J Health Inequal 2024; 10 (1): 22–47

Submitted: 06.06.2023; accepted: 27.06.2024

DOI: https://doi.org/10.5114/jhi.2024.141201

JOURNAL
of Health Inequalities

Recommendations on dietary treatment of obesity in adults: 2024 position of the Polish Society of Dietetics

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FOREWORD

In 2015 the Polish Society of Dietetics initiated the publication of standards for dietary treatment in diverse diseases. The first developed publication was "Standards for the treatment of simple obesity in adults".

Over the past few decades, the incidence of obesity increased in all regions of the world. Reduced physical activity, as well as increased consumption of ultra-processed, high-energy products, rich in animal fats and simple sugars are leading causes of excessive body weight. Other factors related to obesity are the increasing pace of life and the growing stress load, which lead to a number of eating disorders. In 2022, the WHO Regional Office published the newest report on obesity in Europe. It was concluded that the rates of overweight and obesity are reaching epidemic levels and are continuing to rise. None of the 53 member states is currently on track to meet the common goal of stopping the trend of rising obesity by 2025. The fact that 59% of adults and nearly 30% of children in Europe are overweight is alarming.

The growing number of people with obesity is a significant burden on health care systems and budgets in European countries. Overweight and obesity are among the leading causes of death and disability in Europe, with recent estimates suggesting that they account for more than 1.2 million deaths annually, equivalent to more than 13% of the total mortality in Europe.

Each person with obesity should undergo diagnostics to identify the cause of the problem and any diseases accompanying their obesity, and to plan comprehensive therapy. Treatment of obesity requires a team of specialists in various fields, including dietitians.

The experts of the Polish Society of Dietetics hereby present recommendations being practical leads on dietary treatment of simple obesity in adults.

Advisory Panel on dietary treatment recommendations for obesity in adults
Polish Society of Dietetics

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1. The problem of overweight and obesity in Poland and throughout the world

1.1. EPIDEMIOLOGY OF OVERWEIGHT AND OBESITY

According to the *WHO European Regional Obesity Report 2022*, almost 60% of European adults were overweight. The prevalence of overweight and obesity has reached an epidemic scale across the continent and continues to grow. In particular, the statistics for the young population are alarming. It is estimated that almost 8% of children under the age of 5 years and a quarter of adolescents are overweight. It is predicted that no European country will achieve its plan to stop the rise in obesity by 2025 [1].

Data on the epidemiology of obesity worldwide showed that the prevalence of BMI ≥ 30 kg/m^2 varied by country, ranging from 3.7% in Japan to 38.2% in the United States. The prevalence of obesity among adults in Europe is higher than in any other region except the Americas [1, 2]. According to the WHO, the highest prevalence of overweight and obesity in Europe occur in Great Britain, Greece, the Czech Republic, Bulgaria, Spain, Hungary, and Ireland (> 60% of adults with a BMI > 25 kg/m^2). The lowest percentage of overweight and obese people (slightly over 50%) is found in Moldova, Bosnia and Herzegovina, Austria, Switzerland, and Armenia; however, there is an upward trend in every European country [1, 2]. The prevalence of obesity in the European region is projected to increase between 2020 and 2035 among children, adolescents, and adults (14% of girls, 21% of boys, 35% of all women, and 39% of all men, respectively, will be affected by obesity by 2035) [3].

Poland is one of the countries with an obesity epidemic [4, 5]. According to WHO data, 58.3% of adults in Poland are overweight and 23.1% are obese. The percentages of overweight and obese people in Poland have doubled in the last 40 years, as in other developed countries [1, 3]. Based on a nationwide study (WOBASZ II) conducted between 2013 and 2014, covering a representative sample of adult Polish people aged 20-74 years, it was estimated that obesity was present in 25.9% of men and about 26% of women. The incidence of abdominal obesity in people with metabolic syndrome amounted to 28% in men and 41.1% in women [6].

In 2022, in Poland, excessive body weight (BMI ≥ 25 kg/m^2) in adults (20 years or older) was found among 62% of men and 43% of women, while obesity was found in 16% and 12% of adult men and women, respectively. It is highlighted that the prevalence of abnormal body weight increases with age. The highest proportion of people with excessive body weight are adults between 75 and 84 years [7].

According to the report by the *Supreme Audit Office* (*Najwyższa Izba Kontroli* – NIK), the number of overweight of Polish adults in 2022 ranged from 59.2% to 69.2% of the population, depending on the province. The highest percentage of people with excess body weight was recorded in the Śląskie Province (69.2%), while the lowest was in the Małopolskie Province (59.2%). Expenses related to the management of this disease amounted to 9 billion PLN. According to the NIK report, as many as 3 out of 4 people diagnosed with obesity were also treated for obesity-related comorbidities. Most commonly, obesity was complicated by diseases of the cardiovascular system, endocrine disorders, nutritional and metabolic states, and musculoskeletal diseases [4].

According to the *International Federation for the Surgery of Obesity* (IFSO), in 2014 more than 600,000 bariatric surgeries were performed in 56 of the IFSO countries, 20 of which had national bariatric registries. The statistics from Polish bariatric centres showed that the total number of bariatric surgeries performed in Poland in 2016 included 1958 surgeries and 49 endoscopic procedures [8].

1.2. CAUSES OF OVERWEIGHT AND OBESITY

Obesity is a complex clinical problem with a complicated, multifactorial aetiology. It is commonly believed that excessive body weight is a simple consequence of high consumption of calorie-rich foods and a lack of sufficient physical activity. Consuming foods with a high fat content and high energy density, as well as reducing physical activity, leads to a positive energy balance and the accumulation of body fat. However, it is important to remember that at an individual level there are many co-occurring factors (social, psychological, biological and others) contributing to the development of obesity [4].

Environmental factors are the first group of possible causes of weight gain in patients. Widespread automation and mechanisation in everyday life and work contribute to reduced physical activity and a sedentary lifestyle. The work environment often impacts eating regularity causing postponement of larger meals to late evening hours, consumption of energy-dense snacks, and chronic stress. In addition, consumers have easy access to stores and restaurants, which offer both processed foods and fast-food products with high amounts of fat and sugar and low amounts of dietary fibre. Unhealthy eating behaviours are often reinforced by advertising and the media whereas cultural factors such as hospitality manifested by serving very generous meals reinforce unhealthy habits [5, 10].

Environmental, cultural, and lifestyle factors are also related to psychological ones. Chronic stress can adversely affect the quality and quantity of sleep, which can also cause overconsumption and weight gain. Psychological factors that increase the risk of obesity include emotional eating (EE) as well as eating disorders such as binge-eating disorder (BED) and night eating syndrome (NES). Difficult life situations, traumas, difficult childhood experiences, and depression can also affect weight gain

and the failure to adhere to healthy lifestyle recommendations. Such situations and diseases do not give the patient the freedom to pay attention to their diet [5, 10].

Genetic factors affecting the increased risk of developing obesity are also known. Single- and multi-gene mutations are mentioned. More than 100 syndromes occurring with obesity have been described (e.g. Prader-Willi syndrome, Bardet-Biedl syndrome, or proximal deletion syndrome 16p11.2). Many mutations are still undiscovered, but it seems necessary to take genetics into account when working with patients [5, 10].

Another group of factors are endocrine disorders occurring in the development of many diseases, such as Cushing's syndrome, hypothyroidism, polycystic ovary syndrome, and pituitary and hypothalamic diseases [5, 10].

Drugs used to treat numerous conditions can also reduce the basic metabolic rate, increase appetite, or disrupt the brain's reward centre. Drugs after which weight gain is often observed include glucocorticosteroids, hypoglycaemic drugs, some hypotensive drugs, antihistamines, psychotropic drugs, and antiepileptic drugs [5, 10].

Identifying such factors enables the development of personalised treatment strategies. It can also influence the perception of obesity as a disease by the patients themselves and thus reduce social pressure on them [1, 10].

1.3. HEALTH CONSEQUENCES OF OVERWEIGHT AND OBESITY

Obesity is a chronic disease that poses a significant threat to health and life. According to the WHO, obesity is responsible for 2.8 million deaths worldwide annually [1, 2]. The consequences of obesity have health, social, and economic implications. Obesity is related to metabolic disturbances, and it might have an adverse impact on well-being, self-esteem, and relationships, which affects the quality of life of individuals with obesity [11]. Systemic complications of obesity are summarised in Table 1. In Table 2 the increased risk of disease in obese people compared to people of normal weight is presented. The primary goal of the obesity treatment process is not only to reduce body weight, but also mainly to reduce the risk of obesity complications.

TABLE 1. Systemic complications of obesity [5, 12-16]

System	Complications
Diseases of the cardiovascular system	Ischaemic heart disease, hypertension, stroke, thromboembolism, heart failure, chronic and acute coronary syndromes, arrhythmia, venous thromboembolism (VTE)
Metabolic diseases	Type 2 diabetes, insulin resistance, dyslipidaemia, hyperhomocysteinaemia, hyperuricaemia, gout, metabolic syndrome
Diseases of the digestive system and liver	Gastroesophageal reflux disease, gallstones, oesophagitis, Barrett's oesophagus, non-alcoholic fatty liver disease, cirrhosis, acute pancreatitis, intestinal microbiota disorders
Respiratory system diseases	Chronic obstructive pulmonary disease, bronchial asthma, sleep apnoea syndrome, hypoventilation, pulmonary hypertension
Endocrinology disorders	Male and female infertility, polycystic ovarian syndrome (PCOS)
Cancers	Breast, large intestine (colon and rectum), endometrium, ovaries, kidneys, pancreas, oesophagus, gallbladder, liver, prostate, lung, multiple myeloma, lymphoma
Diseases of the osteoarticular system	Degenerative changes of the feet, knees, hip joints, spine, lumbar spine pain syndrome, osteoporosis, polyneuritis
Urinary disorders	Glomerulopathy, proteinuria, stress urinary incontinence, chronic kidney disease
Increased intra-abdominal pressure	Hypoventilation syndrome, urinary incontinence, varicose veins or phlebitis of the lower limbs, leg ulceration, pulmonary embolism, hernia
Psycho-sociological disorders	Deterioration of quality of life, decrease in self-esteem, body image disorders, cognitive limitations, depression, anxiety disorders, social exclusion, discrimination in employment, eating disorders
Dermatological diseases	Keratosis pilaris and nigricans, stretch marks, hyperkeratosis, cellulite, lymphoedema, skin infections

TABLE 2. Increased risk of disease in obese people compared to people with normal body weight [17]

More than triple the risk	Two-three times the risk	One-two times the risk
Type 2 diabetes (90% of people with type 2 diabetes have a BMI > 23 kg/m^2) Hypertension (5-times increased risk) Dyslipidaemia Gallbladder disease (3-times risk for women if BMI > 32 kg/m^2; 7-times risk for women if BMI > 45 kg/m^2) Insulin resistance Shortness of breath Obstructive sleep apnoea syndrome	Ischaemic heart disease Osteoarthritis (knees) Hyperuricaemia and gout	Cancer (breast in postmenopausal women, colon, endometrium) Hormonal disorders Polycystic ovary syndrome Fertility impairment Lumbar spine pain Increased risk of perioperative complications Foetal development disorders

2. Principles of organisation of medical care for an adult with excessive body weight

R.1. All adults with excessive body weight should receive dietary counselling tailored to their individual needs. An individual with a BMI in the range of 25-30 kg/m^2 (without additional risk factors) can be effectively and safely treated with behavioural therapy.

