective as diets with standard macronutrients proportional to portion size control ^{[24][25]}.

A well-balanced hypocaloric diet should be initiated among all obese children in consultation with a dietician ^[26]. The total daily energy of the diet should be calculated related to the ideal body weight for the height of the child and macronutrients proportion should fulfill the National Recommended Nutrient Intake Levels for Healthy Children (**Table 2**) ^[14]. The appropriate caloric restriction should be determined by a dietitian. The daily caloric value of the diet established to the ideal body weight for the height of the child may be reduced by 200–500 kcal. However, it should be noted that little to no evidence supports these specific recommendations. Rather, they represent an expert opinion. The reduced caloric intake should not be lower than 1000 kcal/day. For children with metabolic complications of obesity, especially insulin resistance and/or diabetes, more macronutrient modifications are needed.

Table 2. Share of macronutrients in meal plan.

	Nutrient Intake	
Obesity	Severe Obesity and/or Metabolic Complications	
Carbohydrate *	45–65% kcal/day	45–50% kcal/day
Simple sugars *	<10% of total daily energy intake (unless the sugars are contained in fresh fruits and vegetables)	
Proteins	No less than 1 g/kg of actual body weight/day	
Fat *	20–35% of the diet (35–40% in toddlers)	20–30% of the diet (not less than 30% in toddlers)
Fibre	age (year) + 5–10 g/day	

* % of daily energy intake.

4.5. Dietary Advice

In dietary treatment, decisions about the range of dietary restrictions must be made depending on the degree of excess weight and existing complications. Lifestyle recommendations listed in **Table 1** are the basis of any intervention. Caution should be exercised regarding micronutrient and vitamin intake, particularly for the hypocaloric diet. If individually necessary, diet supplements should be used to meet the daily recommended intake [27].

4.6. Traffic Light and Modified Traffic Light Diet/Front-of-Pack (FOP) Nutrition Labeling

Food labels are considered a key component of strategies to prevention unhealthy diets and obesity. Nutrition labeling can be an effective approach to encourage consumers to choose healthier products. Interpretive labels, such as traffic light labels, can be more effective ^[28]. Appropriate labeling of foods with a Nutri Score can provide an important contribution to raising awareness for parents and children to support health-oriented purchases and influence improved diet quality ^[29]. Food is classified into one of three groups: RED, YELLOW, or GREEN. RED foods are foods that are high in fat and/or calories. This group also includes all sweets and sweetened beverages. GREEN foods are those that are low in fat and/or calories per serving. YELLOW foods fit between the two categories. Do not exceed 1200 to 1500 calories per day and do not eat more than four RED foods per week ^[30].

4.7. "Non-Restrictive" Approach

It does not consider the stated daily caloric intake or individual nutrients and focuses on eating foods that are low in fat and high in nutrients.

4.8. Industrial Diet (in the Original Replacement Meals, Replacement Meal)

Not recommended because efficacy and safety have not been tested in children/young adults.

4.9. Hypocaloric Diets with Low Glycemic Index

There was no evidence that the low glycemic index diet differed in effectiveness in reducing BMI or aspects of metabolic syndrome compared with other dietary recommendations in children and adolescents with obesity ^[24]. The low glycemic index diet was as effective as the low-fat diet. Studies do not indicate that a low glycemic index diet suppresses hunger or increases satiety in children and adolescents with obesity ^[31].

4.10. Physical Exercise

Eating habits and the level of PA affect human energy balance ^[32]. Current studies have already shown that, in childhood, there is an increase in the frequency of sedentary lifestyle, such as spending time on playing or working with a computer or watching television (TV) ^[33]. The increase in sedentary behavior and the reduction in the time spent in PA are important risk factors of the development of obesity in children ^{[34][35]}.

Regular PA is associated with improvements in aerobic capacity, strength, muscle growth, bone mass, and body weight or body composition ^[36].

Metabolic benefits include lowering blood pressure, reduction of leptin, glycemia, and insulin resistance, improved lipid profile with lowering of TC, and increased HDL-C ^{[37][38]}. The physical activity reduces the levels of these inflammatory cytokines leading in addition to increasing anti-inflammatory cytokines, such as interleukin 10 and adiponectin, even without modifying diet or lifestyle changes ^{[39][40][41]}. Although exercise contributes to many health benefits, research suggests that exercise can play a role in both short- and long-term weight loss and maintenance. Obese children have to work harder than healthy weight children to perform the same task and therefore need an appropriate load. An exercise program for obese children should aim to increase caloric expenditure ^[42].

