

WHO guideline on the integrated management of obesity in adolescents



World Health
Organization



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Abbreviations

ALT	alanine aminotransferase
BMI	body mass index
CI	confidence interval
EDC	endocrine-disrupting chemicals
EMA	European Medicines Agency
FAO	UN Food and Agriculture Organization
FDA	United States Food and Drug Administration
GDG	Guideline Development Group
GLP-1 RA	glucagon-like peptide-1 receptor agonists
GRC	WHO Guidelines Review Committee
IMCI	Integrated Management of Childhood Illness
ICF	WHO International Classification of Functioning, Disability and Health
MID	minimally important difference
MBS	metabolic bariatric surgery
PICO	population, intervention, comparison, outcome
PUFA	polyunsaturated fatty acid
RCT	randomized controlled trial
RoB	risk of bias
RR	relative risk
SCT	social cognitive theory
SD	standard deviation
SMD	standard mean difference
WHO	World Health Organization
YQOL	youth quality of life

Glossary

Access (to health services): The ability, or perceived ability, to obtain appropriate health services when needed. Barriers to access may involve finances, geography, epidemiology, and cultural or sociological issues.

Adolescent: A person in the phase of life between childhood and adulthood, from 10 to 19 years of age.

Carers (also called caregivers, or informal carers): Individuals who provide care for a member or members of their family, friends or community. They may provide regular, occasional, or routine care, or be involved in organizing care delivered by others. Carers are in contrast with providers, who are associated with a formal service delivery system, whether paid or volunteer (formal caregiver).

Care pathway (also called clinical pathway): A structured multidisciplinary management plan that maps the route of care through the health system for individuals with specific clinical problems. A care pathway includes clinical guidelines.

Child: A person under 19 years of age. This includes *newborn* or *neonate* (the first 28 days of life); *infant* (29 days to less than 12 months of life); *toddler* (from 12 months to less than 3 years of age); *pre-school-aged* (from 3 to less than 5 years); *school-aged* (from 5 to less than 10 years); and *adolescent* (from 10 to 19 years).

Clinical guidelines: Systematically developed recommendations that support health workers and patients to make decisions about care in specific clinical circumstances. They often include recommendations for diagnosis, treatment, and management of specific diseases or conditions, and address screening methods, follow-up care, and patient education.

Continuum of care: The spectrum of personal and population health care needed throughout all stages of a condition, injury, or event throughout a lifetime. It may include health promotion, disease prevention, diagnosis, treatment, rehabilitation, and palliative care.

Disability: The experience of any condition that makes it more difficult for a person to do certain activities or have equitable access within a given society. Disabilities may be cognitive, developmental, intellectual, mental, physical, sensory, or a combination of multiple factors.

Empowerment: A process whereby individuals and communities gain greater control over the decisions and actions that affect their lives. This includes having the knowledge, skills, and freedom to make their own choices, express their needs, and influence the factors shaping their well-being.

Equity in health: The absence of systematic or remediable differences in health status, access to health care and health-enhancing environments, and treatment in one or more aspects of health across populations or population groups defined socially, economically, demographically or geographically within and across countries.

Essential medicines: Medicines that satisfy the priority health care needs of the population and are selected based on public health relevance, on evidence of efficacy and safety, and on comparative cost-effectiveness. They are selected with consideration of disease prevalence and the effectiveness of treatments. The WHO Model Lists provide a blueprint for national authorities to adapt according to local health priorities, thereby improving access to necessary medications.

First level of care: The point of entry into the health care system at the interface between services and community. When the first level of care satisfies specific quality criteria, it is called primary care. See: primary care.

Functioning: The dynamic interaction between an individual's health conditions and contextual factors (both environmental and personal). It refers to the ability to perform daily activities and engage in social roles, considering a person's body functions and structures, their activities, and participation in life situations.

Gender equality: The process of being fair to people of all genders. To ensure fairness, strategies and measures must be available to compensate for women's, girls' and gender minorities' historical and social disadvantages that prevent women, men, girls, boys and gender minorities from otherwise operating on a level playing field. Equity leads to equality.

Health: A state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity.

Health benefits package: A benefits package that defines the specific health care interventions, services, and programmes that will be provided to the population. It serves as a key tool for achieving universal health coverage by specifying what services are covered, who can receive them, and what proportion of the cost is covered.

Health in All Policies: An approach to public policies across all sectors, to improve population health and health equity. It systematically takes into account the implications of decisions on health and health systems, seeks collaborations and avoids harmful health impact. In addition, it emphasizes the effect of public policies on health determinants and aims to improve the accountability of policymakers for the effects on health of all levels of policy-making.

Health service: Any service aimed at contributing to improved health or to the diagnosis, treatment and rehabilitation of individuals and populations.

Health worker, health professional: People who study, advise on or provide preventive, curative, rehabilitative and promotional health services, based on an extensive body of theoretical and factual knowledge.

In all their diversity: The acknowledgement, respect, and inclusion of everyone, recognizing their unique differences and characteristics such as gender, age, race, ethnicity, sexual orientation, religion, disability and more. It is a concept used to promote inclusion and ensure that policies and actions are made with the understanding that individuals within a group are not a monolith and may have varying needs and experiences.

Integrated health services: The management and delivery of health services provided, ranging from health promotion to disease prevention, diagnosis, treatment, disease management, rehabilitation and palliative care through the different functions, activities and sites of care within the health system.

Mental health: A state of well-being in which every individual realizes their own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to their community.

Multisectoral action on health: The collaboration between the health sector and non-health sectors for policy development, implementation and other actions which address social, economic and environmental determinants of health and associated commercial factors or improve health and well-being. Examples include involving agriculture and trade ministries developing or implementing nutrition policies.

Obesity-associated disability: Impairments or health conditions associated with obesity that interact with personal and environmental factors and that result in negative consequences. Impairments may include physical limitations due to excess body weight; symptoms associated with type 2 diabetes, hypertension, and other chronic diseases; and mental health issues such as anxiety and depression. Negative consequences may include a lack of access to the environment, stigma, discrimination, and lack of access to health care.

People-centred care: An approach to care that deliberately considers the perspectives of individuals, carers, families and communities as both participants in and beneficiaries of health systems that respond to their needs in humane and holistic ways. People-centred care also requires that people have the education and support they need to make decisions and participate in their own care.

Personal health services: Health services that target the individual. These include health promotion, disease prevention, timely diagnosis and treatment, rehabilitation, palliative care, acute care and long-term care services.

Population-based approach: An approach to health services that uses information about the population to make decisions about health planning, management, and geographical location. It seeks to improve the effectiveness and equity of interventions, and to achieve improved health and distribution of health in the context of the culture, health status, and health needs of geographical, demographic, or cultural groups.

Population health services: Health services targeted at the population as a whole, with the aim of improving health and well-being on a large scale.

Primary care: A key process in the health system that supports first-contact, accessible, continued, comprehensive and coordinated patient-focused care.

Primary health care: A society-wide approach to health that aims to maximize the level and distribution of health and well-being through three components: (a) primary care and essential public health functions as the core of integrated health services, (b) multisectoral policy and action, and (c) empowered people and communities.

Primary health care-oriented health system: A health system organized and operated to guarantee the right to the highest attainable level of health as the main goal, while maximizing equity and solidarity. A primary health care-oriented health system is composed of a core set of structural and functional elements that support achieving universal coverage and access to services that are acceptable to the population and equity enhancing.

Referral: Directing an individual to the appropriate facility or specialist in a health system or network to address relevant health needs. Counter-referral may occur when an individual is directed back to primary care for follow-up after a procedure in secondary or tertiary care.

Referral form: A standardized form throughout the network of service providers that ensures that the same essential information is provided whenever a referral is initiated. It is designed to facilitate communication in both directions: the initiating facility completes the outward referral, and at the end of care, the receiving facility completes the counter-referral to the original facility.

Sex: Refers to the different biological and physiological characteristics of females, males and intersex persons. Characteristics include chromosomes, hormones and reproductive organs.

Well-being: A multidimensional construct aiming at capturing a positive life experience, frequently equated to quality of life and life satisfaction. Measures of well-being typically focus on reported outcomes covering a wide range of domains, such as happiness, positive emotions, engagement, meaning, purpose, vitality and calmness.

Executive summary

Obesity has important, negative effects on the physical and mental well-being, educational attainment and quality of life of adolescents (1, 2, 3).

The World Health Organization (WHO) defines childhood as the period from 0 to 19 years of age. *Newborn* or *neonate* refers to the first 28 days of life; *infant* refers to ages 29 days to less than 12 months; *toddler* to 12 months to less than 3 years; *pre-school-aged* to 3 years to less than 5 years; *school-aged* to 5 to less than 10 years; and *adolescent* to 10 to 19 years (4, 5, 6). The WHO International Classification of Diseases 11 (ICD-11) defines obesity as “a chronic complex disease defined by excessive adiposity that can impair health. It is in most cases a multifactorial disease due to obesogenic environments, psycho-social factors and genetic variants”.

Childhood obesity predisposes the early onset of other noncommunicable diseases and obesity in adulthood (3, 7). With a high prevalence of existing childhood obesity in many communities worldwide, effective measures for obesity management are essential to protect the health of adolescents during these formative and vulnerable periods of life (1, 2, 7).

Scope and purpose, objectives, and target audience

This guideline aims to provide Member States and their partners with adoptable and adaptable, clear, practice- and science-informed global clinical and public health recommendations on the integrated management and care of adolescents in all their diversity 10 to 19 years of age with obesity for improved health, functioning and reduced obesity-associated disability, using a primary health care approach. Recommendations are grounded in gender equality, equity and human rights, to ensure that no one is left behind. “In all their diversity” recognizes the uniqueness of each adolescent, promoting inclusion, policies, and actions that acknowledge varying needs and experiences.

The scope of this work is on primary health care-based interventions, including but not limited to diet therapy; physical activity, sleep hygiene and sedentary behaviours; behaviour changing interventions; multimodal interventions; digital health interventions; pharmacological interventions; and weight-control related surgery. Recommendations consider the perspective of the individual, the community, the multiple sectors involved and the health systems.

The primary target audiences include decision-makers and public health policymakers in ministries of health and other offices at the national, sub-national and local levels. This guideline is also aimed at health workers, including providers at the primary care level, integrated health programme managers, and health system managers. The recommendations

are of interest to non-governmental and other organizations as well as professional societies involved in planning and managing interventions for adolescents with obesity, and other health and well-being actions. The guideline can be used to inform the general public, as well as parents and caregivers of adolescents with obesity.

Guideline development methodology

This guideline adheres to the procedures set out in the WHO Handbook for guideline development (8). The WHO Obesity Steering Committee, led by the Department of Nutrition and Food Safety, oversaw the entire guideline development process. The Guideline Development Group (GDG) included individuals with a range of expertise, skills, and perspectives related to the management of adolescents with obesity. Members represented diversity in sex, age, and geography.

A second relevant guideline for obesity management in children was completed following an independent guideline development process. Each guideline had its own GDG. The guideline for obesity management in children can be accessed [here](#).

The WHO Obesity Steering Committee drafted an initial list of questions and outcomes for guideline development. This list was subject to a public notice and comment. The results were discussed by the GDG, which approved a final list of questions and outcomes that was then ratified by the WHO Guidelines Review Committee (GRC).

Each question was addressed through evidence retrieval, assessment and synthesis carried out according to guidance from WHO (8), Cochrane (9, 10), and GRADE (11). A team of systematic reviewers participated in the guideline development process by presenting evidence and identifying research priorities. The GDG considered additional factors for the implementation of revised obesity management guidelines, including equitable access to health care (12).

The outcomes considered by the GDG to be critical for decision-making were 1) body mass index (BMI)/BMI z-score reduction, stabilization and/or maintenance (kg/m^2), 2) weight reduction, stabilization and/or maintenance (kg), 3) physical well-being (functional mobility, self-care, getting along, life activities and participation, as defined by trialists), 4) mental well-being (anxiety, stress, depression, isolation, self-esteem, body image, suicidal ideation, eating disorders, as defined by trialists), 5) physical activity (type, duration, intensity, frequency, as defined by trialists), 6) overall quality of life, 7) blood pressure, 8) adiposity and fat distribution (objective measures: dual energy x-ray absorptiometry, magnetic resonance, as defined by trialists; anthropometric measures: skinfolds, waist-to-hip ratio, waist circumference, as defined by trialists), 9) adverse events associated with the interventions, 10) presence of obesity-coexisting conditions (any other noncommunicable disease), and 11) obesity-associated disability.

The outcomes considered to be important for decision-making were 1) hyperinsulinemia [1.7 mmol/L (30 mg/dL)] or higher when 1 mg of glucagon is administered intramuscular or intravenous (or as defined by trialists), 2) resistance to insulin (as defined by trialists), 3) glycaemia (in mg/dL , fasting), 4) alterations in lipid metabolism or in adipogenesis and fat accumulation, 5) lipid hormones (for example, leptin or adiponectin), 6) alterations in hunger or satiety (as defined by trialists), 7) reduced disability in any of the functionality domains according to the WHO International Classification of Functioning, Disability and Health (ICF), 8) mortality, 9) prevalence of obesity in adulthood, and 10) access to health services. Outcomes were also informed by evidence on views, values, and preferences of adolescents with obesity, as well as of health workers, family members and community members.

The WHO Secretariat presented a comprehensive, objective synthesis of the evidence to the WHO Obesity Steering Committee and the GDG to inform the recommendations.

When discussing and deciding on recommendations, the GDG considered the results of the evidence retrieval, synthesis and assessment and of evidence-to-decision frameworks, such as the balance between benefits and harms, stakeholders' values and preferences, costs, cost effectiveness, equity considerations, acceptability, and feasibility. In addition, they explicitly took into consideration factors of human rights and sociocultural adaptability, societal implications, health system considerations, implementation, monitoring and evaluation, and research gaps. Prior to the meetings, all experts participating in WHO meetings declared any interest relevant to the meeting and potential conflicts were managed accordingly. Participants of the GDG meetings took part in their individual capacity and not as institutional representatives.

The final draft guideline was peer-reviewed by an external review group and was subject to public comment and notice. The final version was reviewed by the GDG and ratified by the WHO GRC.

Recommendations, justifications and remarks

Dietary interventions

Recommendation

WHO recommends a structured dietary intervention as one of the components of the integrated management of adolescents with obesity. It should consider age, gender, health status, food preferences and meal frequencies, nutritional education, cultural context, and the adolescent's interests, values and preferences. It should be delivered and supervised by health workers with knowledge on nutrition and involve parents and/or caregivers.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG voted for a strong recommendation because the balance between benefits and harms favours dietary interventions.

Benefits are small, and vary depending on the type of diet; however, the risk of adverse events is low. Adolescents and their parents or caregivers placed a high value on the potential benefits of dietary interventions for obesity management. Acceptability and feasibility are enhanced when dietary interventions involve peers and family members and when they consider societal and cultural norms. Dietary interventions are likely to be cost-effective because of their potential to prevent obesity and chronic diseases in the long term. However, the GDG also considered that financial constraints may prevent families from affording healthy food choices. The effect on equity is unclear; gender, culture, socioeconomic status, and parental or caregiver involvement have a direct impact on food insecurity and health disparities.

Evidence on dietary interventions was limited in the number and quality of studies. A small effect of dietary treatments for less than six months compared to no dietary changes was identified for the critical outcomes of weight and BMI.

Dietary modifications are usually aimed at reducing total energy intake and include, but are not limited to, caloric content restriction (normal or reduced energy intake), varying macronutrient distribution or composition (low carbohydrate, high protein, low fat, omega-3 rich, polyunsaturated fatty acid (PUFA)-rich, or ketogenic), restriction of particular components (low in salt, low in sugar, high in fibre, no food additives, low in industrialized products currently known as ultra-processed

foods, or low glycaemic index (GI) foods), and dietary patterns (Mediterranean, American Heart Association, whole foods, complex carbohydrates or time-restricted diet).

Remarks

Dietary interventions require evaluation by health workers with nutrition knowledge, the inclusion of a physical and mental health evaluation, the family and personal history and environment, and an assessment of risk factors for eating disorders. Health workers should be able to communicate in an empathetic, non-stigmatizing, motivational, and culturally responsive manner, and to display competencies of interdisciplinary collaboration.

WHO supports the consumption of a healthy diet to protect against malnutrition in all its forms as well as against noncommunicable diseases. The keys to a healthy diet include breastfeeding during the first two years of age, with exclusive breastfeeding for the first six months of life; consuming a combination of foods while avoiding monotonous diets; eating plenty of fruits, vegetables, and legumes daily; moderating the consumption of fat; and limiting salt and sugar intake.

Diets need to be universal in their application, based on human biology and underpinned by evidence. According to the statement by WHO and FAO, a healthy diet needs to be adequate, balanced, moderate and diverse. Individual characteristics (for example age, gender, lifestyle and degree of physical activity), cultural context, locally available foods and dietary customs will determine the exact make-up of a diversified, balanced and healthy diet, although the basic principles remain the same. The guidelines and codes of practice included in Codex Alimentarius standards provide potentially relevant advice regarding nutrient compounds that may be used in special dietary foods for infants and children, formula foods for weight control diets, as well as labelling of and claims of prepackaged foods for dietary uses.

Dietary interventions allow school and community involvement in obesity management services by coordinating with caregivers and health workers to provide appropriate foods. This also helps to initiate, support and sustain dietary practices change.

Adolescents and their parents or caregivers prefer interventions that are affordable and easy to apply, including a structured meal plan, hands-on activities, and fun approaches to promoting healthy eating habits. Acceptability is enhanced when dietary interventions are tailored to age and cultural patterns.

The initiation and follow-up of a diet plan require the participation of the adolescent and their parents or caregivers, services with structured guidance, and consideration of the schedule of parents or caregivers to facilitate compliance and engagement with the intervention.

Mental health issues such as anxiety, depression, low self-esteem, and emotional dysregulation may lead to unhealthy eating behaviours. Health workers should address obesity and mental health conditions in the primary health care setting early and together, using inclusive, developmentally appropriate, and family-engaged strategies.

Dietary behaviours are influenced by complex factors, including gender, culture, socioeconomic status, and parental and caregiver involvement, with early education and the environment playing crucial roles in long-term health.

Low-income communities face higher food insecurity and health disparities, underscoring the need for accessible nutrition resources and better nutritional education.

There is a need for assessing risk factors for eating disorders when delivering dietary interventions.

Physical activity, sedentary behaviour, and sleep

Recommendation
WHO recommends a physical activity plan that considers age, gender, health status, sedentary behaviour, sleeping patterns, cultural context, the adolescent's interests, values and preferences and the support of parents and/or caregivers as one of the components of the integrated management of adolescents with obesity.
Strength of the recommendation: Strong.
Quality of the evidence: Very low.

Justification

The GDG agreed on a strong recommendation because of the desirable outcomes of physical activity for adolescents with and without obesity. While the benefits are modest, so are the potential adverse events. Adolescents with obesity and their parents or caregivers place a high value on staying active, particularly when this involves peers and school activities. Physical activity interventions that are appropriate for the adolescent's age, gender, and ethnicity and that use people-first language are more acceptable and feasible. The GDG was mindful that while cost-effective, physical activity may incur costs on families. Physical activity will increase equity only if access to physical activity opportunities is provided, particularly for girls and adolescents in low-income settings, with disabilities, or from underserved populations.

Evidence on physical activity was limited in the number and quality of studies. A small effect of moderate to vigorous physical activity versus no physical activity was identified for the critical outcomes of BMI, weight loss, body fat, adverse effects, and mental well-being.

The 2020 WHO guidelines on physical activity and sedentary behaviour provide physical activity recommendations for adolescents irrespective of gender, cultural background or socioeconomic status (4). The recommendations include:

- Adolescents should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.
- Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, should be incorporated at least three days a week.

The same guidelines recommended that children and adolescents aged 5 to 17 years should limit the amount of sedentary time, particularly the amount of recreational screen time (4).

Remarks

The inclusion of physical activity as part of a scheduled daily routine that also includes schoolwork, commuting, seeing friends, and leisure could help adolescents to engage in physical activity. Non-competitive activities may be the preferred option for some adolescents.

Consider the values and preferences of adolescents and parents/caregivers when deciding how to engage in exercise or physical activity interventions for management of obesity.

Structured physical activity plans that take into consideration their motivation require discussion and agreement with the adolescents and caregivers. In general, adolescent girls prefer to engage in physical activity to facilitate weight loss and improve physical appearance, while adolescent boys do so to build muscle and improve athletic performance.

Health workers should be equipped with the required competencies and knowledge to facilitate discussion with adolescents and caregivers and promote knowledge on body weight and obesity management.

Mental health conditions may result in physical inactivity, sleep disturbances, and social withdrawal. Therefore, health workers should consider both obesity and mental health conditions together using inclusive, developmentally appropriate, and family-engaged strategies.

Physical activity plans should be tailored to the specific needs of population groups, including girls, adolescents exposed to exclusion/discrimination, adolescents with disabilities, or people at risk of developing non-communicable diseases. Health workers should consider any underlying impairments that may hinder physical activity engagement in children with disabilities.

Enable effective multisector collaborations to create policies supporting the establishment of active environments, for example access to parks, athletic facilities, and recreation areas provided at no cost.

Behaviour changing interventions

Recommendation

WHO recommends behaviour changing interventions for the integrated management of adolescents with obesity. The type and duration of the intervention(s) selected should take into consideration age, gender, health status, physical activity, sedentary behaviour, cultural context, the adolescent's interests, and values and preferences with the support of parents and/or caregivers.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG considered this recommendation to be strong because the balance between benefits and harms probably favours behaviour changing interventions. Adolescents and their parents or caregivers perceive that behaviour changing interventions will lead to long-term, holistic lifestyle changes that go beyond weight loss. Interventions are more likely to be feasible and acceptable if they are solution-based, are delivered by trustworthy health workers, and consider access to facilities and to resources to cover costs. Relatedly, the GDG also acknowledged that behaviour changing interventions may incur costs on families, depending on the care setting, delivery strategy, type of behaviour changing intervention, and health workers involved. Other population groups may also face barriers to access due to stigma, discrimination, exclusion, or lack of appropriately tailored services.

WHO has a classification system to design and evaluate behaviour changing interventions in a way that is tailored to different contexts, from individual behaviours to societal-level changes. WHO categorizes interventions by the type of action they promote as, educational/informational interventions, persuasive interventions, normative/structural interventions, environmental interventions, and policy-based interventions, as detailed in the WHO Report on Social Determinants of Health (13), WHO Health Promotion and the 2013 WHO Global Action Plan (14).

A non-exhaustive list of behaviour changing interventions includes behavioural therapy, cognitive behavioural therapy, cognitive therapy, psychotherapy, integrative or holistic therapy, self-monitoring, goal setting and reinforcement, stimulus control, problem solving, motivational techniques, mindfulness-based cognitive therapy, or stress reduction.

Remarks

Adolescents with obesity may be motivated to engage in behaviour changing interventions because of the perceived benefits of such activities, including weight loss, body image, preventing future health problems, self-esteem, and social acceptability.

Adolescents with obesity and their caregivers value personalized, holistic, and practical obesity management interventions that promote benefits such as self-esteem, self-confidence, and social acceptability.

Behaviour changing interventions are more acceptable when they are tailored to the specific needs of adolescents with obesity, and when they incorporate fun and enjoyable activities that are practical and solution-based. There may be a need for referral to specialized services when there are coexisting mental health issues or when interventions do not lead to progress. Referral should include written notification to other health workers, and clear and compassionate communication with the family regarding the reasons for referral.

The cost of behaviour changing interventions may depend on many factors, including the care setting, the type of behaviour changing intervention, and the health workers involved.

Addressing the causes of inequities by all society actors is required to enhance participation in obesity management interventions.

Support from governments, schools, and the community is likely to facilitate the implementation of behaviour changing interventions.

Digital health interventions

Recommendation

WHO suggests digital health interventions as one of the components of the integrated management of adolescents with obesity. It should consider the type and daily duration of the intervention; the age, gender, health status, physical activity, sedentary behaviour, cultural context and interests, values and preferences of the adolescent, and have the support of parents and/or caregivers.

Strength of the recommendation: Conditional.

Quality of the evidence: Very low.

Justification

The GDG agreed on a conditional recommendation because the evidence on digital interventions was limited in the number and quality of studies. Evidence synthesis found a small effect of short- or long-term digital health interventions compared to conventional care alone was identified for the critical outcomes of weight, BMI, and waist circumference.

Digital health interventions under the supervision of parents or caregivers could be potentially useful for promoting and sustaining behaviour change over time, although high-quality evidence on effectiveness is limited.

Remarks

Active video games, exergames, exercise activity applications, pedometers or accelerometers, and other similar interventions may have potential for increasing physical activity and promoting behavioural changes in people with or without accessibility issues or chronic diseases.

When deciding on specific digital health interventions, health workers should determine whether there are any coexisting mental health conditions. This is needed to avoid physical inactivity, sleep disturbances, social withdrawal, and other symptoms associated with anxiety, depression, social dysregulation, and other mental health issues.

Digital health interventions leading to physical activity and behavioural weight-related modifications are desirable while limiting sedentary screen time (such as watching television, searching the internet, or playing video games). Some guidance, including the Canadian Society for Exercise Physiology 24-Hour Movement Guidelines for the Early Years, indicates that regardless of age, recreational time spent in front of a screen in excess of two hours per day is associated with harmful outcomes such as depression and lower quality of life, and thus this could be used as a daily maximum for screen time.

Pharmacotherapy

Recommendation

WHO suggests pharmacological interventions for obesity management among adolescents 10-19 years of age who have obesity and obesity-related complications* only after a structured and supervised programme of multimodal lifestyle modification** has failed to achieve weight loss, limit weight gain or ameliorate obesity-related complications.

* Obesity-related complications may include type 2 diabetes, hyperinsulinemia, resistance to insulin, uncontrolled hypertension, alterations in lipid metabolism or in adipogenesis and fat accumulation, and mental health issues.

** The structured and supervised programme of multimodal lifestyle modification should include a personalized behavioural, dietary, and physical activity intervention for at least six months and periodic monitoring of coexisting conditions. Pharmacological interventions should be prescribed in a specialized multidisciplinary setting after close evaluation of physical development and psychological stability, adherence to healthy diet and physical activity habits, closely monitoring potential adverse events and including a structured long-term follow-up.

Strength of the recommendation: Conditional.

Quality of the evidence: Low.

Justification

The GDG agreed on a conditional recommendation because while the findings suggest that pharmacological treatments likely provide small to moderate benefits, length of follow up was short and important uncertainties remain regarding adverse effects. The overall quality of evidence was low. The systematic review found studies primarily involving adolescents.

Studies were relatively short in duration and mostly in high-income settings. They consistently embedded pharmacotherapy within multimodal care that included lifestyle and behavioural interventions.

The field of pharmacotherapy for obesity management is rapidly evolving; new therapeutic options with different action mechanisms, doses, administration routes, and durations of treatment are under assessment for both adults and adolescents. Research focuses on options with increased efficacy, fewer side effects, convenient administration routes (for example, oral as opposed to parenteral), and shorter treatment duration.

Remarks

For adolescents eligible for pharmacological interventions for obesity management, pharmacotherapy interventions should be delivered as part of a structured and supervised multimodal intervention including behavioural, dietary, and physical activity interventions that consider age, gender, health status, sedentary habits and sleeping patterns, cultural context, the adolescent's interests, values and preferences.

Close evaluation of complete pubertal development, final adult height, and psychological stability are needed when prescribing pharmacological interventions. Prescription should always be in accordance with up-to-date scientific evidence and consider the lack of evidence on long-term follow-up.

Pharmacological interventions should be prescribed in a specialized multidisciplinary setting, closely monitoring potential adverse events. Referral from the primary health care setting to specialized care or to a multidisciplinary team may be required.

The choice of the appropriate pharmacological intervention should depend on the profile of coexisting conditions and be delivered in keeping with relevant medication indications. Parenteral administration may require training for adolescents and their parents or caregivers.

Adolescents with obesity, and their parents or caregivers, should receive continued advice on the potential benefits and adverse events of pharmacotherapy interventions for obesity management. They need to be actively involved in the decision-making process for starting and for discontinuing pharmacological interventions, whether this is due to adverse events, treatment success or failure, or other considerations.

Health workers prescribing pharmacological interventions for obesity management should be knowledgeable of the indications, efficacy, adverse effects and potential alternatives if there are adverse events of pharmacological interventions for obesity management. They should also consider possible barriers to treatment, including but not limited to the adolescent's vulnerability to peer opinion, socio-economic disadvantage, parental support, inability to attend follow-up appointments, and other adherence roadblocks.

Access to pharmacological interventions for obesity management may be hampered due to cost, lack of coverage by public and/or private health insurance packages, or logistics (such as transportation or requirements for refrigeration).

The introduction of new weight-loss medications in the market may lower treatment costs and improve availability, although costs may still be elevated for users and may require the involvement of health services and insurance providers.

Effective multisector collaboration is needed to create policies supporting a continuous, available, accessible, affordable, and safe supply of pharmacological interventions for obesity management, when needed.

Bariatric surgery and weight-loss and weight-management devices

Recommendations
Recommendation 1. WHO suggests bariatric surgery for obesity management for adolescents 10-19 years of age with severe obesity (BMI-for-age greater than 4 standard deviations above the WHO Growth Reference median; or BMI-for-age greater than 3 standard deviations above the WHO Growth Reference median and obesity-related complications*) only after a structured and supervised programme of multimodal lifestyle modification** has failed to achieve weight loss, limit weight gain or ameliorate coexisting conditions. * Obesity-related complications may include type 2 diabetes, hyperinsulinemia, resistance to insulin, uncontrolled hypertension, alterations in lipid metabolism or in adipogenesis and fat accumulation, and mental health issues. ** The structured and supervised programme of multimodal lifestyle modification should include a personalized behavioural, dietary, and physical activity intervention for at least six months and periodic monitoring of obesity-related complications.
Strength of the recommendation 1: Conditional.
Quality of the evidence 1: Low.
Recommendation 2. WHO recommends that bariatric surgery be prescribed/performed in a specialized multidisciplinary setting after close evaluation of complete pubertal development, final adult height, psychological stability, adherence to healthy diet and physical activity habits. There is also need for closely monitoring of potential adverse events and a structured long-term follow-up. Adolescents should be supported to make informed decisions throughout the intervention.
Strength of the recommendation 2: Strong.
Quality of the evidence 2: Low.

Weight-loss and weight-management devices

Due to a lack of evidence, the GDG could not make a recommendation on weight-loss and weight-management devices for obesity management in adolescents.

Justification for recommendations on bariatric surgery

The GDG agreed on a conditional recommendation because while effects are moderate to large, undesirable effects vary. The WHO-commissioned systematic review found two randomized controlled trials (RCT) and three non-RCTs comparing bariatric surgery with lifestyle interventions. This review found that bariatric surgery is more effective compared to no surgery in reducing BMI and weight, and may lead to improvement in other obesity-related outcomes and quality of life.

The GDG considered Recommendation 2 on the need for bariatric surgery to be prescribed/performed in a specialized multidisciplinary setting after close evaluation of complete pubertal development, because these precautions will decrease the potential risks and adverse events that are associated with bariatric surgery. While adolescents and their parents or caregivers were motivated by the potential for weight loss, they were also concerned about the procedure itself and the potential complications.

Remarks

As a general approach, bariatric surgery for obesity management in adolescents must be delivered as part of a structured and supervised multimodal intervention that includes behavioural, dietary, and physical activity interventions that consider age, gender, health status, existing disability, sedentary habits and sleeping patterns, cultural context, the adolescents' interests, values and preferences, and that involves parents and/or caregivers.

Health workers need to assess potential genetic, hereditary, and familial factors when considering bariatric surgery.

The choice of bariatric surgery will depend on a patient's profile and must be delivered in accordance with medical indications and the adolescent's values and preferences when appropriate.

Prior to the intervention, continued advice needs to be provided to adolescents with obesity and their parents or caregivers on the potential benefits and adverse events of bariatric surgery for obesity management. Support and advice should continue after surgery.