R.2. All adults with diagnosed obesity of the 1st, 2nd, or 3rd degree and additional risk factors should be treated by interdisciplinary team of specialists.

Modern standards of medical care, focused on the patient, their needs and preferences, require the creation of interdisciplinary therapeutic teams. The team should include specialists from various fields, including physicians, dietitians, nurses, psychologists, physiotherapists, and other health care providers [18].

2.1. THE ROLE OF PRIMARY HEALTH CARE

Primary care is critical in addressing the problem of obesity in adults. The tasks of the therapeutic team in primary health care include the following:

- identification of causes and risk factors of excessive body weight;
- diagnosis of overweight and obesity;
- assessment of the risk of complications;
- education and implementation of individualised behavioural therapy (diet, physical activity);
- inclusion of psychotherapy and/or pharmacotherapy, depending on the patient's needs;
- monitoring and evaluation of the effects of the therapeutic process, including the evaluation of the diet;
- referring to specialist consultations in complicated cases.

2.2. THE ROLE OF SPECIALISED HEALTH CARE

The tasks of the dietitian as part of specialised care include the following:

- assessing the nutritional status and diet as well as the history of changes in body weight in people with obesity;
- assessing the patient's motivation and potential for readiness to change;
- setting the goals of dietary treatment approved by an interdisciplinary therapeutic team and agreed with the patient;
- implementing individual dietary therapy;
- dietary education of the patient and their caretakers;
- monitoring and assessing the effects of the therapeutic process, including the assessment of the diet;
- identifying barriers that impede the achievement of the assumed therapeutic goal and taking corrective actions.

3. Principles of diagnosis and classification of excessive body weight

R.3. Assessment of the body weight status in adults should be based on the BMI classification, waist circumference, and body composition analysis. Measurements of anthropometric data should be made according to standard procedures.

3.1. ANTHROPOMETRIC MEASUREMENT PROCEDURES

Anthropometric measurements including weight, height, waist circumference, and body composition analysis should be performed during each patient visit, preferably in the morning, and by the same specialist.

Body weight should be measured in patients wearing light clothing, using a standardised scale, and in accordance with the scale manufacturer's instructions. The measurement result should be given with accuracy to the first decimal place. If the measurement is performed

TABLE 3. Interpretation of BMI for adults according to WHO criteria (WHO, 2000) [22]

Body mass category	BMI (kg/m²)
Underweight	< 18.50
Normal range	18.50-24.99
Overweight	≥ 25.00
Pre-obesity	25.00-29.99
Obesity	≥ 30.00
Class I	30.00-34.49
Class II	35.00-39.49
Class III (extreme)	≥ 40.00

on patients wearing clothes, the result should be corrected, i.e. the approximate weight of clothes should be subtracted from the measured value [19]. Depending on the type of clothing, the corrections should range from 0.5 kg (if light clothing is worn) to 1.5 kg (for full clothing) [20].

Body height should be measured in a standing position using a height gauge in patients without footwear, headgear (or ornaments, pins), or outer clothing. The patient's posture should be upright, relaxed, and feet slightly apart (knees and heels together). The measured person should stand with their back to the height gauge, touching the device with their head, shoulders, buttocks, and heels. The upper limbs should be hanging freely along the trunk. The head should be kept straight and the gaze directed straight ahead, so that the upper edge of the ear tragus and the lowest point of the bony edge of the orbit are on the same level (the so-called Frankfort horizontal plane). The specialist performing the measurement should always make sure that the patient has taken the correct posture and then read the measurement result with an accuracy of 0.1 cm [19].

During the measurements, proper hygiene conditions should be ensured (decontamination of measuring instruments, ensuring the appropriate temperature of the room, ventilation of the room). Based on the measured weight and height, the body mass index (BMI) should be calculated as follows:

$$\text{BMI} = \frac{\text{body weight [kg]}}{\text{height [m]}^2}$$

Interpretation of the BMI value for adults should be made based on the WHO classification presented in Table 3. It is worth noting, however, that for the elderly population, the BMI index is not a reliable tool for assessing body weight [21].

The waist circumference should be measured horizontally, at the largest narrowing of the trunk in the middle of the distance between the lower edge of the costal arch and the upper edge of the iliac crest, with an accuracy of 0.1 cm, using a non-elastic anthropometric tape. For greater accuracy of the measurement, it is recommended that the measured values be read twice and the average value retained.

According to the guidelines of the International Diabetes Federation (IDF), abdominal obesity in adults is diagnosed when the waist circumference is equal to or greater than 94 cm in men and 80 cm in women. Differences exist in the distribution of visceral fat in different population groups; therefore, different reference values are adopted for some ethnic groups, e.g. for the South Asian population ≥ 90 cm for men and ≥ 80 cm for women, and for the Japanese population ≥ 85 cm for men and ≥ 90 cm for women [23].

Current guidelines for the diagnosis of obesity clearly indicate the need to measure not only body weight, but also waist circumference. While BMI is still widely used to assess the accuracy of body weight and to classify obesity, it is not considered a sensitive parameter that allows the identification of individuals at higher cardiometabolic risk. Moreover, use of the Edmonton Obesity Staging System (EOSS) is recommended when deciding on a treatment strategy for patients with obesity. It is a 5-point classification system used in clinical practice to assess the health risk associated with obesity, which takes into account somatic and mental symptoms as well as limitations in the patient's functioning [24, 25]. National Institute for Clinical Excellence (NICE) recom-

TABLE 4. Treatment options strategy for obesity [26-28]

BMI classification	Waist circumference			Comorbidities present
	Low	High	Very high	
Overweight (25-29.9 kg/m²)	1	2	2	3
Class I obesity (30-34.9 kg/m²)	2	2	2	3
Class II obesity (35-39.9 kg/m²)	3	3	3	4
Class III obesity (≥ 40 kg/m²)	4	4	4	4

1	General advice on healthy weight and lifestyle
2	Diet and physical activity
3	Diet and physical activity, considering pharmacotherapy
4	Diet and physical activity, considering pharmacotherapy, considering bariatric surgery

mends that the obesity treatment strategy be chosen based on the combined analysis of BMI, waist circumference, and the presence of comorbidities (Table 4). There are 3 categories in the classification and interpretation of waist circumference: small/normal (< 94 cm in men and < 80 cm in women), large/high (94-102 cm in men and 80-88 cm in women), and very large/very high (> 102 cm in men and > 88 cm in women) [26].

In addition, it is also advisable to calculate the WHtR (waist circumference to height ratio), which can enable the prediction of metabolic risk:

- 0.4 to 0.49 – no increased health risk;
- 0.5 to 0.59 – increased health-related risk;
- 0.6 or more – significant risk of metabolic complications [27].

3.2. BODY COMPOSITION ANALYSIS

R.4. Bioelectrical impedance analysis (BIA) should be used to assess the body composition of the patient. It is recommended that devices with a four- or eight-electrode system are used.

An important and useful tool in the treatment of a patient with excessive body weight is the measurement of body composition, including the assessment of body fat, lean body mass, muscle mass, and body water content [29].

The BIA test involves measuring the impedance, which is the electrical resistance of soft tissues through which a low-level electrical current pass. Measurements should be taken in accordance with the instructions provided by the manufacturer of the device, with particular attention paid to the time of the last meal, the type and volume of fluids consumed, and the correct position to be adopted by the patient during the measurement. The device affects the functioning of other devices emitting an electromagnetic field; therefore, it is not recommended that BIA measurements are performed on people with metal implants or pacemakers, or pregnant women [30-34]. Before the test, the patient should be informed about the need to follow several rules to prevent measurement errors, e.g. the patient should be on an empty stomach or 3-4 hours following their last meal; the patient should not drink coffee, alcohol, or energy drinks for at least 12 hours before the measurement; they should avoid intensive physical exercise or visits to the sauna; and the patient's bladder should be empty before the examination [30-34].

It should be remembered that due to the lack of reproducible and reliable results of body composition testing using the BIA system, measurements should not be performed on patients with metal prostheses, endoprosthesis, or other implants, nor on patients with hemiparesis and reduced tissue flow (e.g. in the case of major injuries, burns, during shock).

In the practice of a dietitian, the results of a properly performed body composition test facilitate the selection of a dietary strategy aimed at reducing body weight while obtaining favourable proportions of muscle tissue to fat in individual parts of the body (limbs, body) [35-37]. When available, dual-energy X-ray absorptiometry (DXA) may be used to assess the body composition.

3.3. LABORATORY DATA

In formulating dietary therapy guidelines, particularly in patients with comorbidities, health information is essential, including the following:

- lipid metabolism parameters (total cholesterol, LDL, HDL, non-HDL cholesterol, and triglycerides);
- carbohydrate metabolism parameters (fasting blood glucose, random blood glucose, glycated haemoglobin HbA_{1c}, insulin);
- hepatic transaminases, uric acid;
- serum creatinine with calculation of glomerular filtration rate eGFR;
- C-reactive protein CRP concentration;
- complete blood count;
- general urine test;
- blood pressure.

The tests can be performed at the request of the physician or another member of the therapeutic team. Hormonal and other nutritional status tests may also be necessary in some patients [18].

4. Dietary treatment of overweight and obesity in adults

4.1. GENERAL INFORMATION

R.5. All patients with excessive body weight require a detailed medical history of (but not limited to) socio-demographic factors, health status, dietary history, and physical activity.

During the interview conducted with the patient, the dietitian should gather the following information:

- **general information** on gender, age, ethnicity, circumstances related to weight gain, previous forms of overweight/obesity treatment, profession, socio-economic and psycho-emotional factors, physical activity, smoking, alcohol consumption, and psychoactive substances;
- **information about comorbidities**, including metabolic, endocrine, cardiovascular, respiratory, gastrointestinal, kidney, food allergies and intolerance, fertility disorders, and other significant information;
- **information about medical recommendations**, including medications and supplements;
- **information about nutrition**, including time and place of meal consumption, number of meals during a day, type of food and beverages, food preferences and eating

habits, cooking techniques used, and alcohol consumption.

