International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 4, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Chronic Obesity Disease in Primary Healthcare Management and Prevention

Zuhair Abdullah Almuhnna[1], Ali Hussain Alkhamis [2], Hassan Mahfouz Alali[3], Sukyinah Abdrabalhassan alzoori, [4], Ali Mohammed Almuaybid [5], Abbas Hussain Alhamad [6], Kawther Habib Almubarak [7], Maryam Abdullah Alsalman[8], Fatimeh Ahmed Almuhini [9], Hana Hussein Alrajaa [10], Saud Ali Albqqal[11], Huda Abdullah Alsaffar[12], Zainab Ahmed Alqassim[13], Ahmed Kadhem almuqarrab[14], Asia Ayesh AlAbduladeem[15]

1General Practitioner Doctor, Ministry of Health, Saudi Arabia
2Dental Doctor, Ministry of Health, Saudi Arabia
3Dental Doctor, Ministry of Health, Saudi Arabia
4Nurse specialist, Ministry of Health , Saudi Arabia
5Nurse , Ministry of Health , Saudi Arabia
6 Nurse , Ministry of Health , Saudi Arabia
7Nurse , Ministry of Health , Saudi Arabia
8Nurse , Ministry of Health , Saudi Arabia
9Nurse , Ministry of Health , Saudi Arabia
10Nurse , Ministry of Health , Saudi Arabia
11Nurse , Ministry of Health , Saudi Arabia
12Nurse , Ministry of Health, Saudi Arabia
13Laboratory Technician, Ministry of Health, Saudi Arabia
14Respiratory therapy specialist, Ministry of Health, Saudi Arabia
15Dietitian specialist, Ministry of Health, Saudi Arabia

Received: 14.09.2024 Revised: 12.10.2024 Accepted: 06.11.2024

ABSTRACT

Background: In 1997, The World Health Organisation(WHO) considered obesity as a global epidemic. Now, half a billion people suffer from obesity, which reflects a lot of social costs. Sedentary Lifestyle is the main cause of obesity, Some diseases risk increased with the obesity increase, Like: Type 2 diabetes, hypertension, cardiovascular disease, Alzheimer disease, Asthma and musculoskeletal disorder.

Topics: Obesity diagnosed when BMI 30 kg/m2 or more, obesity rates increased by 27.5% in adults and 47.1% in children, which make WHO activate chronic obesity modules. Obesity is a multifactorial disease such as: genetic, environmental, food quality, medication side effects, diseases and other factors.

Obesity risk isn't only from itself, but from its comorbidities like: cardiovascular disease and strokes, certain types of cancer, type 2 diabetes, digestive problems, osteoarthritis, sleep apnea and non-alcoholic fatty liver disease. Patients with obesity have less work attendance and higher healthcare costs, which have a bad impact on society economically. Childhood obesity is diagnosed when a child has unhealthy weight according to his age and sex, children with obesity have less school attendance.

Truncal obesity is the worst type of obesity as it is more associated with cardiovascular diseases and chronic diseases than other types of obesity. Obesity management's first guideline is lifestyle changes then medications and surgeries. Patients with BMI 25-29.9 without comorbidities, prevention of further weight gain by healthy diet and physical activity rather than weight loss are a suitable target.

Impression: Lifestyle behavior and good food quality is directly proportional with obesity prevention and they are the first guideline in obesity management.

Keywords: Obesity, Causes of obesity, Truncal obesity, Childhood obesity.

INTRODUCTION

WHO(World Health Organization) published a new framework for obesity management and prevention, named that by (Health service delivery framework), this framework discussed how to manage and prevent obesity in all