Multimodal interventions

Recommendation

WHO recommends a structured multimodal intervention including a combination of diet, physical activity, and behavioural components for the integrated management of adolescents with obesity*. It should consider age, gender, health status, food preferences, nutrition education, physical fitness, cultural context, and the adolescent's interests, values and preferences as well as resources and support of parents and caregivers. The intervention should be delivered and supervised by health workers with knowledge on nutrition, physical activity and behaviour changing interventions.

* Other components of multimodal interventions include changes in sleep behaviour and in sedentary behaviour patterns, and the use of digital technologies. Multimodal interventions could involve family, friends, caregivers and schools, could improve access to care, and promote awareness and educational campaigns for adolescents, caregivers, schools and communities.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG reached consensus for a strong recommendation because adolescents with obesity, and their parents, value the perceived benefits of multimodal interventions, including weight loss, prevention of health sequelae, and improved self-esteem, body image and social desirability. While benefits are small and the potential adverse events are unknown, the GDG agreed that benefits likely outweigh the harms. Multimodal interventions are acceptable and feasible, particularly when they include fun, informal (non-competitive) activities and incorporate technology. The GDG was mindful that costs will depend on the specific aspects of the intervention; unequal access may exacerbate obesity and poor health outcomes among marginalized communities and those of low socio-economic status.

The WHO-commissioned review retrieved RCTs of multimodal interventions consisting of dietary, physical activity, and behaviour modifications, compared to usual care delivered either in healthcare settings or in community settings such as schools, churches, and community centres. Results were similar in both settings, including small effects on BMI z-scores at different endpoints, BMI, physical well-being, and quality of life.

Remarks

The recommendations on diet, physical activity and behavioural components, established during the process of developing this guideline, could form the basis of a multimodal intervention. This guideline includes recommendations on sleep behaviour, sedentary behaviour, digital technologies, and the need to involve family, friends, caregivers, schools and the community.

The specific components of the intervention can be decided based on the results of a detailed initial clinical assessment that considers anthropometric measures as well as a comprehensive family and medical history, a review of psychosocial and behavioural factors (such as eating habits, physical activity, sleep routines), and relevant laboratory tests where appropriate.

Parental or caregiver involvement can enhance the effectiveness of lifestyle interventions. Parents or caregivers can support the adolescent throughout the intervention, change their own behaviours, and adapt parenting styles.

Multimodal interventions may be cost-effective due to potential benefits in weight management and prevention of chronic diseases.

Referral from the primary health care setting to specialized care may be required, including notification of other health workers and clear, compassionate communication with the family.

Adolescent obesity experts, secondary or specialized care, and/or the involvement of multidisciplinary teams in multimodal lifestyle interventions could be an option.

The frequency of following up adolescents with obesity should consider overall clinical condition and coexisting conditions, medication use, and social vulnerability.

Whole-of-society approaches that address the causes of inequities in access are required to enhance participation in obesity management interventions.

Support from governments, schools, and the community could facilitate the implementation of multimodal interventions.

Research gaps

Future research on obesity management interventions in adolescents should prioritize well-designed and well-reported RCTs and prospective controlled cohort studies that report efficacy, effectiveness, a safety profile, weight regain, and cost interventions. These studies should include patient-important outcomes that focus on, in addition to anthropometric and cardiometabolic measures, physical and mental well-being, overall quality of life, and reduction in obesity-associated disability.

There is a need to ascertain the serious adverse events of interventions and the long-term effects of various interventions. Studies should also include subgroup analyses for obesity severity, presence of obesity-related complications, and differently-abled people. Since most research to date has been completed in high-income countries, funders should prioritize studies in low- and middle-income countries.

Implementation guidance should highlight parent and caregiver involvement, as well as the adolescent's motivation, preferences and own time planning/distribution. Consideration should be given to specific barriers that adolescents face, to prevent inequities in obesity health outcomes. Lastly, there is a need for implementation support for low- and middle-income countries, considering population characteristics such as gender, age, ethnicity, cultural background, and socio-economic status.

Plans for updating

The WHO Secretariat will monitor the development of research in the area of obesity. This will include emerging evidence, emerging considerations and interests from stakeholders and/or users of the guideline, changes in values and preferences, acceptability, feasibility, or cost-effectiveness of interventions; considerations of human rights, equity, and gender; issues surrounding the coverage of interventions; emerging definitions or cut-off points for defining obesity and severity; the role of new technologies and social media; and the emerging need for recommendations for specific populations, including adolescents with obesity-related complications, migrant populations, or minorities, among others. WHO will work to determine whether new evidence or considerations warrant revisiting or updating specific recommendations. Updates will be incorporated to the overall guideline; changes will be highlighted and disseminated via the regular communication channels of WHO. Lastly, the WHO Secretariat will welcome suggestions regarding additional questions for evaluation throughout the living guideline process.

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Background

The International Classification of Diseases 11 (ICD-11) defines obesity as “a chronic complex disease defined by excessive adiposity that can impair health. It is in most cases a multifactorial disease due to obesogenic environments, psycho-social factors and genetic variants. In a subgroup of patients, single major etiological factors can be identified (medications, diseases, immobilization, iatrogenic procedures, monogenic disease/genetic syndrome). Body mass index (BMI) is a surrogate marker of adiposity calculated as weight (kg)/height² (m²). The BMI categories for defining overweight vary by age and gender in infants, children and adolescents.” (1). In addition to the ill health and disability caused directly by excess weight gain, obesity is linked to a range of diseases and short- to long-term health outcomes (2). These include asthma, cancer, cardiovascular diseases, dementia, depression, diabetes mellitus, dysfunction in fertility and impotence, kidney disease, liver disease, osteoarthritis, pancreatitis, birth complications and sleep apnoea (3). Many children with obesity continue to have obesity as adolescents and adults (4).

Obesity may be coupled with underlying impairments that, in combination with personal and environmental factors, can lead to disability. Underlying impairments related to obesity, such as physical limitations due to excess body weight, symptoms associated with chronic conditions, and mental health issues such as anxiety and depression, may result in further unwanted consequences such as stigma, discrimination, and lack of access to health care, thus generating or exacerbating disability and obesity-associated disability (2, 5).

The World Health Organization (WHO) defines childhood as the period from 0 to 19 years of age, with the following breakdown of age ranges: *newborn* or *neonate* (the first 28 days of life); *infant* (29 days to less than 12 months of life); *toddler* (from 12 months to less than 3 years; of age); *preschool-aged* (from 3 to less than 5 years); *school-aged* (from 5 to less than 10 years); and *adolescent* (from 10 to 19 years) (6, 7, 8).

For children under 5 years of age, overweight is defined as weight-for-height greater than 2 standard deviations (SD) above the median of WHO Child Growth Standards, and obesity is defined as weight-for-height greater than 3 SD above that same median (3). For children and adolescents aged between 5 and 19 years, overweight is defined as BMI-for-age greater than 1 SD above the median, and obesity as BMI-for-age greater than 2 SD above the median (3).

Adolescence is a unique stage of human development and an important time for laying the foundations of good health. Adolescents experience rapid physical, cognitive and psychosocial growth. This affects how they feel, think, make decisions, and interact with the world around them (9).

Globally, the rates of obesity have nearly tripled since 1975, affecting both adults and children (10). In 2022, more than 2.5 billion people aged 18 years and older were overweight, and over 890 million adults had obesity (12). The global age-standardised prevalence of obesity among persons 5 to 19 years of age increased between 1990 and 2022 from 1.7% and 2.1 in girls and boys to 6.9% and 9.3%, respectively (12). In 2022, the global crude obesity prevalence among children and adolescents was about 8%, with sharp increases occurring over the past 20 years (12, 13).

A 2024 pooled analysis reported that, in 2021, 93.1 million children and adolescents between 5 and 14 years of age, and 80.6 million adolescents and young adults 15 to 24 years of age, had obesity, affecting approximately 160 million children and adolescents worldwide. This number is predicted to increase to more than 250 million by 2030 (11). Furthermore, the double burden of underweight and obesity is an increasing problem in many countries. There are varying obesity rates within countries, mostly related to determinants such as poverty, education, and access to health care (12).

Regional differences in prevalence estimates are important to note, since the highest rates of childhood obesity occur in North America (~17%) and the Caribbean (~19%), Central America (~16%), and Polynesia (~20%) (13). In contrast, obesity was lower in Central Africa (~2%), Eastern and Western Africa (~4%), and Southern Africa (~6%) as well as in Western, Eastern and Northern Europe (~5%) (13).

There is no consensus on the reasons behind increases in obesity rates during the past decades, although diet, physical activity and personal behavioural choices have been repeatedly highlighted. Lack of appropriate multisectoral and policy efforts have hampered efforts to stem obesogenic environments, address drivers of obesity, and remove blame from people with obesity and their families (14). Furthermore, people's choices regarding food, physical activity, and consumption practices are deeply influenced by commercial determinants of health, for example private sector actions around the production of industrialized products currently known as ultra-processed foods, marketing of unhealthy commodities, and the promotion of sedentary lifestyles (15). WHO has long advocated for, among other actions, enacting marketing restrictions for breast-milk substitutes, and food and beverage marketing that targets children and adolescents (16).

A recent synthesis of evidence revealed that combining dietary and physical interventions has a limited effect on preventing obesity in children and adolescents. While the risk of serious adverse events appears to be low, the overall quality of evidence is also low (17, 18, 19). Economic and technological changes have resulted in a shift in diets, from subsistence and local food production to commercial food production and a subsequent increase in marketing of industrialized products currently known as ultra-processed foods. This in turn has led to an increase in caloric intake, in the consumption of sugar and processed-foods and of animal-source foods, particularly in low-income countries. It has also led to a decrease in time spent preparing food and a lower consumption of fibre-rich and fresh foods (12, 20, 21). Physical activity in children and adolescents leads to enhanced bone and skeletal health, cardiometabolic health, and the development of cognitive and motor skills. In adults, physical activity also reduces the risk of obesity and non-communicable diseases. Worryingly, as of 2016, 81% of adolescents 11 to 17 years of age do not meet the recommended levels of physical activity (22, 23). In addition, longer periods of screen time have led to increased sedentary behaviour and mental health conditions, both of which are linked to obesity (6, 7).

Individual choices about food and physical activity are influenced by societal and environmental conditions. It is important to recognize this, since obesity tends to be linked to an individual's responsibility and actions. While multimodal interventions have the potential to lead to increased physical activity and modified dietary intake (24), tackling obesity requires multisectoral actions that have a direct impact on access to healthy foods and to physical activity venues, on poverty reduction and urban planning, and on food manufacturing, marketing and pricing (25).

Rationale

In order to respond to current global epidemiology, and to complement existing obesity prevention guidelines, normative guidance from WHO is needed focusing on the people-centred integrated management and care of adolescents in all their diversity. This must be done using a primary health care approach, which has three components: 1) meeting people's health needs throughout their lives; 2) addressing the broader determinants of health through multisectoral policy and action; and 3) empowering individuals, families and communities to take charge of their own health (26). "In all their diversity" recognizes the uniqueness of each adolescent, promoting inclusion, policies, and actions that acknowledge varying needs and experiences (27, 28).

Guidelines for managing obesity also need to consider the developmental stages of children and adolescents. The main considerations include differences in the diagnosis and prognosis of obesity, the role of parents and caregivers, behavioural aspects and mental health, eligibility for interventions, and values and preferences. To address this need, WHO has developed the present obesity management guideline, and another specifically for children. That guideline, which can be accessed [here](#), followed its own independent guideline development process with a separate Guideline Development Group (GDG), in accordance with the WHO Handbook for guideline development (29).

The present guideline aims to provide practice- and science-informed global clinical and public health recommendations to improve case management and care pathways for adolescents with obesity. The recommendations refer to interventions delivered by multidisciplinary teams that provide seamless, coordinated care within the primary care setting and via referrals to secondary and tertiary care (30).

Recommendations considered a people-centred approach, that is, consciously incorporating the views, values and preferences of those affected by the recommendations (31), an intentional commitment to compassionate care (32, 33, 34), and strategies to ensure that family and communities are empowered to improve health practices (35) and to care for their own health (26). Guideline development acknowledged individual differences such as gender, nationality, race, ethnicity, ability, sexual orientation, socio-economic status, religious beliefs, political beliefs, and other ideologies (27, 28) and highlighted related research gaps. The guideline is committed to equity in the form of justice, equality, impartiality and fairness in service provision.

This guideline was built upon knowledge from existing WHO and UN guidance. Previous clinical guidelines have focused on approaches to preventing overweight and obesity (together), including assessing and managing children and adolescents in the primary care setting. The WHO Commission on Ending Childhood Obesity recommended to *"develop and support appropriate weight management services for children and adolescents who are overweight or obese that are family-based, multicomponent (including nutrition, physical activity and psychosocial support) and delivered by multiprofessional teams with appropriate training and resources, as part of Universal Health Coverage"* (4).

WHO's commitment to health equity was reflected in the establishment of the Commission on Social Determinants of Health in 2005 (36), the Global Strategy on Equity and Universal Health Coverage in 2018 (37), and the integration of these aspects into the WHO guideline development methodology (29). There is a need to step away from a one-size-fits-all approach and instead consider specific socioeconomic, cultural and geographic contexts. Guideline development should further acknowledge underlying causes of obesity, for example poverty, education and access to health care. It is also key to take into account differences based on gender, age, nationality, race, ethnicity, ability, socio-economic background, religion, political belief, or other identities (38).

The processes of prioritizing questions and outcomes, and of retrieving, synthesizing and

assessing evidence took into account existing WHO recommendations, specifically those included in the WHO guideline *“Assessing and managing children at primary health care facilities to prevent overweight and obesity in the context of the double burden of malnutrition. Updates for the Integrated Management of Childhood Illness (IMCI)”* (39). Technical work on obesity prevention was also key to determining the scope and mandate of the guideline development process. This work included the Report of the Commission on Ending Childhood Obesity (4); Obesity: preventing and managing the global epidemic. Report of a WHO Consultation (40); and UNICEF’s Prevention of overweight and obesity in children and adolescents (41).

The present guideline incorporates the Global Accelerated Action for the Health of Adolescents (AA-HA!) as an overarching framework on adolescent health (8). It adheres to the WHO Guidelines on physical activity and sedentary behaviour (6, 7). The synthesis of evidence on dietary interventions considered WHO guidelines for the intake of sugar (42), of saturated fatty acid and trans-fatty acid intake (43), and the Food and Agriculture Organization (FAO) Nutrition guidelines and standards for school meals: a report from 33 low and middle-income countries (44). Digital health reviews relied on the WHO Recommendations on digital interventions for health system strengthening (45). Lastly, this guideline integrated WHO work on mental well-being, particularly the Mental Health Gap Action Programme (mhGAP) Guideline for Mental, Neurological and Substance use Disorders (46).

The proposed line of work is aligned with the 2030 Agenda for Sustainable Development, target 3.4, to reduce premature mortality from noncommunicable diseases (47). The Commission on Ending Childhood Obesity, established in 2014, issued six recommendations to successfully tackle childhood and adolescent obesity¹. In 2017, the World Health Assembly welcomed these and the accompanying implementation plan (4). The present guideline also addresses the Comprehensive implementation plan on maternal, infant and young child nutrition as endorsed by the Sixty-fifth World Health Assembly in 2012 (48), the Global Strategy for Women’s, Children’s, and Adolescents’ Health 2016-2030 (49), and the United Nations Decade of Action on Nutrition (50).

¹ The six recommendations are:

1. Implement comprehensive programmes that promote the intake of healthy foods and reduce the intake of unhealthy foods and sugar-sweetened beverages by children and adolescents.
2. Implement comprehensive programmes that promote physical activity and reduce sedentary behaviours in children and adolescents.
3. Integrate and strengthen guidance for noncommunicable disease prevention with current guidance for preconception and antenatal care, to reduce the risk of childhood obesity.
4. Provide guidance on, and support for, healthy diet, sleep and physical activity in early childhood to ensure children grow appropriately and develop healthy habits.
5. Implement comprehensive programmes that promote healthy school environments, health and nutrition literacy and physical activity among school-age children and adolescents.
6. Provide family-based, multicomponent, lifestyle weight management services for children and young people who have obesity.

Scope and purpose, objectives, and target audience

Scope and purpose

This guideline focuses on adolescents 10 to 19 years of age with obesity. The outcomes are primary health care-based interventions, including but not limited to diet therapy or therapeutic diets; physical activity, sleep hygiene and sedentary behaviours; behaviour changing interventions; multimodal interventions; digital health interventions; pharmacological interventions; and weight-control surgery. Recommendations concern the individual, the community, health systems and multiple relevant sectors.

Outcomes were informed by evidence on the perspectives, views, values, and preferences of adolescents with obesity as well as those of health workers, family members and community members.

Objectives

The purpose of this guideline is to provide Member States with adoptable and adaptable, clear, practice- and science-informed clinical and public health recommendations on the integrated management and care of adolescents with obesity for improved health, functioning and reduced obesity-associated disability, using a primary health care approach. Recommendations are grounded in gender equality, equity and human rights, to ensure that no one is left behind. The specific objectives are to:

- a. Provide recommendations on individual, family, community and home-based interventions for the integrated management of adolescents with obesity.
- b. Outline practice and science-informed strategies for managing adolescents with obesity, for their caregivers and the home environment to support health, well-being, functioning, the healthier achievement and maintenance of weight goals, and reduced obesity-associated disability.
- c. Provide guidance on monitoring treatment, health and well-being outcomes, including dietary habits and healthier behaviours and lifestyles.

Target audience

The primary target audiences include decision-makers and public health policymakers in ministries of health and other offices at the national, sub-national and local levels. This guideline is also aimed at health workers, including providers at the primary care level, integrated health programme managers, and health system managers. The recommendations are of interest to non-governmental and other organizations, as well as professional societies involved in planning and carrying out the management of children and adolescents with obesity, and other health and well-being actions. The guideline can be used to inform the general public, as well as parents and caregivers of adolescents with obesity.

Guideline development

Interventions included in this guideline for evidence search and recommendations

Dietary interventions: An approach to creating combinations of calories, macro and/or micronutrients for obesity management. Dietary approaches and food composition depend primarily on the adolescent's age, weight loss goal, coexisting conditions and food preferences and habits (51, 52).

Physical activity: Any bodily movement produced by skeletal muscles that requires energy expenditure (53, 54, 55). Regular physical activity can prevent and contribute to the management of type 2 diabetes, heart disease, hypertension, some types of cancer, and other chronic diseases (54, 55). The 2020 WHO guidelines on physical activity and sedentary behaviour provide physical activity recommendations for people irrespective of gender, cultural background or socioeconomic status (6, 7).

Behaviour changing interventions: Interventions designed to effect individual behaviour change (56, 57). They play a role in obesity management by addressing the energy-balance behaviours that contribute to weight gain, and that hamper obesity management efforts. While there is no consensus on a taxonomy or classification, behaviour changing interventions may include (i) interventions that invoke behavioural models or theory; (ii) interventions based on psychotherapeutic models such as behavioural therapy, cognitive behavioural therapies, mindfulness, attitude and relationship techniques, psychotherapy, psychodynamic therapies, humanistic therapies, stimulus control, goal setting, and self-monitoring; and (iii) multimodal interventions, which are composite approaches to modifying behaviour using more than one component (56, 57).

Multimodal interventions: Therapeutic approaches that incorporate a combination of different methods, strategies, or modes of treatment. Instead of relying on a single approach, multimodal interventions utilize a variety of components, for example behavioural and educational interventions, dietary management, and encouragement to increase physical activity and reduce sedentary behaviour. In this guideline, pharmacological and/or bariatric surgery interventions were not considered as components of multimodal interventions (58).

Digital health interventions: A discrete functionality of digital technology that is applied to achieve health objectives. Digital health interventions may be implemented within digital health applications, and information and communication technology systems, including communication channels (59). They include the use of wearable or implantable devices to monitor diet and physical activity, websites, and text messages or other texting. There are also mobile applications to deliver information on diet and physical activity and monitor behaviours. Other interventions include exergaming or active video gaming to promote physical activity, as well as telemedicine to provide counselling and monitor interventions.

Pharmacological interventions: These aim to reduce energy intake and/or increase energy expenditure. They may be a suitable course of action for obesity management when lifestyle interventions have failed and there are serious coexisting conditions that affect physical and mental well-being (60). However, patients need to be closely monitored for potential adverse events (61). Currently, the United States Food and Drug Administration (FDA) and the European Medicines Agency (EMA) have approved orlistat, semaglutide, and liraglutide for the treatment of obesity in adolescents. The FDA has also approved phentermine and phentermine/topiramate. These pharmacological interventions are to be administered as an adjunct to diet, physical activity, and other lifestyle modifications (62).

Metabolic and bariatric surgery: Surgical procedures to manage obesity and obesity-related conditions. The rationale of metabolic and bariatric surgery is to restrict food intake and reduce the absorption of food. While surgery may be an option given its long-term efficacy outcomes, not all patients are eligible, particularly adolescents with obesity (63). Different types of procedures are available, including Roux-en-Y gastric bypass, adjustable banding, and sleeve gastrectomy. Of these, laparoscopic Roux-en-Y gastric bypass is the most commonly conducted procedure in adolescents (64, 65, 66).

Weight-loss or weight-management devices: Minimally invasive interventions for obesity management. They include weight-loss devices such as intragastric balloons, electrical stimulation, gastric emptying systems; and weight-maintenance devices such as removable oral palatal space-occupying devices, and ingested, transient, space-occupying devices (67, 68).

Principles and existing documents related to this new guideline

The 2016 WHO Commission on Ending Childhood Obesity highlighted the need for recommendations on multimodal obesity management interventions delivered by multiprofessional teams with appropriate training and resources, as part of Universal Health Coverage (4).

The search for evidence aimed to comprise studies from all WHO regions, in any language, not limited to the six official UN languages. The search strategy and results were documented and reported, including the reasons for having excluded specific studies. In addition to intervention reviews, the search covered qualitative evidence syntheses, rapid reviews and overviews on costs. It also considered issues pertaining to the values and preferences of children and adolescents with obesity, family members, carers and health care providers.

The WHO Secretariat identified review teams through a competitive Call for Authors. This Call was distributed via: 1) the WHO website; 2) the nutrition and food safety mailing list (the Campaign Monitor software reaches over 13 000 subscribers); and 3) the WHO LinkedIn account. In addition, members of the WHO Obesity Steering Committee distributed it through their networks. All review teams members completed Declaration of interest and Confidentiality forms.

In addition to considerations on the search and analysis of evidence (29, 69, 70), the following principles guided the development of recommendations:

Primary health care approach: A whole-of-society approach to health that aims to maximize the level and distribution of health and well-being through three components: 1) primary care and essential public health functions as the core of integrated health services; 2) addressing the broader determinants of health through multisectoral policy and action; and 3) empowering individuals, families and communities to take charge of their own health. The function of primary health care is to coordinate the care of people and their health needs over the life course and across the continuum of care, in primary care facilities and communities, and for individuals and populations. Care needs to be comprehensive, coordinated, people-centred, continuous and accessible (26, 71).

Integrated Management of Childhood Illness (IMCI): IMCI includes three components: 1) improving case management skills of health workers, 2) improving overall health systems, and 3) improving family and community practices (39, 72). In health care facilities, IMCI entails the identification of illness in outpatient settings, and adopting a people-centred, integrated care perspective rather than focusing on a specific illness. It also entails working with caregivers, and expediting the referral of severely ill children to the appropriate facility or specialist in the health system or network of service providers to address the relevant health needs (32).

People-centred care: An approach to care that purposely adopts the perspectives of individuals, carers, families and communities as participants in and beneficiaries of trusted health systems that respond to their needs and preferences in humane and holistic ways. People-centred care also requires that people have the education and support they need to make decisions and participate in their own care (33).

Compassionate care: A principled and intentional effort to understand a person, discern their needs, and alleviate their suffering through relational understanding and action. Compassionate care in obesity management requires a competency-based approach where health workers adopt non-judgmental and non-stigmatizing language, attitudes, knowledge, and skills that cover the multiple domains of compassion, as well as assessments by or feedback from patient's families or peers (34, 35, 36).

Disability: The experience of any condition that makes it more difficult for a person to do certain activities or have equitable access within a given society. Disabilities may be cognitive, developmental, intellectual, mental, physical, sensory, or a combination of multiple factors (27, 28).

Equity: Equity refers to a condition in which society is characterized by justice, equality, impartiality and fairness, including fair and equal distribution of power, economic resources, opportunities, goods and services across the social spectrum. In an equitable society people are not excluded from the activities of society, such as education, employment, or health care and there is no bias or favouritism (27, 28).

Gender equality: All persons, regardless of their gender, should enjoy the same status in society; have the same entitlements to all human rights; enjoy the same level of respect in the community; can take advantage of the same opportunities to make choices about their lives; and have the same amount of power to shape the outcomes of these choices (27, 28).

Diversity: Refers to the existence of differences among people with respect to age, class, ethnicity, gender, health, physical and mental ability, race, sexual orientation, religion, physical size, education level, job and function, personality traits, and other human differences (27, 28).

In all their diversity: Recognizing and accepting individual differences such as gender, nationality, race, ethnicity, ability, sexual orientation, socio-economic status, religious beliefs, political beliefs, or other ideologies (27, 28).

Multidisciplinary teams: Various health workers collaborating to provide a broad range of services in a coordinated approach. The composition of multidisciplinary teams in primary care will vary by setting but may include generalist medical practitioners (including family doctors and general practitioners), physician assistants, nurses, specialist nurses, community health workers, pharmacists, social workers, dietitians, mental health counsellors, physiotherapists, patient educators, managers, support staff, and other primary care specialists.

Technical and Guideline Development Group meetings convened for developing this guideline

The assessment and synthesis of evidence followed by decision-making took place during meetings of the WHO Obesity Steering Committee and the GDG. The systematic review teams presented results of synthesized evidence and addressed questions.

Meetings of the WHO Obesity Steering Committee and systematic review teams were scheduled regularly during the early stages of guideline development. These meetings served to design and implement the process of prioritizing questions and outcomes (73), to agree on common guidance for systematic reviews to discuss systematic review findings, and to prepare GDG meetings. Meetings were scheduled as needed during later stages of guideline development.

GDG meetings served to present systematic review findings; to answer questions and discuss results; and to draft and agree on the wording, strength, and remarks of recommendations. There were nine GDG meetings, held between 28 April 2021 and 20 March 2025.

List of guideline questions and outcomes

Questions

Background questions

Background questions pertain to important information on the issues under consideration and their context. They do not relate to evidence of the type that directly informs recommendations, but they do lead to information which helps to frame and formulate the key/foreground questions. Background questions were addressed either by consulting existing reviews or by commissioning narrative reviews following the same procedures used for identifying authors for key questions.

Background questions covered eight topics, namely genetic or familial factors (74, 75), initial clinical assessment (76), follow-up (76), referral (76), gender- or sex-specific considerations (31, 77, 78), disability-specific considerations (30, 79, 80), mental health considerations (81), and provider competencies (82). Details on these questions and answers are listed in [Annex 1. Background questions](#).

Background questions informed GDG deliberations during decision-making for all recommendations. As such, initial clinical assessment, follow up, and referral information were relevant when picturing the health worker-patient interaction. Considerations about gender, sex, disability, and mental health were central to understanding values and preferences, equity, and acceptability.

Key population, intervention, comparison, outcome (PICO) questions

The following questions, presented in Table 1, were prioritized as key for guideline development (73). The questions recognize the diversity and uniqueness of each adolescent, promoting inclusion, policies, and actions that acknowledge varying needs and experiences.

Table 1: Key questions for guideline development included in this guideline

Question 1. Dietary interventions

In adolescents with obesity (P), what is the effect of dietary intervention (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Question 2. Physical activity

In adolescents with obesity (P), what is the effect of physical activity (I) compared to no intervention (C) for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Question 3. Sedentary behaviour

In adolescents with obesity (P), what characteristics of sedentary behaviour (I) in different durations, frequencies, patterns, or types (I, C) are associated with improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?

Question 4. Sleep

Should adolescents with obesity (P), improve sleep and/or sleep hygiene (I) in different duration, frequencies, or patterns as measured by objective and subjective methods (C) for improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?

Question 5. Behaviour changing interventions

In adolescents with obesity (P), what is the effect of behaviour changing interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Question 6. Digital health interventions

In adolescents with obesity (P), what is the effect of digital health interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Question 7. Pharmacotherapy

In adolescents with obesity (P), what is the effect of pharmacotherapy interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 8. Alternatives for medications known to cause weight gain

Should adolescents with obesity (P), change to alternatives for medications known to cause weight gain (I) in comparison to no change (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 9. Bariatric surgery

In adolescents with obesity (P), what is the effect of gastric bypass and other bariatric surgery options (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 10. Weight-loss and weight-management devices

In adolescents with obesity (P), what is the effect of weight-loss or weight-management devices (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 11. Multimodal interventions

In adolescents with obesity (P), what is the effect of multimodal interventions delivered by a multidisciplinary team (I) compared to standard care (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Additional questions

Some questions were prioritized but not covered in this guideline development process. They may be the subject of future evidence synthesis and possible inclusion as recommendations as part of the living guideline approach. They include obesity diagnosis and reference standards; gut microbiota interventions/modulation, dysbiosis procedures, and other microbial-based therapies; reducing exposure to food additives, industrialized ingredients and food processing as well as to products containing endocrine-altering chemicals; obesity management-related messaging aimed at changing behaviour; the effect of including interventions for managing obesity in the list of essential health services and in public and/or private health insurance packages; and obesity surveillance and screening.

Outcomes

The following outcomes were proposed to serve as guidance for retrieving, synthesizing, and assessing evidence to inform the recommendations for treating adolescents with obesity.

Critical (primary) outcomes

1. BMI/BMI z-score reduction, stabilization and/or maintenance (kg/m^2);
2. Weight reduction, stabilization and/or maintenance (kg);
3. Physical well-being (functional mobility, self-care, getting along, life activities and participation, as defined by trialists)*;
4. Mental well-being (anxiety, stress, depression, isolation, self-esteem, body image, suicidal ideation, eating disorders, as defined by trialists);
5. Physical activity (type, duration, intensity, frequency, as defined by trialists);
6. Overall quality of life;
7. Blood pressure;
8. Adiposity and fat distribution (objective measures: dual energy x-ray absorptiometry, magnetic resonance, as defined by trialists; anthropometric measures: skinfolds, waist-to-hip ratio, waist circumference, as defined by trialists);
9. Adverse events associated with the interventions;
10. Presence of obesity-coexisting conditions (any other noncommunicable disease);
11. Obesity-associated disability.

- * Functional mobility: moving and getting around (as defined by trialists);
- Functioning self-care: hygiene, dressing, eating and staying alone (as defined by trialists);
- Functioning getting along: interacting with other people (as defined by trialists);
- Functioning life activities: domestic responsibilities, leisure, work and school (as defined by trialists);
- Functioning participation: joining in community activities (as defined by trialists).

Important (secondary) outcomes

1. Hyperinsulinemia [1.7 mmol/L (30 mg/dL)] or higher when 1 mg of glucagon is administered intramuscular or intravenous (or as defined by trialists);
2. Resistance to insulin (as defined by trialists);
3. Glycaemia (in mg/dL, fasting);
4. Alterations in lipid metabolism or in adipogenesis and fat accumulation;
5. Lipid hormones (for example, leptin or adiponectin);
6. Alterations in hunger or satiety (as defined by trialists);
7. Reduced disability in any of the functionality domains, according to the WHO International Classification of Functioning, Disability and Health (ICF);
8. Mortality;
9. Prevalence of obesity in adulthood;
10. Access to health services.

Recommendations

The GDG acknowledged that the strong recommendations below were based on low- or very low-quality evidence, thus resulting in discord between the quality of evidence and the corresponding strength of the recommendation. The GDG reached consensus and voted for strong recommendations based on factors included in the evidence-to-decision frameworks that reach beyond the evidence on effects. This was because obesity is a multifactorial disease that requires a multimodal approach to address all possible converging factors, since one or more of them can impact individuals at different times or simultaneously. The GDG considered the practicality and universality of adopting diet, physical activity, and behavioural approaches as single or as multimodal interventions, as they are pillars for an adequate approach to obesity management.

According to the WHO Handbook for guideline development (29), a strong recommendation is based on the confidence that the desirable effects associated with a recommendation outweigh the undesirable effects. Most people would want the recommended intervention, and only a small proportion would not. Furthermore, the recommendation can be adopted as policy and as a quality or performance indicator.