Modification of Physical Activity

The effects of PA may depend on the type of PA (aerobic exercise (AE), resistance training (RT), and mixed (CRAE)). For children with obesity, aerobic training (e.g., jumping rope, dancing, running, cycling) at moderate or moderate to vigorous intensity, for 30–60 min a day, 3–5 times a week is recommended ^{[43][44][45][46]}. Meta-analyses available in the literature suggest that AE interventions are effective in lowering fasting insulin levels, insulin resistance ^{[47][48]}, and body fat percentage (BF%) ^[49], as well as improving blood lipid levels ^[50] in adolescents with obesity. In addition, AE training lowers overall body weight, BMI, and LDL-C ^[51].

RT increases muscle strength, power, and/or endurance and is usually done 1 to 3 times a week, while the number of repetitions, series, duration, and intensity of the exercises depend on the RT program. AE training is optimal for reducing BF%, while RT is optimal for increasing lean body mass ^[52].

Mixed training (CRAE) includes both AE and RT elements in a single exercise protocol to provide the benefits of each method is more beneficial for improvement of metabolic parameters and risk factors for cardiovascular

disease than AE or RT alone. CRAE training generally involves performing a series of RT, one set of 8–20 repetitions of RT for the upper and lower body, followed by a series of AE, 20–30 min of moderate intensity, in one session of exercise. It has been shown that CRAE training improves both cardio-respiratory efficiency and muscle strength [46][53] and reduces the body fat, especially visceral [45].

The most appropriate recipe for exercise to reduce obesity in children is the CRAE training protocol, which includes both muscle-toning (RT) and aerobic (AE) ingredients with an emphasis on fat reduction and long-term effects ^[54].

4.11. Family Cognitive Behavioral Therapy and Psychotherapy

Psychological and/or psychotherapeutic support is an essential part of the treatment of obesity in children and adolescents.

Isolated treatment of obesity is not effective due to its multifaceted nature and the multitude of factors that both condition and maintain it ^[55]. Adherence to medical treatment for obesity requires a wide variety of social and psychological skills. Psychological support aims to develop these skills to ensure compliance with medical recommendations ^[55].

Psychological diagnosis can help with the correct choice of interaction methods and reduce the burden of care for the patient.

At the beginning of the interaction, it is important to establish a proper psychological and/or psychiatric diagnosis [56][57]. Patients who will struggle with additional psychiatric disorders may require additional interventions before obesity treatment can be addressed [56]. A correct diagnosis is also intended to allow the most appropriate methods of interaction to be selected. Understanding the patient's point of view can protect the medical team from burnout. This is because it allows for a realistic assessment of the pace and possibilities of the treatment process [58].

Obesity is a chronic disease that triggers an adaptation process in the child. The adaptation process consists of different stages.

As a chronic disease, obesity will provoke different responses in children and adolescents. At some stages of adaptation, it is possible that increased sadness and anger may occur. Being able to express these emotions and receiving help to experience them can contribute to better adaptation to chronic disease ^[59]. Healthy adaptation can, in turn, be associated with greater participation in the treatment process.

Enhanced behavioral control is difficult in a dysregulated nervous system. Psychological support is intended to help restore balance to facilitate natural self-regulation in children and adolescents with obesity.

When a child's nervous system is balanced and when they are not overloaded with excess stress, they have greater access to specific cognitive skills and intentional actions ^[60]. A child or adolescent who is able to regulate his level of arousal is able to withstand discomfort more easily and cope with unpleasant emotions ^[59].

Psychological help for an obese child should be for healthy emotional regulation, as this will facilitate tasks that require self-control [59][60].

Cognitive behavioral therapy is a recommended approach. This is because it allows the development of skills relevant to the perspective of lifestyle and behavior change.

Cognitive behavioral therapy and its methods are recommended for the treatment of obesity ^{[55][58]}. An empathetic attitude on the part of the therapist is also considered important, which is expressed in not judging the difficulties experienced by the patient ^[61]. This is important because criticism does not serve the long-term achievement of goals and can lead to reduced motivation and poorer well-being ^{[62][63]}.

Cognitive behavioral therapy is designed to help children master, among other techniques, (1) continuous monitoring of their behavior, (2) goal setting and management, (3) problem solving, (4) assertiveness, (5) ability to regulate emotions ^{[55][58][64]}. These skills are intended to help the child cope with temptations and maintain a healthy lifestyle. Additionally, cognitive interactions that change the thinking process from one that is maladaptive to one that serves health and life can be helpful ^[64].