ages. Health service delivery framework based on integrating obesity management and prevention into a health care system and determine the needed resources that help this framework to be achieved and continued.
Obesity management and prevention is a package, the health service delivery framework is a component from this package, the other components are: training health care teams and health care providers, WHO Universal Health Coverage brief and the WHO Academy Course.
Obesity disease is a hereditary disease that means fat accumulation in the adipose tissue. Obesity also may be caused by sedentary lifestyle and environmental effects. Obesity patients suffer from life quality and mental health reduction, and also comorbidities as: cardiovascular disease, type 2 diabetes and some types of cancer.
Now, WHO advised to activate chronic obesity disease modules to accelerate obesity management and prevention program and not depend on comorbidities spread firstly, as before.
A study of National Health and Nutrition Examination Survey (NHANES) made between 2011 and 2018 and resulted in: only 40% of adults who are overweight or obese have been counselled, In US, approximately 480 million PC visits per year, so if obesity management and prevention framework integrated in PC, it will help in obesity epidemic decrease.
Obesity management aspects are physician education, especially general practitioner GPs, on how to manage obesity disease and the psychological side of obesity patients mustn't be neglected. In obesity management, rapid weight loss isn't the healthy way for weight loss, but weight loss by 5-10% is the good way to decrease the obesity comorbidities and weight regain prevention is the lifelong goal in any weight loss technique. Economic impacts of obesity disease come from both reduced productivity and human, some studies resulted in: obese patients missing more days of work than normal persons without obesity, and also they have less capacity than normal persons without obesity in the working days. Obesity increases unemployment opportunities, premature deaths and that have a big impact on the economy. Approximately 59 studies on the economic impacts of obesity, which were made in 2010 in high-income countries, clarified the direct and indirect costs of obesity disease. Finally, obesity management and prevention become a global goal and many protocols established for decreasing obesity risk and its comorbidities.

Obesity meaning
Obesity means that the human body has too much fats, some people think obesity is a cosmetic issue, but that isn't true as obesity is a health problem and may lead to other health problems if not treated well.
Obesity may lead to cardiovascular diseases, diabetes type 2 and some cancer types, but on the other hand, just modest weight loss is helpful in preventing obesity comorbidities.
In 2022, a study result clarified that around 2.5 billion adults aged 18 years and older were suffering from overweight and obesity.
Obesity prevalence varied according to the region: 31% in the South-East Asia Region and the African Region and 67% in the Americas Region.

Obesity and overweight causes
When energy intake increases than energy output, the difference will appear in obesity.
Obesity is a multifactorial disease; environmental, genetic, food quality and age factors collaborate in obesity disease, an obesogenic environment, low food quality, genetic variants, old age and physical immobility have a big impact on weight gain.
Other causes of obesity may be drug side effects, other diseases and other factors.

Environmental causes
Social Determinants Of Health (SDOH) refers to the surrounding environment, if it was an unhealthy environment, that means food quality will also be unhealthy and no encouragement to get any physical exercises.

Genetic causes
Obesity is a hereditary disease occurring by variants of several genes that leads to slow genetic changes and these gene variants in turn are responsible for hunger and energy intake.

Food quality causes and insufficient sleep
Unhealthy food, unaffordability for healthy food choices, insufficient sleep influence weight gain.
For example, people in the United States depend mostly on fast food and high- calorie beverages in their day. Of course, that has a big lead to obesity.

Medications and diseases
Some medications have a weight gain side effect like: steroids, anti-seizure drugs, diabetes medications, antipsychotic medications, some beta blockers and certain antidepressants.

Also some diseases have obesity or weight gain as a disease symptom like: hypothyroidism, Prader-Willi syndrome, Cushing syndrome, and others. Arthritis leads to decreased activity, which in turn may result in weight gain.

Age

Although obesity can occur at any age, old people suffer from sedentary lifestyle, decrease in BMI, hormonal changes and decrease in body metabolism. All these changes in old age lead to decrease the body calorie needs and in turn leads to being overweight.

Other factors

- **Pregnancy**
  Some pregnant women gain weight during pregnancy and
  Can't lose weight after delivery.
- **Smoking cessation**
  Obesity after smoking cessation is common due to smoking withdrawal associated with excess eating.
- **Microbiome**
  Low food quality affects good microbes in the body, which in turn may lead to weight gain.
- **Stress**
  Some people when they live in stressed mode, their food needs increase and gain more weight.