For a conditional recommendation, there is less certainty on the balance between the desirable and undesirable effects. While many people would want the recommended intervention, many others would not. Health workers should be aware that different courses of action will be appropriate for different individual patients, who will need support for making decisions that are consistent with their values and preferences. As such, developing policy will require debate and input from different stakeholders.

Dietary interventions

Summary of evidence

WHO commissioned a Cochrane systematic review on dietary interventions for adolescents with obesity. The review included evidence from mixed study populations (2 to 21 years of age) and from adolescent-only study populations (10 to 19 years of age) (51). Authors report that the benefit of dietary interventions on body weight, BMI, and waist circumference varied depending on the types of dietary intervention. The quality of evidence ranged from very low to moderate (Annex 2. Dietary interventions).

Comparison 1: Calorie reduction compared to no calorie reduction

The effect of calorie reduction compared to no reduction was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that calorie reduction may reduce body weight, BMI, waist circumference, systolic blood pressure, and hours of sedentary activity. There was no evidence on quality of life outcomes ([Annex 2. Summary of findings table 1.1](#)).

Comparison 2: Low carbohydrate intake alone compared to no modification or high carbohydrate intake

The effect of dietary interventions with low carbohydrate intake alone compared to no modification or to the intake of high carbohydrate foods was uncertain. Low-certainty evidence from adolescents suggested that low carbohydrate foods may slightly decrease body weight, while very low-certainty evidence from both mixed populations and adolescents suggested that low carbohydrate foods may slightly decrease body weight, BMI, and waist circumference. There was no evidence on systolic blood pressure, hours of sedentary activity, or quality of life outcomes ([Annex 2. Summary of findings table 1.2](#)).

Comparison 3: Mediterranean diet or American Heart Association (AHA) diet with standard lifestyle changes compared to Mediterranean or AHA diet without lifestyle changes

The effect of a Mediterranean diet or AHA diet alone or with standard lifestyle change was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that Mediterranean diet or AHA diet alone, or with standard lifestyle changes, may decrease body weight and slightly decrease BMI, systolic blood pressure and waist circumference ([Annex 2. Summary of findings table 1.3](#)).

Comparison 4: High fibre intake compared to low fibre intake

The effect of dietary interventions with high fibre intake compared to low fibre intake was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that high fibre intake may very slightly increase BMI, waist circumference, and systolic blood pressure. There was no evidence of effect on hours of sedentary activity or quality of life outcomes ([Annex 2. Summary of findings table 1.4](#)).

Comparison 5: Intake of whole foods (including grains) compared to no modification or intake of refined foods (including grains)

The effect of dietary interventions with intake of whole foods compared to no modification or intake of refined foods was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that the intake of whole foods may slightly decrease body weight, BMI, and waist circumference. There was no evidence on hours of sedentary activity or quality of life outcomes ([Annex 2. Summary of findings table 1.5](#)).

Comparison 6: Intake of low glycaemic index (GI) foods compared to no modification or intake of high GI foods

The effect of dietary interventions with a low GI compared to a high GI or no modification was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that low GI diet may very slightly increase body weight, waist circumference and hours of sedentary behaviour, and slightly decrease BMI and systolic blood pressure. There was no evidence on quality of life outcomes ([Annex 2. Summary of findings table 1.6](#)).

Comparison 7: High protein intake alone compared to no modification or low protein intake

The effect of dietary interventions with high protein intake alone compared to no modification or low protein intake was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that high protein intake may slightly increase waist circumference, quality of life, and hours of sedentary activity. It may slightly decrease body weight, BMI, systolic blood pressure, and hours of sedentary activity. ([Annex 2. Summary of findings table 1.7](#)).

Comparison 8: Low fat intake alone compared to no modification or high fat intake or Western diet

The effect of dietary interventions with low fat intake alone compared to no modification or high fat intake or Western diet was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that low fat intake may decrease body weight, slightly decrease waist circumference and systolic blood pressure, and very slightly increase BMI ([Annex 2. Summary of findings table 1.8](#)).

Comparison 9: Low fat and high carbohydrate diet compared to high fat and low carbohydrate diet

The effect of a low fat and high carbohydrate diet compared to a high fat and low carbohydrate diet was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that low fat and high carbohydrate diet may increase BMI. One randomized controlled trial (RCT) with 18 participants suggested that it had a positive effect on the quality of life. There was no evidence on body weight, waist circumference, systolic blood pressure, or hours of sedentary activity outcomes ([Annex 2. Summary of findings table 1.9](#)).

Comparison 10: Ketogenic diet compared to calorie reduction

The effect of a ketogenic diet compared to calorie reduction was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that a ketogenic diet may very slightly increase body weight, BMI, and systolic blood pressure. It may slightly decrease waist circumference. There was no evidence on hours of sedentary activity or quality of life outcomes ([Annex 2. Summary of findings table 1.10](#)).

Comparison 11: Omega-3 or PUFA-rich diet compared to no modification or high fat intake or Western diet

The effect of an omega-3 or polyunsaturated fatty acid (PUFA)-rich diet compared to no modification or high fat intake/Western diet was uncertain. Very low-certainty evidence from mixed populations suggested that an omega-3 or PUFA-rich diet may slightly increase body weight and BMI. There was no evidence on hours of sedentary activity or quality of life outcomes ([Annex 2. Summary of findings table 1.11](#)).

Comparison 12: Time-restricted eating compared to no mealtime restriction

The effect of time-restricted eating compared to no mealtime restriction was uncertain. Very low-certainty evidence from both mixed populations and adolescents suggested that time-restricted eating may very slightly decrease BMI z-scores. There was no evidence on body weight, waist circumference, systolic blood pressure, hours of sedentary activity, or quality of life outcomes ([Annex 2. Summary of findings table 1.12](#)).

Additional evidence from previous reviews reported short-term improvements in weight associated with dietary interventions in adolescents with obesity. Long-term effects remain unclear (83, 84, 85).

A systematic review including 125 studies with children and adolescents 2 to 18 years of age reported a gradient effect of dietary interventions according to energy targets and dietary types. While dietary interventions with no specified energy target resulted in a BMI gain of 0.17 kg/m² (22 studies; 95% CI 0.05 to 0.40), very low-energy diets resulted in a BMI reduction of 4.40 kg/m² in BMI (three studies; 95% Confidence Interval (CI) –7.01 to –1.79) (83).

A Cochrane review assessed low fat intake for weight and body fatness in children and adolescents 2 to 18 years old. The review included three trials providing low- to very low-certainty evidence that lower total fat intake (30% or less total fat) may result in small BMI, total- and LDL-cholesterol reductions (84).

A 2014 systematic review of diets with varying macronutrient distributions in children and adolescents 6 to 14 years of age with obesity reported beneficial effects of a reduced-energy diet on BMI and cardiometabolic risk factors, irrespective of the macronutrient distribution. Evidence, however, was of poor methodological quality and there were inconsistent findings on cardiometabolic benefits (85).

Two relevant primary studies were found. A pilot RCT on a family-based mindful eating intervention in adolescents with obesity, compared to standard dietary counselling, demonstrated feasibility and acceptability of this intervention. However, effects were limited to improved high density lipoprotein cholesterol (86). An observational study on adolescents 12 to 17 years of age with obesity reported that intermittent energy restriction may be a feasible dietary approach to achieve weight loss in adolescents (87).

The studies mentioned above and other recent reviews (88) reveal that dietary interventions, as part of multimodal lifestyle change interventions, result in small, short- to long-term weight reductions. As such, there is growing interest on newer approaches for obesity management. Systematic reviews were commissioned to explore those approaches.

Gut microbiome interventions may have an impact on the diversity and abundance of intestinal bacteria, which may in turn be linked to obesity via ingested compounds or derivatives affecting small intestine functions, substrate availability affecting colonic microbial composition, and microbial end products and their effect on metabolism (89). A 2025 Cochrane systematic review including 17 RCTs with 838 participants from different countries evaluated prebiotics, probiotics, synbiotics, short-chain fatty acids, and faecal microbiota transplantation. In general, these interventions may result in little to no difference in obesity-related outcomes (90).

Another approach consists of tailored nutrition-based interventions accounting for individual variations in responses to dietary interventions, compared to “one-size-fits-all” strategies. These tailored or personalized approaches may provide benefits in obesity management because they consider genetic variations, social conditions, circadian rhythms, and psychosocial phenotypes for optimizing nutrition interventions (91). A recent Cochrane systematic review including three studies with 105 participants reported very uncertain evidence on the effect of these interventions (92).

Recommendation

WHO recommends a structured dietary intervention as one of the components of the integrated management of adolescents with obesity. It should consider age, gender, health status, food preferences and meal frequencies, nutritional education, cultural context, and the adolescent's interests, values and preferences. It should be delivered and supervised by health workers with knowledge on nutrition, and involve parents and/or caregivers.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG voted for a strong recommendation because the balance between benefits and harms favours dietary interventions ([Annex 3. Evidence-to-decision considerations for dietary interventions](#)). Benefits are small, and they vary depending on the type of diet; however, the risk of adverse events is low. Adolescents and their parents or caregivers placed a high value on the potential benefits of dietary interventions for obesity management. Acceptability and feasibility are enhanced when dietary interventions include peers and family members and when they consider societal and cultural norms. Dietary interventions are likely to be cost-effective because of their potential to prevent obesity and chronic diseases in the long term. However, the GDG also considered that financial constraints may prevent families from affording healthy food choices. The effect on equity is unclear; gender, culture, socioeconomic status, and parental or caregiver involvement have a direct impact on food insecurity and health disparities ([93](#)) ([Annex 3. Evidence-to-decision considerations for dietary interventions](#)).

Evidence on dietary interventions was limited in the number and quality of studies. A small effect of dietary treatments for less than six months compared to no dietary changes was identified for the critical outcomes of weight and BMI ([51](#)).

Dietary modifications are usually aimed at reducing total energy intake and include, but are not limited to, caloric content restriction (normal or reduced energy intake), varying macronutrient distribution or composition (low carbohydrate, high protein, low fat, omega-3 rich, PUFA rich, or ketogenic), restriction of particular components (low in salt, low in sugar, high in fibre, no food additives, low in industrialized products currently known as ultra-processed foods, or low GI foods), and dietary patterns (Mediterranean, American Heart Association, whole foods, complex carbohydrates or time-restricted diet).

Remarks

Dietary interventions require evaluation by health workers with nutrition knowledge, the inclusion of a physical and mental health evaluation, the family and personal history and environment, and an assessment of risk factors for eating disorders ([76](#), [81](#)). Health workers should be able to communicate in an empathetic, non-stigmatizing, motivational, and culturally responsive manner, and to display competencies of interdisciplinary collaboration.

WHO supports the consumption of a healthy diet to protect against malnutrition in all its forms as well as against noncommunicable diseases. The keys to a healthy diet include breastfeeding during the first two years of age, with exclusive breastfeeding for the first six months of life; consuming a combination of foods while avoiding monotonous diets; including plenty of fruits, vegetables, and legumes daily; moderating the consumption of fat; and limiting salt and sugar intake.

Diets need to be universal in their application, based on human biology and underpinned by evidence. According to the statement by WHO and FAO, a healthy diet needs to be adequate, balanced, moderate and diverse. Individual characteristics (for example age, gender, lifestyle and degree of physical activity), cultural context, locally available foods and dietary customs will determine the exact make-up of a diversified, balanced and healthy diet, although the basic principles remain the same (94, 95). The guidelines and codes of practice included in Codex Alimentarius standards provide potentially relevant advice regarding nutrient compounds that may be used in special dietary foods for infants and children, formula foods for weight control diets, as well as labelling of and claims of prepackaged foods for dietary uses (96).

Dietary interventions allow school and community involvement in obesity management services by coordinating with caregivers and health workers to provide appropriate foods. This also helps to initiate, support and sustain dietary practices change (93, 97).

Adolescents and their parents or caregivers prefer interventions that are affordable and easy to apply, including a structured meal plan, hands-on activities, and fun approaches to promoting healthy eating habits. Acceptability is enhanced when dietary interventions are tailored to age and cultural patterns.

The initiation and follow-up of a diet plan require the involvement of the adolescent and their parents or caregivers, services with structured guidance, and consideration of the schedule of parents or caregivers to facilitate compliance and engagement with the intervention.

Mental health issues such as anxiety, depression, low self-esteem, and emotional dysregulation may lead to unhealthy eating behaviours. Health workers should address obesity and mental health conditions in the primary health care setting early and together, using inclusive, developmentally appropriate, and family-engaged strategies (81).

Dietary behaviours are influenced by complex factors, including gender, culture, socioeconomic status, and parental and caregiver involvement, with early education and the environment playing crucial roles in long-term health.

Low-income communities face higher food insecurity and health disparities, underscoring the need for accessible nutrition resources and better nutritional education.

There is a need for assessing risk factors for eating disorders when delivering dietary interventions.

Research gaps

Studies to determine the risk of serious adverse events for certain restrictive diets (such as very low-calorie diets, ketogenic diets, or time-restricted eating) and the effect of long-term restrictive dietary treatments.

Studies on the effect of restrictive diets, diets modifying a particular macronutrient, or monotonous diets on growth, physical and mental well-being, lipid metabolism, and risk of cardiovascular disease. Research on dietary interventions in adolescents should prioritize well-designed and well-reported RCTs and prospective controlled cohort studies reporting efficacy, effectiveness, safety profile, long-term secondary effects, weight regain, and cost.

Summary of judgements

When reviewing and voting on the evidence-to-decision framework for this question, GDG members found evidence supporting small desirable effects of diet therapies for the management of adolescents with obesity, with undesirable effects being moderate to small, and very-low-certainty evidence. Despite these limitations in the body of evidence, the GDG considered that this recommendation should be strong.

When benefits are highlighted to them, adolescents with obesity placed a high value on the potential benefits of dietary interventions for obesity management. The involvement of peers and family members fostered continued engagement with dietary changes (93, 97).

The GDG considered that acceptability and feasibility vary depending on whether dietary interventions are tailored to age, cultural patterns, and other characteristics (97, 98, 99). Costs and resource requirements vary; healthy foods and interventions-specific meal plans may incur costs on the families (97, 99). The GDG determined that dietary interventions are probably cost-effective due to potential benefits in weight management and the prevention of chronic diseases (100).

Dietary behaviours were influenced by complex factors, including gender, culture, socioeconomic status, and parental and caregiver involvement, with early education and the environment playing crucial roles in young people's long-term health (101). GDG members concluded that while the impact on equity of dietary interventions is uncertain, low-income and historically marginalized communities faced higher food insecurity and health disparities (102-109) ([Annex 3. Evidence-to-decision considerations for dietary interventions](#)).

Physical activity, sedentary behaviour, and sleep

Summary of evidence

The WHO-commissioned systematic review retrieved 30 parallel RCTs with 1508 participants. Among those studies reporting gender and age, 46% of participants were female with a mean age range between 10.1 and 16.9 years. Most studies compared physical activity against no intervention (110) ([Annex 2. Physical activity, sedentary behaviour, and sleep](#)).

Low-certainty evidence from 14 RCTs (n= 537) indicated that physical activity versus control may reduce BMI in adolescents (-1.38 kg/m², 95% CI -1.94 to 0.83).

Low-certainty evidence from 17s RCT (n= 749) indicated that physical activity versus control may reduce body weight in adolescents (MD -1.88 kg, 95% CI -3.34 to -0.42).

Low-certainty evidence from one RCT (n= 56) indicated that moderate-to-vigorous resistance training may improve overall self-reported mental health outcomes compared to no intervention, in adolescents with obesity. Self-esteem and self-efficacy improved at end of the intervention, but values were not sustained long-term for any domain.

Low-certainty evidence suggested that physical activity interventions may reduce body fat percent and waist circumference compared to no intervention, in adolescents with obesity.

There is very low- to low-certainty evidence for a small potential benefit of physical activity on metabolic biomarkers such as hyperinsulinemia, resistance to insulin, glucose, fasting glucose, total cholesterol, LDL, HDL, triglycerides, leptin, and adiponectin ([Annex 2. Summary of findings table 2](#)).

No reported evidence from RCTs or prospective cohort studies was identified on the relationship between sedentary behaviour or sleep patterns with health indicators for obesity management in adolescents. Secondary analysis of two excluded studies provided relevant information. One study reported a positive association between screen time and higher BMI, higher diastolic blood pressure, and higher cardiometabolic outcomes, such as concentrations of triglycerides and low-density lipoprotein in adolescents. The other study, in pre-schoolers and adolescents, found that earlier bedtimes (either 15 minutes earlier or before 21:00) were associated with lower BMI z-scores.

Previous reviews of limited methodological quality have reported beneficial effects of physical activity in adolescents. A systematic review of reviews with meta-analysis suggested that exercise has the potential to reduce percent body fat in adolescents with overweight and obesity (111). Another systematic review with meta-analysis suggested that exercise has a positive impact on reducing the BMI z-scores in adolescents with overweight and obesity (112). Moreover, both aerobic exercise and a combination of aerobic and strength training appeared to be associated with improvements in adiposity outcomes among adolescents with overweight and obesity (113).

Sedentary behaviour and inadequate sleep are lifestyle determinants of obesity in children and adolescents. However, a 2024 literature review reported that there is a paucity of RCTs or prospective studies on the effect of sedentary behaviour (different durations, frequencies, patterns, or types) or improved sleep and/or sleep hygiene on obesity-related outcomes in children and adolescents (87).

Recommendation
WHO recommends a physical activity plan that considers age, gender, health status, sedentary behaviour, sleeping patterns, cultural context, the adolescent’s interests, values and preferences and the support of parents and/or caregivers as one of the components of the integrated management of adolescents with obesity.
Strength of the recommendation: Strong.
Quality of the evidence: Very low.

Justification

The GDG agreed on a strong recommendation because of the desirable outcomes of physical activity for adolescents with and without obesity (Annex 3. Evidence-to-decision considerations for physical activity, sedentary behaviour, and sleep). While the benefits are modest, so are the potential adverse events. Adolescents with obesity and their parents or caregivers place a high value on staying active, particularly when this involves peers and school activities. Physical activity interventions that are appropriate for the adolescent’s age, gender, and ethnicity and that use people-first language are more acceptable and feasible. The GDG was mindful that while cost-effective, physical activity may incur costs on families. Physical activity will increase equity only if access to physical activity opportunities is provided, particularly for girls and adolescents in low-income settings, with disabilities, or from underserved populations (Annex 3. Evidence-to-decision considerations for physical activity, sedentary behaviour, and sleep).

Evidence on physical activity was limited in the number and quality of studies. A small effect of moderate to vigorous physical activity versus no physical activity was identified for the critical outcomes BMI, weight loss, body fat, adverse effects, and mental well-being (110).

The 2020 WHO guidelines on physical activity and sedentary behaviour provide physical activity recommendations for adolescents irrespective of gender, cultural background or socioeconomic status (6). The recommendations include:

- Adolescents should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.
- Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, should be incorporated at least three days a week.

The same guidelines recommend that children and adolescents aged 5 to 17 years should limit the amount of sedentary time, particularly the amount of recreational screen time (6).

Remarks

The inclusion of physical activity as part of a scheduled daily routine that also includes schoolwork, commuting, seeing friends, and leisure could help adolescents to engage in physical activity. Non-competitive activities may be the preferred option for some adolescents.

Consider the values and preferences of adolescents and parents/caregivers when deciding how to engage in exercise or physical activity interventions for management of obesity.

Structured physical activity plans that take into consideration their motivation require discussion and agreement with the adolescents and caregivers. In general, adolescent girls prefer to engage in physical activity to facilitate weight loss and improve physical appearance, while adolescent boys do so to build muscle and improve athletic performance.

Health workers should be equipped with the required competencies and knowledge to facilitate discussion with adolescents and caregivers and promote knowledge on body weight and obesity management (82).

Mental health conditions may result in physical inactivity, sleep disturbances, and social withdrawal. Therefore, health workers should consider both obesity and mental health conditions together using inclusive, developmentally appropriate, and family-engaged strategies (81).

Physical activity plans should be tailored to the specific needs of population groups, including girls, adolescents exposed to exclusion/discrimination, adolescents with disabilities, or people at risk of developing non-communicable diseases (77, 78). Health workers should consider any underlying impairments that may hinder physical activity engagement in children with disabilities (32, 80).

Enable effective multisector collaborations to create policies supporting the establishment of active environments, for example access to parks, athletic facilities, and recreation areas provided at no cost.

Research gaps

Well-designed and well-reported RCTs and prospective cohort studies on physical activity, sedentary behaviour and/or sleep patterns in adolescents with obesity, including 1) the efficacy and potential adverse events of different exercise types, intensities and durations, reporting: 2) subgroup analyses for severity of obesity, obesity-related complications, and type of intervention, and 3) implementation considerations for low- and middle-income countries, including population characteristics such as gender, age, ethnicity, and socio-economic status.

Studies on the initiation and continued engagement with programmes on physical activity and weight management, and the determinants of adherence. Consideration should be given to parent and caregivers involvement, as well as the adolescent's motivation, preferences and own time planning/distribution.

Addressing disability considerations in physical activity interventions, both individually and from a health policy viewpoint.

Summary of judgements

GDG members determined that this recommendation should be strong. The balance of desirable and undesirable effects favours physical activity for the management of obesity in adolescents, with small benefits and small to trivial harms. Adolescents with obesity place a high value on the potential benefits of physical activity interventions. They may be motivated to exercise and to stay active because of the perceived benefits of such activities (97). In order to avoid physical or mental harm, determining the intensity and duration of physical activity should consider age, physical and health status. GDG members considered that there may probably be important variability on how adolescents value physical activity.

The GDG considered physical activity interventions to be acceptable and feasible. Safe spaces, equipment, and opportunities to engage in physical activity at home, school, and the community may enhance acceptability, accessibility and participation (97, 114).

GDG members believe physical activity interventions may be cost-effective due to potential benefits in weight management and the prevention of chronic diseases. In addition, these interventions are likely to incur low direct costs to families. Economic analyses reported that physical activity programmes are cost-effective due to the detrimental effects of physical inactivity (115), and the potential benefits of physical activity in obesity management and prevention of chronic diseases (116-122).

Worldwide, women, minoritized ethnic groups, disadvantaged communities, and individuals living with disabilities or chronic diseases are more prone to inactivity (123). The GDG highlighted that physical activity may increase equity and help combat discrimination in any form, although this is based on the premise that enhanced access to physical activity opportunities are provided, and that potential barriers to accessing opportunities to engage in physical activity are considered (Annex 3. Evidence-to-decision considerations for physical activity, sedentary behaviour, and sleep).

Behaviour changing interventions

Summary of evidence

WHO commissioned a systematic review to assess behaviour changing interventions for obesity management in adolescents aged 10 to 19 (124) (Annex 2. Behaviour changing interventions). Studies that included adolescents or children were eligible if they compared any type of behaviour changing intervention designed with cognitive therapy or behavioural therapy components, for example, cognitive therapy components (such as cognitive restructuring), behavioural therapy components (such as goal setting, problem solving), and educational components (such as psychoeducation) and/or any combinations of the above. Interventions were also assessed as group or individual, remote or not remote, and parental involvement or not. The comparator was a minimal control intervention (such as usual care, no intervention, feedback only and active control treatment). Systematic review authors completed a frequentist random-effects component network meta-analysis.

A total of 125 trials were eligible, including 16 513 children and adolescents. Participants had a mean age of 11.2 years, and 56.8% were girls. The mean baseline BMI was 27.68 kg/m² with a mean z-score of 2.32. The included trials were conducted across 29 countries/regions, mostly the United States (58 trials, 46%). A total of fourteen trials (11.4%) were completed in low- or middle-income countries, including Brazil, China, Indonesia, Iran, Malaysia, Mexico, and Turkey.

The effects of cognitive behavioural interventions varied for BMI z-scores, body fat, and waist circumference. Subgroup analyses suggested that there were no differences between children and adolescents. The effects varied by components, ranging from a small benefit to no effects, while the quality of evidence was predominantly very low to low.

For conceptual-level components, compared to minimal education, behavioural therapy likely reduces BMI z-scores (MD, -0.08%; 95% CI, -0.10 to -0.05; low certainty), body fat percentage (MD, -1.16%; 95% CI, -1.68 to -0.64; moderate certainty), and waist circumference (MD, -1.70 cm; 95% CI, -2.74 cm to -0.67 cm; moderate certainty), and improves quality of life (standard mean difference (SMD), 0.16; 95% CI, 0.03 to 0.30; moderate certainty) and mental health (MD, 1.00%; 95% CI, -4.07 to 6.07; moderate certainty) ([Annex 2. Summary of findings table 5.1](#)).

Concerning the effects of technical-level components on BMI z-scores, parental involvement (MD, -0.09; 95% CI, -0.16 to -0.03; moderate certainty) and stimulus control (MD, -0.07; 95% CI, -0.12 to -0.01; moderate certainty) are probably small but lead to statistically significant improvements. Preplanning (MD, -3.05%; 95% CI, -5.82% to -0.28%; moderate certainty) and feedback (MD, -2.73%; 95% CI, -5.31% to -0.14%; moderate certainty) probably reduce body fat percentage, while device-monitoring, problem solving, rule-setting and relaxation training might increase body fat percentage ([Annex 2. Summary of findings table 5.2](#)).

Several reviews and studies assessed the effectiveness of various behaviour changing interventions for children and adolescents. These reviews suggest that behaviour changing interventions may be promising in maintaining healthy lifestyles, however, the evidence on the effectiveness of obesity outcomes is limited, especially long-term effectiveness ([125-133](#)).

In their review of the effectiveness of various psychological treatments for childhood and adolescent obesity, Altman et al. found that effective treatments need to be comprehensive and incorporate dietary changes, increased physical activity, and involve family members ([125](#)).

Bagherniya et al. conducted a systematic review on the effectiveness of social cognitive theory (SCT) for obesity management in adolescents. This review included 12 studies and concluded that the overall impact of SCT-based interventions for obesity was limited. The quality of the evidence was “weak” ([126](#)).

A scoping review by Li et al. ([127](#)) identified two systematic reviews on motivational interviewing. These interventions had a small to medium effect on various anthropometric outcomes, such as BMI, waist circumference, and body fat percentage. Notably, greater effects were observed in adolescent girls and adolescents who fully participated (≥ 11 years old).

The systematic review by López-Alarcón et al. ([128](#)) evaluated the efficacy and safety of mindfulness interventions for managing obesity in children and adolescents. The review included seven RCTs with a total of 335 participants aged 8-19 years. Findings indicated that mindfulness interventions, such as mindful eating and mindfulness-based stress reduction, showed potential benefits in improving anthropometric measurements such as BMI, BMI z-scores, and fat mass. Additionally, four studies reported positive effects on psychological outcomes, including reductions in stress, anxiety, and depression. However, there were risk of bias concerns for the included RCTs.

Selvendran et al. conducted a systematic review and meta-analysis to assess the effectiveness of weight loss treatments in young people (< 21 years) with obesity. This review included eight studies on behavioural interventions and estimated that behavioural interventions decreased BMI by a mean of 0.18 kg/m² (95%CI: – 0.52 to 0.15) (129).

Thomason and colleagues identified 10 RCTs on self-management strategies for weight loss among adolescents. The included studies showed that self-management strategies were effective and most successful when family members were involved (130).

Tsiros and colleagues conducted a systematic review of treatment strategies for adolescents with overweight and obesity (98). This review identified RCTs on the use of behavioural therapy and cognitive behavioural therapy. While the amount and quality of the evidence was limited, behavioural therapy and cognitive behavioural therapy, combined with strategies to improve diet and physical activity, could be useful in the long-term maintenance of healthy behaviours (131).

Whitlock et al. reviewed 18 trials involving 1794 children and adolescents with overweight or obesity on the effectiveness of behavioural weight management interventions compared to minimal or no treatment controls. Most trials demonstrated positive short-term weight outcomes, though long-term maintenance of weight loss was seldom reported (132).

Zolotarjova et al. reviewed evidence on multidisciplinary interventions for children and adolescents with morbid obesity; they identified 16 eligible studies. Treatment components such as physical activity, nutrition education, behavioural modification, and family involvement may improve weight loss and health-related outcomes; however, weight loss often proved to be unsustainable in the long term (133).

Recommendation

WHO recommends behaviour changing interventions for the integrated management of adolescents with obesity. The type and duration of the intervention(s) selected should take into consideration age, gender, health status, physical activity, sedentary behaviour, cultural context, the adolescent's interests, and values and preferences with the support of parents and/or caregivers.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG considered this recommendation to be strong because the balance between benefits and harms probably favours behaviour changing interventions (Annex 3. Evidence-to-decision considerations for behaviour changing interventions). Adolescents and their parents or caregivers perceive that behaviour changing interventions will lead to long-term, holistic lifestyle changes that go beyond weight loss. Interventions are more likely to be feasible and acceptable if they are solution-based, are delivered by trustworthy health workers, and consider access to facilities and to resources to cover costs. Relatedly, the GDG also acknowledged that behaviour changing interventions may incur costs on families, depending on the care setting, delivery strategy, type of behaviour changing intervention, and health workers involved. Other population groups may also face barriers to access due to stigma, discrimination, exclusion, or lack of appropriately tailored services (Annex 3. Evidence-to-decision considerations for behaviour changing interventions).

WHO has a classification system to design and evaluate behaviour changing interventions in a way that is tailored to different contexts, from individual behaviours to societal-level changes. WHO categorizes interventions by the type of action they promote as, educational/informational interventions, persuasive interventions, normative/structural interventions, environmental interventions, and policy-based interventions, as detailed in the WHO Report on Social Determinants of Health (36), WHO Health Promotion and the 2013 WHO Global Action Plan (72).

A non-exhaustive list of behaviour changing interventions includes behavioural therapy, cognitive behavioural therapy, cognitive therapy, psychotherapy, integrative or holistic therapy, self-monitoring, goal setting and reinforcement, stimulus control, problem solving, motivational techniques, mindfulness-based cognitive therapy, or stress reduction.

Remarks

Adolescents with obesity may be motivated to engage in behaviour changing interventions because of the perceived benefits of such activities, including weight loss, body image, preventing future health problems, self-esteem, and social acceptability.

Adolescents with obesity and their caregivers value personalized, holistic, and practical obesity management interventions that promote benefits such as self-esteem, self-confidence, and social acceptability.

Behaviour changing interventions are more acceptable when they are tailored to the specific needs of adolescents with obesity, and when they incorporate fun and enjoyable activities that are practical and solution-based. There may be a need for referral to specialized services when there are coexisting mental health issues (81) or when interventions do not lead to progress. Referral should include written notification to other health workers, and clear and compassionate communication with the family regarding the reasons for referral (76).

The cost of behaviour changing interventions may depend on many factors, including the care setting, the type of behaviour changing intervention, and the health workers involved.

Addressing the causes of inequities by all society actors is required to enhance participation in obesity management interventions.

Support from governments, schools, and the community is likely to facilitate the implementation of behaviour changing interventions.

Research gaps

A common taxonomy is required to define and classify behaviour changing interventions.

Research on behaviour changing interventions for adolescents should prioritize well-designed and well-reported studies with different combinations of treatment components, reporting efficacy, effectiveness, safety profile, long-term secondary effects, weight regain, and cost.

Behaviour changing interventions need to consider the specific barriers that adolescents face, in order to prevent inequities in obesity health outcomes.

Studies on the cost-effectiveness analysis of behaviour changing interventions for adolescents with obesity.

Studies on the cost or resources use of behaviour changing interventions in adolescents with obesity.

Summary of judgements

The GDG agreed that the balance of effects probably favours behaviour changing interventions, with small benefits and small to trivial undesirable effects. The quality of the evidence was very low. GDG members underscored that there is no important variability on how adolescents and caregivers value the main outcomes. Adolescents and caregivers are motivated by the expectation that behaviour changing interventions will lead to long-term, holistic lifestyle changes that go beyond weight loss (56). The GDG also considered that behaviour changing interventions are acceptable and feasible. Acceptability is enhanced when interventions are tailored to the specific needs of adolescents, including fun and enjoyable interventions and, preferably, a digital component. Lack of time, access to appropriate facilities, transportation, and resources to cover costs may limit feasibility (56, 114).