The information obtained should constitute the basis for the development of individualised behavioural therapy. The nutritional interview should be conducted in accordance with the rules of the Code of Ethics for Dietitians [38]. Being a member of religious group may also be a factor determining the dietary treatment of a patient with obesity. Therefore, this factor needs to be taken into account in the therapeutic process.

4.2. ASSESSMENT OF THE PATIENT'S READINESS TO INITIATE THERAPY

R.6. Prior to the dietary treatment for overweight/obesity, the dietitian (or other member of the therapeutic team) should assess the patient's readiness to introduce lifestyle changes.

Changes in the patient's eating behaviour can be related to changes in other areas of their life or the life of the patient's relatives and family. This, in turn, may affect the patient's readiness to undertake necessary changes and their ability to implement them. Imposing a change that is not related to the patient's own decision, despite initial acceptance, may cause rapid abandonment of the established dietary guidelines. The decision to start a weight-loss journey, despite good motivation, may also lead to anxiety and concern about achieving satisfactory results. In addition, the very effect of weight loss may paradoxically cause concern about how it will affect various elements related to psycho-social relationships and the perception of one's own body [39]. On one hand, people who have previously used various reduction diets may also have doubts about the proposed dietary modifications. On the other hand, excessive concentration of patients on dietary recommendations is often associated with low self-esteem and psycho-emotional problems, which, if not resolved, increase the tension and discomfort associated with the use of a reduction diet [40].

Reactions to either a change or the idea of change are mostly determined by the patient's attitude. If the patient sees the change as welcome and beneficial, they react actively; however, if they perceive the change in eating behaviour as a challenge, they may feel overwhelmed and unable to cope with it. Making the patient aware of the dangers of excessive body weight might further exacerbate their feelings of fear and anger. The bigger the change (for example to improve the health condition), the bigger the fear of failure. Listening to the patient, making eye contact, and providing positive emotional contact helps to relieve tension and reduce anxiety. Creating group programs and/or support groups can help reduce the fear of change, although not all patients may be ready to talk about their problems or concerns with others [41, 42].

Introducing the change in eating behaviour gradually in distinct stages can significantly decrease the anxiety and associated negative emotions and turn them into positive emotions. This in turn may encourage the patient to adhere to dietary modifications associated with the reduction diet. Similarly, accepting the need for changes in eating behaviour can help to conclude a contract/agreement between the patient and the dietitian or the patient with themself. The patient undertakes the performance of a specific task related to the implementation of dietary recommendations in exchange for specific actions on the part of the dietitian or in exchange for obtaining specific effects, not necessarily related to weight reduction. However, the dietitian should avoid promises that will be difficult to keep or will go against the principles of a weight-reduction diet [43].

Some patients distance themselves from reality, to shield themselves from possible unwanted changes. This can manifest as ignoring the seriousness of the disease and finding excuses for their inability to change their eating habits. Such a situation may favour the emergence of other behaviours, for example, addictions that distract the patient from the problems associated with excessive body weight and the need to reduce it [44].

Accepting changes in eating behaviour in people with excessive body weight may be more difficult due to previous failures, a lack of faith in dealing with the problem, a lack of self-acceptance, and anger related to the fact that the patient led themself to an unfavourable situation for their health and was unable to solve it. The dietitian should support the patient, trying to improve their self-acceptance and positive thinking about themself [45].

Acceptance of changes related to weight reduction, requiring changes not only in nutrition but also changes in many lifestyle-related behaviours, should be spread over time. This requires systematic meetings and/or an interactive way of supporting and caring for the patient. Every change involves leaving something known behind, but also obtaining something new. The associated uncertainty can be worrying, but also exciting. Emphasising emotions such as curiosity, interest, hope, and desire in place of emotions such as frustration, fear, uncertainty, and hopelessness helps to achieve the intended goals of the reduction diet. The patient is more likely to successfully make a change if they feel that the benefits to be gained from the change will outweigh the benefits of continuing their current eating behaviour [46].

The dietitian should individualise the therapeutic approach and obtain the patient's acceptance for introducing changes in eating behaviour depending on their needs, both in individual and group counselling. Depending on the patient's readiness for change and the stage of implementation, these techniques may involve a liberal, peer-to-peer way of communicating or a prescriptive, directive way of providing information and recommendations.

TABLE 5. Goals for weight management according to BMI [49]

BMI < 25 kg/m²	Maintaining body weight, avoiding weight gain
BMI 25.0-29.9 kg/m² and no comorbidities	Avoiding weight gain or decreasing body weight to the value of BMI < 25 kg/m²
BMI 25.0-29.9 kg/m² and presence of comorbidities	Reduction in body weight by 5-10% in 6 months and maintenance of this effect in the long term
BMI ≥ 30 kg/m²	Reduction of body weight by at least 5-10% in 6 months and maintenance of this effect in the long term

The basis for such an approach is active listening, empathy, but also assertiveness that allows the dietitian to provide all the necessary information. A patient-centred approach related to meeting their needs and supporting them in the implementation of changes can increase the effectiveness of weight reduction programs [47].

Among the tools commonly used around the world to assess a patient's readiness to introduce lifestyle changes, there are behavioural techniques, cognitive techniques, behavioural-cognitive techniques, and the transtheoretical model. In this model, the following phases of change are distinguished: pre-contemplation (lack of readiness), contemplation (considering change), preparation for change (planning for the near future), action, and sustaining change [48].

One of the effective methods used to change eating habits is the small steps method, e.g. the SMART method (*specific, measurable, achievable, attractive, realistic, time-bound*), which involves the gradual pursuit of a set goal. Gradually introducing changes makes it easier to get used to them and create new habits. Dividing the changes in eating behaviour into stages does not exhaust the patient's psycho-emotional resources, minimising the feeling of tiredness, weariness, and impatience. The established goals for changing eating behaviours should be measurable/estimable and achievable in a specific duration (these may include anthropometric indicators, health status indicators, or dietary characteristics). Goals should also be realistic and achievable, and at the same time attractive to the patient. It is also important to introduce the principle of *mindful eating*, which allows the patient to focus on their body's reactions, including the feeling of fullness and satiety, controlling the portion consumed, and building a positive relationship with food.

4.3. SETTING THE GOALS OF THE TREATMENT

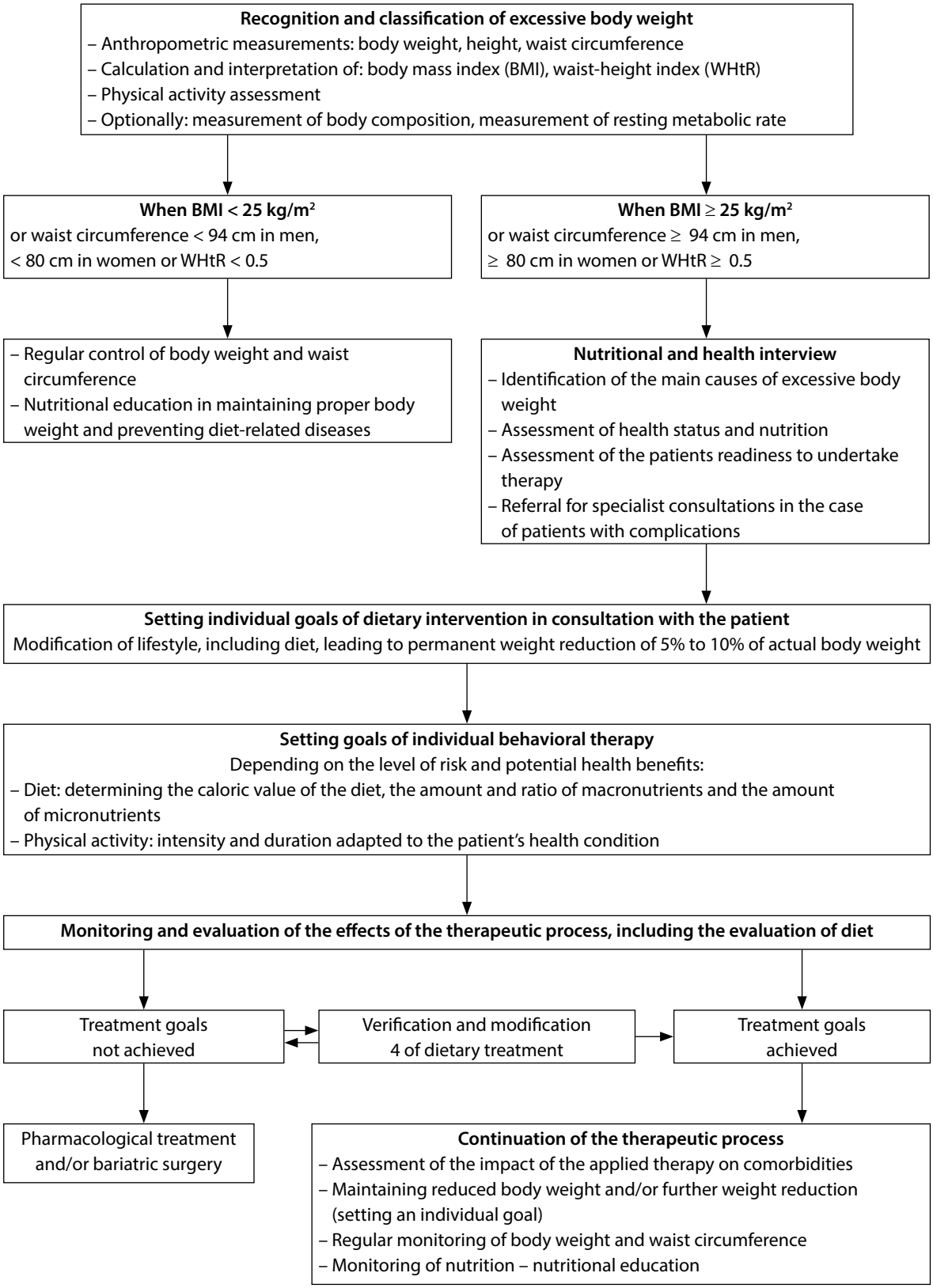
R.7. Individual and achievable treatment goals should be established in adults with excessive body weight.

The practical goal is the reduction of body weight and its long-term maintenance. Even a 3-5% reduction in body weight, in relation to the initial weight, leads to measurable benefits regarding the health of patients (for example, lowering the concentration of triglycerides and glucose in the blood, lowering the risk of developing type 2 diabetes). Greater weight loss (5% to 10% of initial weight) additionally reduces risk factors for cardiovascular disease (for example, lowering LDL cholesterol, lowering blood pressure). In patients at high risk of cardiovascular disease, a 5-10% reduction and maintenance of body weight over 6 months brings a significant improvement in lipid and carbohydrate metabolism indicators [18, 49]. The optimal rate of weight loss should be between 0.5 and 1 kg/week for the first 3-6 months of therapy, depending on the individual patient's response to the dietary treatment strategy used. The dietitian, together with the patient (and the therapeutic team) should determine an individual, optimal, and achievable goal of dietary treatment. Most people with obesity are advised to reduce their body weight by 1 kg/week or about 10% of their initial body weight. People with obesity and prediabetes are recommended to reduce from 5% to 7% of their initial body weight. However, people with obesity and type 2 diabetes have significant health benefits from a reduction of 7% to 15% of their initial body weight [50]. Therapeutic goals for weight management are presented in Table 5.