Obesity symptoms

To diagnose obesity disease, BMI (body mass index) should be calculated by this way: multiply body weight in pounds by 703, divide by body height in inches, then also divide by body height in inches.
There is another way to calculate BMI, divide body weight in kilograms by body height in metres squared.

BMI	Result
Below 18.5	Underweight
18.5-24.9	healthy
25-29.9	overweight
30 and higher	obesity

Depending on BMI to diagnose obesity isn't fully accurate, as BMI does not reflect body fat amount. For example, BMI in athletes results will appear obesity, even though they don't have excess body fat
The other way to diagnose obesity is waist circumference, results over 40 inches related to health problems in men and results over 35 inches related to health problems in women.
Visceral Adiposity Index (VAI) is a sensitive diagnostic tool of obesity disease, work as an indicator for cardiometabolic diseases risk and its sensitivity come from that: the visceral fat has a direct relation with the portal venous system, so VAI tool is a more accurate tool.
Body fat percentage is a way to track weight loss progress during a weight diet program.

Obesity complications

Obesity risk come from its complications, as obesity is responsible for many health problems, like:

- **Cardiovascular disease and strokes**
  Obesity leads to hypertension and LDL-cholesterol level increase, which in turn result in heart problems and strokes. Clinical studies clarified that, for each 5 unit increase of BMI, the risk of coronary artery disease increases by 30%. Another study resulted in obese patients with Framingham heart having a 5% increase in the risk of developing Atrial Fibrillation, for each unit increase in BMI, particularly >30 kg/m^2.
- **Type 2 diabetes**
  Obesity is one of the causes of insulin resistance, as it makes changes in the process of insulin use in body sugar level control.
  A recent study clarified that obese people with BMI of 30-35 kg/m2 have a five times increased risk of type 2 diabetes and 12 times those with BMI of 40-45 km/m2.
  Direct studies resulted in remission of type 2 diabetes and decrease fats in liver and pancreas appeared with a very low-calorie diet (600–853 kcal/day) that continued for 8 weeks to achieve the goal of 15 kg weight loss.
- **Certain cancer types**
  Obesity is the second biggest, after smoking, cause of cancer in the UK and targeting weight loss to the normal weight could prevent 22,800 UK cases annually.

The International Agency for Research on Cancer in 2001 revealed that Obesity could lead to some cancer types such as: oesophagus by 25%, colon by 11% and post-menopausal breast cancer by 10%.
A population-based prospective cohort study clarified that BMI has a relation with 17 cancers. with 5 kg/m2 increase in BMI, cancer of the uterus, gallbladder, kidney, cervix, thyroid and leukaemia risk increase.

- **Digestive problems**
  Obesity increases heartburn, gallbladder disease and liver disease risk.
- **Osteoarthritis**
  Obesity means increased weight on body joints, which leads to joint inflammation, swelling and may also result in osteoarthritis. Some studies clarified that Caloric restriction has an effective impact in reducing inflammation in obesity.
- **Sleep apnea**
  Obese persons suffer from difficulty in sleeping due to during sleep breathing repeatedly stops and starts.
- **Non alcoholic Fatty liver disease**
  Obesity means too much fats in the body, some of these fats when deposited on the liver make fatty liver disease and in dangerous cases may lead to liver cirrhosis.
  A meta-analysis of 20 studies resulted in the odds of NAFLD increasing by 13–38% per 1-unit increase in BMI.
- **Complicated COVID-19 symptoms**
  Studies clarify that obese persons when they get COVID-19 virus need intensive care to control their severe symptoms.

Childhood obesity

Childhood obesity is a chronic condition occurring when child weight exceeds the normal healthy weight according to child age and sex. In childhood obesity of children aged 2 years or older, BMI is at or exceeds the 95th percentile for child age and sex.
In the US, U.S. Centers for Disease Control and Prevention (CDC) studies from 2017 to 2020 resulted in obesity disease affecting 19.7% (around 14.7 million)of children and adolescents aged 2 to 19 years.
Obesity percentages according to children age are:

- 12.7% obesity risk in children aged 2 to 5 years.
- 20.7% obesity risk in children aged 6 to 11 years.
- 22.2% obesity risk in adolescents aged 12 to 19 years.