The GDG concluded that costs of behaviour changing interventions could vary widely and that there was no direct evidence on cost-effectiveness. Effect on equity also varies. The GDG clarified that impact on equity will depend on the specific setting. For example girls, people with disabilities, adolescents with diverse sexual orientations and gender identities, and adolescents from underserved, minoritized, or low-resourced communities may be less likely to have access to behaviour changing interventions (123, 134, 135) ([Annex 3. Evidence-to-decision considerations for behaviour changing interventions](#)).

Digital health interventions

Summary of evidence

WHO commissioned a systematic review on digital health interventions for the management of obesity in adolescents (10-19 years) (136) ([Annex 2. Digital health interventions](#)). This review included 15 trials: five from the United States, three from Sweden, and one each from Canada, China, Ireland, Italy, South Korea, Switzerland, and Thailand. There were 911 participants aged 10 to 19 years, with 10 studies including only adolescents and five studies also including younger children, 0-9 years of age. All trials included either a dietary and/or physical activity component in their interventions; eight included both components, four included only a physical activity component, and three included only a dietary component. Nine trials were short-term (<six months), and six trials were long-term (six months or more). This systematic review found very low- to low-certainty evidence that digital interventions may lead to weight reduction.

Digital interventions combined with conventional care compared to conventional care alone (eight trials)

Moderate-certainty evidence from three trials (203 participants) indicated that a digital intervention compared to the control group (conventional care alone) showed a mean difference in body fat mass percentage of -2.63 (95% CI -4.47, -0.78). Low-certainty evidence from the same three studies (203 participants) indicated that the digital interventions compared to control reported a mean difference in waist circumference at the end of the study of -1.16 cm (95% CI -3.91 to 1.60) ([Annex 2. Summary of findings table 6.1](#)).

Digital interventions alone compared to conventional care alone (seven trials)

Low-certainty evidence from one study (26 participants) indicated that digital interventions compared to control (conventional care alone) resulted in a mean difference in BMI at the end of the study of -3.90 kg/m² (95% CI -11.06, 7.85). and a mean difference in waist circumference of -4.30 cm (95% CI -16.45 to 7.85) ([Annex 2. Summary of findings table 6.2](#)).

There are additional systematic reviews addressing the effects of digital interventions for children or adolescents with obesity or overweight. These reviews generally had a narrower scope of digital intervention than the commissioned review. Five reviews covered digital interventions in general (137-141). Regarding specific digital interventions, the most reviewed technology was gamed-based interventions (142-147), followed by smartphone applications (148-151), web-based programmes (152, 153), mobile health in general (which included short message service, mobile applications, and wearable devices) (154, 155), web-based self-monitoring programme (156), and technology-based counselling (122). The list also includes Internet of things-enabled technologies, which are technologies such as smartphones, wearables, sensors, and linked mobile applications that contain sensors that can be used to collect data (157), and internet or mobile-based information and communication technology (158).

All previous systematic reviews included fewer studies than the WHO-commissioned Cochrane review. For obesity outcomes, the findings from these reviews were similar to those of the commissioned review, suggesting a small effect on obesity related outcomes, also based on limited or uncertain evidence or on low-quality evidence when using the GRADE approach (149, 156). Notably, the Cochrane systematic review by Metzendorf and colleagues, which identified two RCTs comparing smartphone applications with personal coaching, concluded that a smartphone application resulted in little to no difference in BMI z-scores compared to personal coaching, at the six-month follow-up (MD 0, 95% CI -0.2 to 0.2; 1 study; 107 participants) (149).

For other outcomes, Andrade et al. found that gamed-based interventions may improve self-esteem (143). Kaakinen et al suggested that technology-based counselling may lead to changes in physical activity and diet (157). The authors suggested that there was minimal data for adolescents using smartphone apps for obesity and overweight, furthermore, evidence is also scarce for low- and middle-income countries as well as for people with different socio-economic and cultural backgrounds.

Recommendation
WHO suggests digital health interventions as one of the components of the integrated management of adolescents with obesity. It should consider the type and daily duration of the intervention; the age, gender, health status, physical activity, sedentary behaviour, cultural context and interests, values and preferences of the adolescent, and have the support of parents and/or caregivers.
Strength of the recommendation: Conditional.
Quality of the evidence: Very low.

Justification

The GDG agreed on a conditional recommendation because the evidence on digital interventions was limited in the number and quality of studies. Evidence synthesis found a small effect of short- or long-term digital health interventions compared to conventional care alone was identified for the critical outcomes of weight, BMI, and waist circumference (136).

Digital health interventions under the supervision of parents or caregivers could be potentially useful for promoting and sustaining behaviour change over time, although high-quality evidence on effectiveness is limited.

Remarks

Active video games, exergames, exercise activity applications, pedometers or accelerometers, and other similar interventions may have potential for increasing physical activity and promoting behavioural changes in people with or without accessibility issues or chronic diseases.

When deciding on specific digital health interventions, health workers should determine whether there are any coexisting mental health conditions. This is needed to avoid physical inactivity, sleep disturbances, social withdrawal, and other symptoms associated with anxiety, depression, social dysregulation, and other mental health issues (81).

Digital health interventions leading to physical activity and behavioural weight-related modifications are desirable while limiting sedentary screen time (such as watching television, searching the internet, or playing video games). Some guidance, including the Canadian Society for Exercise Physiology 24-Hour Movement Guidelines for the Early Years, indicates that regardless of age, recreational time spent in front of a screen in excess of two hours per day is associated with harmful outcomes such as depression and lower quality of life, and thus could be used as a daily maximum for screen time (160-163).

Research gaps

Guidance on definition, included activities, duration and on how to implement digital health interventions while limiting sedentary screen time. Studies on adverse events, maximum daily screen time, use or misuse of telemedicine, electronic health, mobile health, smartphone applications and other remote contact approaches, active video games, exergames, exercise activity applications, and other similar interventions for obesity management.

Summary of judgements

The GDG concluded that the balance between desirable and undesirable effects is unclear. While desirable effects are likely small, the undesirable effects are unknown. The quality of evidence was very low.

GDG members considered there is probably no important uncertainty or variability on values and preferences. Indirect evidence suggested that adolescents and their families may place a high value on the benefits of digital health interventions, although concerns exist about data security (164, 165, 166). Users also used digital interventions for their effect on empowerment and self-management (167).

Digital health interventions are in general acceptable to adolescents and their families (168, 169); the ease of use and provision of personalized information were important factors for adherence to digital health interventions (164). The GDG also clarified that digital health interventions are probably feasible, however, there is a need to engage young people in a sustained and meaningful way with interventions that fit the intended health outcomes and audience.

The GDG agreed, based on a model-based cost-effectiveness analysis (170), that costs and cost-effectiveness vary based on delivery format, development process, components of intervention, workers involved, and settings. Equity considerations include limited resources, poor internet connectivity and low digital literacy (171, 172). The effect on equity will thus vary; evidence is limited, and results differed by country (Annex 3. Evidence-to-decision considerations for digital health interventions).

Pharmacotherapy

Summary of evidence

The WHO-commissioned Cochrane systematic review included 37 RCTs assessing pharmacological interventions for obesity. Of these, 25 included only adolescents. Eight studies recruited children between 6 and 9 years of age; seven assessed metformin and one assessed liraglutide ([Annex 2. Pharmacotherapy](#)). Seventeen were completed in high-income countries, six in middle-income countries and three in low-income countries. Fourteen were multicentre trials completed in different countries ([172](#)).

Study length ranged from three to 16 months, while follow-up ranged from six to 31, with a median of 11 months.

As commonly implemented in clinical practice, in which medicines for obesity are part of a multimodal strategy of care, the included studies had baseline treatments administered to both the intervention (pharmacotherapy) and control groups. These baseline treatments were heterogeneous but generally included behavioural or lifestyle interventions, dietary or physical activity advice or prescription, with a variety of combinations among these elements.

Out of the 37 studies, 31 compared pharmacological interventions to placebo ([Annex 2. Summary of findings table 7.1](#)) as follows:

- metformin: 14 studies
- glucagon-like peptide-1 receptor agonists (GLP-1 RA) semaglutide, exenatide, and liraglutide: five studies
- sibutramine: six studies
- orlistat: three studies
- topiramate: one study
- topiramate/phentermine: one study
- comparing four different treatment strategies: metformin alone, fluoxetine alone, metformin plus fluoxetine and placebo: one study.

The remaining six studies compared pharmacological interventions to no treatment. These studies provided evidence on a very limited number of outcomes and with few participants. Results are nonetheless similar to those of the analyses of the 31 studies comparing pharmacological interventions to placebo ([Annex 2. Summary of findings table 7.2](#)).

Previous systematic reviews focused mostly on three interventions: metformin, sibutramine, and orlistat. Overall, the findings of previous systematic reviews for BMI and weight change were similar to the findings of this review.

The Cochrane review by Axon et al ([174](#)) assessed the use of metformin, sibutramine, orlistat and fluoxetine. Authors reported that pharmacological interventions may lead to a small reduction in body weight and BMI; the quality of evidence was low or very low.

Other reviews found that the use of metformin led to a small reduction in BMI and may improve fasting insulin sensitivity in adolescents with obesity ([129, 175-177](#)). Reviews on GLP-1 RA ([178](#)), orlistat ([129, 179-182](#)) and sibutramine ([128, 179, 180, 182](#)) report that pharmacotherapy using these products may lead to weight loss and BMI reduction. Evidence was generally of low quality due to short term follow-up and evaluation, and to the small number of studies and participants.

The WHO-commissioned Cochrane systematic review included new pharmacological interventions, notably GLP-1 RA. As per consultation with the general public and with the GDG, the review also included outcomes such as physical and mental well-being, quality of life, and additional cardiometabolic outcomes. Lastly, this review aimed to collect data for potential analyses by, among others, type of pharmacological treatment, length of follow-up, and geographical region. Data on combination therapy with anti-obesity drugs for adolescents has not emerged yet; this is currently a developing field among adults with obesity (183, 184).

In addition to these reviews, a 2024 phase 3a RCT in children 6 to <12 years of age with obesity assessed once-daily subcutaneous liraglutide at a dose of 3.0 mg (or the maximum tolerated dose) or placebo, plus lifestyle interventions. At week 56, the mean percentage change from baseline in BMI was -5.8% with liraglutide and 1.6% with placebo. Adverse events were reported in 50 of 56 participants (89%) in the liraglutide group and in 23 of 26 participants (89%) in the placebo group during the treatment period. Most adverse events were mild or moderate (185).

A 2025 systematic review and network meta-analysis of RCTs that included children and adolescents with a mean age below 18 years assessed the use of phentermine/topiramate, semaglutide, exenatide, liraglutide, topiramate, metformin, fluoxetine, metformin/fluoxetine, sibutramine, and orlistat. Phentermine-topiramate was better at lowering BMI than exenatide, liraglutide, metformin, fluoxetine, metformin/fluoxetine, topiramate, orlistat, and sibutramine. Semaglutide demonstrated superior efficacy over other anti-obesity medications (MD -8.28 to -1.24) and over exenatide (MD -12.43, 95% CI -23.95 to -0.30) regarding percentage change in BMI. Metformin and sibutramine reduced BMI in the group with a BMI ≥ 35 kg/m² compared to the control groups. Conversely, orlistat showed more greater benefits than the control groups in the BMI <35 kg/m² group (186).

Another systematic review, published in 2024, assessed anti-obesity medications among children and adolescents under 18 years of age with obesity. Overall, anti-obesity medications led to improvements in cardiometabolic health outcomes. There is uncertainty about long-term effects and potential adverse events (187).

A 2023 summary of the literature assessed possible unintended consequences or adverse effects of GLP-1 RAs on children and adolescents. Authors reported that GLP-1 RAs may result in unbalanced and inappropriate energy intake reductions. Other potential issues may include misuse among patients with eating disorders or athletes (188). Relatedly, a 2024 research letter reported an assessment of GLP-1 RAs medication dispensing among adolescents and youth 12 to 25 years of age. The assessment, spanning between 2020 and 2023, was obtained from a private database reporting prescriptions from 93.6% of US retail pharmacies. Authors found that while GLP-1 RA dispensing increased by close to 600% in this population, dispensing of drugs other than GLP-1 RAs decreased by about 3% (189).

When managing obesity in adolescents, it is also important to consider the role of some medications used for conditions other than obesity and their effect on adiposity. A 2024 literature review assessed the physiology and mechanisms of weight gain and metabolic dysregulation of medications used for conditions related and not related to obesity. Antipsychotics, glucocorticoids, beta-adrenergic blockers, tricyclic antidepressants, antihistamines, insulin, neuropathic agents, sleep agents, and steroids appear to be related to pharmacologic causes of weight gain. Health workers should be cognizant of these potential side effects (190).

Health workers should also assess potential genetic, hereditary, and familial factors when considering pharmacotherapy (74, 75).

Recommendation

WHO suggests pharmacological interventions for obesity management among adolescents 10-19 years of age who have obesity and obesity-related complications* only after a structured and supervised programme of multimodal lifestyle modification** has failed to achieve weight loss, limit weight gain or ameliorate obesity-related complications.

* Obesity-related complications may include type 2 diabetes, hyperinsulinemia, resistance to insulin, uncontrolled hypertension, alterations in lipid metabolism or in adipogenesis and fat accumulation, and mental health issues.

** The structured and supervised programme of multimodal lifestyle modification should include a personalized behavioural, dietary, and physical activity intervention for at least six months and periodic monitoring of coexisting conditions. Pharmacological interventions should be prescribed in a specialized multidisciplinary setting after close evaluation of physical development and psychological stability, adherence to healthy diet and physical activity habits, closely monitoring potential adverse events and including a structured long-term follow-up.

Strength of the recommendation: Conditional.

Quality of the evidence: Low.

Justification

The GDG agreed on a conditional recommendation because while the findings suggest that pharmacological treatments likely provide small to moderate benefits, length of follow up was short and important uncertainties remain regarding adverse effects. The overall quality of evidence was low. The systematic review found studies primarily involving adolescents. Studies were relatively short in duration and mostly in high-income settings. They consistently embedded pharmacotherapy within multimodal care that included lifestyle and behavioural interventions.

The field of pharmacotherapy for obesity management is rapidly evolving; new therapeutic options with different action mechanisms, doses, administration routes, and durations of treatment are under assessment for both adults and adolescents. Research focuses on options with increased efficacy, fewer side effects, convenient administration routes (for example, oral as opposed to parenteral), and shorter treatment duration.

Remarks

For adolescents eligible for pharmacological interventions for obesity management, pharmacotherapy interventions should be delivered as part of a structured and supervised multimodal intervention including behavioural, dietary, and physical activity interventions that consider age, gender, health status, sedentary habits and sleeping patterns, cultural context, the adolescent's interests, values and preferences.

Close evaluation of complete pubertal development, final adult height, and psychological stability are needed when prescribing pharmacological interventions. Prescription should always be in accordance with up-to-date scientific evidence and consider the lack of evidence on long-term follow-up.

Pharmacological interventions should be prescribed in a specialized multidisciplinary setting, closely monitoring potential adverse events. Referral from the primary health care setting to specialized care or to a multidisciplinary team may be required.

The choice of the appropriate pharmacological intervention should depend on the profile of coexisting conditions and delivery must be in keeping with relevant medication indications. Parenteral administration may require training for adolescents and their parents or caregivers.

Adolescents with obesity, and their parents or caregivers, should receive continued advice on the potential benefits and adverse events of pharmacotherapy interventions for obesity management. They need to be actively involved in the decision-making process for starting and for discontinuing pharmacological interventions, whether this is due to adverse events, treatment success or failure, or other considerations.

Health workers prescribing pharmacological interventions for obesity management should be knowledgeable about the indications, efficacy, adverse effects and potential alternatives if there are adverse events of pharmacological interventions for obesity management. They should also consider possible barriers to treatment, including but not limited to the adolescent's vulnerability to peer opinion, socio-economic disadvantage, parental support, inability to attend follow-up appointments, and other adherence roadblocks.

Access to pharmacological interventions for obesity management may be hampered by cost, lack of coverage by public and/or private health insurance packages, or logistics (such as transportation or requirements for refrigeration).

The introduction of new weight-loss medications in the market may lower treatment costs and improve availability, although costs may still be elevated for users and may require the involvement of health services and insurance providers.

Effective multisector collaboration is needed to create policies supporting a continuous, available, accessible, affordable, and safe supply of pharmacological interventions for obesity management, when needed.

Research gaps

There is a need for high-quality evidence on the long-term benefits and harms of the different drugs, different doses, and/or their active ingredients for obesity management in eligible populations.

Research on pharmacological interventions for obesity management in eligible populations should prioritize well-designed and well-reported RCTs and prospective cohort studies that report 1) efficacy, effectiveness, duration of treatment, continued engagement, route of drug administration, safety profile, long-term secondary effects, access, and cost; 2) subgroup analyses for severity of obesity, coexisting conditions, and type of intervention; and 3) implementation considerations for low- and middle-income countries, including population characteristics such as gender, age, ethnicity, cultural background, and socio-economic status.

Summary of judgements

The GDG agreed that the balance of effects probably favours pharmacological interventions. While benefits are small to moderate, there is uncertainty about adverse events. The quality of evidence was low.

There is probably important uncertainty or variability on values and preferences. GDG members considered that while some young people feel enthusiastic about using medication to lose weight, others may feel disappointed that they require pharmacological assistance (191). Acceptability varies; pharmacological interventions are in general less acceptable compared to

lifestyle or behavioural interventions. Injected treatments are viewed less favourably than oral medications given fear of needles, finding injections painful, or possibly being stigmatized for self-injecting. Parents perceive that young people should not be required to endure the side effects of medications (191). When side effects outweigh benefits, adolescents decide to stop taking their medication (191). The GDG underscored that pharmacological therapy is probably feasible, although feasibility will vary based on the pros and cons of alternative options and the young person's readiness to try pharmacological interventions (191).

The GDG determined that costs vary; resource needs can be moderate to large depending on the specific treatment option. Cost-effectiveness probably favours pharmacological interventions, although cost-effectiveness results were sensitive to the assumptions underlying the effectiveness of long-term treatment (62, 192).

The GDG cautioned that pharmacological interventions are likely to reduce health equity due to differential access to quality and continuous pharmacological treatment. The global scarcity of pharmacotherapy for paediatric obesity starkly reflects the broader disparities in access to health care, which disproportionately affects adolescents from underserved communities (193, 194) ([Annex 3. Evidence-to-decision considerations for pharmacotherapy](#)).

Bariatric surgery and weight-loss and weight-management devices

Summary of evidence

Bariatric surgery

WHO commissioned a systematic review on metabolic and bariatric metabolic surgery for children and adolescents with obesity (195) ([Annex 2. Bariatric surgery and weight-loss and weight-management devices](#)). The search included three categories: 1) metabolic bariatric surgery (adjustable gastric banding, laparoscopic sleeve gastrectomy, Roux-en-Y gastric bypass, one anastomosis gastric bypass, biliopancreatic diversion and variants, endoscopic sleeve gastroplasty); 2) weight-loss devices (intra-gastric balloons, electrical stimulation, gastric emptying system); and 3) weight-maintenance devices (oral removable palatal space-occupying devices, and ingested, transient, space-occupying devices).

The systematic review found studies only on bariatric surgery in adolescents, including two RCTs and three observational prospective controlled cohort studies that compared bariatric surgery with lifestyle interventions. No studies were identified on weight-loss or weight-management devices (195). Authors reported low-certainty evidence that metabolic and bariatric surgery may be more effective than lifestyle interventions in reducing BMI (-11.67 kg/m², 95% CI: -13.22 to -10.11, two RCTs, 100 participants) and reducing weight (-20.87 kg, 95% CI: -23.64 to -18.09, three RCTs, 152 participants).

Evidence from nonrandomized studies showed similar results on BMI and weight reduction. Low-quality evidence found that metabolic and bariatric surgery may lead to improvement in other obesity-related outcomes such as lower risks of metabolic syndrome, impaired fasting plasma glucose, and improvement in quality of life ([Annex 2. Summary of findings table 9](#)).

Additional systematic reviews addressed the effects of metabolic and bariatric surgery for adolescents with obesity. These reviews differed in the types of surgery and estimates of effect.

A previous Cochrane review (63) with the most stringent inclusion criteria identified only one small RCT including 50 adolescents between 14 and 18 years of age and a BMI > 35. The review

found that laparoscopic gastric banding led to greater body weight loss compared to a multi-component lifestyle programme.

Black et al. conducted a systematic review and meta-analysis, including 637 participants from 23 studies (22 studies included adolescents only, and one study included participants from 5 to 21 years of age) (196). Authors estimated that metabolic and bariatric surgery led to a mean reduction in BMI of 13.5 kg/m² after 12 months (95% CI -15.1, -11.9). Roux-en-Y gastric bypass was the surgery type associated with the largest reduction in BMI.

Other reviews reported similar results (129, 132, 133). In people younger than 21 years of age, Selvendran reported mean BMI reductions of 9.74 kg/m² (95% CI: -11.61, -7.87 kg/m²), 17.06 kg/m² (95% CI: -19.68, -14.45 kg/m²), 16.13 kg/m² (95% CI: -17.92, -14.33 kg/m²) for laparoscopic adjustable banding, Roux-en-Y gastric bypass, and laparoscopic sleeve gastrectomy, respectively. However, long-term effectiveness data is lacking.

The WHO-commissioned systematic review did not identify any eligible studies to address the effects or safety of weight-loss or weight-management devices for adolescents. Moreover, existing evidence from prior systematic reviews is limited, primarily focusing on intragastric balloons for adult populations. A systematic review by Tate and Geliebter found only indirect evidence from eight RCTs on adults with obesity. The pooled estimates of total body weight loss were 9.7% for intragastric balloon, compared with 5.6% for control (197). Vantanasiri and colleagues conducted a systematic review on a swallowable gastric balloon, including six nonrandomized studies with 2013 adults with obesity. They estimated that the percentage of total weight loss at four to six months after completion of treatment was 12.8% (95% CI, 11.6–13.9%), and 10.9% (95% CI, 5.0–16.9%) at 12 months (198). There was large degree of heterogeneity across included studies.

Recommendation 1

WHO suggests bariatric surgery for obesity management for adolescents 10-19 years of age with severe obesity (BMI-for-age greater than 4 standard deviations above the WHO Growth Reference median; or BMI-for-age greater than 3 standard deviations above the WHO Growth Reference median and obesity-related complications*) only after a structured and supervised programme of multimodal lifestyle modification** has failed to achieve weight loss, limit weight gain or ameliorate coexisting conditions.

* Obesity-related complications may include type 2 diabetes, hyperinsulinemia, resistance to insulin, uncontrolled hypertension, alterations in lipid metabolism or in adipogenesis and fat accumulation, and mental health issues.

** The structured and supervised programme of multimodal lifestyle modification should include a personalized behavioural, dietary, and physical activity intervention for at least six months and periodic monitoring of obesity-related complications.

Strength of recommendation 1: Conditional.

Quality of the evidence 1: Low.

Recommendation 2

WHO recommends that bariatric surgery be prescribed/performed in a specialized multidisciplinary setting after close evaluation of complete pubertal development, final adult height, psychological stability, adherence to healthy diet and physical activity habits. There is also need for closely monitoring of potential adverse events and a structured long-term follow-up. Adolescents should be supported to make informed decisions throughout the intervention.

Strength of recommendation 2: Strong.

Quality of the evidence 2: Low.

Weight-loss and weight-management devices

Due to a lack of evidence, the GDG could not make a recommendation on weight-loss and weight-management devices for obesity management in adolescents.

Justification for recommendations on bariatric surgery

The GDG agreed on a conditional recommendation because while effects are moderate to large, undesirable effects vary. The WHO-commissioned systematic review found two RCTs and three non-RCTs comparing bariatric surgery with lifestyle interventions. This review found that bariatric surgery is more effective compared to no surgery in reducing BMI and weight, and may lead to improvement in other obesity-related outcomes and quality of life (195).

The GDG considered Recommendation 2, on the need for bariatric surgery to be prescribed/performed in a specialized multidisciplinary setting after close evaluation of complete pubertal development, because these precautions will decrease the potential risks and adverse events that are associated with bariatric surgery ([Annex 3. Evidence-to-decision considerations for bariatric surgery and weight-loss and weight-management devices](#)). While adolescents and their parents or caregivers were motivated by the potential for weight loss, they were also concerned about the procedure itself and the potential complications ([Annex 3. Evidence-to-decision considerations for bariatric surgery and weight-loss and weight-management devices](#)).

Remarks

When indicated, bariatric surgery for obesity management in adolescents must be delivered as part of a structured and supervised multimodal intervention that includes behavioural, dietary, and physical activity interventions that consider age, gender, health status, existing disability, sedentary habits and sleeping patterns, cultural context, the adolescents' interests, values and preferences, and that involves parents and/or caregivers.

Health workers need to assess the potential genetic, hereditary, and familial factors when considering bariatric surgery (74, 75).

The choice of bariatric surgery will depend on a patient's profile and must be delivered in accordance with medical indications and the adolescent's values and preferences when appropriate.

Prior to the intervention, continued advice needs to be provided to adolescents with obesity and their parents or caregivers on the potential benefits and adverse events of bariatric surgery for obesity management. Support and advice should continue after surgery.

Research gaps

There is a need for high-quality evidence on the long-term benefits and harms of bariatric surgery and weight-loss or weight-management devices for obesity management in eligible populations.

Research on bariatric surgery and weight-loss or weight-management devices in eligible populations should prioritize well-designed and well-reported RCTs and prospective controlled cohort studies that report efficacy, effectiveness, safety profile, long-term secondary effects, weight regain, and cost.

Summary of judgements

The GDG agreed that desirable effects are moderate to large, and undesirable effects vary. The balance of effects probably favours bariatric surgery, based on low-quality evidence.

GDG members determined that there was probably no important variability on values and preferences, and that bariatric surgery is probably acceptable. Adolescents expressed expectation for weight loss as well as concerns about the extent of weight loss achievable and possible weight regain (199). Adolescents who had undergone bariatric surgery expressed happiness that the surgery led to weight loss and social, physical and mental health benefits, but they could also experience unexpected negative consequences, such as continued weight-based bullying (199). Feasibility varies and will depend on whether access to adequate information is available, as well as funding in certain contexts (199).

The GDG considered that costs are large and dependent on many factors, including the setting of care, the type of surgery, and the health workers involved. They also concluded that bariatric surgery is probably cost effective. Several model-based cost-effectiveness analyses suggested that bariatric surgery may be cost-effective for adolescents. However, cost-effectiveness may depend on the time horizon and the effectiveness over this time horizon, as well as the comparator (200, 201, 202). Health equity is probably reduced, since access remains limited, particularly for underserved populations due to insurance barriers and a shortage of specialized providers. The shortage of paediatric obesity experts and bariatric surgeons trained for younger populations poses a significant obstacle to effective obesity care, especially in densely populated areas lacking such specialized providers (203) (Annex 3. Evidence-to-decision considerations for bariatric surgery and weight-loss and weight-management devices).

Multimodal interventions

Summary of evidence

WHO commissioned a systematic review on the effects of combined (multimodal) health-related behaviour interventions for adolescents 10 to 19 years of age with obesity (58) (Annex 2. Multimodal interventions). This review retrieved 20 health care-based interventions implemented in primary care and hospitals, and 13 community-based interventions in schools, churches, and community centres. Interventions included sessions on dietary modification, physical activity, and behavioural change.

This review found low-certainty evidence for the effects of health care-based multimodal interventions on BMI z-scores, physical well-being, physical and emotional functioning, physical activity, and quality of life. Health care-based interventions may result in little to no difference in BMI z-scores at 12 to 18 months (MD -0.11, 95% CI -0.19 to -0.02; 17 studies; 2666 participants) and 24 months (MD 0.50, 95% CI -0.35 to 1.35; 1 study; 33 participants); and no difference in physical well-being at 12 months follow-up (PedsQL, DISABKIDS, GW-LQ-KJ, SMD 0.13, 95% CI -0.13 to 0.39; 4 studies; 1006 participants). Interventions may improve physical functioning and quality of life but have little to no difference in self-reported physical activity and emotional functioning ([Annex 2. Summary of findings table 11.1](#)).

Similarly, the review found very low- to low-certainty evidence for the effects of community-based multimodal interventions on these outcomes. Community-based multimodal interventions may result in little to no difference in BMI z-scores at 12 months (change from baseline and final values, MD -0.07, 95% CI -0.21 to 0.08; 5 studies; 585 participants, very low-certainty evidence) and 24 months follow-up (change from baseline and final values, MD -0.47, 95% CI -0.96 to 0.02; 3 studies; 430 participants, low certainty). These interventions may increase physical well-being but result in little to no difference in mental well-being, self-reported physical activity, and quality of life ([Annex 2. Summary of findings table 11.2](#)).

There was very limited evidence on adverse events. One health care-based intervention study reported adverse events unrelated to the intervention; two others reported isolated events related to physical activity. There was no data on adverse events for community-based interventions.

Previous reviews have reported similar results regarding the effect of multimodal interventions in adolescents with obesity. The absolute or relative weight change from these interventions is generally modest and varies by treatment intensity and setting. Long-term effects, however, remain unclear ([204](#)).

A Cochrane review conducted by Al-Khudairy et al. included 44 trials on diet, physical activity and behavioural interventions for treating overweight or obesity in adolescents aged 12 to 17 years. When compared to no treatment, there was low-certainty evidence that multidisciplinary interventions involving a combination of diet, physical activity and behavioural components reduced BMI. Authors also identified moderate-quality evidence that these interventions may reduce weight in adolescents with overweight or obesity ([205](#)). Similarly, Mead and colleagues assessed multi-component behaviour-changing interventions that incorporate diet, physical activity and behaviour change in children aged 6 to 11 years with obesity; there was very low- to low-certainty evidence of small, short-term reductions in BMI, BMI z-scores and weight ([52](#)).

A systematic review by Ho et al. ([206](#)) reported that multimodal interventions may improve weight and cardio-metabolic outcomes in children and adolescents with obesity. Another review by Salam et al. ([207](#)) found low- to moderate-certainty evidence that diet with exercise, diet with behavioural therapy, or a combination of diet, exercise, and behavioural therapy may reduce BMI. Whitlock et al. ([132](#)) assessed behavioural interventions in schools or specialty health care settings; according to the review, these interventions can lead to small to moderate short-term improvements. Zolotarjova et al. ([133](#)) reviewed 16 studies from 1995 to 2017 combining physical activity, nutrition education, behaviour modification, and family involvement; there were small reductions in BMI (or z-score) and cardiovascular risk factors.

Recommendation

WHO recommends a structured multimodal intervention including a combination of diet, physical activity, and behavioural components for the integrated management of adolescents with obesity*. It should consider age, gender, health status, food preferences, nutrition education, physical fitness, cultural context, and the adolescent's interests, values and preferences as well as resources and support of parents and caregivers. The intervention should be delivered and supervised by health workers with knowledge on nutrition, physical activity and behaviour changing interventions.

* Other components of multimodal interventions include changes in sleep behaviour and in sedentary behaviour patterns, and the use of digital technologies. Multimodal interventions could involve family, friends, caregivers and schools, could improve access to care, and promote awareness and educational campaigns for adolescents, caregivers, schools and communities.

Pharmacotherapy and bariatric surgery for adolescents need to follow the corresponding recommendations included in this guideline development process.

Strength of the recommendation: Strong.

Quality of the evidence: Very low.

Justification

The GDG reached consensus for a strong recommendation because adolescents with obesity and their parents value the perceived benefits of multimodal interventions, including weight loss, prevention of health sequelae, and improved self-esteem, body image and social desirability ([Annex 3. Evidence-to-decision considerations for multimodal interventions](#)). While benefits are small and the potential adverse events are unknown, the GDG agreed that benefits likely outweigh the harms. Multimodal interventions are acceptable and feasible, particularly when they include fun, informal (non-competitive) activities and incorporate technology. The GDG was mindful that costs will depend on the specific aspects of the intervention; unequal access may exacerbate obesity and poor health outcomes among marginalized communities and those of low socio-economic status ([Annex 3. Evidence-to-decision considerations for multimodal interventions](#)).