4.4. ALGORITHM FOR THE DIETARY TREATMENT OF OVERWEIGHT AND OBESITY

Algorithm for the dietary treatment of overweight and obesity: see Diagram 1.

DIAGRAM 1.


Recognition and classification of excessive body weight
– Anthropometric measurements: body weight, height, waist circumference
– Calculation and interpretation of: body mass index (BMI), waist-height index (WHtR)
– Physical activity assessment
– Optionally: measurement of body composition, measurement of resting metabolic rate
When BMI < 25 kg/m²
or waist circumference < 94 cm in men,
< 80 cm in women or WHtR < 0.5
When BMI ≥ 25 kg/m²
or waist circumference ≥ 94 cm in men,
≥ 80 cm in women or WHtR ≥ 0.5
– Regular control of body weight and waist circumference
– Nutritional education in maintaining proper body weight and preventing diet-related diseases
Nutritional and health interview
– Identification of the main causes of excessive body weight
– Assessment of health status and nutrition
– Assessment of the patients readiness to undertake therapy
– Referral for specialist consultations in the case of patients with complications
Setting individual goals of dietary intervention in consultation with the patient
Modification of lifestyle, including diet, leading to permanent weight reduction of 5% to 10% of actual body weight
Setting goals of individual behavioral therapy
Depending on the level of risk and potential health benefits:
– Diet: determining the caloric value of the diet, the amount and ratio of macronutrients and the amount of micronutrients
– Physical activity: intensity and duration adapted to the patient's health condition
Monitoring and evaluation of the effects of the therapeutic process, including the evaluation of diet
Treatment goals not achieved
Verification and modification 4 of dietary treatment
Treatment goals achieved
Pharmacological treatment and/or bariatric surgery
Continuation of the therapeutic process
– Assessment of the impact of the applied therapy on comorbidities
– Maintaining reduced body weight and/or further weight reduction (setting an individual goal)
– Regular monitoring of body weight and waist circumference
– Monitoring of nutrition – nutritional education

5. Principles of calorie-restricted diets for the treatment of overweight and obesity in adults

5.1. ENERGY REQUIREMENT

R.8. The measurement of the resting metabolic rate (RMR) by indirect calorimetry should be used to determine the individual energy requirements of adults with excessive body weight.

R.9. The empirical calculation of the resting metabolic rate in overweight adults should be based on the Mifflin-St. Jeor formula.

Estimating the total energy expenditure of the body should take the following into account:

- **basic energy expenditure** (*basal metabolic rate,* BMR; *basal energy expenditure*, BEE), about 60-70% of the total expenditure in people with sedentary lifestyles and about 50% in physically active people;
- **diet-induced thermogenesis (**DIT), which is about 5-15% of total energy expenditure;
- **energy expenditure connected with physical activity,** which is about 15-30% of total energy expenditure in a person who does not work out.

The value of the body's basic energy expenditure depends on genetic conditions, hormonal factors (mainly thyroid hormone metabolism), gender, past or existing diseases, medications taken (e.g. glucocorticoids or other hormonal drugs), nutritional status, and type of character or psychic condition. The body weight of people who stop smoking without a properly planned diet may increase by about 10 kg per year [51].

The most variable component of daily energy expenditure is that related to physical activity, which depends on its intensity and duration.

Both baseline and activity-related energy expenditure depend on body weight. In obese people, due to the greater mass of adipose and lean tissue, energy expenditure is usually higher than in people of the same height, sex, and age but with normal body weight. Reducing body weight may result in a decrease in basic energy expenditure, especially when it is associated with a decrease not only in fat but also in lean body mass, including muscle mass. This extends the period of weight loss, reduces the effectiveness of diet therapy, and makes it difficult to maintain the effects of weight loss or eliminate them [52-54]. Therefore, it is important to implement regular physical activity adapted to the health and physical condition of a person with excessive body weight.

The use of generally accepted formulas estimating resting or basic energy expenditure in people with excessive body weight (including mainly increased fat tissue content) may give values that differ from actual energy expenditure. Overestimation of basal or resting energy expenditure in obese individuals may result in incorrect estimation of the energy value of a weight-reducing diet.

To accurately determine energy expenditure in people with endocrine disorders or using drugs that increase the risk of obesity, who have frequently tried to lose weight, RMR measurements using indirect respirometry should be considered [54, 55].

The choice of weight reduction strategy and the energy deficit should be decided with the patient. If the resting metabolic rate cannot be measured by indirect calorimetry, RMR should be calculated using the formula designed by Mifflin *et al.* [56] based on the current body weight of the patient:

RMR = (9.9 × body weight [kg]) + (6.25 × height [cm]) – (4.92 × age) – 161 for women

RMR = (9.9 × body weight [kg]) + (6.25 × height [cm]) – (4.92 × age) + 5 for men

The literature data shows that the Mifflin-St. Jeor formula is suitable for estimating the energy needs of obese people with a BMI of 25-40 kg/m^2 [18, 57]. However, studies indicate that in patients with severe obesity (BMI > 40 kg/m^2), the application of the above equation may be subject to significant error; therefore, it is recommended that energy expenditure be measured in these patients [54].

The total energy requirement of the body is determined by increasing the value of basic energy expenditure by defined *physical activity levels* (PALs). In the practice of a dietitian, the following coefficient of physical activity can be used:

- from 1.0 to < 1.4 – sedentary lifestyle;
- from 1.4 to < 1.6 – low/moderate physical activity;
- from 1.6 to < 1.9 – high physical activity;
- from 1.9 to 2.5 – very high physical activity [18, 58].

In practice, data on the number of steps from accelerometers, pedometers, or applications for mobile devices can be used to estimate the level of physical activity (Table 6).

TABLE 6. Classification of physical activity level based on pedometer data in healthy adults [58]

Number of steps	Level of Physical Activity Level
< 5000	Sedentary lifestyle/ very low physical activity
5000-7499	Low physical activity
7500-9999	Moderate physical activity
≥ 10000	High physical activity
> 12500	Very high physical activity

Intense physical exercise performed at least 5 days a week for 30 to 60 minutes requires an increase in the assumed PAL value by 0.3. Performing intensive physical work requires a physical activity level of 2.0-2.4. Physical activity at a PAL level above 2.4 is difficult to maintain in the long term.

R.10. Reduced-calorie diets accounting for individually determined needs should be recommended to adults with obesity in the dietary treatment. The daily caloric deficit should range between 500 and 800 kcal.

R.11. The caloric value of a weight-reduction diet should be adjusted and adapted to the patient's changing body weight.

The energy value of a weight-reduction diet can be estimated in one of the 3 following methods:

1. Assumption of a specific daily energy deficit concerning the total energy demand. A deficit of 500 to 800 kcal is considered safe. In theory, a daily deficit of 500 kcal results in a weekly deficit of 3500 kcal and weight loss of approximately 0.5 kg per week. In the case of patients with low motivation, even small changes leading to a deficit of 100-200 kcal per day can be beneficial.
2. Planning a diet with a defined calorie content, less than the amount of energy needed to maintain body weight. For women, the caloric content of the diet may range from 1200 kcal/d to 1500 kcal/d, and for men from 1500 kcal/d to 1800 kcal/d.
3. Estimating the caloric content of the diet as 75-80% of the current total energy requirement (BMR calculated from the formula or measured and measured or estimated physical activity) [18, 52].

The above calculations require a detailed health and nutrition interview using standardised tools. The caloric deficit should be adjusted according to the patient's age, gender, current health status, physical activity, history of weight change, patient motivation, dietary habits and preferences, and the individual weight reduction strategy adopted. The energy deficit and caloric content of the diet must be adjusted according to the patient's changing body weight.

Rapid weight loss strategies remain appealing to patients with obesity, but a gradual weight loss approach may produce better long-term outcomes. Gradual weight loss is associated with greater reduction in fat mass and body fat tissue, as well as enhanced maintenance of RMR.

When justified, in patients under the care of the therapeutic team, it is also possible to use a *very low caloric diet* (VLCD), in which the daily energy intake does not exceed 800 kcal. An indication for this type of diet may be the need for rapid weight loss (for example before surgery) [27, 28].

5.2. MACRONUTRIENT COMPOSITION

R.12. For people with excessive body weight, a dietitian can recommend nutritionally adequate low-energy diets with different compositions of macronutrients, following the general principles of healthy nutrition, and tailored to the patient's individual needs and preferences.

There are many possible, effective dietary strategies for weight loss. There is insufficient scientific evidence for the greater effectiveness of low-carbohydrate or low-fat diets in achieving permanent weight loss in obese patients. Studies show that with good control of the energy value of the diet, the macronutrient composition, the glycaemic index and the glycaemic load of the diet are not related to weight reduction, and the effect of modifying the diet profile on weight reduction results may depend on the individual predisposition of those following it [18, 49].

The recommended range of macronutrients are as follows: for protein, 15-35% of total diet energy; for carbohydrates, 40-65%; and for fat, 10-35% of total diet energy. Diets recommended in the treatment of obesity include those with various modification of macronutrients, including low-fat, low-carbohydrate, moderate, or high protein, all of which are reduced in calories. Weight reduction requires an energy deficit, i.e. the amount of energy taken with food should be less than the amount of energy expended. In the treatment of obesity, various nutritional models are used, such as the DASH diet, the Mediterranean diet, the Portfolio diet, diets based on products with a low glycaemic index, plant-based diets – including the flexitarian diet, and many others [18, 50].

Attention should be paid to the need to limit high-calorie, low-nutritional-value foods in the diets of people with obesity. Among the diets recommended for the treatment of obesity are those with different proportions of macronutrients, including low-fat, low-carbohydrate, moderate, or high protein – all with reduced caloric intake. In weight reduction, an energy deficit is essential, the amount of energy intake should be lower than the amount of energy expended. Various dietary models are used in the treatment of obesity, with (low-carbohydrate, low-fat) or without modification of macronutrient supply, such as the DASH diet, the Mediterranean diet, the Portfolio diet, diets based on products with a low glycaemic index, or plant-based diets (Table 7) [18, 50]. Due to the potential risk of nutrient deficiencies and the lack of studies confirming the safety of their use, single-ingredient, rigorous, nutritionally unbalanced diets are not recommended [28].