The important role of motivation to maintain change should be considered ^[55]. If motivation is insufficient, the focus should be on the use of motivational dialogue ^{[55][61]}. Psychological support for children with obesity also has a protective function against psychological disturbances. Obesity is a risk factor for the development of psychosocial problems and mental disorders ^{[57][65]}. Children with obesity are more likely to be isolated from peers and treated as less attractive playmates ^[66]. This may cause the development of low self-esteem and as mood diseases such as anxiety and depression ^{[57][65]}. Psychological interventions can correct the psychosocial situation of children and allow for the restoration of healthy self-esteem. Psychotherapy is a necessary part of the treatment of eating disturbances such as emotional eating, BED, and night eating syndrome.

Parental involvement in therapy is crucial for younger children.

It should be remembered that for school children, parental involvement in the child's therapy is important ^{[64][67]}. The influence of parents on children's dietary compliance and PA is significant and important. The success of therapy will also depend on the functioning of the entire family system and the patient's environment ^[68]. Therefore, systemic therapy may be a helpful solution in the treatment of childhood obesity ^[68].

4.12. Pharmacotherapy

Pharmacotherapy for children or adolescents with obesity may only be considered after a formal program of intensive lifestyle modification has not been effective in limiting weight gain or improving obesity complications in adolescents aged ≥ 12 years with obesity defined as BMI corresponding ≥ 30 kg/m² in adults.

The only drug registered in Poland and Europe for people <18 years of age is the analog of the human glucagon like peptide 1—liraglutide. While there are currently two formulations of liraglutide on the market, only one has been approved for the treatment of obesity under the name Saxneda. It may be used as a supplement to a healthy diet and increased PA ^[69]. Liraglutide, a glucagon-like peptide 1 (GLP-1) analogue, increases the postprandial insulin level in a glucose-dependent manner, reduces glucagon secretion, delays gastric emptying, and induces weight loss through reductions in appetite and energy intake ^[70]. Liraglutide under the name Saxenda approval was based on a 56-week, double-blind, randomized, placebo-controlled study in 251 pediatric pubertal patients aged 12 to 17 years. After a 12-week lifestyle run-in period, patients were randomized to Saxenda (3.0 mg) or placebo once a day. The mean change in BMI SDS from baseline to week 56 was –0.23 in the Saxenda group and –0.00 in the placebo group. The estimated treatment difference in the reduction in SDS in BMI from baseline between Saxenda vs. placebo was –0.22 (95% CI: –0.37, –0.08; p = 0.0022) ^[70].

Approved pharmacotherapy for obesity should be administered only with a concomitant lifestyle modification program of the highest intensity available and only by clinicians who are experienced in the use of drugs supporting the treatment of obesity and are aware of the potential for adverse reactions. Most adverse events of liraglutide are mild or moderate gastrointestinal events—including nausea, vomiting, and diarrhea ^[70]. The therapy should be discontinued and reevaluated if patients have not lost at least 4% of their BMI or BMI z-score after 12 weeks on the 3.0 mg/day or maximum tolerated dose ^[69].

It is not recommended to use metformin as a drug supporting the treatment of obesity in children and adolescents [71]. Metformin in children with overweight or obesity and metabolic complications reduces hepatic glucose production and increases peripheral insulin sensitivity [72]. It is not recommended to prescribe drugs supporting the weight loss off-label due to: (1) the limited data on safety and efficacy between children and adolescents, (2) the limited efficacy demonstrated in adults for most agents, (3) the need to weigh the relative risk of drug-induced adverse events in children and adolescents against the long-term theoretical potential of a drug to reduce obesity complications and mortality, and (4) the risk of creating a false belief that the drug can replace basic, effective, and safe methods of obesity treatment—change diet and increase PA ^[73].

4.13. Bariatric Surgery

4.13.1. Requirements for Reference Centers

Bariatric surgery is more effective than conservative management ^[74]. Numerous studies have demonstrated the positive results of bariatric surgery on BMI reduction, reduction of blood pressure values, improvement in lipid and carbohydrate metabolism, and reduction of OSA ^[75][76][77][78].

Bariatric surgery should only be performed in highly specialized centers based on the collaboration of an experienced multidisciplinary team capable of providing long-term care.

The team should include a pediatric endocrinology and diabetes specialist or a pediatrician with experience in obesity treatment, a psychologist, an anesthetist, pediatric surgeon, a dietitian, and a physiotherapist. Depending on the needs, the team can be supplemented with specialists from other disciplines. The center should provide nephrology, gastroenterology, orthopedics, cardiology, pulmonology, psychiatric, and other consultations.