The WHO-commissioned review retrieved RCTs of multimodal interventions consisting of dietary, physical activity, and behaviour modifications, compared to usual care delivered either in health care settings or in community settings such as schools, churches, and community centres. Results were similar in both settings, including small effects on BMI z-scores at different endpoints, BMI, physical well-being, and quality of life ([58](#)).

Remarks

The recommendations on diet, physical activity and behavioural components, established during the process of developing this guideline, could form the basis of a multimodal intervention. This guideline includes recommendations on sleep behaviour, sedentary behaviour, digital technologies, and the need to involve family, friends, caregivers, schools and the community.

The specific components of the intervention can be decided based on the results of a detailed initial clinical assessment that considers anthropometric measures as well as a comprehensive family and medical history, a review of psychosocial and behavioural factors (such as eating habits, physical activity, sleep routines), and relevant laboratory tests where appropriate ([76](#)).

Parental or caregiver involvement can enhance the effectiveness of lifestyle interventions. Parents or caregivers can support the adolescent throughout the intervention, change their own behaviours, and adapt parenting styles.

Multimodal interventions may be cost-effective due to potential benefits in weight management and prevention of chronic diseases.

Referral from the primary health care setting to specialized care may be required, including notification of other health workers and clear, compassionate communication with the family (76).

Adolescent obesity experts, secondary or specialized care, and/or the involvement of multidisciplinary teams in multimodal lifestyle interventions could be an option.

The frequency of following up adolescents with obesity should consider overall clinical condition and coexisting conditions, medication use, and social vulnerability (76).

Whole-of-society approaches that address the causes of inequities in access are required to enhance participation in obesity management interventions (3).

Support from governments, schools, and the community could facilitate the implementation of multimodal interventions.

Research gaps

Research on multimodal interventions in adolescents should prioritize well-designed and well-reported RCTs and prospective controlled cohort studies that report efficacy, effectiveness, safety profile, long-term secondary effects, weight regain, and cost.

Multimodal interventions need to consider the specific barriers that adolescents face in order to prevent inequities in obesity health outcomes.

Studies are needed to analyse the cost-effectiveness of multimodal interventions for adolescents with obesity.

Studies are also needed on the cost or resources required to implement multimodal interventions in adolescents with obesity.

Summary of judgements

The GDG considered that desirable effects are small. The balance of effects probably favours multimodal interventions, although adverse events are unclear, both for health care-based and community-based multimodal interventions. The certainty of evidence was very low.

The GDG voted that this recommendation should be strong. There was probably no important uncertainty or variability in values and preferences. Adolescents with obesity value the expected benefits of multimodal interventions, including weight loss, the prevention of health sequelae, improved self-esteem, body image and social desirability. Parents and adolescents prefer interventions that incorporate supportive interactions, including family engagement and broader influences beyond the family unit. They value interventions that address weight loss as well as behaviour change and self-esteem (135, 97). The GDG agreed that multimodal interventions are probably acceptable and feasible, particularly when they include fun, noncompetitive activities that incorporate technology and that foster interactions with families and peers. Roadblocks such as costs and parental schedules or lack of knowledge may hinder long-term adherence (93, 115).

The GDG concluded that costs vary. Lifestyle changes such as diet, exercise, and behaviour change may incur costs depending on the components of the intervention, the duration, setting and health workers involved (97, 98). The GDG also underscored that multimodal interventions are probably cost-effective due to potential benefits in weight management and prevention of chronic diseases.

Impact on health equity varies. Girls, people with disabilities, adolescents with diverse sexual orientations and gender identities, and those from underserved or minoritized communities are less likely to have access to obesity management interventions; whole-of-society approaches that consider the multiple causes of these inequities are needed to enhance the participation of underserved groups in obesity management interventions (123, 134, 135) ([Annex 3. Evidence-to-decision considerations for multimodal interventions](#)).

Guideline development methodology

This guideline adheres to the procedures set out in the WHO Handbook for guideline development (29).

Participants in the guideline development process

The WHO Obesity Steering Committee ([Annex 4. WHO Obesity Steering Committee](#)), led by the Department of Nutrition and Food Safety, oversaw the entire guideline development process; activities were coordinated by the Responsible Technical Officer. The WHO Obesity Steering Committee provided overall advice on the composition of the GDG; on drafting questions and outcomes for guideline development; and on finalizing and submitting the planning proposal and final guideline to the WHO Guidelines Review Committee (GRC). The WHO Obesity Steering Committee also oversaw: the retrieval, assessment and synthesis of evidence, the assessment of disclosures of conflicts of interest, the drafting of recommendations based on the decisions of the GDG, the drafting of the final guideline and peer review process and the publication and dissemination of the guideline. The same Committee monitors new information for assessing when a guideline update may be needed.

The GDG members ([Annex 5. WHO Guideline Development Group](#)) included individuals with a range of expertise, skills, and perspectives related to the management of adolescents with obesity. Members represented diversity in gender, age, and geography, from all WHO Regions and from low, middle and high-income countries. The GDG was identified with support from the WHO Obesity Steering Committee, WHO expert advisory panels, and previous GDG membership. A call for experts was published on the WHO Nutrition and Food Safety website and disseminated via social media and mailing lists. Once selected, and in order to strengthen public trust and transparency, the names and brief biographies of each GDG member were published on the WHO website two weeks before each meeting to allow time for public notice and comment.

The systematic review teams ([Annex 6. Systematic review teams](#)) retrieved, assessed and synthesized evidence with input from the WHO Secretariat. The systematic review teams presented a comprehensive, objective synthesis of the evidence to the WHO Obesity Steering Committee and the GDG to inform recommendations. The guideline methodologist provided expert technical methodological support for the guideline development process; for evidence retrieval, assessment and synthesis; and for drafting recommendations and the final version of the guideline.

Each GDG meeting consisted of GDG members, systematic review teams and other experts relevant for each particular topic, observers ([Annex 7. Observers](#)), and the WHO Secretariat

([Annex 8. WHO Secretariat](#)). The observers included stakeholders and organizations with relevant expertise on content, evidence assessment and guideline development. They lent relevant technical support and maintained confidentiality relating to the guideline's development process and outcomes.

The external reviewers ([Annex 9. External reviewers](#)) included technical experts, end-users, programme managers, advocacy groups and individuals affected by the conditions addressed in the guideline, among other stakeholders. They critically appraised the final version of the guideline.

Declarations of interest and management of conflicts of interest

According to the WHO Basic Documents and the processes in the WHO Handbook for guideline development ([29](#)), all experts participating in WHO meetings declared any interest relevant to the meeting, prior to their participation. Attendants of the GDG meetings participated in their individual capacity and not as institutional representatives. Members of the GDG, The systematic review teams, external reviewers, and observers completed Declarations of interest and confidentiality undertaking forms. The WHO Obesity Steering Committee, in compliance with the WHO guidelines for Declaration of interests for WHO experts and in collaboration with the Department of Compliance and Risk Management and Ethics, managed all potential conflicts of interests. An updated curriculum vitae was also required from each GDG member.

Both sets of forms, together with information from the internet or media, were assessed in order to identify any public statements or positions held, and were assessed for potential financial and non-financial bias that may be perceived to, or actually, affect impartiality. All concerns or potential issues were discussed on a case-by-case basis with the WHO Office of Compliance, Risk Management and Ethics. In addition, all GDG meeting participants verbally declared potential conflicts of interest at the beginning of each meeting.

Table 2 includes a summary of conflicts of interest declared by participants during the guideline development process and the actions taken to address them.

Table 2: Conflicts of interest declarations, and how potential conflicts were addressed during the guideline development process

Meeting	Participant	Group	Conflict of interest	Action
Third to eighth meetings of the Guideline Development Group	Dr Mardia López-Alarcón	Guideline Development Group	Commissioned by WHO to complete a manuscript related to mindfulness, meditation, and other psychological interventions in the management of obesity.	Asked to recuse herself during recommendation drafting on mindfulness, meditation, and other psychological interventions.
Third meeting of the Guideline Development Group	Professor Paulina Nowicka	Guideline Development Group	Held a consultancy contract with WHO at the time of the meeting.	Asked to participate as observer.

Formulation of questions and selection of outcomes

The WHO Obesity Steering Committee ([Annex 4. WHO Obesity Steering Committee](#)) drafted an initial list of questions and outcomes for guideline development. This list was subject to a public notice between 12 February and 12 April 2021. The WHO Secretariat consulted the WHO regional and country offices, as well as various departments and programmes at WHO headquarters, to identify stakeholders who could potentially participate in the public notice and comment. The following stakeholders external to WHO were targeted for participation: representatives of WHO Member States; intergovernmental organizations, international partners and UN agencies; non-State actors in official relations with WHO, which may include nongovernmental organizations, private sector entities, philanthropic foundations, and academic institutions; participants in multi-stakeholder initiatives, for example international experts and WHO advisory panels; WHO collaborating centres; scientific societies; grassroots organizations; members of WHO mailing lists; people with obesity, their families, and the public. In addition, members of the WHO Obesity Steering Committee provided contact information for international experts and WHO advisory panels, scientific societies, and members of relevant WHO mailing lists. Lastly, the WHO Secretariat approached the public through available channels such as the WHO website and social media.

The WHO Secretariat and the WHO Obesity Steering Committee ([Annex 4. WHO Obesity Steering Committee](#)) provided the GDG with a summary of the results of the Delphi consensus survey that ensued from the public notice and comment exercise. The GDG held online meetings to discuss the proposed questions and outcomes. Subsequently, they rated questions and outcomes a second time via an online survey.

The WHO Obesity Steering Committee ([Annex 4. WHO Obesity Steering Committee](#)) analysed results of the GDG deliberations. A final list of questions was then drafted and presented to the GDG for final approval. Lastly, the approved questions and outcomes were sent to the WHO GRC for final review and ratification.

Evidence retrieval, synthesis and assessment

The WHO Obesity Steering Committee and The systematic review teams completed evidence searches for each guideline question, and Cochrane and non-Cochrane systematic reviews were commissioned. Evidence retrieval, assessment and synthesis adhered to the WHO Handbook for guideline development ([29](#)), GRADE methodology ([208, 209](#)), and Cochrane guidance ([69, 70](#)) when applicable. Evidence was systematically and exhaustively searched in the main scientific literature databases, grey literature repositories, the International Clinical Trials Registry Platform, and through consulting with experts and authors, among other strategies. There were no language restrictions.

The quality of the evidence refers to the extent of the confidence that the estimates of an effect are adequate to support a particular decision or recommendation ([29](#)). The systematic review teams classified the quality of the evidence for each outcome in four categories: high, moderate, low or very low. Risk of bias, inconsistency or heterogeneity, indirectness, imprecision, and publication bias decreased quality, while large effect, dose response and confounders increased quality. Once all outcomes had been evaluated, a level of overall confidence in the estimates of effect was given in order to support a recommendation. Subsequently, GRADE Summary of findings tables were prepared ([Annex 2. GRADE summary of findings tables](#)).

Developing recommendations

The WHO Secretariat and the WHO Obesity Steering Committee drafted initial recommendations based on the results of evidence retrieval, synthesis and assessment. These were then presented to the GDG before and during GDG meetings. For each meeting, a Chair and potentially a co-Chair were nominated to moderate the discussion. Members of the WHO secretariat and The systematic review teams were available to answer questions and coordinate the meeting logistics, but were not allowed to vote.

When discussing and deciding on recommendations, the GDG considered the results of the evidence retrieval, synthesis and assessment, and of evidence-to-decision frameworks, which The systematic review teams prepared following the GRADE methodology. The evidence-to-decision framework is based on the synthesis of evidence for each PICO question on the balance between benefits and harms, stakeholders' values and preferences, costs, cost effectiveness, equity considerations, acceptability, and feasibility ([Annex 3. Summary of Guideline Development Group considerations to determine the strength of the recommendations](#)). In addition, the GDG explicitly took into consideration factors of human rights and sociocultural adaptability, societal implications, health system considerations, implementation, monitoring and evaluation, and research gaps.

The GDG discussed, reached consensus, and anonymously voted on the wording and strength of each recommendation. Agreement of two thirds of members was required. If no consensus was reached, more time was allowed for deliberation and for additional rounds of voting. If requested, divergent opinions could be recorded in the guideline.

External review

The final draft guideline was peer-reviewed by five content experts, who provided technical feedback ([Annex 9. External reviewers](#)). These external reviewers were identified through various expert panels within and outside WHO.

These peer reviewers were not involved in the guideline development process (29) and were only asked to provide comments on the final draft guideline. Their role was to identify any errors or missing data and to comment on clarity, setting-specific issues and implications for implementation; they were not permitted to change the recommendations formulated by the GDG. Reviews from such individuals or organizations on a draft guideline may be helpful in anticipating and dealing with controversy, improving the clarity of the final document and promoting engagement with all stakeholders.

Final guideline manuscript and WHO Guidelines Review Committee approval

A preliminary version of the guideline manuscript was drafted by the responsible technical officer of the guideline and shared with the WHO Obesity Steering Committee for input. The final version, after external peer review, GDG revision, and public comment and notice feedback, was approved by the WHO Guidelines Review Committee.

Dissemination, implementation, monitoring, evaluation, and ethical considerations

Dissemination

This guideline will be disseminated through electronic media such as webinars, posters, slide presentations and the internet, through the WHO Nutrition mailing lists, social media, the WHO Nutrition and Food Safety web page (210), and the WHO e-Library of Evidence for Nutrition Actions (eLENA) (211). eLENA compiles and displays WHO guidelines related to nutrition, along with complementary documents such as systematic reviews, and other evidence that informed the guideline. It includes biological and behavioural rationales as well as and additional resources produced by Member States and global partners. The guideline will also be disseminated through a broad international network, including WHO country and regional offices, ministries of health and other related offices, WHO collaborating centres, universities, other United Nations agencies and nongovernmental organizations. Derivative products that are useful for end-users, such as summaries and a collation of normative statements related to obesity management in adolescents may be developed.

Particular attention will be given to improving access to this guideline for stakeholders that face more, or specific, barriers in access to information, or to those that play a crucial role in implementation, for example, policymakers and decision-makers at subnational level. Specialized technical assistance will be provided to any WHO regional office willing to translate the full guideline into any of these languages and support countries in implementation.

Implementation

Implementation of this guideline is appropriate for all WHO regions and countries. This work will support the essential role of National Health Policies, Strategies and Plans in defining a country's vision, policy directions and strategies for ensuring the health of its population. Ideally, this guideline should be implemented as part of a continuum-of-care and integrated programme on child and adolescent health, incorporated into ongoing initiatives and, when available, current national guidance. Intersectoral action is fundamental in those settings where the intervention is delivered in coordination with sectors such as education and social development. Linking the implementation of these recommendations to other intersectoral interventions will benefit sustainability and scale-up.

Ongoing assessment of the accessibility and acceptability of the intervention can inform implementation to increase therapeutic adherence. This is particularly relevant in settings where the prevailing social norms and determinants may set unequal conditions and opportunities for different groups. A comprehensive identification and assessment of the social determinants of health that affect the target groups should be done at an early stage of implementation; these determinants include gender norms, roles and relations.

Monitoring and evaluating guideline implementation

The impact of this guideline will be evaluated within countries (by monitoring and evaluating the programmes implemented at national or multi-country scale) and across countries (that is, the adoption and adaptation of the guideline globally). An efficient system for the routine collection of relevant data, including determinants of health, therapeutic adherence, and measures of clinical impact and performance, is critical to ensure that the recommendations are effective and sustained, and that they lead the achievement of the right to health for all population groups. Monitoring differences across groups in terms of accessibility, availability, acceptability, equity and the quality of the interventions contributes to designing better public health programmes. It also advances the 2030 Agenda for Sustainable Development pledge to leave no one behind.

Ethical considerations

Ethics refers to standards of what is right or wrong and fair or unfair. Ethics can serve to guide people on what to do and not do in terms of rights, obligations and benefits to society and individuals. Ethics is central to science, research, policy making, and implementation. Every field of human action, including public health nutrition, is subject to facing ethical challenges. Ethical principles lead to consideration of whether an intervention is: producing benefits to individuals and communities; preventing harm, also at the individual and societal levels; distributing health benefits across social groups (specifically, how much an intervention is contributing to health equity); and respecting and promoting the exercise of human rights. An assessment of the accessibility and acceptability of obesity management can inform programme design and development. In some settings gender norms may create unequal opportunities for girls and boys at any age, both within and out of school; in other settings, social perceptions around ethnicity and race intervene in how certain population groups access and use an intervention. Sound implementation of this guideline, as informed by these considerations, can contribute to the systematic detection of facilitators and barriers to achieving programme goals, and to the design of scaling-up strategies.

Updating recommendations

Following the proposed “living guideline” approach, the WHO Secretariat will monitor ongoing and new research in the area of obesity, particularly for questions for which the quality of evidence was found to be low or very low. Monitoring will be conducted for emerging evidence, emerging considerations and interests from stakeholders and/or users of the guideline, changes in values and preferences, acceptability, feasibility, or cost-effectiveness of interventions; human rights, equity, and gender considerations; issues surrounding the coverage of interventions; emerging definitions or cut-off points for defining obesity and severity; the role of new technologies and social media; and the emerging need for recommendations for specific populations, including adolescents with obesity-related complications, migrant populations, or minorities, among others.

There will be careful assessment of forthcoming evidence regarding the effects and safety of interventions, including bariatric surgery, pharmacotherapy, and the potential inclusion of anti-obesity medications in WHO guidelines and documents such as the WHO Model Lists of Essential Medicines. There will also be surveillance of new studies on the values and preferences of adolescents, their parents or caregivers, health workers, and other stakeholders affected by the interventions. Other considerations that could trigger updates may be related to future WHO guidance on GLP-1 RAs for adults with obesity or any updates for WHO and FAO standards, guidelines and codes of practice adopted by the Codex Alimentarius Commission (81).

Guideline updates and the proposed living guideline approach will include the consideration of questions developed but not prioritized in the current guideline development process, as well as new evidence or emerging considerations that justify revisiting or modifying existing recommendations. The process will be assessed and coordinated by the WHO Department of Nutrition and Food Safety and will adhere to formal procedures outlined in the WHO Handbook for guideline development (29). In collaboration with the systematic review teams, the WHO Obesity Steering Committee will assess whether new evidence or emerging considerations justify revisiting or modifying existing recommendations and if the new data alter the supporting evidence or affect the reliability of the recommendation. Any updates will be integrated into the overall guideline, with changes clearly marked and shared through regular WHO communication platforms.

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Annex 1. Background questions

Genetic or familial factors

Question 1. Are there genetic, hereditary, and familial factors that need to be considered when managing adolescents with obesity?

Obesity is a complex phenotype arising from genetic, environmental, and developmental (foetal programming) interactions. Approximately 135 loci, many concentrated in 12 to 15 genes, show consistent and reproducible associations with common obesity in children and adolescents (74). Many of these variants are also associated with adult obesity, suggesting that genetic contributions to body composition are relatively stable across the life course. The most extensively studied genes include the FTO (fat mass and obesity-associated) gene (especially SNP rs9939609, associated with modest increases in BMI and replicated across European, Asian, and Amerindian populations), MC4R, and others frequently involved in appetite and energy regulation, such as TMEM18, SEC16B, ADCY3, BDNF, and NEGR1 (74). Although gene-gene interactions and genetic risk scores have been investigated, findings remain inconclusive. These findings suggest that obesity is a polygenic trait, with numerous small-effect variants acting alongside environmental influences (74).

To date, DNA methylation is the most extensively studied mechanism, often in blood or cord blood, with some studies identifying CpG sites associated with later adiposity (75). Circulating microRNAs (miRNAs) also showed differential expression in childhood obesity, though findings varied due to heterogeneity in methods and tissues used.

There are significant gaps in understanding how environmental exposures, particularly endocrine-disrupting chemicals (EDCs), shape epigenetic changes linked to obesity risk (75).

Initial Clinical Assessment

Question 2. What are the components of an initial clinical assessment* when managing adolescents with obesity?

*** Besides anthropometry and physical examination, an initial clinical assessment may include family and psycho-social history, behaviour, initial clinical assessment and biochemical parameters.**

For adolescents with overweight or obesity, taking a thorough medical history is essential for guiding care and building rapport with the adolescent and their caregiver. It should be respectful, age-appropriate, and culturally sensitive, using open-ended questions and including the adolescent in the discussion. Consent ought always to be asked of both the adolescent and the parent or caregiver before undertaking any assessment in relation to weight. The history should explore specific risk factors related to obesity. These include dietary habits (portion sizes and frequency of consuming junk food and sugary drinks), physical activity levels, and screen time (76).

A family history of obesity, type 2 diabetes, or maternal gestational diabetes should be assessed, along with psychosocial stressors and prolonged corticosteroid use. The health worker should also ask about symptoms related to potential causes or complications of obesity, such as headaches (suggesting hypertension), sleep disturbances, joint pain, bullying, depression, low self-esteem, binge-eating, irregular menses or signs of polycystic ovary syndrome, polyuria/polydipsia (suggesting diabetes), and abdominal pain (suggesting cholelithiasis) (76).

A complete physical examination is essential and should take into consideration the adolescent's comfort using appropriate physical space, including larger equipment (for example an exam table, a chair, and blood pressure cuffs). The exam should include a systematic assessment of the skin, head and neck, respiratory, cardiovascular, abdominal, musculoskeletal, neurological, and developmental systems, as well as growth measurements and vital signs. Special attention should be given to measuring blood pressure to assess for hypertension, evaluating pubertal stage, and inspecting for acanthosis nigricans—dark, velvety patches in skin folds—indicating resistance to insulin. Signs of endocrine disorders such as Cushing syndrome should also be considered, including central obesity, moon face, buffalo hump, easy bruising, and pink striae. Growth parameters (including BMI, waist circumference and other anthropometric measures), developmental milestones, and behavioural cues should be reviewed in a compassionate manner, with appropriate referrals made when specialized assessments or investigations are needed (76).

Follow-up

Question 3. What is the optimal frequency of follow-up (for example, intensive follow-up (three months or less) compared to non-intensive follow-up (more than three months post-intervention) in the clinical setting for the integrated management of adolescents with obesity?

Are there specific indications according to sex/gender or disability?

How often should anthropometric, dietary and physical activity measurements be monitored and tracked in the clinical setting?

For the care of obesity and chronic conditions, there is no single optimal follow-up frequency. Frequency should be individualized based on clinical severity, coexisting conditions, medication prescription, or whether there are signs that suggest a worsening condition. Health workers should advise caregivers and adolescents to return for a follow-up visit in a specific number of days and to check progress or response to a treatment, which may be before the scheduled follow-up visit (76).

Tables and tools exist for assessing the appropriate weight, length/height, and BMI for boys and for girls. No fixed follow-up schedule has been defined by sex, nonetheless inclusive and developmentally appropriate care is essential. Moreover, it is helpful for adolescent to be able to share their concerns with a health worker; there may be situations where parents or caregivers are asked to leave the room. It is also important to explore health-related and psychosocial developmental risks and other social determinants of health such as poverty, caregiver mental health, substance abuse or family conflicts or violence.

The use of flexible, adolescent-friendly communication methods may enhance follow-up and behaviour change. This includes the use of mobile applications, phone check-ins, and other telehealth tools. These are particularly useful for maintaining the continuity of care between in-person visits, or for adolescents living in remote or underserved areas (76).

Referral

Question 4. What are the criteria for a referral to specialized obesity management care* when managing adolescents with obesity?

*** Specialized obesity management care including but not limited to an endocrinologist, a dietitian, a clinical nutritionist, a paediatrician, a psychologist, a medical laboratory technologist, or another member of a multidisciplinary team.**

Referral to specialist or inpatient care should be considered if comprehensive lifestyle interventions, such as improvements in diet and physical activity, have been unable to achieve persistent healthy lifestyle changes, or if the adolescent presents with severe coexisting conditions. Referral could also include psychological support and nutritional counselling with a trained nutritionist. Additionally, referral to a specialist for further evaluation can be considered if the underlying cause appears to extend beyond lifestyle factors, or if additional concomitant conditions are present, such as acanthosis nigricans (76).

When referring an adolescent with obesity to specialized care or to a hospital setting, proper communication with the family must be ensured. Key aspects to explain include why the adolescent is being referred, what will happen in the hospital or at the specialist, and how that will help the adolescent. Reassure the adolescent and their caregivers that the referral will ensure access to the necessary expertise, equipment, and personnel. Regarding the referral facility, make sure that they obtain a note with the most relevant information, with an emphasis on the reasons for referral, previous treatment information, and any other relevant medical history (76).

Gender- or sex-specific considerations

Question 5. Are there any gender- or sex-specific aspects that need to be considered when managing adolescents with obesity in the primary health care setting?

There are important gender- and sex-specific considerations that should be addressed when managing adolescents with obesity in the primary health care setting. Evidence shows that sex influences the prevalence and health outcomes of obesity, as well as adolescents' experiences of stigma, help-seeking behaviour, and how they engage with health care. Girls, for instance, are more likely to internalize weight-related stigma, report lower self-esteem, and experience body dissatisfaction, which may contribute to disordered eating or avoidance of physical activity. Meanwhile, boys may be less likely to seek help due to norms around masculinity and may underreport emotional struggles associated with weight (33, 77, 78).

Health workers in primary care should be equipped to recognize these patterns and apply a gender-responsive approach. This includes using non-stigmatizing, non-judgemental and inclusive language, creating safe spaces for adolescents to express body image concerns, and tailoring interventions that are culturally and socially appropriate (33, 77, 78).

Sex and gender often overlap with other social factors such as poverty, disability, ethnicity, and sexual identity. For instance, girls in food-insecure households may have less access to nutritious food, and adolescents with disabilities may face structural barriers to physical activity or health care due to barriers in the surrounding environment. Therefore, managing adolescent obesity effectively requires a holistic, equity-oriented approach that respects adolescents and strengthens inclusive, person-centred care in the primary health care setting (31, 77, 78).

Disability-specific considerations

Question 6. Are there any disability*-specific aspects that need to be considered when managing adolescents with obesity in the primary health care setting?

*** Disability refers to the outcome of the interaction between health conditions and impairments that an adolescent might have with personal and environmental factors.**

Recognizing the relationship between obesity and disability is essential. Obesity can worsen functional limitations and medical complications, while some disabilities inherently increase the risk of weight gain. Addressing both conditions in an integrated, equitable way is key to improving outcomes for adolescents with complex care needs. Adolescents with physical, intellectual, or developmental disabilities face a significantly higher risk of obesity compared to their peers without disabilities. This elevated risk stems from overlapping factors, including but not limited to reduced opportunities for physical activity, dietary challenges (such as feeding difficulties, sensory sensitivities, or limited access to nutritious food), side effects of medication, and social exclusion (32, 79, 80).

Developmental delays may be more common in adolescents with obesity; hormonal changes during adolescence can also affect how the condition progresses or how treatments work. For example, puberty-related shifts in hormone levels can alter insulin sensitivity or exacerbate weight gain. Beyond physical health, these chronic conditions can take a toll on psychological well-being, limit opportunities for peer interaction and social engagement, and disrupt school attendance (32, 79, 80).

In clinical care, health workers must adapt assessment and treatment plans to account for functional limitations and ensure accessibility. For example, standard growth and weight tracking may not be appropriate for all disability types, and interventions must be modified to accommodate physical, cognitive, or communication needs. The WHO International Classification of Functioning, Disability and Health (ICF) offers a practical framework to assess functioning, track progress, and guide holistic, person-centred care.

Importantly, many adolescents with disabilities are excluded from standard obesity prevention or treatment programmes due to physical barriers, lack of accessible information, and limited provider training. Inclusive care must therefore address these structural challenges by involving caregivers, tailoring communication approaches, and coordinating support across services. Follow-up schedules and behaviour-change strategies should be flexible, developmentally appropriate, and responsive to both medical and social needs (32, 79).

Mental health considerations

Question 7. What are the approaches for treating and/or co-managing mental health conditions* in adolescents with obesity?

Should considerations be explored regarding how mental health issues can exacerbate obesity or vice versa, and if so, starting at what age?

*** WHO conceptualizes mental health as a “state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community”. Mental health conditions include but are not limited to eating disorders, anxiety, stress, depression, isolation, suicidal ideation, weight-based stigmatization and victimisation, low self-esteem and poor body image.**

For adolescents, mental health care is a critical component of effective obesity management and should be explored at every stage of care. Adolescents with obesity are at increased risk of experiencing depression, anxiety, body dissatisfaction, social isolation, bullying, and low self-esteem. These experiences can reinforce unhealthy behaviours such as emotional eating, avoidance of physical activity, or substance use, all of which may further contribute to weight gain. At the same time, existing mental health conditions can impair motivation, executive function, and adherence to treatment, making obesity more difficult to manage (81).

Primary health care providers should adopt integrated, person-centred approaches that address both physical and emotional health. This includes regular mental health screening during obesity care, the use of non-stigmatizing communication, and referral pathways to specialized psychological support when needed. Effective interventions include cognitive behavioural therapy, group support programmes, stress management strategies, and caregiver involvement in treatment planning (81).

Importantly, mental health services should be inclusive and responsive to the diverse identities and needs of adolescents, including those with disabilities, neurodevelopmental conditions, and who come from marginalized or gender-diverse backgrounds. These adolescents may face multiple forms of stigma that intensify mental health challenges and impact access to care. Safe, confidential, and adolescent-friendly health settings are vital to encourage help-seeking and sustained engagement.

The WHO-UNICEF *Helping adolescents thrive toolkit* emphasizes that mental health promotion should be part of routine adolescent health care, especially among those with chronic conditions such as obesity. To be effective, these efforts must consider local mental health determinants, risk factors, and access barriers (81).

Provider competencies

Question 8. What is the competency-based training (required knowledge, attitude and skills) that primary health care workers should receive to manage adolescents with obesity for improved health, functioning and obesity-associated disability?

Primary care settings play a vital role in the early identification, management, and coordination of care for children and adolescents with obesity. To support health workers in delivering effective, patient-centred care, a set of core competencies has been proposed. These are based on a review of existing literature on the roles and training needs of primary health care workers (82), and are organized into four key domains:

1. Medical knowledge, patient care, and procedural skills: Emphasizes accurate use of BMI charts, percentiles and growth charts, early recognition of obesity-related coexisting conditions, and adherence to evidence-based treatment guidelines. Health workers should provide developmentally appropriate care and refer patients to specialists when necessary.
2. Interpersonal and communication skills: Highlights the use of empathetic, non-stigmatizing communication, motivational interviewing, and culturally responsive counselling. It also stresses the importance of engaging families, recognizing social determinants of health, and connecting patients with community-based supports.
3. Practice-based learning, improvement, and professionalism: Underscores the need to incorporate obesity-specific competencies into pre-service education and continuing professional development. Training should address provider bias, developmental considerations, and include regular assessment of competency.
4. Systems-based practice: Promotes interdisciplinary collaboration, timely referrals, and integration of obesity care into clinical workflows and electronic health records. It calls for enabling policies, sustainable resources, and scalable, context-sensitive strategies to support implementation across diverse health systems.

Together, these skills equip health workers in primary care to: (1) assess and manage obesity in a clinically sound and developmentally appropriate manner; (2) communicate effectively to support patient and family engagement; (3) collaborate with specialists to coordinate comprehensive care; and (4) pursue continuous learning and improvement to maintain high-quality obesity care (82).

Annex 2. GRADE summary of findings tables

Annex 2 includes standardized tables summarizing the main findings of evidence syntheses for each of the questions included in the development of this guideline. These tables adhered to guidance methodology and provide the following GRADE levels of certainty:

High certainty: We are very confident that the true effect lies close to that of the effect estimate.

Moderate certainty: We are moderately confident in the effect estimate. The true effect is likely to be close to the effect, but there is a possibility that it is substantially different.

Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the effect estimate.

Very low certainty: We have very little confidence in the effect estimate. The true effect is likely to be substantially different from the effect.