TABLE 7. Selected dietary patterns for the management of obesity [28, 50]

Type of eating pattern	Description
DASH (Dietary Approaches to Stop Hypertension)	Emphasises vegetables, fruits, and low-fat dairy products, whole grains, poultry, fish, and nuts; reduced in saturated fat, red meat, sweets, foods with added sugar; sodium reduction (< 2300 mg or 1500 mg for severe heart diseases); alcohol consumption is not encouraged
Mediterranean	Emphasises plant-based food including vegetables, whole grains, fruits, nuts and seeds, legumes; fish and seafood; extra-virgin olive oil (EVOO) as the main source of dietary fat; moderate amount of low-fat dairy products (mainly yogurt and cheese); eggs; low amounts of red meat; moderate/low amount of wine
Portfolio	Emphasizes foods rich in soluble fibre (20 g/d), soy protein (15-20 g), plant sterols/stanols (2 g/d), and tree-nuts (30 g/d); food components/food that have been found to associate with a cholesterol lowering effect
Plant-based diet: vegetarian, vegan, and flexitarian (primarily vegetarian with the occasional inclusion of meat or fish)	Emphasise plant-based food fruits, vegetables, legumes, whole grains, cereal, tubers, roots, vegetable oils, nuts, and seed oils; the flexitarian diet is a flexible alternative to being vegetarian. Emphasises fruits, vegetables, whole grains, legumes and nuts, and occasionally meat, poultry, and fish

5.3. MINERALS AND VITAMINS

R. 13. The reduced-calorie diet should meet the requirements for minerals and vitamins in accordance with the applicable standards and/or dietary recommendations adequate to the patient's health condition.

R. 14. Most adults with excessive weight treated with a moderate calorie deficit diet do not require vitamin and mineral supplementation. Supplementation should be considered individually.

There is no need to routinely recommend dietary supplementation for people with obesity. The content of vitamins and minerals in the diet should be modified and adjusted individually to the patient's needs if their health condition requires it. The reduced-calorie diet should be constantly monitored in terms of nutritional value, and micronutrient deficiencies should be corrected accordingly [27, 28]. An adequate supply of calcium in the diet is of particular importance in the process of reducing body weight. Calcium promotes increased fat excretion in the faeces, increased lipolysis, and reduced lipogenesis in adipocytes. The amount of calcium in low-calorie diets should be 1000-1500 mg/day.

Vitamin D is connected to the calcium economy. As research shows, it is crucial in the pathogenesis and prevention of metabolic diseases. Vitamin D is a factor that stimulates active intestinal calcium transport and increases its absorption to 40-50%. It should be noted that adipose tissue is a storehouse of vitamin D. In this aspect, obesity is a risk factor for vitamin D deficiency, as fat-soluble 25(OH)D is sequestered in adipose tissue, making it biologically unavailable [60].

Zinc is also important as it acts as a catalyst for enzymes involved in the metabolism of lipids, carbohydrates, and proteins. An adequate supply of magnesium in the diet may help to lower blood pressure, lower triglycerides, and increase HDL cholesterol in the blood.

As in the recommendations for proper nutrition for the general population, in low-energy diets, the recommended sodium intake cannot exceed 2.4 g/day, which means the need to eliminate adding salt to prepared dishes and meals.

An appropriate supply of zinc in the daily food ration and supplementation with vitamin D (in the case of its deficiency) may improve insulin sensitivity in people aiming to reduce their body weight. The role of chromium in slimming therapies is controversial. Chromium is part of the glucose tolerance factor (GTF), and its action consists, among others, of increasing the number of insulin receptors and activating the insulin receptor by its phosphorylation, ultimately improving carbohydrate metabolism [60].

5.4. DIETARY SUPPLEMENTS

R.15. Dietary supplements for weight loss are not routinely recommended.

R.16. The dietitian may consider including a dietary supplement in the treatment process. Results of scientific research must confirm the safety and effectiveness of such supplementation.

According to the definition presented in the Food and Nutrition Safety Act of 25 August 2006 (Journal of Laws 2006 No. 171, item 1225 as amended), a dietary supplement is a food the purpose of which is to supplement the diet. It is a concentrated source of vitamins or minerals or other substances with a nutritional or other physiological effect, single or in combination, placed on the market in a dosage form, excluding products having the properties of a medicinal product within the meaning of the provisions of the pharmaceutical law [60].

According to the Regulation of the European Parliament and European Council from 28 January 2002 (178/2002), placing dietary supplements on the market does not require a permit, and the manufacturer or entrepreneur marketing foodstuffs, including dietary supplements, bears full responsibility for health quality, labelling, presentation, and advertising [61].

Due to the global problem of overweight and obesity, there is growing interest in dietary supplements that reduce body weight. Data from American studies suggest that in over 30% of cases, weight reduction therapy used supplements or other types of products without a doctor's recommendation [62]. Every year, dozens of commonly available, new products appear on the market, the declared effects of which are controversial [63]. Supplements available on the market contain ingredients with various potential mechanisms of action supporting the process of weight reduction. Most often, supplements use ingredients with a potential effect on the feeling of satiety (for example dietary fibre, konjac, chitin, psyllium, guar gum), reducing the synthesis and/or increasing the oxidation of fat (CLA, L-carnitine, capsaicin), or increasing energy expenditure – usually by increasing the basal metabolic rate (for example caffeine, green tea extracts, capsaicin, ginseng) [64]. Most studies indicate that only caffeine and green tea caused increased fat oxidation, although the effect of increased fat oxidation on weight management is not entirely clear. For other ingredients, there is insufficient scientific evidence of their beneficial and effective increase in fat oxidation [65, 66]. An analysis of 33 randomised clinical trials indicates that both the efficacy and safety of herbal and food-based supplements are still largely unknown. Therefore, further, long-term clinical trials are necessary to assess the potential role of supplements in the process of weight reduction and obesity treatment [67].

It is important to note that weight loss supplements, like all dietary supplements, may have harmful side effects and may interact with medications as well as over-the-counter pharmaceutical preparations. Many weight-loss supplements contain ingredients that have not been tested together, and their combined effects are unknown. For example, in 2004, the US Food and Drug Administration (FDA) banned the use of ephedrine in dietary supplements for safety reasons. Ephedrine, the source of which in supplements is usually the ephedra herb, can cause nausea, vomiting, anxiety, mood swings, seizures, high blood pressure, arrhythmias, stroke, heart attack, and even death [68].

5.5. SWEETENERS

R. 17. The recommendation to reduce the calorie level in a diet by introducing intense sweeteners and products with their addition to the diet cannot constitute the only element of dietary treatment of people with excessive body weight; it can only be an element of a behavioural weight reduction program.

Sweeteners are food additives that, in accordance with applicable law, may be directly placed on the market (for example table-top sweeteners) or added to specific food products and beverages to give a sweet taste without increasing the energy value or increasing it at a low energy level.

Based on the caloric value the following sweeteners are recognised:

- **intense sweeteners**: do not provide energy or the energy provided by them is negligible due to consumption in very small quantities;
- **polyols**, the energy value of which is on average 2 kcal/1 g (excluding erythritol).

In Poland (and in the EU) the following sweeteners are approved for sale and/or use in food products:

- **intense sweeteners**: acesulfame K (E 950), aspartame (E 951), aspartame-acesulfame salt (E 962), advantame (E 969), cyclamates (E 952), saccharin (E 954), thaumatin (E 957), neohesperidin DC (E 959),sucralose (E 955), neotame (E 961), steviol glycosides from stevia (E 960a), steviol glycosides produced enzymatically (E 960c), and glucosylated steviol glycosides (E960d);
- **polyols**: sorbitol (E 420), mannitol (E 421), isomalt (E 953), maltitol (E 965), lactitol (E 966), xylitol (E 967), erythritol (E 968), and polyglycitol syrup (E 964) [69].

The basis for allowing the use of sweeteners in food is the assessment of their safety, which is carried out by the European Food Safety Authority (EFSA). For intense sweeteners, maximum values are specified, while polyols (except for polyglycitol syrup) may be added by producers to food in the lowest dose necessary to achieve the intended technological effect and in accordance with good manufacturing practice. The characteristics of sweeteners approved for use as food additives are presented in Table 8.

New sweeteners classified as novel foods are also noteworthy. The use of these substances is governed by the Regulation of European Parliament and European Council (EU) 2015/2283 from 25 November 2015 on novel foods, amending Regulation (EU) No. 1169/2011

TABLE 8. Characteristics of sweeteners [69-71]

Sweetener	E symbol	Acceptable daily intake (ADI) mg/kg b.w.	Sweetening power compared to sucrose (sucrose = 1)	Energy value (kcal/g)
Sorbitol	E 420	–	0.5-0.7	2.6
Mannitol	E 421	–	0.5-0.7	1.6
Acesulfame K	E 950	0-15	150-200	0
Aspartame	E 951	0-40	160-200	4
Cyclamates	E 952	0-7	30-50	0
Isomalt	E 953	–	0.4-0.6	2.0
Saccharin	E 954	0-5	300-500	0
Sucralose	E 955	0-15	400-800	0
Thaumatin	E 957	–	1600-3000	4
Neohesperidin DC	E 959	0-5	400-2000	2
Steviol glycosides from stevia	E 960a	0-4	30-250	0
Steviol glycosides produced enzymatically	E 960c	0-4	30-250	0
Glucosylated steviol glycosides	E 960d	0-4	30-250	0
Neotame	E 961	0-2	7000-13,000	0
Aspartame and acesulfame salt	E 962	0-40	350-400	4
Polyglycitol syrup	E 964	–	0.25-0.5	3
Maltitols	E 965	–	0.9	2.1
Lactitol	E 966	–	0.3-0.4	2.0
Xylitol	E 967	–	0.9	2.4
Erythritol	E 968	–	0.6-0.8	0.2
Advantame	E 969	0-5	20,000	0

of the European Parliament and of the Council and repealing Regulation No. 258/ 97 of the European Parliament and of the Council and Commission Regulation No. 1852/2001 (European Journal of Laws L 327 from 11.12.2015, p 1-22, as amended) [72]. The Commission Implementing Regulation (EU) 2017/2470 of 20 December 2017 establishing the EU list of novel foods under Regulation (EU) 2015/2283 of the European Parliament and of the Council on Novel Foods is also important (European Journal of Laws L 351 from 30.12.2017, pp. 72-201, as amended) [73]. According to this regulation, the following substances with sweetening properties are considered to be novel foods: isomaltulose, D-tagatose, trehalose, and sucromalt. These substances are characterised by lower sweetness compared to sucrose; therefore, to obtain the same sweetness in products, they should be used in appropriately higher concentrations. However, it should be emphasised that these substances do not rapidly increase blood glucose levels and cause lower insulin secretion compared to glucose, which is why they can be recommended for use in products for diabetics [74]. Table 9 provides a summary of the properties of new sweeteners, their glycaemic index, energy value, maximum levels of use in food, and additional specific labelling requirements for foods containing these sweeteners.