4.13.2. Qualification

Bariatric surgery should be considered in pediatric patients with BMI > 40 kg/m² or BMI > 35 kg/m² with associated: diabetes mellitus, prediabetes, hypertension, OSA syndrome, dyslipidemia (especially hypertriglyceridemia), signs of intracranial hypertension (pseudotumor cerebri), MAFLD, severe skeletal abnormalities, and urinary incontinence. An additional indication is a significant deterioration in patient quality of life and limitation of daily activities.

The decision to qualify for treatment should be preceded by at least 12 months of treatment with modification of diet and PA and, in selected cases, pharmacotherapy. The best candidates for treatment are patients who have obtained satisfactory results from this treatment, but in spite of this, severity of obesity or obesity complications continue to threaten their health and life [11][79][80][81][82][83].

However, a prerequisite is that the patient and their parents are able to give their informed consent associated with a complete understanding of the nature of the surgery, the risks and benefits. It is also necessary to ensure that the minor patient has the support of his family during the preoperative and postoperative period. Consent should be preceded by psychological and psychiatric counseling for the patient and their family, and in selected cases by behavioral therapy. Currently, the prerequisite is no longer the sexual maturity of at least Tanner IV, the completion of the skeletal maturation, or the growth process, since no negative effects of bariatric surgery on growth and sexual maturation have been proven ^[84].

Contraindications to bariatric surgery include substance or alcohol addiction, pregnancy or planning a pregnancy within 2 years of surgery, breastfeeding, lack of informed consent and consent to surgery, lack of cooperation from the patient and family, untreated psychiatric illness, severe personality disorders, incurable debilitating illness that is life-threatening in the short term, and high risk of anesthesia for surgery. Relative contraindications to surgery or indications for its postponement are states of exacerbation or temporary imbalance of chronic diseases. With great caution, the decision about bariatric surgery should be made in patients with intellectual disability due to the problems with following the recommendation after surgery.

4.13.3. Types of Bariatric Surgery

There are many types of bariatric surgery methods. Choosing the appropriate method is decided by the doctor in collaboration with the patient based on their health history, medical indications, and risk assessment. Laparoscopic surgery is the preferred surgical technique due to its lower surgical risk. Among the interventions with well-documented effects on weight reduction and expected metabolic outcomes, sleeve gastrectomy (SG) and Roux-en-Y gastric bypass (RYGB) are the most commonly performed in adolescents.

4.13.4. Post-Treatment Monitoring

For at least two years after surgery, preferably until transfer to adult specialist care, the patient should remain under close multispecialty surveillance by the treating center.

Adolescents should have access to lifelong monitoring following bariatric surgery to ensure that nutritional requirements, and risks of developing post-bariatric surgery-related nutritional deficiencies, are monitored. The type and frequency of nutritional monitoring should reflect the bariatric procedure and may need to be individualized. The first post-operative visit should be done preferably after 7–14 days after the procedure. The next schedule of follow-up for the first 6 months includes 4 visits for 1, 2, 3, and 6 months. Until the second year after the procedure, subsequent visits should be carried out every 6 months. After 2 years, patients should be offered transition to adult care monitoring of nutritional status at least annually as a part of multidisciplinary-care management. Renal and liver function, full blood count, and ferritin have to be monitored at 3, 6, and 12 months in the first year and then at least annually. Regular monitoring of folates, vitamin B12, 25-hydroxyvitamin D, and calcium is essential. PTH levels have to be checked if not performed before surgery to exclude primary hypoparathyroidism. HbA1c and lipids have to be monitored in patients with preoperative diabetes and dyslipidemia. Requirements for other minerals and vitamins (zinc, selenium, thiamine, etc.) assessment are related to the specific symptoms and comorbidities ^[85]. Regular bone mineral density assessment (preferably annually) has to also be considered until peak bone mass has been reached ^[86].

Once the patient has reached adulthood, treatment should be provided in adult reference centers following bariatric surgery ^{[79][80][84]}. In the first-year post-operation, bariatric surgery results in a substantial weight loss of about 37%, leading to a significant decrease of all obesity-related metabolic complication, significantly improving health-related quality of life. However, in longer follow-ups, weight regain is observed in 50% of patients. Furthermore, reduced bone mass and nutritional deficiencies were reported in up to 90% of patients ^[87].

4.14. Effectiveness of Obesity Treatment in the Pediatric Population

Obesity treatment in the pediatric population aims to change the behavioral habits of patient and their closest environment (family, neighborhood, school) ^[88]. In long-term evaluation, those changes should result in improving the quality of liver and decreasing the risk of obesity complications ^[89]. However, in everyday practice, clinical evaluation, and study facilities, several anthropometric measurements should be used.