Summary of findings: Dietary interventions

Question 1. Dietary interventions

In adolescents with obesity (P), what is the effect of dietary intervention (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Summary of findings table 1.1. Calorie reduction compared to no reduction in calories

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based, or hospital-based, or metabolic laboratory-based

Intervention: Calorie reduction

Comparison: No reduction in calories

Outcomes	Anticipated absolute effects (95% CI)			Certainty of the evidence (GRADE)	Comments
	Risk with no reduction in calories	Risk with reduction in calories	No of participants (studies)		
Body weight (kg) 10–19 years	Mean body weight: 84.74 kg	MD 0.54 lower (2.22 lower to 1.15 higher)	75 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 32.97 kg/m ²	MD 0.16 lower (0.79 lower to 0.46 higher)	74 (2 RCTs)	⊕⊕⊕⊕ Very low ^c	

Outcomes	Anticipated absolute effects (95% CI)			Certainty of the evidence (GRADE)	Comments
	Risk with no reduction in calories	Risk with reduction in calories	N _o of participants (studies)		
Body mass index (kg/m²) 10–19 mixed (studies included participants <10 and > 10 years)	Mean body mass index: 30.98 kg/m²	MD 1.02 lower (2.37 lower to 0.33 lower)	190 (5 RCTs)	⊕⊕⊕⊕ Very low ^d	
Waist circumference (cm) 10–19 years	Mean waist circumference: 98.87 cm	MD 1.41 lower (4.1 lower to 1.28 higher)	73 (2 RCTs)	⊕⊕⊕⊕ Very low ^e	
Waist circumference (cm) 10–19 mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 94.67 cm	MD 1.24 lower (3.73 lower to 1.26 higher)	125 (3 RCTs)	⊕⊕⊕⊕ Very low ^f	
Systolic blood pressure (mmHg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Systolic blood pressure (mmHg) 10–19 mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 122.15 mmHg	MD 0.96 lower (14.95 lower to 13.02 higher)	73 (2 RCTs)	⊕⊕⊕⊕ Very low ^g	
Hours of sedentary activity 10–19 years	-	Not pooled	(0 RCTs)	-	
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)	Mean hours of sedentary activity: 0.76 hours	MD 0.01 higher (0.21 lower to 0.23 higher)	53 (1 RCT)	⊕⊕⊕⊕ Very low ^h	

Outcomes	Anticipated absolute effects (95% CI)			Certainty of the evidence (GRADE)	Comments
	Risk with no reduction in calories	Risk with reduction in calories	Nº of participants (studies)		
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years	No studies included in this review reported on these outcomes				
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

- ^a Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by two levels for imprecision: optimal information size were not met, and wide confidence intervals that crossed the line of null effect.
- ^b Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 81.9\%$); downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^c Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by one level for imprecision: optimal information size were not met.
- ^d Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: optimal information size not met and wide confidence intervals crossing the clinical threshold and the line of null effect.
- ^e Downgraded by one level for RoB: analysis included one study with some concerns for RoB; downgraded by three levels for imprecision: optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^f Downgraded by one level for RoB: analysis included one study with some concerns for RoB; downgraded by one level for indirectness: data for this analysis was partially retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^g Downgraded by one level for RoB: analysis included studies with high RoB; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 73\%$); downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^h Downgraded by one level for RoB: analysis included studies with high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by one level for imprecision: optimal information size were not met.

Summary of findings table 1.2. Low carbohydrate intake alone compared to no modification or intake of high carbohydrate foods

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based, or hospital-based, or metabolic laboratory-based

Intervention: Low carbohydrate intake alone

Comparison: No modification or intake of high carbohydrate foods

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or intake of high carbohydrate foods	Risk with low carbohydrate intake alone			
Body weight (kg) 10–19 years	Mean body weight: 97.04 kg	MD 1.51 lower (3.71 lower to 0.69 higher)	170 (5 RCTs)	⊕⊕⊕⊕ Low ^a	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 95.47 kg	MD 0.63 lower (1.21 lower to 0.05 lower)	237 (8 RCTs)	⊕⊕⊕⊕ Very low ^b	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 36.05 kg/m²	MD 1.28 lower (2.63 lower to 0.07 higher)	186 (5 RCTs)	⊕⊕⊕⊕ Very low ^c	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 36.44 kg/m²	MD 1.30 lower (2.55 lower to 0.04 lower)	211 (6 RCTs)	⊕⊕⊕⊕ Very low ^d	
Waist circumference (cm) 10–19 years	Mean waist circumference: 105.98 cm	MD 0.30 lower (3.87 lower to 3.28 higher)	137 (3 RCTs)	⊕⊕⊕⊕ Very low ^e	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 105.98 cm	MD 0.30 lower (3.87 lower to 3.28 higher)	137 (3 RCTs)	⊕⊕⊕⊕ Very low ^e	

Outcomes	Anticipated absolute effects (95% CI)			No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or intake of high carbohydrate foods	Risk with low carbohydrate intake alone				
Systolic blood pressure (mmHg) 10–19 years						
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)						
Quality of life 10–19 years						
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)	No studies included in this review reported on these outcomes.					
Adverse events 10–19 years						
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)						

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

- ^a Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by one level for imprecision: the optimal information size were not met.
- ^b Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by one level for imprecision: the optimal information size were not met.
- ^c Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification ; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 72\%$); downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^d Downgraded by two levels for RoB: analysis included studies with some concerns or a high RoB with effect modification analysis included studies with some concerns or with high RoB as well as high RoB effect modification ; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^e Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.3. Mediterranean diet or American Heart Association diet (AHA) alone or with standard lifestyle changes compared to comparator for Mediterranean diet (low fat or standard diet with or without lifestyle changes)

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based, or hospital-based, or metabolic laboratory-based

Intervention: Mediterranean diet or AHA diet alone or with a standard lifestyle changes

Comparison: Comparator for Mediterranean diet (low fat or standard diet with or without lifestyle changes)

Outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with comparator for Mediterranean diet (low fat or standard diet with or without lifestyle change interventions)	Risk with the Mediterranean diet or AHA diet alone or with standard lifestyle	No of participants (studies)	Certainty of the evidence (GRADE)	
Body weight (kg) 10–19 years	Mean body weight: 89.9 kg	MD 7.6 lower (18.62 lower to 3.42 higher)	44 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 77.84 kg	MD 1.07 lower (6.30 lower to 4.17 higher)	219 (5 RCTs)	⊕⊕⊕⊕ Very low ^b	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 33.7 kg/m²	MD 2.6 lower (5.62 lower to 0.42 higher)	44 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 30.35 kg/m²	MD 1.08 lower (2.39 lower to 0.22 higher)	191 (4 RCTs)	⊕⊕⊕⊕ Very low ^b	
Waist circumference (cm) 10–19 years	Mean waist circumference: 109 cm	MD 7.1 lower (14.25 lower to 0.05 higher)	44 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 96.24 cm	MD 0.24 lower (5.31 lower to 4.83 higher)	175 (4 RCTs)	⊕⊕⊕⊕ Very low ^c	

Outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with comparator for Mediterranean diet (low fat or standard diet with or without lifestyle change interventions)	Risk with the Mediterranean diet or AHA diet alone or with standard lifestyle	No of participants (studies)	Certainty of the evidence (GRADE)	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 108.67 mmHg	MD 2.95 lower (6.88 lower to 0.99 higher)	130 (3 RCTs)	⊕⊕⊕⊕ Very low ^c	
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)	Mean hours of sedentary activity: 0.76	MD 0.01 higher (0.21 lower to 0.23 higher)	53 (1 RCT)	⊕⊕⊕⊕ Very low ^d	
Quality of life 10–19 years	No studies included in this review reported on these outcomes.				
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: analysis included studies with a high RoB; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^b Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^c Downgraded by two levels for RoB: all studies included in this analysis had some concerns or a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^d Downgraded by one level for RoB: the only study included in this analysis had high a RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by one level for imprecision: the optimal information size were not met.

Summary of findings table 1.4. High fibre intake compared to low fibre intake

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based, or hospital-based, or metabolic laboratory-based

Intervention: High fibre intake

Comparison: Low fibre intake

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with low fibre intake	Risk with high fibre intake			
Body weight (kg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	-	Not pooled	(0 RCTs)	-	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 31 kg/m²	MD 0.3 higher (0.89 lower to 1.49 higher)	100 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 31 kg/m²	MD 0.3 higher (0.89 lower to 1.49 higher)	100 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 years	Mean waist circumference: 98.2 cm	MD 0.5 higher (2.71 lower to 3.71 higher)	100 (1 RCT)	⊕⊕⊕⊕ Very low ^b	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 94.4 cm	MD 0.29 higher (2.14 lower to 2.72 higher)	255 (2 RCTs)	⊕⊕⊕⊕ Very low ^c	
Systolic blood pressure (mmHg) 10–19 years	Mean systolic blood pressure: 110 mmHg	MD 1 higher (3.73 lower to 5.73 higher)	100 (1 RCT)	⊕⊕⊕⊕ Very low ^b	

Outcomes	Anticipated absolute effects (95% CI)		N _e of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with low fibre intake	Risk with high fibre intake			
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 112.65 mmHg	MD 1.06 higher (1.82 lower to 3.94 higher)	255 (2 RCTs)	⊕⊕⊕⊕ Very low ^c	
Hours of sedentary activity 10–19 years					
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)		No studies included in this review reported on these outcomes.			
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by two levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the line of null effect.

^b Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^c Downgraded by one level for RoB: analysis included studies with some concerns or a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.5. Intake of whole foods (including grains) compared to no modification or intake of refined foods (including grains)

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Intake of whole foods (including grains)

Comparison: No modification or intake of refined foods (including grains)

Outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with no modification or intake of refined foods (including grains)	Risk with intake of whole foods (including grains) (range)	№ of participants (studies)	Certainty of the evidence (GRADE)	
Body weight (kg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 58.25 kg	MD 0.42 lower (3.95 lower to 3.10 higher)	252 (3 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 years	-	Not pooled	(0 RCTs)	-	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 26.6 kg/m ²	MD 0.62 lower (1.47 lower to 0.23 higher)	252 (3 RCTs)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 years	-	Not pooled	(0 RCTs)	-	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 82.6 cm	MD 1.5 lower (4.25 lower to 1.25 higher)	198 (2 RCTs)	⊕⊕⊕⊕ Very low ^b	
Systolic blood pressure (mmHg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 111.5 mmHg	MD 0 (3.84 lower to 3.84 higher)	88 (1 RCT)	⊕⊕⊕⊕ Very low ^c	

Outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with no modification or intake of refined foods (including grains)	Risk with intake of whole foods (including grains) (range)	No of participants (studies)	Certainty of the evidence (GRADE)	
Hours of sedentary activity 10–19 years					
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					No studies included in this review reported on these outcomes.
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

- ^a Downgraded by two levels for RoB: all studies included in this analysis had a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by two levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the line of null effect.
- ^b Downgraded by two levels for RoB: all studies included in this analysis had a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^c Downgraded by one level for RoB: the only study included in this analysis had a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.6. Intake of low glycaemic index (GI) foods compared to no modification or intake of high GI foods

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Low GI

Comparison: High GI or no modification

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with high GI or no modification	Risk with low GI			
Body weight (kg) 10–19 years	Mean body weight: 80.09 kg	MD 2.30 higher (3.45 lower to 8.06 higher)	249 (5 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 82.19 kg	MD 2.14 higher (2.95 lower to 7.22 higher)	279 (7 RCTs)	⊕⊕⊕⊕ Very low ^b	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 30.9 kg/m²	MD 0.14 lower (0.93 lower to 0.64 higher)	282 (7 RCTs)	⊕⊕⊕⊕ Very low ^c	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 31.13 kg/m²	MD 0.25 (0.50 lower to 0.99 higher)	425 (10 RCTs)	⊕⊕⊕⊕ Very low ^d	
Waist circumference (cm) 10–19 years	Mean waist circumference: 94.7 cm	MD 0.83 higher (1.62 lower to 3.28 higher)	204 (4 RCTs)	⊕⊕⊕⊕ Very low ^e	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 97.35 cm	MD 0.70 (1.60 lower to 2.99 higher)	234 (6 RCTs)	⊕⊕⊕⊕ Very low ^f	
Systolic blood pressure (mmHg) 10–19 years	Mean systolic blood pressure: 114.84 mmHg	MD 1.33 lower (4.68 lower to 2.02 higher)	138 (4 RCTs)	⊕⊕⊕⊕ Very low ^e	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 113.29 mmHg	MD 0.43 lower (3.17 lower to 2.31 higher)	168 (6 RCTs)	⊕⊕⊕⊕ Very low ^f	

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with high GI or no modification	Risk with low GI			
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)	Mean number of hours of sedentary activity: 2.8	MD 0.67 higher (0.32 lower to 1.65 higher)	63 (1 RCT)	⊕⊕⊖⊖ Low ^c	
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years					No studies included in this review reported on these outcomes.
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

- ^a Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 59\%$); downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^b Downgraded by two levels for RoB: analysis included studies with some concerns or with high RoB as well as high RoB effect modification; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^c Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by one level for imprecision: the optimal information size were not met.
- ^d Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 83.8\%$); downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by one level for imprecision: optimal information size not met.
- ^e Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^f Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: optimal information size not met and wide confidence intervals crossing the clinical threshold and the line of null effect.

Summary of findings table 1.7. High protein intake alone compared to no modification or low protein intake

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: High protein intake alone

Comparison: No modification or low protein intake

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or low protein intake	Risk with high protein intake alone			
Body weight (kg) 10–19 years	Mean body weight: 94.6 kg	MD 0.90 lower (3.70 lower to 1.90 higher)	136 (3 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 94.72 kg	MD 1.04 lower (3.61 lower to 1.53 higher)	259 (5 RCTs)	⊕⊕⊕⊕ Very low ^b	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 34.46 kg/m²	MD 0.84 lower (2.57 lower to 0.89 higher)	172 (4 RCTs)	⊕⊕⊕⊕ Very low ^c	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 34.37 kg/m²	MD 0.65 lower (1.89 lower to 0.58 higher)	295 (6 RCTs)	⊕⊕⊕⊕ Very low ^d	
Waist circumference (cm) 10–19 years	Mean waist circumference: 106 cm	MD 1.6 higher (1.51 lower to 4.71 higher)	49 (1 RCT)	⊕⊕⊕⊕ Very low ^e	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 106 cm	MD 1.6 higher (1.51 lower to 4.71 higher)	49 (1 RCT)	⊕⊕⊕⊕ Very low ^e	
Systolic blood pressure (mmHg) 10–19 years	-	Not pooled	(0 studies)	-	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 113.02 mmHg	MD 1.00 (5.44 lower to 7.44 higher)	95 (1 RCTs)	⊕⊕⊕⊕ Very low ^f	
Hours of sedentary activity 10–19 years	Mean number of hours of sedentary activity: 8	MD 0.67 higher (0.32 lower to 1.65 higher)	63 (1 RCT)	⊕⊕⊕⊕ Low ^g	

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or low protein intake	Risk with high protein intake alone			
Quality of life 10–19 years	Mean paediatric quality-of-life score: 74.97	MD 2.46 higher (6.68 lower to 11.6 higher)	34 (1 RCT)	⊕⊕⊕⊕ Very low ^h	
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)	Mean paediatric quality-of-life score: 74.97	MD 2.46 higher (6.68 lower to 11.6 higher)	34 (1 RCT)	⊕⊕⊕⊕ Very low ^h	
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)	No studies included in this review reported on these outcomes.				

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

- ^a Downgraded by two levels for RoB: all studies included in this analysis had some concerns or high RoB; downgraded by one level for imprecision: optimal information size not met.
- ^b Downgraded by two levels for RoB: all studies included in this analysis had some concerns or high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by one level for imprecision: the optimal information size not met.
- ^c Downgraded by two levels for RoB: all studies included in this analysis had some concerns or high RoB; downgraded by one level for inconsistency: presence of unexplained heterogeneity ($I^2 = 67\%$); downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^d Downgraded by two levels for RoB: all studies included in this analysis had some concerns or high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^e Downgraded by one level for RoB: the only study included in this analysis had a high RoB; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^f Downgraded by one level for RoB: the only study included in this analysis had a high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.
- ^g Downgraded by one level for RoB: the only study included in this analysis had a high RoB; downgraded by one level for imprecision: the optimal information size were not met.
- ^h Downgraded by one level for RoB: the only study included in this analysis had a high RoB; downgraded by two levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the line of null effect.

Summary of findings table 1.8. Low fat intake alone compared to no modification, or high fat intake, or Western diet for adolescents

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Settings Home-based or hospital-based or metabolic laboratory-based

Intervention: Low fat intake alone

Comparison: No modification, or high fat intake, or Western diet

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or high fat intake or Western diet	Risk with low fat intake alone			
Body weight (kg) 10–19 years	Mean body weight: 95.46 kg	MD 12.67 lower (26.27 lower to 0.92 higher)	46 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 86.15 kg	MD 7.12 lower (16.57 lower to 2.32 higher)	75 (4 RCTs)	⊕⊕⊕⊕ Very low ^b	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 34.82 kg/m²	MD 0.14 higher (1.57 lower to 1.84 higher)	79 (4 RCTs)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 32.91 kg/m²	MD 0.07 lower (1.58 lower to 1.45 higher)	108 (6 RCTs)	⊕⊕⊕⊕ Very low ^b	
Waist circumference (cm) 10–19 years	Mean waist circumference: 107.77 cm	MD 2.54 lower (10.18 lower to 5.10 higher)	64 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 102.71 cm	MD 0.82 lower (4.08 lower to 2.44 higher)	80 (4 RCTs)	⊕⊕⊕⊕ Very low ^b	
Systolic blood pressure (mmHg) 10–19 years	Mean systolic blood pressure: 106.95 mmHg	MD 1.83 lower (7.07 lower to 3.4 higher)	32 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 107.47 mmHg	MD 1.96 lower (5.6 lower to 1.67 higher)	61 (4 RCTs)	⊕⊕⊕⊕ Very low ^b	

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or high fat intake or Western diet	Risk with low fat intake alone			
Hours of sedentary activity 10–19 years					
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years	No studies included in this review reported on these outcomes.				
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.

^b Downgraded by one level for RoB: analysis included studies with some concerns or high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies that included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met, and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.9. Low fat and high carbohydrate diet compared to high fat and low carbohydrate diet for adolescents

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Low fat and high carbohydrate diet

Comparison: High fat and low carbohydrate diet

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with high fat and low carbohydrate diet	Risk with low fat and high carbohydrate diet			
Body weight (kg) 10–19 years		Not pooled	(0 studies)	-	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)		Not pooled	(0 studies)	-	
Body mass index (kg/m²) 10–19 years	Mean body mass index: 36 kg/m ²	MD 0.3 higher (4 lower to 4.6 higher)	18 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 36 kg/m ²	MD 0.3 higher (4 lower to 4.6 higher)	18 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 years					
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)					
Systolic blood pressure (mmHg) 10–19 years					
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)					No studies included in this review reported on these outcomes.
Hours of sedentary activity 10–19 years					
Hours of sedentary activity 10–19 mixed (studies included participants <10 and > 10 years)					

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with high fat and low carbohydrate diet	Risk with low fat and high carbohydrate diet			
Quality of life 10–19 years	Mean paediatric quality-of-life score: 75.8	MD 4.20 higher (7.96 lower to 16.36 higher)	18 (1 RCT)	⊕⊖⊖⊖ Very low ^b	
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)	Mean paediatric quality-of-life score: 75.8	MD 4.20 higher (7.96 lower to 16.36 higher)	18 (1 RCT)	⊕⊖⊖⊖ Very low ^b	
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. MD: Mean difference. RCT: Randomized controlled trial. RR: Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: the only study included in this analysis included had some concerns; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^b Downgraded by one level for RoB: the only study included in this analysis included had some concerns; downgraded by two levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the line of null effect.

Summary of findings table 1.10. Ketogenic diet compared to calorie reduction

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Ketogenic diet

Comparison: Calorie reduction

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with calorie reduction	Risk with ketogenic diet			
Body weight (kg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 68 kg	MD 1.60 higher (5.05 lower to 8.26 higher)	105 (2 RCTs)	⊕⊖⊖⊖ Very low ^a	
Body mass index (kg/m²) 10–19 years	-	Not pooled	(0 RCTs)	-	

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with calorie reduction	Risk with ketogenic diet			
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 7.92 kg/m ²	MD 0.85 higher (0.48 lower to 2.18 higher)	105 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 years	-	Not pooled	(0 RCTs)	-	
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean waist circumference: 89.9 cm	MD 1.29 lower (7.10 lower to 4.52 higher)	105 (2 RCTs)	⊕⊕⊕⊕ Very low ^a	
Systolic blood pressure (mmHg) 10–19 years	-	Not pooled	(0 RCTs)	-	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 107 mmHg	MD 1 higher (5.39 lower to 7.39 higher)	38 (1 RCT)	⊕⊕⊕⊕ Very low ^b	
Hours of sedentary activity 10–19 years	No studies included in this review reported on these outcomes.				
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by two levels for RoB: all studies included in this analysis had high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^b Downgraded by one level for RoB: the only study included in this analysis had high RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.11. Omega-3 or polyunsaturated fatty acid (PUFA) rich diet compared to no modification or high fat intake or Western diet for adolescents

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Omega-3 or PUFA rich diet

Comparison: No modification or high fat intake or Western diet

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or high fat intake or Western diet	Risk with omega-3 or PUFA rich diet			
Body weight (kg) 10–19 years	-	Not pooled	(0 studies)	-	
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body weight: 78.2 kg	MD 2.5 higher (33.16 lower to 38.16 higher)	39 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Body mass index (kg/m²) 10–19 years	-	Not pooled	(0 studies)	-	
Body mass index (kg/m²) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean body mass index: 31 kg/m ²	MD 0.9 higher (6.73 lower to 8.53 higher)	39 (1 RCT)	⊕⊕⊕⊕ Very low ^a	
Waist circumference (cm) 10–19 years	No studies included in this review reported on these outcomes.				
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)					
Systolic blood pressure (mmHg) 10–19 years	Mean systolic blood pressure: 128.05 mmHg	MD 0 (6.03 lower to 6.03 higher)	112 (2 RCTs)	⊕⊕⊕⊕ Very low ^b	
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)	Mean systolic blood pressure: 128.05 mmHg	MD 0 (6.03 lower to 6.03 higher)	112 (2 RCTs)	⊕⊕⊕⊕ Very low ^b	

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no modification or high fat intake or Western diet	Risk with omega-3 or PUFA rich diet			
Hours of sedentary activity 10–19 years					
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)					
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: analysis included studies with some concerns for RoB; downgraded by one level for indirectness: data for this analysis were retrieved from studies which included the mixed age range; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

^b Downgraded by two level for RoB analysis included studies with high RoB; downgraded by three levels for imprecision: the optimal information size were not met and wide confidence intervals crossed the clinical threshold and the line of null effect.

Summary of findings table 1.12. Time restricted eating compared to no mealtime restriction for adolescents

Patient or population*: Adolescents aged 10–19 years or 10–19 + mixed age range

Setting: Home-based or hospital-based or metabolic laboratory-based

Intervention: Time restricted eating

Comparison: No mealtime restriction

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no mealtime restriction	Risk with time restricted eating			
Body weight (kg) 10–19 years	No RCTs found				
Body weight (kg) 10–19 + mixed (studies included participants <10 and > 10 years)					
Body mass index (kg/m ²) z-score 10–19 years	Mean BMI z-score: 2.34	MD 0.04 lower (0.12 lower to 0.04 higher)	34 (1 RCT)	⊕⊖⊖⊖ Very low ^a	
Body mass index (kg/m ²) z-score 10–19 + mixed (studies included participants <10 and > 10 years)	Mean BMI z-score: 2.34	MD 0.04 lower (0.12 lower to 0.04 higher)	34 (1 RCT)	⊕⊖⊖⊖ Very low ^a	
Waist circumference (cm) 10–19 years	No studies included in this review reported on these outcomes.				
Waist circumference (cm) 10–19 + mixed (studies included participants <10 and > 10 years)					
Systolic blood pressure (mmHg) 10–19 years					
Systolic blood pressure (mmHg) 10–19 years					
Systolic blood pressure (mmHg) 10–19 + mixed (studies included participants <10 and > 10 years)					
Hours of sedentary activity 10–19 years					

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no mealtime restriction	Risk with time restricted eating			
Hours of sedentary activity 10–19 + mixed (studies included participants <10 and > 10 years)					
Quality of life 10–19 years					
Quality of life 10–19 + mixed (studies included participants <10 and > 10 years)	No studies included in this review reported on these outcomes.				
Adverse events 10–19 years					
Adverse events 10–19 + mixed (studies included participants <10 and > 10 years)					

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

* “10–19 years” indicates adolescents in the 10 to 19 year age group; “10–19 + mixed” indicates adolescents in the <10 to 19 year age group, if age-stratified data for ≥10 years were not available.

The timepoint for each outcome reflects the study endpoint (that is, the final measurement point or change from baseline in each included study), which may vary across studies due to differences in intervention duration or follow-up period.

Footnotes:

^a Downgraded by one level for RoB: analysis included studies with some concerns; downgraded by one level for imprecision: the optimal information size were not met.

Summary of findings: Physical activity, sedentary behaviour, and sleep

Question 2. Physical activity

In adolescents with obesity (P), what is the effect of physical activity (I) compared to no intervention (C) for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Question 3. Sedentary behaviour

In adolescents with obesity (P), what characteristics of sedentary behaviour (I) in different durations, frequencies, patterns, or types (I, C) are associated with improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?

Question 4. Sleep

Should adolescents with obesity (P), improve sleep and/or sleep hygiene (I) in different duration, frequencies, or patterns as measured by objective and subjective methods (C) for improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?

Summary of findings table 2. Physical activity (any form) compared to no intervention

Patient or population: Adolescents with obesity in all their diversity

Setting: School, gym, community, home, and health care settings

Intervention: Physical activity

Comparison: No intervention

Outcomes	Anticipated absolute effects (95% CI)		N _e of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no intervention	Risk with physical activity			
BMI (kg/m²)	Mean BMI: 28 kg/m²	MD 1.38 kg/m² lower (1.94 lower to 0.83 lower)	537 (14 RCTs)	⊕⊕⊕⊕ Very low ^{a,b}	The evidence is very uncertain about the effect of physical activity on BMI (kg/m ²).
BMI (kg/m²) 12-months follow-up (6 months post-intervention)	Mean BMI at 12 months follow-up (6 months post-intervention): 33.5 kg/m²	MD 1.6 kg/m² lower (4.54 lower to 1.34 higher)	56 (1 RCT)	⊕⊕⊕⊕ Low ^c	Physical activity may result in little to no difference in BMI (kg/m ²) 12 months follow-up (6 months post-intervention).
BMI z-score	Mean BMI z- score: 4	MD 0.01 higher (0.34 lower to 0.37 higher)	250 (6 RCTs)	⊕⊕⊕⊕ Very low ^{d,e}	The evidence is very uncertain about the effect of physical activity on BMI z-score.
BMI percentile	Mean BMI percentile: 95	MD 0.7 higher (1.96 lower to 3.36 higher)	28 (1 RCT)	⊕⊕⊕⊕ Very low ^{c,d}	Physical activity may increase/or have little to no effect on BMI percentile, but the evidence is very uncertain.
Body weight (kg)	Mean body weight: 76 kg	MD 1.88 kg lower (3.34 lower to 0.42 lower)	749 (17 RCTs)	⊕⊕⊕⊕ Low ^{a,b}	Physical activity may reduce body weight (kg) slightly.
Body weight (kg) at 6 months post-intervention	Mean body weight at 6 months post-intervention: 105 kg	MD 5.4 kg lower (17.39 lower to 6.59 higher)	56 (1 RCT)	⊕⊕⊕⊕ Low ^c	Physical activity may result in little to no difference in body weight (kg) at 6 months post-intervention.

Outcomes	Anticipated absolute effects (95% CI)		N _e of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no intervention	Risk with physical activity			
Mental well-being	Mean mental well-being: 3	MD 0.25 higher (0.05 higher to 0.04 higher)	56 (1 RCT)	⊕⊕⊕⊖ Low ^{f,g}	Physical activity may result in little to no difference in mental well-being.
Physical activity (steps/ day)	Mean physical activity: 7219 steps per day	MD 91.85 steps per day lower (1391.82 lower to 1208.13 higher)	154 (3 RCTs)	⊕⊖⊖⊖ Very low ^{c,h,i}	The evidence is very uncertain about the effect of physical activity on the number of steps by day.
Physical activity vigorous intensity (min/day)	Mean physical activity vigorous intensity: 6.6 min/day	MD 1.13 minutes/day higher (4.95 lower to 7.22 higher)	73 (2 RCTs)	⊕⊖⊖⊖ Very low ^{c,h,j}	The evidence is very uncertain about the effect of physical activity on physical activity-vigorous intensity (min/day).
Physical activity moderate-to-vigorous intensity (min/day)	Mean physical activity moderate-to-vigorous intensity: 41.8 min/day	MD 15.02 minutes/day higher (4.69 higher to 25.35 higher)	61 (1 RCT)	⊕⊕⊕⊖ Low ^{d,g}	Physical activity may result in a slight increase in physical activity-moderate-to-vigorous intensity (min/day).
Physical activity moderate intensity (min/day)	Mean physical activity moderate intensity: 51.2 min/day	MD 5.75 minutes/day higher (5.33 lower to 16.83 higher)	73 (2 RCTs)	⊕⊖⊖⊖ Very low ^h	Physical activity may increase/have little to no effect on physical activity-moderate intensity (min/day) but the evidence is very uncertain.
Physical activity light intensity (min/day)	Mean physical activity light intensity: 103 min/day	MD 2.82 minutes/day higher (8.88 lower to 14.51 higher)	73 (2 RCTs)	⊕⊖⊖⊖ Very low ^{d,h}	The evidence is very uncertain about the effect of physical activity on physical activity-light intensity (min/day).
Systolic blood pressure (mmHg)	Mean systolic blood pressure: 121 mmHg	MD 3.43 mmHg lower (5.15 lower to 1.72 lower)	210 (5 RCTs)	⊕⊖⊖⊖ Very low ^{i,k,l}	Physical activity may reduce/have little to no effect on systolic blood pressure (mmHg) but the evidence is very uncertain.

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no intervention	Risk with physical activity			
Diastolic blood pressure (mmHg)	Mean diastolic blood pressure: 73 mmHg	MD 0.83 mmHg lower (2.01 lower to 0.35 higher)	210 (5 RCTs)	⊕⊕⊕⊕ Very low ^{k,m}	Physical activity may reduce/have little to no effect on diastolic blood pressure (mmHg) but the evidence is very uncertain.
Blood pressure (mmHg)	Mean blood pressure: 90 mmHg	MD 1.78 mmHg lower (6.54 lower to 2.97 higher)	86 (2 RCTs)	⊕⊕⊕⊕ Very low ^{c,d}	Physical activity may reduce/have little to no effect on blood pressure (mmHg) but the evidence is very uncertain.
Body fat (%)	Mean body fat: 35.5 %	MD 2.96 % lower (3.52 lower to 2.39 lower)	313 (9 RCTs)	⊕⊕⊕⊕ Low ^{a,m}	The evidence suggests physical activity results in a slight reduction in body fat %.
Waist circumference (cm)	Mean waist circumference: 95 cm	MD 2.88 cm lower (3.7 lower to 2.06 lower)	476 (10 RCTs)	⊕⊕⊕⊕ Low ^h	Physical activity may reduce waist circumference (cm) slightly.
Sum of skinfolds (mm)	Mean sum of skinfolds: 251 mm	MD 2.7 mm higher (37.72 lower to 43.12 higher)	56 (1 RCT)	⊕⊕⊕⊕ Low ^c	Physical activity may result in little to no difference in sum of skinfolds (mm).
Waist-to-height ratio	Mean waist-to-height ratio: 0.56	MD 0.03 lower (0.06 lower to 0)	82 (2 RCTs)	⊕⊕⊕⊕ Very low ^{g,i,k}	The evidence is very uncertain about the effect of physical activity on waist-to-height ratio.
Visceral adipose tissue (VAT)	Mean visceral adipose tissue (VAT): 84.4 cm²	MD 14.36 cm² lower (19.26 lower to 9.46 lower)	106 (1 RCT)	⊕⊕⊕⊕ Very low ^{g,n,o}	The evidence is very uncertain about the effect of physical activity on visceral adipose tissue (VAT).
Insulin (μU/mL)	Mean insulin: 16 μU/mL	MD 3.64 μU/mL lower (4.39 lower to 2.89 lower)	224 (5 RCTs)	⊕⊕⊕⊕ Very low ^{g,k,p}	Physical activity may reduce/have little to no effect on insulin (μU/mL) but the evidence is very uncertain.
Resistance to insulin	Mean resistance to insulin: 3.5 (HOMA index)	MD 0.99 (HOMA index) lower (1.25 lower to 0.73 lower)	256 (6 RCTs)	⊕⊕⊕⊕ Very low ^{g,h,i}	The evidence is very uncertain about the effect of physical activity on resistance to insulin.