A natural preference for a sweet taste can lead to overconsumption of sugary foods and sugary drinks. Although not all studies confirm the relationship between the consumption of sugar from various food sources and weight gain [75], the WHO recommends limiting the consumption of so-called added sugars (mono- and disaccharides added in the production process, sugars contained in honey and natural fruit juices) up to a maximum of 10% of the diet energy. High consumption of added sugar foods, especially sugar-sweetened beverages, contributes to increased energy intake, but at the same time may reduce the intake of nutrient-dense foods, leading to poorer diet quality, weight gain, and an increased risk of diet-related diseases [76]. Research suggests that replacing traditionally sweetened foods and drinks with those sweetened with intense sweeteners may help to reduce the caloric value of the diet. A meta-analysis

TABLE 9. List of properties of novel sweeteners: isomaltulose, D-tagatose, trehalose, and sucromalt

Substance	Glycaemic index (GI)/ Sweetening power compared to sucrose (sucrose = 1)	Energy value (kcal/g)	Maximum levels	Additional specific labelling requirements
Isomaltulose	32/0.48	4	Not specified	1. The designation of the novel foods on the labelling of the food containing it shall be „Isomaltulose".
				2. In addition to the name of the novel foods, the labelling shall include the words: „Isomaltulose is a source of glucose and fructose".
D-tagatose	3/0.92	3	Not specified	1. The designation of the novel foods on the labelling of the food containing it shall be "D-tagatose".
				2. Products with levels of D-tagatose greater than 15 g per serving and all beverages containing more than 1% D-tagatose (in ingested form) shall be labelled with the words "excessive consumption may have a laxative effect".
Trehalose	72/0.48	4	Not specified	1. The designation of the novel foods on the labelling of the foodstuffs containing it shall be „Trehalose", and this name shall appear on the labelling of the product or in the list of ingredients of the foodstuffs containing it.
				2. In addition to the name of the novel foods, the labelling shall include the words: „trehalose is a source of glucose".
Sucromalt	53/0.7	4	Not specified	1. The designation of the novel foods on the labelling of the food containing it shall be "sucromalt".
				2. In addition to the name of the novel foods, the labelling shall include information that the product is a source of glucose and fructose".

of 51 studies in different age groups showed a beneficial effect of intense sweeteners compared to sugar on body weight, body mass index, and energy intake [77].

Intervention studies indicate that reducing or replacing traditionally sweetened beverages with their substitutes with the addition of intense sweeteners has a beneficial effect not only on weight reduction (Rogers and Appleton, 2021) but it can also reduce the desire to eat sweets [78]. Most studies indicate that the consumption of intense sweeteners and/or food products with their addition does not increase the preference for a sweet taste [79]. The benefits of using products with the addition of intense sweeteners in the treatment of excessive body weight depend primarily on the amount of sugar eliminated from the diet in this way.

Some observational and prospective cohort studies indicate a positive correlation between the consumption of intense sweeteners and the risk of obesity, hypertension, and cardiovascular events [80, 81]. However, these associations can largely be explained by an increase in the consumption of intense sweeteners to compensate for an incorrect diet and/or lifestyle [82]. Randomised and controlled intervention studies indicate the beneficial role of intense sweeteners, especially in combination with behavioural therapy [83, 84]. A meta-analysis of 20 randomised clinical trials showed that study participants consuming products with intense sweeteners showed significantly lower body weight compared to people not consuming this type of products [85].

Intense sweeteners can be considered good sugar substitutes, which, provided that the permitted doses are not exceeded, can be safely used by overweight and obese adults. Products that have a calorific value partially or completely reduced by the use of low-calorie sweet-

eners (for example: drinks, jellies, ice cream, dairy products, etc.) may be a practical solution for aware patients, depending on the level of calorie reduction in the final product/diet. It is important to pay attention to their energy value and fat content when including light products containing sweeteners in the diet of patients. Consumption of products with reduced calorie content due to the use of intense sweeteners should not be the only element of lifestyle changes in the treatment of excessive body weight.

5.6. PROBIOTICS, SYNBIOTICS, AND POSTBIOTICS

R.18. The use of probiotics, synbiotics (combination of a probiotic with a prebiotic), and postbiotics supporting weight reduction in overweight and obese people is not routinely recommended.

R.19. A dietitian may consider including probiotics, synbiotics, and postbiotics in the dietary treatment process, especially in the case of coexisting gastrointestinal diseases, metabolic disorders, with a risk of side effects associated with pharmacotherapy, and before planned surgery (especially in the abdominal cavity and gastrointestinal tract) and /or bariatric surgeries.

The results of scientific studies based on meta-analyses of randomised clinical trials confirm the safety and effectiveness of such a procedure to reduce the risk of infections associated with pharmacotherapy (especially for the prevention of *Clostridioides difficile* infection in connection with antibiotic therapy) [86, 87] and in the perioperative period or if other adverse reactions occur related to the operation [88].

Intestinal microbiota disorders, by affecting the immune, endocrine, and nervous systems and the intestinal barrier, may adversely affect lipid metabolism and energy homeostasis. In addition, disruption of the microbiota and intestinal barrier function may result in the translocation of antigens and other harmful substances of bacterial origin, which may be related to chronic systemic inflammation, which also adversely affects metabolism and promotes the development of fatty liver disease and its complications [89, 90].

Recent systematic reviews and meta-analyses indicate that taking probiotics and/or postbiotics has the potential to reduce weight gain and waist circumference, improve some metabolic parameters, and become an effective strategy to prevent and support the treatment of obesity in adults [91-93]. Noteworthy are studies on the Polish population, in which an improvement in metabolic markers was observed after administration of a multi-strain probiotic in obese postmenopausal women [94-96]. Moreover, probiotics can be used in obese patients with comorbidities such as irritable bowel syndrome (IBS) [97], non-alcoholic fatty liver disease [98], and polycystic ovaries syndrome (PCOS) [99]. Another specific situation in which probiotics and synbiotics should be considered is major surgery, including bariatric surgery. Based on systematic literature reviews and meta-analyses, their use has been shown to reduce the risk of side effects and local and systemic infections associated with surgery [88, 100]. However, the determination of the specific place of probiotics and the selection of specific strains of probiotic bacteria in the dietary treatment of overweight and obesity requires further research. Of particular interest is the possibility of using postbiotics (preparations obtained from non-living microorganisms and/or their components, the use of which brings health benefits), which include pasteurised *Akkermansia muciniphila* Muc^{T}. This product gained the status of Novel Foods EFSA Panel on Nutrition [101]. In a "proof of concept" study conducted on overweight and obese people, it was shown that the administration of pasteurised *Akkermansia Muciniphila* Muc^{T} improved insulin sensitivity, decreased insulin, total plasma cholesterol, body weight, body fat mass, and hip circumference, and reduced levels of markers of liver dysfunction and inflammation [102]. It should be emphasised that the examined people did not have the recommended lifestyle modification.

Also noteworthy is the new research on the role of probiotics in the prevention and mitigation of viral infections and their complications (influenza, rhinovirus, respiratory syncytial virus), including SARS-CoV-2 virus infection, especially in patients with abnormal body weight at an increased risk of serious complications from the upper respiratory tract, the circulatory system, and the digestive tract [86, 103, 104].

5.7. PHYSICAL ACTIVITY

R.20. All people with excessive body weight should be physically active on a regular basis.

In people with excessive body weight, in addition to a healthy diet, it is necessary to implement regular physical activity. Many overweight and obese people have certain limitations regarding the possibility of performing physical exercises, which is why it is important to individually select the type and duration of exercise after consulting a professional (physiotherapist, personal trainer). It is suggested that the patient starts with moderate intensity activity, and for patients in poor condition, light-intensity activity. Unless contraindicated, 150 to 420 minutes or more of physical activity per week is recommended. Physical activity exceeding 150 minutes/week allows body weight reduction by about 2-3 kg, while higher intensity (220-420 minutes/week) allows body weight reduction by up to 5-7.5 kg [49, 105].

TABLE 10. Recommendations for physical activity in weight reduction and weight maintenance

Weight maintenance	150-250 min/week	Be active every day or no less than every second day of the week; avoid consecutive days without physical activity; limit time in a sedentary position; gradually increase the intensity of physical activity
Weight reduction	150-420 min/week	
Maintaining reduced body weight	200-300 min/week	

Combining dietary treatment with well-planned, moderate physical exercise may give better results in terms of weight reduction; improving body composition, including reducing body fat; improving insulin sensitivity; increasing mitochondrial biogenesis; improving metabolic parameters, improving respiratory efficiency; improving the efficiency of the circulatory system and the musculoskeletal system; mental health and sexual health; and maintaining body weight after the weight loss process is completed.

Studies confirm that in adults and older people, 30-60 minutes of physical activity (moderate and/or vigorous) on most days of the week (about 2.5 hours a week) reduces the risk of death from various causes and reduces the risk of cardiovascular disease, cardiovascular events, hypertension, and type 2 diabetes. Increased physical activity increases energy expenditure, improves body composition by reducing body fat content, and reduces the risk of losing lean body mass.

Physical exercise, thanks to the anabolic effect, prevents the reduction of basic metabolism during weight loss, which prevents the "yo-yo" effect. Physical exercise also increases the ability to mobilise and oxidise fat, increases the sensitivity of tissues to insulin, lowers the concentration of total cholesterol and LDL cholesterol in the blood, lowers blood pressure, improves the efficiency of the musculoskeletal system, cardiovascular system, and respiratory system, and has a positive effect on well-being. Additional health benefits come from increasing physical activity (over 150 minutes/week) by increasing the intensity, frequency, and/or duration. Endurance and strength exercises are recommended [18, 105]. Recommendations for physical activity in weight reduction and maintenance are provided in Table 10. Before introducing intensive physical activity, specialist consultation is required.

5.8. BODY MASS REDUCTION IN PEOPLE OVER THE AGE OF 65 YEARS

R.21. The patient's advanced age is not a contraindication to obesity diet therapy; however, weight reduction should be carried out carefully to avoid a significant reduction in lean body mass.

Diet therapy for obesity in the elderly is a challenge for the dietitian because it is extremely difficult to change the eating habits established over many years in this group of patients. The aging of the body is associated with a lower metabolism rate, lower energy requirement, and low physical activity. Weight reduction in obese elderly patients is also associated with a reduction in lean body mass, which may adversely affect their nutritional status and increase the risk of malnutrition [106].