4.14.1. BMI

The simplest, most often used measurement is BMI related to a standard population matrix—presented as standard deviation score (SDS), z-score, BMI centiles or 95th percentile for BMI (%BMIp95) ^[90]. These measurements are simple to use and repetitive. They can be performed in almost every facility with very limited equipment. Based on several measurements in time frames, it is easy to track any changes in the weight status of the patient using local or WHO based centile charts. The decrease in the SDS of 0.5 over 0–6 months of intervention is supposed to be associated with a decrease in body fat ^[91]. As is known, these methods have serious limitations. They do not really track changes in health status, only in relative body mass. Additionally, they do not track the decrease of fat tissue nor the increase in body muscles. This is why, nowadays, BMI-based measures can/should be used in population-based studies and screening procedures as the "best available" method. Unfortunately, there is no other golden standard for clinical practice. Waist circumference can be used as

a measure of visceral fat change as it is more accurate for tracking changes in fat tissue, yet not effective in assessing increases in body lean or muscle mass [91][92].

4.14.2. Other Anthropometric Measurements

More precise methods like bioimpedance, dual energy X-ray absorptiometry (DEXA), CT, or MRI are used mostly in tertiary reference centers for research purposes ^[93]. The availability of good quality and the reproducibility of bioimpedance is increasing, giving more accurate results on changes in fat and free fat mass. This method needs trained stuff and prepared patient—to give accurate and replicable measurements ^[94]. DEXA together with MRI are reserved mostly for clinical trials and have also some limitations—like the luck of standard charts/values for the pediatric population ^[93].

4.14.3. Validation of Treatment Effects

There are limited data on the impact of body mass/fat mass reduction on long-term health effects—assessed from childhood until late adulthood ^[95]. The ones available are mainly observational or retrospective studies with limited factors accounted as possible bias. This also limits the usefulness of both anthropometric and equipment measures for assessing the changes of obesity ^[96]. Moreover, the assessment of changes in behavior is even harder, as it is mostly based on questionnaire/survey tools. Assessment of nutritional or PA habits has this important limitation of self-awareness and veracity ^[97]. PA is easily assessed by simple screening methods (step test, gait test, strength assessment) in both primary and reference centers. Therefore, the implementation of these methods would probably improve the quality of the assessment of changes in patients ^[98].

As of now, there is no ideal measure of the long-term effectiveness of lifestyle changes that can be used in a daily clinical practice. Long-term follow-up—30–40 years—to detect a reduction in obesity complications development and mortality is available in a limited number of population-based studies ^[96]. Moreover, focusing on weight and BMI-dependent measures may cause an increased risk of weight stigma and weight bias, which can contribute to discrimination, and can arise when children do not fit social norms for body weight or shape. This, in practice, can relay to the increased risk of depression, eating disorders, and low self-esteem, additionally contributing to overeating and decrease in PA behaviors ^[99].

All these factors contribute to the issue of qualitative and quantitative assessment and comparison of different public health, clinical and healthcare interventions. In most interventional studies, independently from their structure (family-based, school-based, individual, and group interventions), the BMI or related measure is still used as the most important and easiest in comparison measure. On the other hand, it is very hard to believe that there will be other easier-to-use measures, especially understanding the long-term consequences, relapse character, and multifactorial nature of obesity ^[100].

4.14.4. Long-Term Monitoring

Monitoring and evaluation are an essential element of most processes, including the therapeutic process in obesity. The main goal of obesity treatment in children and adolescents is to prevent and treat obesity complications, including metabolic disorders, and to improve the quality of life of patients. Treatment of obesity in children should result in the development of health-promoting behaviors in the field of nutrition and PA, and their consolidation for the rest of the child's life ^[101]. There is evidence of short-term efficacy of multi-module interventions in the treatment of childhood obesity for age groups up to 6 years ^[102], 6 to 11 years old ^[102], and from 12 to 17 years of age ^[90].

Obesity as a chronic disease requires long-term lifestyle changes and thus long-term patient monitoring ^[103]. One should remember about the possibility of recurrence of the disease, and thus the reevaluation of the causes of its occurrence and the selection of appropriate treatment methods, tailored to the patient's abilities and needs. There are no long-term patterns of how often an obese patient should undergo specialist visits when he or she obtains the goals set in the treatment plan—not only weight reduction, but also all above behavior modification. The regular visits at intervals that would allow the therapeutic effect to be maintained and early identification of body weight gain should be recommended. In the case of bariatric surgery, except for the first two years after surgery, one visit per year is recommended in the following years ^[104].

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