Outcomes	Anticipated absolute effects (95% CI)		N _e of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no intervention	Risk with physical activity			
Glucose (mmol/L)	Mean glucose: 5 mmol/L	MD 0.29 mmol/L lower (0.45 lower to 0.12 lower)	299 (7 RCTs)	⊕⊕⊕⊕ Very low ^{g,k,o}	The evidence is very uncertain about the effect of physical activity on glucose (mmol/L).
Fasting glucose (mmol/L)	Mean fasting glucose: 4.8 mmol/L	MD 0 mmol/L (0.35 lower to 0.35 higher)	32 (1 RCT)	⊕⊕⊕⊕ Low ^c	The evidence suggests that physical activity results in little to no difference in fasting glucose (mmol/L).
Total cholesterol (mg/dL)	Mean total cholesterol: 162 mg/dL	MD 8.03 mg/dL lower (16.4 lower to 0.34 higher)	191 (5 RCTs)	⊕⊕⊕⊕ Very low ^{c,k}	The evidence is very uncertain about the effect of physical activity on total cholesterol (mg/dL).
LDL (mg/dL)	Mean LDL: 80 mg/dL	MD 8.63 mg/dL lower (14.48 lower to 2.78 lower)	191 (5 RCTs)	⊕⊕⊕⊕ Very low ^{c,k,q}	The evidence is very uncertain about the effect of physical activity on LDL (mg/dL).
HDL (mg/dL)	Mean HDL: 42 mg/dL	MD 0.87 mg/dL higher (1.83 lower to 3.58 higher)	191 (5 RCTs)	⊕⊕⊕⊕ Very low ^{c,k}	Physical activity may increase/have little to no effect on HDL (mg/dL) but the evidence is very uncertain.
Triglycerides (mg/dL)	Mean triglycerides: 108 mg/dL	MD 9.5 mg/dL lower (13.82 lower to 5.17 lower)	191 (5 RCTs)	⊕⊕⊕⊕ Very low ^{g,k}	Physical activity may reduce/have little to no effect on triglycerides (mg/dL) but the evidence is very uncertain.
Leptin (ng/mL)	Mean leptin: 17 ng/dL	MD 2.66 ng/mL lower (4.35 lower to 0.97 lower)	158 (3 RCTs)	⊕⊕⊕⊕ Very low ^{d,g,o}	The evidence is very uncertain about the effect of physical activity on leptin (ng/mL).
Adiponectin (μg/mL)	Mean adiponectin: 8 μg/mL	MD 2.58 μg/mL higher (1.98 higher to 3.17 higher)	151 (3 RCTs)	⊕⊕⊕⊕ Very low ^{g,k}	The evidence is very uncertain about the effect of physical activity on adiponectin (μg/mL).

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. MD: Mean difference. RCT: Randomized controlled trial. RR: Risk ratio.

Footnotes:

- ^a Issues of RoB: selection, reporting, and other biases.
- ^b Reporting bias: funnel plot asymmetry.
- ^c Wide confidence intervals and small sample size.
- ^d Issues of RoB: selection and attrition.
- ^e Wide confidence intervals cross the minimally important difference (MID) of 0.25 SD and small sample size. We assumed a minimal clinically important between-group difference (MCID) of 0.25 SD on BMI z-scores.
- ^f Issues of RoB: detection bias.
- ^g Small sample size.
- ^h Issues of RoB: selection, attrition, reporting, and other biases.
- ⁱ Substantial statistical heterogeneity (I² >60%).
- ^j High statistical heterogeneity (I² >70%).
- ^k Issues of RoB: selection, attrition, and reporting.
- ^l Wide confidence intervals crosses MID of >2 mmHg and small sample size. We assumed a minimal clinically important between-group difference (MCID) of >2 mmHg on SBP.
- ^m Wide confidence intervals cross MID of >2 mmHg and small sample size. We assumed a minimal clinically important between-group difference (MCID) of >2 mmHg on DBP.
- ⁿ Issues of RoB: reporting and other biases.
- ^o High statistical heterogeneity (I² >70%).
- ^p Considerable heterogeneity (I² >90%) - This issue explored via a sensitivity analysis that investigated studies in which data errors were suspected and subgroups and not downgraded for heterogeneity (I² = 42%).
- ^q Substantial statistical heterogeneity (I² >50%).

Summary of findings: Behaviour changing interventions

Question 5. Behaviour changing interventions

In adolescents with obesity (P), what is the effect of behaviour changing interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Summary of findings table 5.1. Technical-level treatment components of cognitive behavioural therapy

Population: Children and adolescents with overweight or obesity

Setting: Any

Intervention: Technical-level treatment components of cognitive behavioural therapy

Comparison: Minimal education

Treatment components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Device-monitoring	BMI z-score (assessed at the end of treatment)	1167 (18 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.00 higher BMI z-score (0.06 lower to 0.07 higher).
	Body fat (%) (assessed at the end of treatment)	502 (7 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	3.69 higher fat mass % (0.56 higher to 6.83 higher).
	Waist circumference (cm) (assessed at the end of treatment)	638 (8 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	1.48 higher waist circumference in cm (2.16 lower to 5.11 higher).
	Height (cm) (assessed at the end of treatment)	493 (8 studies)	⊕⊕⊕⊖ Low	The mean height at the end of the treatment ranged from 121.5 cm to 171.7 cm .	1.46 higher height in cm (0.20 higher to 2.72 higher).
	Quality-of-life score (assessed at the end of treatment)	402 (5 studies)	⊕⊕⊕⊖ Low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.15 higher quality-of-life score (0.17 lower to 0.48 higher).
Feedback	BMI z-score (assessed at the end of treatment)	3594 (45 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.02 higher BMI z-score (0.02 lower to 0.07 higher).
	Body fat (%) (assessed at the end of treatment)	919 (12 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	2.73 lower fat mass % (5.31 lower to 0.14 lower).
	Waist circumference (cm) (assessed at the end of treatment)	1125 (15 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	1.15 higher waist circumference in cm (1.11 lower to 3.41 higher).
	Quality-of-life score (assessed at the end of treatment)	936 (9 studies)	⊕⊕⊕⊖ Low	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.77 lower quality-of-life score (1.34 lower to 0.20 lower).
	Mental health score (assessed at the end of treatment)	348 (3 studies)	⊕⊕⊕⊖ Moderate ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.04 lower mental health score (0.24 lower to 0.17 higher).

Treatment components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Parental involvement	BMI z-score (assessed at the end of treatment)	7953 (89 studies)	⊕⊕⊕⊖ Moderate ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.09 lower BMI z-score (0.16 lower to 0.03 lower).
	Body fat (%) (assessed at the end of treatment)	1993 (28 studies)	⊕⊕⊕⊖ Moderate ^a	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	0.55 lower fat mass % (2.85 lower to 1.74 higher).
	Waist circumference (cm) (assessed at the end of treatment)	2760 (37 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	0.10 higher waist circumference in cm (2.13 lower to 2.32 higher).
	Height (cm) (assessed at the end of treatment)	1782 (25 studies)	⊕⊕⊕⊖ Very low ^a	The mean height at the end of the treatment ranged from 121.5 cm to 171.7 cm .	0.02 lower height in cm (0.55 lower to 0.50 higher).
	Quality-of-life score (assessed at the end of treatment)	1783 (17 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.09 higher quality-of-life score (0.17 lower to 0.34 higher).
	Mental health score (assessed at the end of treatment)	487 (6 studies)	⊕⊕⊕⊖ Very low ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.09 lower mental health score (0.46 lower to 0.28 higher).
Preplanning	BMI z-score (assessed at the end of treatment)	1779 (27 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.01 higher BMI z-score (0.05 lower to 0.07 higher).
	Body fat (%) (assessed at the end of treatment)	499 (8 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	3.05 lower fat mass % (5.82 lower to 0.28 lower).
	Waist circumference (cm) (assessed at the end of treatment)	615 (10 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	0.46 lower waist circumference in cm (3.57 lower to 2.65 higher).
	Quality-of-life score (assessed at the end of treatment)	125 (3 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.20 lower quality-of-life score (1.05 lower to 0.64 higher).
	Mental health score (assessed at the end of treatment)	214 (2 studies)	⊕⊕⊕⊖ Very low ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.01 lower mental health score (0.36 lower to 0.33 higher).

Treatment components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Problem solving	BMI z-score (assessed at the end of treatment)	3755 (49 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.00 lower BMI z-score (0.05 lower to 0.04 higher).
	Body fat (%) (assessed at the end of treatment)	1052 (20 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	2.90 higher fat mass % (0.30 higher to 5.50 higher).
	Waist circumference (cm) (assessed at the end of treatment)	1735 (25 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	1.18 lower waist circumference in cm (3.78 lower to 1.42 higher).
	Quality-of-life score (assessed at the end of treatment)	891 (10 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.15 lower quality-of-life score (0.71 lower to 0.40 higher).
	Mental health score (assessed at the end of treatment)	355 (5 studies)	⊕⊕⊕⊖ Low ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.34 higher mental health score (0.22 lower to 0.90 higher).
Relaxation training	BMI z-score (assessed at the end of treatment)	68 (4 studies)	⊕⊕⊕⊖ Moderate	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.16 higher BMI z-score (0.00 lower to 0.32 higher).
	Body fat (%) (assessed at the end of treatment)	52 (3 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	8.08 higher fat mass % (0.82 higher to 15.34 higher).
	Waist circumference (cm) (assessed at the end of treatment)	52 (3 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	5.50 lower waist circumference in cm (12.46 lower to 1.46 higher).
	Quality-of-life score (assessed at the end of treatment)	10 (1 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.22 lower quality-of-life score (0.73 lower to 0.29 higher).
	Mental health score (assessed at the end of treatment)	34 (2 studies)	⊕⊕⊕⊖ Moderate ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.18 lower mental health score (0.46 lower to 0.11 higher).

Treatment components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Rule-setting	BMI z-score (assessed at the end of treatment)	964 (16 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.00 higher BMI z-score (0.08 lower to 0.09 higher).
	Body fat (%) (assessed at the end of treatment)	245 (2 studies)	⊕⊕⊕⊖ Moderate	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	4.32 higher fat mass % (0.16 higher to 8.47 higher).
	Waist circumference (cm) (assessed at the end of treatment)	482 (5 studies)	⊕⊕⊕⊖ Very low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	0.95 lower waist circumference in cm (7.26 lower to 5.36 higher).
	Quality-of-life score (assessed at the end of treatment)	54 (2 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.56 higher quality-of-life score (0.42 lower to 1.53 higher).
Stimulus control	BMI z-score (assessed at the end of treatment)	3487 (42 studies)	⊕⊕⊕⊖ Moderate	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.07 lower BMI z-score (0.12 lower to 0.01 lower).
	Body fat (%) (assessed at the end of treatment)	1027 (15 studies)	⊕⊕⊕⊖ Low ^a	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	2.66 higher fat mass % (1.12 lower to 6.44 higher).
	Waist circumference (cm) (assessed at the end of treatment)	1176 (17 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	0.42 lower waist circumference in cm (3.04 lower to 2.20 higher).
	Quality-of-life score (assessed at the end of treatment)	521 (8 studies)	⊕⊕⊕⊖ Very low ^a	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.39 higher quality-of-life score (0.89 lower to 1.67 higher).
	Mental health score (assessed at the end of treatment)	244 (3 studies)	⊕⊕⊕⊖ Low ^a	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.07 lower mental health score (0.22 lower to 0.07 higher).

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

^a Downgraded by one level for imprecision.

The downgrading reasons for RoB, heterogeneity, indirectness and publication bias were shown only for direct estimates due to the method limitation. The downgrading reasons due to inadditivity, intransitivity, incoherence, and imprecision were shown for all pooled estimates.

Summary of findings table 5.2. Conceptual-level treatment components of cognitive behavioural therapy

Population: Children and adolescents with overweight or obesity

Setting: Any

Intervention: Conceptual-level treatment components of CBT

Comparison: Minimal education

Treatment Components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Behavioural therapy	BMI z-score (assessed at the end of treatment)	3934 (44 studies)	⊕⊕⊕⊕ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.08 lower BMI z-score (0.10 lower to 0.05 lower).
	Body fat (%) (assessed at the end of treatment)	1428 (20 studies)	⊕⊕⊕⊕ Moderate ^b	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	1.16 lower fat mass % (1.68 lower to 0.64 lower).
	Waist circumference (cm) (assessed at the end of treatment)	1438 (21 studies)	⊕⊕⊕⊕ Moderate ^b	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	1.70 lower waist circumference in cm (2.74 lower to 0.67 lower).
	Quality-of-life score (assessed at the end of treatment)	1204 (10 studies)	⊕⊕⊕⊕ Moderate ^c	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.16 higher quality-of-life score (0.03 higher to 0.30 higher).
	Mental health score (assessed at the end of treatment)	16 (1 study)	⊕⊕⊕⊕ Moderate ^d	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	1.00 higher mental health score (4.07 lower to 6.07 higher).
Cognitive behavioural therapy	BMI z-score (assessed at the end of treatment)	1622 (29 studies)	⊕⊕⊕⊕ Very low ^e	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.07 lower BMI z-score (0.10 lower to 0.03 lower).
	Body fat (%) (assessed at the end of treatment)	710 (11 studies)	⊕⊕⊕⊕ Low ^f	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	1.00 lower fat mass % (1.69 lower to 0.31 lower).
	Waist circumference (cm) (assessed at the end of treatment)	1200 (17 studies)	⊕⊕⊕⊕ Low ^f	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	1.76 lower waist circumference in cm (2.86 lower to 0.67 lower).
	Quality-of-life score (assessed at the end of treatment)	351 (6 studies)	⊕⊕⊕⊕ Low ^f	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.44 higher quality-of-life score (0.26 higher to 0.63 higher).
	Mental health score (assessed at the end of treatment)	196 (2 studies)	⊕⊕⊕⊕ Moderate ^d	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.04 lower mental health score (0.93 lower to 0.86 higher).

Treatment Components	Outcomes (follow-up)	Number of participants (studies) treated with the specific component	Certainty of the evidence (GRADE)	Anticipated effects (95% CI)	
				Risk with minimal education alone	Risk with target treatment
Cognitive therapy	BMI z-score (assessed at the end of treatment)	184 (2 studies)	⊕⊕⊕⊖ Low ^a	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.03 lower BMI z-score (0.17 lower to 0.11 higher).
	BMI z-score (assessed at the end of treatment)	408 (6 studies)	⊕⊕⊕⊖ Very low ^d	The mean BMI z-score at the end of the treatment ranged from 1.34 to 4.2 .	0.06 lower BMI z-score (0.14 lower to 0.01 higher).
Psychoeducation	Body fat (%) (assessed at the end of treatment)	216 (5 studies)	⊕⊕⊕⊖ Very low ^d	The mean fat mass at the end of the treatment ranged from 26.2% to 47.9% .	0.15 higher fat mass % (0.91 lower to 1.22 higher).
	Waist circumference (cm) (assessed at the end of treatment)	137 (3 studies)	⊕⊕⊕⊖ Low ^a	The mean waist circumference at the end of the treatment ranged from 66 cm to 115.2 cm .	0.74 higher waist circumference in cm (2.03 lower to 3.51 higher).
	Quality-of-life score (assessed at the end of treatment)	134 (2 studies)	⊕⊕⊕⊖ Very low ^d	The mean quality-of-life score at the end of the treatment ranged from 63.7 to 86.6 .	0.05 lower quality-of-life score (0.35 lower to 0.26 higher).
	Mental health score (assessed at the end of treatment)	16 (1 study)	⊕⊕⊕⊖ Moderate ^d	The mean mental health score at the end of the treatment ranged from 5.7 to 6.67 .	0.00 higher mental health score (5.93 lower to 5.93 higher).

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

^a Downgraded by one level for risk of bias and one level for imprecision.

^b Downgraded by one level for heterogeneity.

^c Downgraded by one level for risk of bias.

^d Downgraded by one level for imprecision.

^e Downgraded by one level for risk of bias, one level for heterogeneity, and one level for imprecision.

^f Downgraded by one level for risk of bias and one level for heterogeneity.

The downgrading reasons for RoB, heterogeneity, indirectness and publication bias were shown only for direct estimates due to the method limitation. The downgrading reasons due to inadditivity, intransitivity, incoherence, and imprecision were shown for all pooled estimates.

Summary of findings: Digital health interventions

Question 6. Digital health interventions

In adolescents with obesity (P), what is the effect of digital health interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Summary of findings Table 6.1. Digital interventions combined with conventional care compared to conventional care alone

Population: Children aged 0 to 9 years and adolescents aged 10 to 19 years

Setting: Any

Intervention: Digital interventions combined with conventional care

Comparison: Conventional care alone

Outcomes (follow-up)	Number of participants	Certainty of the (studies) evidence (GRADE)	Anticipated absolute effects (95% CI)	
			Risk with conventional care alone	Risk with digital intervention plus conventional care
BMI z-score (assessed at the end of the study)	170 (2 studies)	⊕⊕⊕⊕ Very low ^a	The mean BMI z-score at the end of the study ranged from 2 to 2.34 .	0.05 higher BMI z-score (0.06 lower to 0.16 higher).
BMI (kg/m²) (assessed at the end of the study)	138 (2 studies)	⊕⊕⊕⊕ Very low ^b	The mean BMI at the end of the study ranged from 29.3 to 30.4 kg/m² .	0.06 lower BMI (1.39 lower to 1.26 higher).
Waist circumference (cm) (assessed at the end of the study)	203 (3 studies)	⊕⊕⊕⊕ Low ^c	The mean waist circumference at the end of the study ranged from 84.9 to 101 cm .	1.16 lower waist circumference in cm (3.91 lower to 1.60 higher).
Fat mass (%) (assessed at the end of the study)	203 (3 studies)	⊕⊕⊕⊕ Moderate ^d	The mean fat mass at the end of the study ranged from 35.2% to 42.4% .	2.63 lower fat mass % (4.47 lower to 0.78 lower).

Footnotes:

^a Downgraded by one level for RoB: high RoB for allocation concealment in one study; performance bias (no blinding of participants and personnel) in both studies; and incomplete outcome data in one study. Downgraded by two levels for imprecision (only two small studies and 95% confidence interval includes no effect).

^b Downgraded by one level for high risk of performance bias (no blinding of participants and personnel in two studies). Downgraded by two levels for imprecision (only two small studies, and 95% confidence interval includes no effect).

^c Downgraded by one level for RoB (high RoB for allocation concealment in one study and performance bias in all studies). Downgraded by one level for imprecision (the 95% confidence interval includes no effect).

^d Downgraded by one level for RoB (high RoB for allocation concealment in one study and for performance bias in all studies).

Summary of findings 6.2. Digital interventions alone compared to conventional care alone

Patient or population: Children aged 0 to 9 years and adolescents aged 10 to 19 years

Setting: Any

Intervention: Digital interventions alone

Comparison: Conventional care alone

Outcomes (follow-up)	Number of participants (studies)	Certainty of the evidence (GRADE)	Anticipated absolute effects (95% CI)	
			Risk with conventional care alone	Risk with digital intervention plus conventional care
BMI z-score (assessed at end of study)	185 (3 studies)	⊕⊕⊖⊖ Low ^a	The mean BMI z-score at the end of the study ranged from 2.2 to 3.12 .	0.01 higher BMI z-score (0.09 lower to 0.11 higher).
BMI (kg/m²) (assessed at end of study)	26 (1 study)	⊕⊖⊖⊖ Very low ^b	The mean BMI at the end of the study was 39.4 kg/m² .	3.90 lower BMI (11.06 lower to 3.26 higher).
Waist circumference (cm)	26 (1 study)	⊕⊖⊖⊖ Very low ^b	The mean waist circumference at the end of the study was 115.6 cm .	4.30 lower waist circumference (16.45 lower to 7.85 higher).

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** mean difference. **RCT:** randomized controlled trial. **RR:** Risk ratio.

Footnotes:

^a Downgraded by one level for RoB (high RoB for allocation concealment in one study, blinding of participants and personnel in all studies); downgraded by one level for imprecision (the 95% confidence interval includes no effect).

^b Downgraded by one level for RoB (high RoB for blinding of participants and personnel in the only study included); downgraded by two levels for imprecision (only one small study, and 95% confidence interval includes no effect).

Summary of findings: Pharmacotherapy

Question 7. Pharmacotherapy

In adolescents with obesity (P), what is the effect of pharmacotherapy interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 8. Alternatives for medications known to cause weight gain

Should adolescents with obesity (P), change to alternatives for medications known to cause weight gain (I) in comparison to no change (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Summary of findings 7.1. Any pharmacological interventions compared to placebo

Patient or population: Children and adolescents with obesity

Setting: Outpatient clinic, children's hospital, community clinic, division of paediatrics, paediatric endocrine centres

Intervention: Pharmacological interventions

Comparison: Placebo

Outcomes	Anticipated absolute effects (95% CI)			Relative effect (95% CI)	No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with placebo	Risk with pharmacological interventions					
BMI change follow-up: median 11 months		MD 1.80 kg/m² lower (2.36 lower to 1.24 lower)	-		3091 (25 RCTs)	⊕⊕⊕⊖ Low ^{a,b}	
Weight change follow-up: median 11 months		MD 5.47 kg lower (7.45 lower to 3.5 lower)	-		2380 (20 RCTs)	⊕⊕⊕⊖ Low ^{b,c}	
Any adverse events follow-up: median 13.5 months	846 per 1000	872 per 1000 (846 to 906)		RR 1.03 (1.00 to 1.07)	1877 (8 RCTs)	⊕⊕⊕⊖ Moderate ^d	
Discontinuation due to adverse events follow-up: median 12 months	23 per 1000	40 per 1000 (21 to 76)		RR 1.70 (0.90 to 3.22)	2255 (14 RCTs)	⊕⊕⊕⊖ Low ^{e,f}	
Incidence or severity of obesity-related outcomes follow-up: mean 6 months	No evidence of a difference between sibutramine and placebo (data reported as number of participants with high blood pressure, glucose, triglycerides, total cholesterol, LDL, HDL)				51 (1 RCT)	⊕⊕⊕⊖ Low ^{g,h}	
Quality of life assessed with: Impact of Weight on Quality of Life (IWQOL) – Kids questionnaire Scale from: 0 to 100 follow-up: median 14 months		MD 1.02 points higher (1.94 lower to 3.98 higher)	-		741 (4 RCTs)	⊕⊕⊕⊖ Moderate ^h	

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

- ^a Downgraded due to six studies at high RoB, 12 at some concerns.
- ^b Downgraded due to substantial heterogeneity.
- ^c Downgraded due to six studies at high RoB and eight having some concerns.
- ^d Downgraded due to one study at high RoB and five having some concerns.
- ^e Downgraded due to four studies at high RoB and six having some concerns.
- ^f Downgraded due to imprecision, number of events was small (<200).
- ^g Downgraded due to high RoB (single study).
- ^h Downgraded due to imprecision, wide conference intervals.

Summary of findings 7.2. Any pharmacological interventions compared to no intervention

Patient or population: Children and adolescents with obesity

Setting: Outpatient clinic, children's hospital, community clinic, division of paediatrics, paediatric endocrine centres

Intervention: Pharmacological interventions (metformin)

Comparison: No intervention

Outcomes	Anticipated absolute effects (95% CI)		No of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no intervention	Risk with pharmacological interventions (metformin)			
BMI change follow-up: median 6 months		MD 1.51 kg/m² lower (2.29 lower to 0.73 lower)	151 (3 RCTs)	⊕⊕⊕⊕ Very low ^{a,b}	
Weight change follow-up: median 6 months		MD 3.2 kg lower (6.12 lower to 0.28 lower)	42 (1 RCT)	⊕⊕⊕⊕ Very low ^{c,d}	
Any adverse events - not reported	-	-	-	-	
Discontinuation due to adverse events - not reported	-	-	-	-	
Incidence or severity of obesity-related outcomes: not reported		-	-	-	
Quality of life: not reported	-	-	-	-	

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

^a All studies judged at high RoB for the outcome.

^b Wide confidence interval.

^c Study judged at high RoB for the outcome.

^d Single study, wide confidence interval.

Summary of findings: Bariatric surgery and weight-loss and weight-management devices

Question 9. Bariatric surgery

In adolescents with obesity (P), what is the effect of gastric bypass and other bariatric surgery options (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 10. Weight-loss and weight-management devices

In adolescents with obesity (P), what is the effect of weight-loss or weight-management devices (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Summary of findings Table 9.1. Metabolic bariatric surgery compared to lifestyle changes

Patient or population: Adolescents with obesity

Intervention: Metabolic bariatric surgery

Comparison: Lifestyle changes

Outcomes (follow-up)	Patients (studies), N	Absolute effects (95% CI)			Certainty
		Lifestyle changes	Metabolic bariatric surgery	Difference	
BMI - RCTs (follow-up 1-2 years)	100 (2 RCTs)			-11.67 (-13.22 to -10.11)	⊕⊕⊕⊖ Low ^{a,b}
BMI - non-RCTs (follow-up 1-5 years)	307 (3 non-randomized studies)			-14.49 (-15.69 to -13.3)	⊕⊕⊕⊖ Low ^{c,d}
BMI reduction- n TOTAL	407 (5 studies)			-13.45 (-14.4 to -12.5)	⊕⊕⊕⊖ Low ^{a,b,c,d}
Weight - RCTs (follow-up 1-2 years)	152 (3 RCTs)			-20.87 (-23.64 to -18.09)	⊕⊕⊕⊖ Low ^{e,f}
Weight - non-RCTs (follow-up 1-5 years)	173 (2 non-randomized studies)			-31.15 (-34.26 to -28.04)	⊕⊕⊕⊖ Moderate ^g
Weight - total	325 (5 studies)			-25.43 (-27.5 to -23.36)	⊕⊕⊕⊖ Low ^{e,f,g}

Outcomes (follow-up)	Patients (studies), N	Absolute effects (95% CI)		
		Lifestyle changes	Metabolic bariatric surgery	Certainty
Obesity-related outcome (RCTs): follow-up 1-2 years.	159 (3 RCTs)	One RCT at high RoB showed a lower proportion of participants with metabolic syndrome in the MBS group at follow up, compared to the lifestyle group. One study at low RoB showed a significant lower proportion of participants with impaired fasting plasma glucose and increased triglycerides compared to the lifestyle group, and no differences in raised fasting plasma insulin and raised blood pressure. One study at moderate RoB showed a lower proportion of participants having type 2 diabetes mellitus (T2DM) in the surgery group at follow up.		
Obesity-related outcomes (non-RCTs) follow-up range 1 years to 5 years. No of participants: 341 (2 non-RCTs)	341 (2 non-randomized studies)	One study at critical RoB reported data on T2DM, impaired fasting plasma glucose, increased fasting plasma insulin, dyslipidaemia, elevated triglycerides, blood pressure, and alanine aminotransferase (ALT). One study at serious RoB reported data on T2DM and prediabetes, increased non-HDL cholesterol, hypertension, and increased ALT. Both studies reported an improvement compared to baseline in the MBS group. Differences versus the lifestyle groups were not described qualitatively.		
Adverse events (RCTs and non-RCTs): not measured.	-	RCTs only described adverse events qualitatively. One RCT and two non-RCTs reported adverse events only for the MBS group. One non-RCT did not report data on adverse events.		
Quality of life (RCT) (RAND-36 questionnaire, Obesity-related Problems scale-14, Child Health Questionnaire 50) follow-up 2 years.	100 (2 RCTs)	One study at low RoB found a difference in the physical quality of life (physical functioning and general health perceptions) favouring the MBS group. No evidence of a difference was found in any of the items concerning mental quality of life (energy or fatigue, emotional well-being, emotional role functioning, social role functioning). One study at high RoB found a difference in physical functioning and a change in health favouring the MBS group. No evidence of difference was found in general health, self-esteem, mental health, general behaviour, family activities, or cohesion.		
Quality of life (non-RCTs) assessed with SF-36 follow-up: 5 years.	161 (1 non-randomized study)	The MBS group scored higher than the lifestyle control group only on the SF-36 physical role functioning item (the number of assessed participants was not reported).		

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

^a Downgraded due to study limitations (one study out of two at high RoB).

- ^b Downgraded due to imprecision; although the estimate CI falls beyond the threshold for null and small effects, it is unlikely the review information size was reached (100 participants).
- ^c Downgraded due to study limitations (two studies at serious and one at critical RoB).
- ^d Downgraded due to inconsistency (moderate heterogeneity).
- ^e Downgraded due to study limitations (one study out of three at high RoB).
- ^f Downgraded due to inconsistency (large heterogeneity).
- ^g Downgraded due to study limitations (two studies at serious RoB).

Summary of findings: Multimodal interventions

Question 11. Multimodal interventions

In adolescents with obesity (P), what is the effect of multimodal interventions delivered by a multidisciplinary team (I) compared to standard care (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Summary of findings table 11.1. Health care-based multimodal health-related behaviour changing interventions compared to control for adolescents living with obesity

Patient or population: Adolescents aged 10-19 years

Setting: Health care (primary care and specialized care)

Intervention: Health care-based multimodal health behaviour-changing interventions

Comparison: Control

Critical outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with control	Risk with health care-based multimodal health behaviour-changing interventions	No of participants (studies)	Certainty of the evidence (GRADE)	
Physical well-being assessed with multiple scales (higher scores indicate improvement) follow-up: 12 months	-	SMD 0.13 higher (0.13 lower to 0.39 higher)	1006 (4 RCTs)	⊕⊕⊖⊖ Low ^{a,b,c}	Health care-based multimodal intervention may result in little to no difference in physical well-being at 12 months. This corresponds to an MD in PedsQL (range 0 to 100) of 2.6 (95% CI -2.6 to 7.8).
Physical well-being assessed with multiple scales (higher scores indicate improvement) follow-up: 18 months	-	SMD 0.59 higher (0.17 higher to 1.01 higher)	95 (1 RCT)	⊕⊕⊖⊖ Low ^{d,e}	Health care-based multimodal intervention may increase physical well-being. This corresponds to an MD in PedsQL physical functioning (range 0 to 100) of 11.8 (95% CI 3.4 to 20.2).

Critical outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with control	Risk with health care-based multimodal health behaviour-changing interventions	No of participants (studies)	Certainty of the evidence (GRADE)	
Mental well-being emotional functioning assessed with multiple scales (higher scores indicate improvement) follow-up: range 12 to 18 months	-	SMD 0.09 higher (0.07 lower to 0.24 higher)	693 (4 RCTs)	⊕⊕⊕⊖ Low ^{a,f}	Health care-based multimodal interventions may result in little to no difference in mental well-being / emotional functioning. This corresponds to an MD in PedsQL emotional functioning (range 0 to 100) of 1.8 (95% CI 1.4 to 4.8).
Physical activity – final values assessed with self report (multiple scales) (higher scores indicate improvement) follow-up: 12 months	-	SMD 0.51 higher (0.07 lower to 1.1 higher)	964 (4 RCTs)	⊕⊖⊖⊖ Very low ^{a,b,f}	Health care-based multimodal interventions have little to no effect on physical activity assessed by multiple self-reported scales at 12 months', but the evidence is very uncertain.
Physical activity – change from baseline assessed with self report (multiple scales) (higher scores indicate improvement) follow-up: 12 months	-	SMD 0.02 higher (0.29 lower to 0.34 higher)	156 (2 RCTs)	⊕⊕⊕⊖ Low ^{a,f}	Health care-based multimodal interventions may result in little to no difference in change from baseline physical activity assessed by multiple self-reported scales at 12 months.
Health-related quality of life assessed with: multiple scales (higher scores indicate improvement) follow-up: 12 months	-	SMD 0.13 higher (0.02 higher to 0.24 higher)	1454 (7 RCTs)	⊕⊕⊕⊖ Low ^{a,f}	Health care-based multimodal intervention may lead to little to no difference in health-related quality of life assessed by multiple scales at 12 months. This corresponds to an MD in PedsQL score (range 0 to 100) of 2.6 (95% CI 0.4 to 4.8)
Obesity-associated disability - not reported					
Adverse events	One study reported no adverse events.		30 (1 RCT)	⊕⊖⊖⊖ Very low ^{d,g}	The evidence is very uncertain about the effect of multimodal intervention on adverse events.