The goal of treating obesity in the elderly should be to maintain or improve the quality of life and physical fitness. The optimal method of dietary treatment of obesity in the elderly consists of a slight reduction in the diet energy value and the introduction of physical activity adapted to the patient's health and capabilities [107]. In the elderly, it is important to avoid a decrease in lean body mass, including muscle and bone mass, and to prevent or reduce the development of sarcopaenic obesity. In the case of older people with sarcopaenic obesity, diets with a lower energy deficit (200-500 kcal/day) and increased protein supply (1.5 g/kg/day) are recommended in the case of normal kidney function. Regular physical exercise, including flexibility, balance, aerobic, and resistance training, is an important element of obesity treatment in the elderly. It should be emphasised that obesity is associated with a higher risk of mortality in young and middle-aged people, while in the case of older people such a relationship is not observed. This phenomenon in the elderly is referred to as the obesity paradox [108, 109].

6. Principles of monitoring and evaluation of body mass reduction effectiveness

6.1. NUMBER OF CONTROL VISITS AND THEIR DURATION

R.22. The dietary treatment strategy for obese patients should include at least 12 visits (individual or group) within the first 6 months of therapy.

The optimal dietary treatment strategy assumes frequent, individual contact with the patient, for a period of not less than 6 months. In practice, dietary counselling can be provided in the form of individual meetings, group meetings, and meetings with the use of audiovisual techniques (telemedicine) and their combination. The greatest effectiveness in reducing and maintaining

body weight in adults is achieved by means of individual counselling. The optimal number of meetings (individual/group/in-person) should be at least 12 in the first 6 months and at least 6 in the subsequent 6 months of treatment. Obesity diet therapy should last not less than 3 months, and control meetings should not be less frequent than once a month.

The intensive program of dietary obesity treatment assumes individual meetings with the patient in the following arrangement: once a week for the first month of therapy; once every 2 weeks in the next 5 months of therapy; and once a month for the next 6 months of therapy [18].

The duration of visits for dietary counselling should be tailored to the individual needs and expectations of the patient. The visit devoted to gathering general information and nutritional history should not be shorter than one hour. The duration of other visits may be shorter (0.5 hours). The greatest changes in body weight are observed in the first 12-16 weeks of obesity diet therapy; however, the main goal of obesity treatment is to maintain the obtained effects in the long term. A satisfactory outcome of weight loss maintenance is no change or weight gain of less than 3 kg for 2 years and maintaining a waist circumference reduction of at least 4 cm.

6.2. ASSESSMENT OF NUTRITIONAL VALUE OF THE DIET

R.23. Monitoring the course of treatment of adults with excessive body weight should include an assessment of the nutritional value of the diet.

Regular control of the nutritional value of calorie-reduced diets used by obese patients is aimed at eliminating the risk of developing nutritional deficiencies, which may significantly reduce the effects of the recommended therapy. Qualitative and quantitative assessment of dietary recommendations allows their modification during the weight reduction process and adaptation to the patient's individual needs. The analysis of the implemented diet should be based on current data on the nutritional value of products and dishes with the use of ICT tools.

6.3. EDUCATIONAL MATERIAL FACILITATING COMPLIANCE AND DIET CONTROL

R.24. Adults with excessive body weight should receive educational materials concerning the diet therapy. The form of the materials should be adapted to the patient's expectations and cognitive abilities.

A dietitian should develop a daily food ration and/or a system of exchanges and suggest a few sample menus taking into account the patient's nutritional preferences, in a form that enables its practical use by the patient. Depending on the dietary scheme, it is also worth providing the patient with other dietary aids that facilitate the implementation of the recommendations. It is also important to monitor the principle of *mindful eating*, which draws attention to consciously eating a meal and focusing on this activity.

In addition, it is recommended that the patient be provided with a food diary in which it will be possible to record the type and amount of products consumed at a certain time during each day. To achieve the planned effects of a low-energy diet, it is important not only to systematically control the diet but also to properly plan self-control of the applied diet therapy, the feeling of hunger and satiety, physical activity, and the patient's well-being. The scope of nutritional education and the type and form of dietary aids used should be modified depending on the degree of implementation of recommendations and the effects of diet therapy.

7. Other methods of obesity treatment

7.1. PHARMACOTHERAPY

R.25. In people who fail to achieve weight reduction using behavioural therapy, the physician can decide to use pharmacological treatment, and in special cases, surgical treatment. However, even then, appropriate dietary treatment and physical activity tailored to the patient's abilities are essential.

Pharmacological treatment of obesity can be used along with an appropriate diet and physical exercise in people who have not achieved significant weight loss as a result of dietary and behavioural management and have not achieved the assumed therapeutic goals. According to the position of the Polish Society for the Treatment of Obesity from 2022, the introduction of pharmacotherapy should be considered in adults with a BMI $\geq$ 30 kg/m^2, and $\geq$ 27 kg/m^2 in the presence of other risk factors for cardiovascular diseases, prediabetes or diabetes, hypertension, dyslipidemia or obstructive sleep apnea after failure of behavioural therapy [16]. The decision to introduce pharmacotherapy is made by the doctor, and the choice of orlistat, or bupropion in combination with naltrexone remains available from the drugs registered for the treatment of obesity. Recently, the latest group of drugs, i.e. GLP-1 receptor agonists, has become available. Liraglutide is a drug from this group with a registered indication for weight control along with a low-calorie diet and increased physical exercise. The second incretin drug, semaglutide, is indicated for the treatment of type 2 diabetes in patients treated with at least 2 hypoglycaemic drugs, with obesity (defined as BMI $\geq$ 30 kg/m^2), and a very high risk of cardiovascular diseases.

For a dietitian, it is important to know the potential interactions of these drugs with food. Orlistat, the mechanism of action of which consists of blocking the activity of lipases in the gastrointestinal tract, so that fats from food are not hydrolysed and thus are not absorbed. Thanks to this action of the drug, the calories consumed by the body are limited. When using orlistat at the recommended doses, fat absorption is reduced by an average of 30%. Very little of this drug is absorbed from the gastrointestinal tract (less than 5%) [110, 111].

It is recommended to take this medicine immediately before, during, or up to one hour after each main meal containing fat, and if the patient does not eat a meal, or if the meal does not contain fat, the dose of orlistat should be omitted. Due to the risk of deficiencies of some nutrients, treatment with orlistat should not last longer than 6 months, and if the effect in the form of weight loss is not achieved, it is recommended that therapy be discontinued after 3 months of use. Since orlistat may reduce the absorption of fat-soluble vitamins (particularly vitamin D_3), it is recommended to use preparations with such vitamins and beta-carotene at least 2 hours before or after administration of the drug. Currently, orlistat is considered a third-choice drug in the pharmacological treatment of obesity [16, 111].

Another therapy supporting weight loss is the combination of bupropion with naltrexone, i.e. noradrenaline and dopamine re-uptake inhibitor with an opioid receptor antagonist. Co-administration of the 2 prolonged-release tablets with a high-fat meal increased bioavailability and maximum concentration (C_{max}) almost 1.5- and 2-times for bupropion and twice and almost 4 times for naltrexone, respectively. At a steady state, the presence of food led to a significant increase, especially for naltrexone AUC and C_{max}. These results indicate that such a combination of drugs should be taken during a meal [112].

AGLP-1 drugs stimulate insulin secretion depending on glucose concentration, inhibit glucagon production, and slow gastric emptying, thus improving glycaemic control and causing satiety in the patient after a meal. These drugs increase the body's signalling of satiety and decrease of hunger. Liraglutide is available as a solution for injection. There are no specific recommendations for administering this formulation with food, but it should be taken at the same time of day.

In January 2022, the European Medicines Agency (EMA) registered semaglutide for the pharmacological treatment of obesity. This medicine comes in the form of solutions for injection and tablets. In the case of subcutaneous administration, the tablets can be taken with or without food, the tablets should be administered on an empty stomach, and no food or liquids should be consumed for at least 30 minutes after taking the tablets [16, 111].

7.2. BARIATRIC SURGERY

R.26. Bariatric surgery is recommended in the treatment of class III obesity (BMI ≥ 40 kg/m^2), as well as in patients with a BMI of 35-40 kg/m^2, in whom the expected weight loss will contribute to a significant improvement in health.

R.27. Surgical treatment of obesity requires special supervision and control of the patient's nutrition in the period of preparation for surgery, as well as after surgery due to the risk of nutritional deficiencies and malnutrition.

Scientific research confirms the low effectiveness of conservative treatment of obesity of a greater degree. The effects of such treatment are often unsatisfactory and short-term [113]. Surgical treatment of obesity (bariatric surgery) has not only proven its effectiveness in the treatment of morbid obesity but also has a positive metabolic effect. As a result of a significant reduction in body weight, complications of morbid obesity such as hypertension, dyslipidaemia, type 2 diabetes, or non-alcoholic fatty liver disease regress. Bariatric surgeries can contribute to prolonging the patient's life and significantly improving its quality [114, 115].

The criteria for qualifying patients for bariatric treatment are described in detail in the Polish recommendations on bariatric and metabolic surgery [116]. According to the recommendations, bariatric procedures are recommended to patients aged 18-65 years who meet the following criteria:

- body mass index BMI ≥ 40 kg/m^2;
- body mass index BMI between 35 and 40 kg/m^2 in patients for whom surgical treatment of obesity may additionally result in clinical improvement in diseases/disorders coexisting with obesity (including type 2 diabetes, cardiovascular diseases, non-alcoholic steatohepatitis, non-alcoholic fatty liver disease, significant social and psychological problems);
- surgical treatment of obesity may also be considered in patients with BMI in the range of 30.0-34.9 kg/m^2 and type 2 diabetes if hyperglycaemia persists despite the use of oral drugs and insulin;
- for patients who have previously undergone bariatric procedures, in which the therapeutic effect was not achieved (concerning weight reduction or regression of obesity-related diseases), a revision procedure should be proposed.

The BMI criteria concern the highest value of this indicator documented in the patient's medical history. Contraindications to bariatric surgery are not BMI values lower than those listed in the recommendations if it was obtained as a result of weight reduction before the planned surgery. The lack of documented attempts

to reduce body weight before planned bariatric surgery using behavioural methods is not a contraindication to the procedure in the group of adults [116].

Patients qualified for surgical treatment of obesity should be provided with comprehensive care by a therapeutic team, including a dietitian specialising in the diet therapy of bariatric patients. Dietary consultations and nutritional education should take place systematically, both before and after surgery, according to a previously agreed schedule. A dietician should explain to the patient that the long-term success of therapy, apart from surgery, is influenced by lifestyle, including, above all, diet [117, 118].

Before, during, and after bariatric surgery, the patient remains under the care of a therapeutic team consisting of doctors, including a bariatric surgeon and anaesthesiologist, a dietitian, a nurse, a psychologist or a psychiatrist, and a physiotherapist. In the preoperative period, the patient should start using a properly planned low-energy diet, which reduces the risk of peri- and postoperative complications and prepares the patient for further dietary modifications. The purpose of meetings with the patient before the planned operation is nutrition education. The patient's diet should be assessed, nutritional errors discussed and corrected, and a thorough interview should be conducted on the attempts to reduce body weight and factors influencing its regain (e.g. consumption of sweetened beverages, alcohol, stress, work mode). During the dietary interview, it is also recommended to assess the patient's attitude to change and his/her motivation. It is worth emphasising that a dietitian should help the patient in setting a realistic goal that the patient will aim to achieve [117, 119]. Dietary care should also include the peri-procedural period, requiring the use of modifications typical for procedures on the gastrointestinal tract (recommendations of an easily digestible diet, first with a changed consistency, then switching to a solid diet) and the period after the procedure, related to the continued adherence to a low-energy diet.