Critical outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with control	Risk with health care-based multimodal health behaviour-changing interventions	No of participants (studies)	Certainty of the evidence (GRADE)	
Anthropometry: BMI z-score follow-up: range 12 to 18 months	Mean BMI z-score: 2.5	MD 0.11 z-score lower (0.19 lower to 0.02 lower)	2666 (17 RCTs)	⊕⊕⊖⊖ Low ^{a,b}	Health care-based multimodal interventions may result in little to no difference in BMI z-score at 12 to 18 months.
Anthropometry: BMI z score follow-up: 24 months	Mean BMI z-score: 1.5	MD 0.50 z-score higher (0.35 lower to 1.35 higher)	33 (1 RCT)	⊕⊕⊖⊖ Low ^{a,f}	Health care-based multimodal interventions may result in little to no difference in BMI z-scores at 24 months.

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

- ^a Downgraded one level due to a high RoB: all of the studies had a high RoB in several domains.
- ^b Downgraded one level due to inconsistency: the point estimates indicated high between-study variability with little overlap of some confidence intervals.
- ^c Although the confidence interval is wide and crosses the minimally important differences threshold we did not downgrade because the imprecision results from high heterogeneity.
- ^d Downgraded one level due to high RoB: the included study was at a high RoB.
- ^e Downgraded one level due to imprecision: although the confidence interval does not cross the minimally important difference threshold, the sample size is small (<240 for optimal information size)
- ^f Downgraded one level due to imprecision: the confidence interval crosses the minimally important difference threshold.
- ^g Downgraded two levels due to severe imprecision: very few events, and the confidence interval includes substantial benefits and harms.

Summary of findings Table 11.2. Community-based multimodal health related behaviour-changing interventions compared to control for adolescents living with obesity

Critical outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with control	Risk with community-based multimodal health behaviour-changing interventions	N _e of participants (studies)	Certainty of the evidence (GRADE)	
Physical well-being assessed with: youth weight-specific instruments (YQOL) (higher scores indicate improvement) Scale from: 0 to 100 follow-up: 12 months	Mean physical well-being: 63.6	MD 13.5 higher (4.99 higher to 22.01 higher)	136 (1 RCT)	⊕⊕⊕⊖ Low ^{a,b}	Community-based multimodal intervention may increase physical well-being at 12 months.
Mental well-being assessed with: strengths and difficulties questionnaire (lower scores indicate improvement) Scale from: 0 to 40 follow-up: 12 months	-	SMD 0.2 higher (0.08 lower to 0.47 higher)	208 (1 RCT)	⊕⊕⊕⊖ Low ^{a,c}	Community-based multimodal intervention likely results in little to no difference in mental well-being at 12 months.
Physical activity	β coefficient 0.04 (95% CI -0.3 to 0.2)		280 (1 RCT)	⊕⊕⊕⊖ Low ^{a,c}	Community-based multimodal may result in little to no difference in physical activity.
Health-related quality of life assessed with: multiple scales (higher scores indicate improvement) follow-up: 12 months	-	SMD 0.06 higher (0.11 lower to 0.24 higher)	666 (4 RCTs)	⊕⊕⊕⊖ Moderate ^d	Community-based multimodal intervention likely results in little to no difference in health-related quality of life at 12 months.
Health-related quality of life assessed with: multiple scales (higher scores indicate improvement) follow-up: 24 months	-	SMD 0.03 lower (0.33 lower to 0.27 higher)	188 (1 RCT)	⊕⊕⊕⊖ Low ^{a,b}	Community-based multimodal intervention may result in little to no difference in health-related quality of life at 24 months.
Obesity-associated disability: not reported					
Adverse events: not reported					

Critical outcomes	Anticipated absolute effects (95% CI)				Comments
	Risk with control	Risk with community-based multimodal health behaviour-changing interventions	№ of participants (studies)	Certainty of the evidence (GRADE)	
Anthropometry: BMI z-score follow-up: 12 months	Mean BMI z-score: 2.33	MD 0.07 lower (0.21 lower to 0.08 higher)	585 (5 RCTs)	⊕⊕⊖⊖ Low ^{d,f,g}	Community-based multimodal intervention may result in little to no difference in BMI z-scores at 12 months.
Anthropometry: BMI z score follow-up: 24 months	Mean BMI z-score: 2.1	MD 0.47 lower (0.96 lower to 0.02 higher)	430 (3 RCTs)	⊕⊕⊖⊖ Low ^{d,f,g}	Community-based multimodal intervention may reduce BMI z-scores at 24 months.

The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval. **MD:** Mean difference. **RCT:** Randomized controlled trial. **RR:** Risk ratio.

Footnotes:

- ^a Downgraded one level due to RoB: the included study was at an overall high RoB.
- ^b Downgraded one level due to imprecision: although the confidence interval does not cross the minimally important difference, it is a study with a small sample size (<240, below the lower threshold for optimal information size).
- ^c Downgraded one level due to imprecision: the confidence interval crosses the minimally important difference (0.2 points).
- ^d Downgraded one level due to high RoB: all included studies were at an overall high RoB.
- ^e Downgraded two levels due to severe imprecision: no events.
- ^f Downgraded due to inconsistency: high between-study variability and the distribution of the point estimates cross the minimally important difference of 0.2 points.
- ^g Not downgraded due to imprecision: although the confidence interval crosses the minimally important difference, this is largely attributable to the high statistical heterogeneity (already downgraded)
- ^h Downgraded due to inconsistency: high between-study variability and the distribution of the point estimates cross the minimally important difference of 0.89 points.
- ⁱ Downgraded one level due to imprecision: the confidence interval crosses the minimally important difference of 4 kg.

Annex 3. Summary of Guideline Development Group considerations to determine the strength of the recommendations

Evidence-to-decision considerations for dietary interventions

Question 1. Dietary interventions

In adolescents with obesity (P), what is the effect of dietary intervention (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG considered that benefits were small. Effects on outcomes of interest differed according to the type of diet.
Harms	The GDG agreed that undesirable effects are small, including non-severe adverse events such as hunger, fatigue, muscle cramps, or nausea.
Certainty of evidence	The certainty of evidence for critical outcomes was very low.
Values and preferences	The GDG found that adolescents with obesity placed a high value on the potential benefits of dietary interventions for obesity management. Adolescents and parents preferred interventions that are safe, affordable, and easy to apply, with the involvement of peers and family members. When benefits are highlighted to them, adolescents with obesity placed a high value on the potential benefits of dietary interventions for obesity management. The involvement of peers and family members fostered continued engagement with dietary changes (93, 97).
Balance between benefits and harms	A majority of the GDG considered that the balance between benefits and harms probably favours the intervention.
Resources	Cost is a concern to maintain healthy food choices because financial constraints hinder parents and adolescents from adhering to intervention-specific food or meal plans (97, 99).
Cost-effectiveness	GDG members considered that while the cost-effectiveness of dietary interventions varies, in general they may be cost-effective due to potential benefits in weight management and prevention of chronic diseases (100).

Equity	Since dietary behaviours are influenced by complex factors, including gender, culture, socioeconomic status, and parental or caregiver involvement, the GDG agreed that those factors have a direct impact on food insecurity and health disparities. GDG members concluded that while impact on equity of dietary interventions is uncertain, low-income and historically marginalized communities faced higher food insecurity and health disparities (102-109).
Acceptability	The GDG highlighted that adolescents' motivation to engage in dietary interventions varies depending on subjective norms, societal and cultural norms, stigmatization, and perceived body weight.
Feasibility	Feasibility varies depending on the costs and knowledge required to prepare healthy meals and on caregiver involvement, among other variables (97, 98, 99).

Evidence-to-decision considerations for physical activity, sedentary behaviour, and sleep

Question 2. Physical activity
In adolescents with obesity (P), what is the effect of physical activity (I) compared to no intervention (C) for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?
Question 3. Sedentary behaviour
In adolescents with obesity (P), what characteristics of sedentary behaviour (I) in different durations, frequencies, patterns, or types (I, C) are associated with improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?
Question 4. Sleep
Should adolescents with obesity (P), improve sleep and/or sleep hygiene (I) in different duration, frequencies, or patterns as measured by objective and subjective methods (C) for improved health, functioning and reduced obesity-associated disability (O) for the integrated management of obesity?

Evidence-to-decision considerations

Benefits	The GDG highlighted that while benefits are small, physical activity results in an array of desirable outcomes in adolescents with and without obesity.
Harms	The GDG considered that undesirable effects appear to be trivial to small. Type, intensity, and duration of physical activity should consider age, physical and health status in order to avoid harm.
Certainty of evidence	The certainty of evidence for critical outcomes was very low.

Values and preferences	The GDG found there is probably important variability in how much people value the main outcomes. Adolescents with obesity place a high value on the potential benefits of physical activity interventions. They may be motivated to exercise and to stay active because of the perceived benefits of such activities (97). The motivation of adolescents to engage in physical activity may be linked to body image and social desirability. Negative perspectives such as gaining no pleasure, negative self-image, or stress from exercise often keep adolescents with obesity from engaging in physical activity (97).
Balance between benefits and harms	The GDG considered that the balance between benefits and harms probably favours physical activity.
Resources	The GDG considered that resources required varied. In high-income settings, access to parks, athletic facilities, and recreation areas may be provided at no cost, while in low-income settings, building, maintaining, and increasing access to safe parks, athletic facilities, and recreation areas need resource investment.
Cost-effectiveness	GDG members considered that physical activity interventions may be cost-effective due to potential benefits in weight management and prevention of chronic diseases. Economic analyses reported that physical activity programmes are cost-effective due to the high costs of physical inactivity (115), as well as the potential benefits of physical activity in managing obesity and preventing chronic diseases (99-109).
Equity	Worldwide, women, minoritized ethnic groups, disadvantaged communities, and individuals living with disabilities or chronic diseases are more prone to inactivity (123). The GDG concluded that physical activity may increase equity if access to physical activity opportunities is provided, particularly among girls and among adolescents in low-income settings, with disabilities, or from underserved populations.
Acceptability	Tailored and personalized physical activity interventions are more acceptable if they incorporate interactions with health workers, peers and schools; they are appropriate for the adolescent's age, gender, ethnicity; and they use people-first language (97).
Feasibility	Safe spaces, equipment, and opportunities to engage in physical activity at home, school, and the community may enhance participation in physical activity.

Evidence-to-decision considerations for behaviour changing interventions

Question 5. Behaviour changing interventions

In adolescents with obesity (P), what is the effect of behaviour changing interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG considered that benefits are small. Effects differed depending on the components of the interventions; long-term data was scarce.
Harms	The risk of adverse events associated with behaviour changing interventions may be low.
Certainty of evidence	The certainty of evidence for critical outcomes was very low.
Values and preferences	The GDG agreed there is probably no important uncertainty about or variability in how much people value the main outcomes. Adolescents and caregivers are motivated by the expectation that behaviour changing interventions will lead to long-term, holistic lifestyle changes that go beyond weight loss (56). Adolescents and caregivers valued perceived benefits of behaviour changing interventions such as long-term, holistic lifestyle changes that go beyond weight loss, body image improvement and social desirability (56).
Balance between benefits and harms	The GDG considered that the balance between benefits and harms probably favours the intervention.
Resources	The GDG highlighted that resource requirements will vary based, among other considerations, on the care setting, delivery strategy, type of behaviour changing intervention, and health workers involved.
Cost-effectiveness	There were no cost-effectiveness studies. Indirect evidence from adults indicated that behavioural counselling and education on behavioural modification may be cost-effective.
Equity	The GDG considered that impact on health equity varies. Access to behaviour changing interventions may be limited among marginalized communities and those of low socio-economic status, girls, minoritized ethnic groups, people with disabilities, and adolescents with diverse sexual orientations and gender identities (123, 134, 135).
Acceptability	Behaviour changing interventions are more acceptable when they are fun and enjoyable, include a digital component, are solution-based and are delivered by trusted health workers (56, 114).
Feasibility	The GDG considered that feasibility will be affected by lack of time, access to appropriate facilities, transport, and resources to cover costs.

Evidence-to-decision considerations for digital health interventions

Question 6. Digital health interventions

In adolescents with obesity (P), what is the effect of digital health interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and to reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG agreed that benefits are small. Digital interventions, in combination with conventional care or alone, may lead to desirable effects compared to conventional care.
Harms	Undesirable effects are unknown. It is of key importance to assess how digital health interventions may result in the misuse of social media, access to unsafe messages, exposure to cyberbullying, isolation, overexposure, depression, anxiety, poor self-esteem, or in promoting sedentary behaviours or increased screen time.
Certainty of evidence	The certainty of evidence for critical outcomes was very low.
Values and preferences	GDG members determined that adolescents and their families placed a high value on benefits of health interventions for obesity and their potential for patient empowerment and self-management (164, 165, 166). Families also expressed concerns about data security (167).
Balance between benefits and harms	Unknown.
Resources	The GDG considered that costs vary based on the delivery format, development process, components of the intervention, workers involved, and settings.
Cost-effectiveness	Cost-effectiveness varied; according to a model-based cost-effectiveness analysis (170), digital health interventions could be less costly and more effective compared to no intervention.
Equity	Impact on health equity varies. Equity considerations included, among others, limited resources, poor internet connectivity and low digital literacy, which likely vary across countries (171, 172).
Acceptability	GDG members agreed that digital health interventions delivered across different platforms are highly acceptable. Ease of use or lack of personalization may be barriers for use (168, 169).
Feasibility	Digital health interventions are likely feasible. Challenges for implementation included potential disconnectedness between digital health tools and clinical care, threats to privacy and security, and difficulty in identifying high-value digital health products (168, 169).

Evidence-to-decision considerations for pharmacotherapy

Question 7. Pharmacotherapy

In adolescents with obesity (P), what is the effect of pharmacotherapy interventions (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Question 8. Alternatives for medications known to cause weight gain

Should adolescents with obesity (P), change to alternatives for medications known to cause weight gain (I) in comparison to no change (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG highlighted that benefits are small to moderate, which varied according to medication type.
Harms	Undesirable effects vary. Glucagon-like peptide-1 receptor agonist (GLP-1 RA) and orlistat presented higher rates of discontinuation due to adverse events.
Certainty of evidence	The certainty of evidence for critical outcomes was low.
Values and preferences	The GDG agreed that there is probably important variability on values and preferences; adolescents with obesity may be motivated by potential benefits or disappointed for requiring pharmacological assistance or by side effects (191).
Balance between benefits and harms	The GDG considered that the balance between benefits and harms probably favours the intervention.
Resources	GDG members clarified that resource requirements vary. Costs depend on setting, coverage, types, dose and duration of treatment.
Cost-effectiveness	Pharmacological interventions may be cost-effective due to potential benefits in weight management and in preventing chronic diseases, although cost-effectiveness results were sensitive to the assumptions underlying the long-term treatment effectiveness (63, 192).
Equity	Pharmacological interventions likely reduce health equity. Differential access to quality and continuous pharmacological treatment could affect health outcomes. The global scarcity of pharmacotherapy for paediatric obesity starkly reflects the broader disparities in health care access, disproportionately impacting adolescents from underserved communities (193, 194).
Acceptability	The GDG concluded that acceptability varies. Adolescents prefer to administer medication without being seen, or to use treatment options that do not make them feel different from their peers. Injected treatments are viewed less favourably than oral medications given the fear of needles, finding injections painful, or being stigmatized for self-injecting. Parents view side effects of medications as something that young people should not be required to endure (191). When side effects outweigh benefits, adolescents decide to stop taking their medication (191).
Feasibility	Pharmacological interventions are likely feasible. Structured, age-appropriate, supportive communication is crucial to discuss how the medication works and potential adverse events (193, 194).

Evidence-to-decision considerations for bariatric surgery and weight-loss and weight-management devices

Question 9. Bariatric surgery

In adolescents with obesity (P), what is the effect of gastric bypass and other bariatric surgery options (I) compared to no intervention (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG determined that benefits are moderate to large. Bariatric surgery may be more effective compared to no surgery for some obesity-related outcomes.
Harms	Undesirable effects vary. The GDG underscored that adolescents undergoing bariatric surgery may need revisional procedures or experience wound-related complications. Other adverse events such as gallstones and anaemia could be due to an increased risk of adverse events, compared to no surgery.
Certainty of evidence	The certainty of evidence for critical outcomes was low.
Values and preferences	The GDG considered that there is probably no important uncertainty about or variability in how adolescents expressed hopes that the surgery would deliver weight loss and physical and mental health benefits. Adolescents were concerned about weight regain and the level of weight loss that they could expect (199). Those who had undergone bariatric surgery expressed satisfaction that the surgery delivered weight loss and social, physical and mental health benefits, but some also experienced unexpected negative consequences, such as continued weight-based bullying (199).
Balance between benefits and harms	The GDG considered that the balance between benefits and harms probably favours the intervention.
Resources	Although in general high, costs depend on many factors, including the care setting, type of surgery, and health workers involved.
Cost-effectiveness	The GDG agreed that bariatric surgery may be cost-effective for adolescents with obesity, depending on the time horizon and the effectiveness of the intervention over this time horizon (200, 201, 202).
Equity	Bariatric surgery likely reduces health equity. The GDG highlighted that those from underserved backgrounds may experience coverage or financial constraints accessing bariatric surgery. The shortage of paediatric obesity experts and bariatric surgeons trained for younger populations poses a significant obstacle to effective obesity care, especially in densely populated areas lacking such specialized providers (203).
Acceptability	The GDG considered that bariatric surgery is likely acceptable. Adolescents were motivated by potential weight loss and improvements in physical activity and mental health resulting from the surgery. They were concerned about the procedure itself, the achievable weight loss, the complications that can follow, and potential weight regain.
Feasibility	The GDG concluded that bariatric surgery could represent a feasible intervention for adolescents with obesity, although the procedure is optional and has a high cost in certain contexts.

Evidence-to-decision considerations for multimodal interventions

Question 11. Multimodal interventions

In adolescents with obesity (P), what is the effect of multimodal interventions delivered by a multidisciplinary team (I) compared to standard care (C) in the clinical setting for the integrated management of obesity to improve health, functioning and reduce obesity-associated disability (O)?

Evidence-to-decision considerations

Benefits	The GDG voted that benefits are likely small. Effects differed depending on the components of the interventions and long-term data was scarce.
Harms	Undesirable effects are unknown.
Certainty of evidence	The certainty of evidence was very low.
Values and preferences	The GDG agreed there is probably no important uncertainty about or variability in how much people value the main outcomes. Adolescents with obesity value the expected benefits of multimodal interventions, including weight loss, prevention of health sequelae, improved self-esteem, improved body image, and social desirability. Parents and adolescents prefer interventions that incorporate supportive interactions, including family engagement and broader influences beyond the family unit. They value interventions that address weight loss as well as behavioural change and self-esteem (97, 99).
Balance between benefits and harms	The GDG considered that the balance between benefits and harms probably favours the intervention.
Resources	GDG members highlighted that cost requirements vary. Multimodal interventions may incur costs to parents and adolescents; the extent of these costs will depend on the specific aspects of the intervention (97, 99).
Cost-effectiveness	Probably favours the intervention. Multimodal interventions may be potentially cost-effective; however, the long-term outcomes to determine cost-effectiveness are uncertain.
Equity	Impact on health equity varies. GDG members considered that unequal access to multimodal interventions may exacerbate obesity and poor health outcomes among marginalized communities and those of low socio-economic status. Girls, minoritized ethnic groups, people with disabilities, and adolescents with diverse sexual orientations and gender identities are also less likely to engage in physical activity and other health-promoting interventions; whole-of-society approaches that consider the multiple causes of these inequities are needed to enhance participation of underserved groups in obesity management interventions (123, 134, 135).
Acceptability	The GDG underscored that the acceptability of multimodal interventions is enhanced when they include fun, informal (non-competitive) activities and incorporate technology. The support of health workers and peer involvement foster participation in multimodal interventions (93, 115).
Feasibility	Safe spaces, equipment, and facilities at home, school, and the community may enhance accessibility. While school-based interventions are more feasible for adolescents, there may be a need for financial support, particularly for affording healthy foods and promoting structured physical activity programmes.

Annex 4. WHO Obesity Steering Committee

Dr Onyema Ajuebor

Technical Officer, Health Workforce
Human Resources for Health and Standards for Health Workforce
Geneva, Switzerland

Dr Valentina Baltag

Scientist, Adolescent and Young Adult Health
Department of Maternal, Newborn, Child and Adolescent Health and Ageing
Geneva, Switzerland

Dr Elaine Borghi

Unit Head, Monitoring Nutritional Status and Food Safety Events
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Francesco Branca

Former director, Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Vanessa Cavallera

Technical Officer, Brain Health
Department of Mental Health and Substance Use
Geneva, Switzerland

Dr Alarcos Cieza

Unit Head, Sensory Functions, Disability and Rehabilitation
Department of Noncommunicable Diseases
Geneva, Switzerland

Dr Luz De Regil

Director, Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Padmini Angela De Silva

Regional Adviser, Health Risk Factors
WHO Regional Office for South-East Asia
New Delhi, India

Dr Maria Nieves Garcia Casal

Scientist, Standards and Scientific Advice Unit
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Ameena Goga

Medical Officer, Child Health and Development
Department of Maternal, Newborn, Child and Adolescent Health and Ageing
Geneva, Switzerland

Dr Laurence Grummer-Strawn

Unit Head, Food and Nutrition Action in Health Systems Unit
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Aiysha Malik

Technical Officer, Mental Health
Department of Mental Health and Substance Use
Geneva, Switzerland

Dr Robert Marten

Scientist, Alliance for Health Policy and Systems Research
Geneva, Switzerland

Mr Leendert Nederveen

Nutrition and Physical Activity
PAHO/WHO Regional Office for the Americas
Washington, DC, United States of America

Dr Laetitia Ouedraogo Nikiema

Nutrition and Food Safety
WHO Regional Office for Africa
Brazzaville, Democratic Republic of the Congo

Dr Juan Pablo Peña-Rosas

Head, Global Initiatives (cross-cutting)
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Abdul Baseer Qureshi

Regional Adviser, Nutrition
WHO Regional Office for the Eastern Mediterranean
Cairo, Egypt

Dr Kremlin Wickramasinghe

Regional Adviser, Nutrition, Physical Activity and Obesity
WHO Regional Office for Europe
Copenhagen, Denmark

Dr Juana Willumsen

Technical Officer, More Physical Activity
Department of Health Promotion
Geneva, Switzerland

Annex 5. WHO Guideline Development Group

Dr Zulfiqar Bhutta

Professor Department of Paediatrics, University of Toronto
Toronto, Canada

Professor Jean Philippe Chaput

Professor, Department of Pediatrics, University of Ottawa
Ottawa, Canada

Dr Nain-Feng Chu

Adjunct Professor School of Public Health National Defense Medical Center
Chinese Taipei, China

Ms Solange Durão

Senior scientist, Health Systems Research Unit South African Medical Research Council
Cape Town, South Africa

Professor Jalila El Ati

Professor, National Institute of Nutrition and Food Technology
Tunis, Tunisia

Professor Davina Gherzi

Adjunct Professor, Sydney Medical School, Visiting Fellow, UK Cochrane Centre
Sydney, Australia

Professor Toru Kikuchi

Professor, Department of Paediatrics, Saitama Medical University Hospital
Saitama, Japan

Professor Michael Lean

Chair of Human Nutrition, Glasgow University
Glasgow, United Kingdom of Great Britain and Northern Ireland

Dr Mardia López Alarcón

Head, Medical Research section
Instituto Mexicano del Seguro Social
Mexico City, Mexico

Ms Arafa Mkumbo

Nutritionist II, Muhimbili National Hospital
Dar Es Salaam, United Republic of Tanzania

Dr Eduardo Fernandes Nilson

Oswaldo Cruz Foundation (Fiocruz)
Brasilia, Brazil

Professor Paulina Nowicka

Professor in Food Studies, Nutrition and Dietetics, Uppsala University
Uppsala, Sweden

Dr Nasrin Omidvar

Professor, Shahid Beheshti University of Medical Sciences
Tehran, The Islamic Republic of Iran

Dr Abha Saxena

Independent Senior Bioethics Consultant
Geneva, Switzerland

Dr Suzanne Soares-Wynter

Clinical Nutritionist, Caribbean Institute for Health Research, University of the West Indies
Kingston, Jamaica

Dr Claudia Valli

Fundación Avedis Donabedian
Barcelona, Spain

Dr Jacqueline Walker

Honorary Research Fellow, Health and Wellbeing Queensland
Brisbane, Australia

Professor Pujitha Wickremasinghe

Senior Professor in Paediatrics, University of Colombo
Colombo, Sri Lanka

Annex 6. Systematic review teams

Systematic review on dietary interventions

Dr Samantha Huey

Research Associate
Cornell University
Ithaca, United States of America
Precision nutrition and gut microbiome research

Dr Saurabh Mehta

Janet and Gordon Lankton Professor Division of Nutritional Sciences
Cornell University
Ithaca, United States of America
Nutrition, epidemiology, infectious diseases, and diagnostics

Dr Kripa Rajagopalan

Researcher
Cornell University
Ithaca, United States of America
International nutrition

Systematic review on physical activity

Dr Jose Meneses

Researcher
Universidad Maria Cano
Medellin, Colombia
Physical therapy

Systematic review on behaviour changing interventions

Dr Sheyu Li

Department of Endocrinology and Metabolism and Department of Guideline and Rapid Recommendation
Cochrane China Center, MAGIC China Center, Chinese Evidence-Based Medicine Center, West China Hospital, Sichuan University
Chengdu, China
Endocrinology

Systematic review on digital health interventions

Dr Cristina Palacios

Professor of Dietetics and Nutrition
Florida International University
Miami, United States of America
Dietetics and nutrition

Dr Jessica Ramella

Associate Professor, Department of Biomedical Engineering
Florida International University
Miami, United States of America
Biomedical engineering

Systematic review on pharmacotherapy**Ms Eleonora Allocati**

Researcher, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
"Mario Negri" (IRCCS)
Milan, Italy
Health research methodology

Dr Rita Banzi

Head, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
"Mario Negri" (IRCCS)
Milan, Italy
Clinical pharmacology

Dr Francesco Carrano

Assistant Professor
Division of General and Emergency Surgery
Rome St. Andrea Hospital
Faculty of Medicine and Psychology, Department of Medical-Surgical Sciences and
Translational Medicine
Sapienza University of Rome
Rome, Italy
Bariatric surgery

Dr Chiara Gerardi

Senior Researcher, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
"Mario Negri" (IRCCS)
Milan, Italy
Clinical pharmacology

Dr Gabriela Prutsky

Pediatric Hospitalist, Knowledge and Evaluation Research Unit in Endocrinology, Mayo
Clinic
Mankato, United States of America
Paediatrics

Systematic review on bariatric surgery and weight-loss and weight-management devices

Ms Eleonora Allocati

Researcher, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
“Mario Negri” (IRCCS)
Milan, Italy
Health research methodology

Dr Rita Banzi

Head, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
“Mario Negri” (IRCCS)
Milan, Italy
Clinical pharmacology

Dr Francesco Carrano

Assistant Professor
Division of General and Emergency Surgery
Rome St. Andrea Hospital
Faculty of Medicine and Psychology, Department of Medical-Surgical Sciences and
Translational Medicine
Sapienza University of Rome
Rome, Italy
Bariatric surgery

Dr Chiara Gerardi

Senior Researcher, Laboratory of Health Regulatory Policy
Centro di Politiche Regolatorie in Sanità Istituto di Ricerche Farmacologiche
“Mario Negri” (IRCCS)
Milan, Italy
Clinical pharmacology

Systematic review on multimodal interventions

Dr Juan Franco

Unit leader, Medical Faculty
Heinrich-Heine-University Düsseldorf
Düsseldorf, Germany
Internal medicine, Health research methodology

Values and preferences

Professor Andrew Booth

Researcher, University of Sheffield
Sheffield, United Kingdom of Great Britain and Northern Ireland
Qualitative research

Dr Chris Carroll

Researcher, University of Sheffield
Sheffield, United Kingdom of Great Britain and Northern Ireland
Qualitative research

Genetic considerations

Dr María Elizabeth Tejero

Medical researcher
Laboratory of Nutrigenetics and Nutrigenomics, INMEGEN
Mexico City, Mexico
Genomic medicine

Annex 7. Observers

Academy of Nutrition and Dietetics

Dr Deepa Handu

Chicago, United States of America

Agriculture, Food and Nutrition Evidence Center, Texas A&M University System

Dr Maureen Spill

College Station, United States of America

Centers for Disease Control and Prevention

Dr Brook Belay

Atlanta, United States of America

Cochrane Nutrition

Professor Celeste Naude

Cape Town, South Africa

Food and Agriculture Organization of the United Nations (FAO)

Dr Trudy Wijnhoven

Rome, Italy

UNICEF

Deepika Sharma

New York, United States of America

World Obesity Federation

Johanna Ralston

London, United Kingdom of Great Britain and Northern Ireland

Annex 8. WHO Secretariat

Dr Mirna Amaya

Methodologist
Cornell University
Ithaca, United States of America

Dr Hana Bekele

WHO Medical Officer, Nutrition and Food Safety
WHO Regional Office for Africa
Harare, Zimbabwe

Dr Francesca Celletti

WHO Technical Lead, Obesity
Office of the Director
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Katrin Engelhardt

WHO Scientist, Healthy Diet Policies
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Marjam Heinen

WHO Regional Office for Europe
Copenhagen, Denmark

Dr Ariel Izcovich

Researcher, Hospital Aleman
Buenos Aires, Argentina

Mr Jørgen Johnsen

WHO Consultant, Food and Nutrition Action in Health Systems
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Kaloyan Kamenov

Technical Officer, Sensory Functions, Disability and Rehabilitation
Department of Noncommunicable Diseases and Mental Health
Geneva, Switzerland

Dr Lucero Lopez

Consultant, Statistics and methods
Agriculture, Food and Nutrition Evidence Center, Texas A&M University System
College Station, United States of America

Dr Ricardo X. Martinez

Consultant, Statistics and methods
Agriculture, Food and Nutrition Evidence Center, Texas A&M University System
College Station, United States of America

Dr Hector Pardo-Hernandez

WHO Consultant, Guideline Methodologist
Standards and Scientific Advice Unit
Department of Nutrition and Food Safety
Barcelona, Spain

Dr Ximena Ramos Salas

Co-Founder
Replica Communications
Skåne, Sweden

Dr Sanjoy Saha

Methodologist, Agriculture, Food, and Nutrition Evidence Center
Texas A&M University System
College Station, United States of America

Ms Amaya Stifano

WHO Consultant, Guideline development support and special projects
Department of Nutrition and Food Safety
Geneva, Switzerland

Dr Julianne Williams

Technical Officer, NCD Surveillance
WHO Regional Office for Europe
Copenhagen, Denmark

Dr Yuan Zhang

Methodologist
Cornell University
Ithaca, United States of America

Annex 9. External reviewers

Dr Huda Al Hourani

Associate Professor
The Hashemite University
Zarqa, Jordan

Professor Yvonne Anderson

Associate Dean, Head of Medicine; Professor of Paediatrics and Child Health Curtin
Medical School, Faculty of Health Sciences, Curtin University
Perth, Australia

Dr Mamadou Bah

Postdoctoral Researcher, Nutrition and Planetary Health Theme
Medical Research Council Unit The Gambia
Banjul, Gambia

Dr Michele Polfuss

Associate Professor
College of Nursing, University of Wisconsin
Milwaukee, United States of America

Dr Jennifer Sacheck

Provost's Professor and Chair Department of Social & Behavioral Sciences Center for
Health Promotion & Health Equity
Brown University
Providence, United States of America



For more information, please contact:

Department of Nutrition and Food Safety

World Health Organization

Avenue Appia 20 1211 Geneva 27 Switzerland

Email: nfs@who.int

Website: <https://www.who.int/teams/nutrition-and-food-safety>