Changing the patient's diet should be based on regulating the time of meals and a conscious choice of food products (preferably as little processed as possible). The patient should also be trained in chewing food thoroughly and refraining from drinking fluids before, during, and just after a meal, which is an important element of postoperative diet therapy. The patient should also change culinary techniques, give up eating meals in fast food restaurants, replace sweet and salty snacks with vegetables and fruits, and exclude sweetened and carbonated drinks in favour of still water. Patients can be recommended the DASH diet and the Mediterranean diet.

Data indicate that people with obesity, due to high consumption of high-calorie, processed food of low nutritional value, alcohol overuse, and the use of pharmacotherapy (for example diuretics, drugs that inhibit the secretion of hydrochloric acid, containing proton pump inhibitors and metformin) may be exposed to vitamin (thiamine, cobalamin, folates, vitamins D and A) and mineral (iron, zinc, copper) deficiencies [120, 121]. Therefore, it is important to provide this group of patients with specialist dietary care in the perioperative period to compensate for existing deficiencies and prevent the occurrence of new ones. In addition, in 2019, it was shown that patients who corrected the identified deficiencies before planned bariatric surgery did not develop new deficiencies during the first year after surgery. On the other hand, in patients whose deficiencies were not compensated, despite supplementation, the deficiencies deepened and/or new ones developed [121].

The diet of a bariatric patient in the postoperative period should ensure a negative caloric balance with an appropriate supply of macro- and micronutrients, which will result in a progressive reduction of body weight, with minimal risk of nutritional deficiencies. It is recommended that the patient consumes meals in such a way as to avoid unpleasant ailments that may occur after surgery, e.g. abdominal pain, vomiting, diarrhoea, constipation, or postprandial syndrome [117].

The basis of diet therapy is proper hydration of the body (at least 1.5 l of water/day) and regular preventive supplementation. In 2019, an update of the guidelines for supplementation in bariatric patients was released [123]:

- vitamin B_1 – min. 12 mg/day, and in patients with higher risk 50-100 mg/day;
- vitamin B_{12} – 350-1000 μg/day orally or in tablet/liquid form; intra-nasally as prescribed by a doctor or 1000 μg/month intramuscularly;
- folic acid – 400-800 μg/day from a multivitamin preparation or 800-1000 μg/day in women of childbearing age;
- calcium – doses depend on the type of surgery. In patients after sleeve gastrectomy, a dose of 1200-1500 mg/day should be used. Doses should be divided. Calcium carbonate should be taken with meals and citrate with or without meals;
- vitamin A – the dose of prophylactic supplementation depends on the type of surgery; after sleeve gastrectomy and gastrointestinal bypass, a dose of 5000-10,000 IU/day should be used; higher doses may be used in those with a history of vitamin A deficiency; pregnant women should be given special care;
- vitamin E – 15 mg/day; higher doses can be given to patients with a history of vitamin E deficiency;
- vitamin K – 90-120 μg/day; higher doses can be given to patients with a history of vitamin K deficiency; pregnant women should be given special care;
- vitamin D – the dose should be selected based on the concentration of vitamin D in the blood serum; however, it is recommended to use min. 3000 IU/day to achieve 25(OH)D > 30 ng/ml;
- iron – in men and people without a history of anaemia min. 18 mg/day from a multivitamin preparation or 46-60 mg/day in menstruating women and people

with a history of anaemia. Importantly, the iron supplement should not be taken together with preparations containing calcium or in the company of drugs that inhibit the secretion of hydrochloric acid in the stomach, or during meals rich in phytates and polyphenols;
- zinc – 8-11 mg/day (sleeve gastrectomy) and 8-22 mg/day (gastrointestinal bypass); the supplementation protocol should include a supplementation ratio of 8-15 mg of zinc per 1 mg of supplemented copper to reduce the risk of copper deficiency;
- copper – 1 mg/day (sleeve gastrectomy) and 2 mg/day (gastrointestinal bypass); the supplementation protocol should include a supplementation ratio of 1 mg of copper for every 8-15 mg of supplemented zinc to reduce the risk of copper deficiency.

The document cited above also contains instructions on how to treat possible deficiencies.

The energy supply in patients after bariatric surgery is not clearly defined. Observational studies show that patients initially consume about 500 kcal, and after a year the energy value of the diet reaches about 1200 kcal [117, 124]. Other studies show that patients consume 1200-1500 kcal just 6 months after surgery, and 1500-1800 kcal after a year [123].

The protein intake depends on the type of surgery performed. Patients after sleeve gastrectomy should consume about 60-80 g of protein per day (1.5 g/kg of ideal body weight/day). After bypassing the gastrointestinal tract, the protein supply should be as much as 60-160 g per day. In individual cases, a higher protein supply, even up to 2.1 g/kg of ideal body weight, may be beneficial. About 40-45% of the energy of the diet should come from carbohydrates and 20-35% from fats. Research also shows that a significant proportion of patients do not achieve the recommended protein intake from a conventional diet, even many months after surgery, which is associated with lower stomach capacity and poor tolerance to high-protein products (e.g. meat and dairy products). Adequate protein intake is extremely important in this group of patients because it protects against the loss of lean body mass, gives a feeling of satiety and reduces the risk of deficiencies. A reasonable course of action in this case seems to be the addition of about 30 g/d of a protein supplement to a conventional diet (preferably in liquid form) [117].

The postoperative diet consists of 5 stages (of variable consistency): liquid diet (1-2 days), liquid reinforced diet (5-14 days), easily digestible mushy diet (2-8 weeks), easily digestible solid diet (2-8 weeks), and low-energy diet. The individual stages differ in duration, depending on the type of procedure performed and the patient's well-being. Conducting systematic nutritional education seems to be necessary to obtain long-term treatment effects. However, there are no universal guidelines that would present the scheme of dietary care implemented in the long term after surgical intervention. Moize *et al.* [125] proposed a food pyramid for patients after gastrointestinal bypass and the following recommendations:
- eating 3 balanced meals and 2 snacks a day;
- drinking mostly water, avoiding sweet and sparkly beverages;
- chewing food thoroughly and eat small portions;
- eating slowly, at least 20 minutes;
- eating the recommended portions and avoiding overeating;
- taking recommended vitamin and mineral supplements daily;
- avoiding overcooked food and eating leftovers;
- avoiding drinking while eating, educating the patient to drink beverages 30 minutes before a meal and 30 minutes after a meal to avoid unpleasant symptoms such as vomiting, diarrhoea, and a quick feeling of hunger after a meal.

Cambi and Baretta [126] proposed the bariatric plate model (BPM) for patients after surgical obesity treatment. This concept can be easier for patients to understand. This model assumes that half of the daily intake should be good sources of protein (meat, eggs, dairy products, legumes), 30% vegetables and fruits (a source of vitamins, minerals, and dietary fibre), and 20% cereal products (preferably whole grains). The patient should remember about daily, regular supplementation (protein, vitamins, minerals), physical activity, and proper hydration of the body (preferably 30 ml/kg b.w.).

Despite the ever-increasing popularity of surgical treatment of obesity, long-term follow-up is extremely difficult because patients resign from post-operative follow-up, which increases the risk of discontinuation of supplementation, nutritional deficiencies, and weight regain [127]. Studies show that despite the reduction of the total energy value of the diet, the diet of patients is deficient in terms of micronutrients and protein and is characterised by excessive consumption of fats [128].

8. Benefits from body weight reduction

The management of obesity is a long-term process that requires the integrated action of several specialists. The potential benefits of weight reduction may have a multi-directional beneficial effect on the patient's health, and length and quality of life. Weight reduction can bring additional physical, metabolic, endocrine, and psychological benefits to patients with obesity, leading to the following:
- changes in body composition (decrease in fat tissue and increase in lean body mass);
- normalisation of the lipid profile (lowering total cholesterol, LDL cholesterol, and triglycerides in the blood, while increasing HDL cholesterol);
- lowered level of glucose in the blood and increasing insulin sensitivity;

- improved blood pressure;
- reduced risk of several diseases, including cardiovascular diseases, type 2 diabetes, cancers (colon, breast, ovarian and prostate), liver and bile duct diseases, and degenerative joint diseases;
- reduced risk of death;
- reduced drug doses (hypotensive, hypoglycaemic);
- improved physical performance and sleep quality;
- psycho-emotional benefits: increased self-esteem and self-acceptance, improved mood, reduced risk of depression;
- improved quality of life [18].

9. Future directions

The future direction of care of people with obesity should include a range of multi-level strategies and interventions provided by a team of qualified professionals focused on improving the spread and effectiveness of care and increasing support for individuals with obesity.

We have identified the following main lines of simultaneous action:

1. Special attention should continue to be paid to educational projects/programmes aimed at **increasing awareness and public knowledge of** obesity, its risk factors, consequences (health, psychosocial, and economic), prevention activities, and obesity treatment interventions in different population groups, with simultaneous building of social support for people with obesity.
2. In times of increasing awareness of the connections between daily choices (including dietary ones), health, and environmental impact, a sustainable diet dominated by plant-based products should be promoted. Hence, it is not only important to provide an individualised approach to the treatment of obesity, but also to be able to incorporate elements of global sustainable lifestyle strategies in the prevention and treatment aspects of diet-related diseases. This involves monitoring and verifying the health benefits of plant-based diets in the management of obesity, with a particular focus on their impact on reducing the risk of cardiovascular disease and type 2 diabetes.
3. **The use of new technologies.** The use of new technologies, such as telemedicine, digital platforms, artificial intelligence, and mobile apps developed by specialists in the relevant areas can be helpful to increase outreach and maintain constant/regular contact with patients.
4. **Multi-centre studies on the long-term health effects of pharmacotherapy for obesity.** It is also worth considering interdisciplinary, multi-centre collaborative projects to investigate the long-term health effects of different intervention strategies in the treatment of obesity, including the increasingly used pharmacotherapy, to develop a holistic therapeutic approach.
5. Investigating the role of modern diagnostic technologies, including metabolomics, proteomics, and genomics, in identifying biomarkers associated with obesity and the response to specific dietary strategies.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTIONS

DG prepared research concept and design of the publication. DG, EL, PK, ABD, SG, WG, WM, LP, EPG, PP, LPS, KS, JMR wrote the article. All authors took part in preparation of the final version of the manuscript.