Obesity risk concentrates more in these populations:

- 26.2% obesity risk in Hispanic children.
- 24.8% obesity risk in non-Hispanic Black children.
- 16.6% obesity risk in non-Hispanic white children.
- 9.0% obesity risk in non-Hispanic Asian children.

Truncal obesity

Truncal obesity is a medical condition that means fat deposition is more concentrated in the body Centre than extremities.
The ideal tool for truncal obesity diagnosis is (waist to height ratio) calculation, the cutoff point is 0.5.
Waist circumference tool could also be used for truncal obesity diagnosis, truncal obesity results in waist measurement tool are 35-37 inches for males and 31.4 inches for females.
Truncal obesity is the worst type of obesity as it is more associated with cardiovascular diseases and chronic diseases than other types of obesity, Other risks caused by truncal obesity include:

- type 2 diabetes
- Heart problems
- Certain cancer types
- early death

Obesity diagnosis

Some physical exams should be performed to diagnose obesity disease:

- **Health history**
  Health care team asks patients about family history, eating patterns, appetite, medications history, diseases history, weight history, physical activity and patients stress level.
- **Physical exam**
  Measure patient vital signs as: blood pressure, heart rate and temperature. Check the patient's abdomen and measure his height.
- **BMI measure**

To determine the obesity case: overweight or obesity, and compare the new results with the previous results, especially in measuring diet program progression.

- **Waist size measure**
  Distance around the waist is called waist circumference, when fat deposits too much in waist circumference, heart problems and diabetes risk increases. Studies clarified that women's waist circumference more than 35 and men's waist circumference more than 40, have more health problems.
- **Health problems check**
  Measure other health problems such as: underactive thyroid, high cholesterol level, diabetes and hypertension.

Obesity management

Obesity is a chronic disease that affects, in the United States, more than 4 in 10 adults, and approximately 1 in 10 Americans have risky obesity.Obesity management's goal is reaching a healthy weight, the first weight measure is called modest weight and the patient needs to lose 5% to 10% of the modest weight to start his health improvement. (A healthy diet and being more active) is the secret for obesity management.
The first guideline to manage obesity is lifestyle change, otherwise weight loss medicines and surgeries may be helpful in some cases.

Lifestyle changes

Losing weight safely could be targeted by adopting a healthy eating plan, in which calories decreased, and being active to increase calories output. A healthcare specialist should tailor a weight loss program for every patient individually and weight monitor every week to measure the progression.

The Food Guide Pyramid

Is an outline of what to eat each day based on the Dietary Guidelines . It's not a rigid prescription but a general guide that lets you choose a healthful diet that's right for you.

- The Pyramid calls for eating a variety of foods to get the nutrients you need and at the same time the right amount of calories to maintain healthy weight.
- Use the Pyramid to help you eat better every day...the Dietary Guidelines way.
- Start with plenty of breads, cereals, rice, pasta, vegetables, and fruits. Add 2-3 servings from the milk group and 2-3 servings from the meat group.
- Remember to go easy on fats, oils, and sweets, the foods in the small tip of the Pyramid.

Exercise and activity

Getting more physical activity or exercise is an essential part of obesity treatment:

- **Exercise.** People with obesity need to get at least 150 minutes a week of moderate-intensity physical activity. This can help prevent further weight gain or maintain the loss of a modest amount of weight. You'll probably need to gradually increase the amount you exercise as your endurance and fitness improve.
- **Keep moving.** Even though regular aerobic exercise is the most efficient way to burn calories and shed excess weight, any extra movement helps burn calories. For example, park farther from store entrances and take the stairs instead of the elevator. A pedometer can track how many steps you take over the course of a day. Many people try to reach 10,000 steps every day. Gradually increase the number of steps you take daily to reach your goal.

Weight Loss prescribed medicines

- **Orlistat (Xenical)**

  Approved for adults and children over 12 years, orlistat is prescribed when patient BMI 28 or more with other complications such as high blood pressure or type 2 diabetes or when patient BMI is 30 or more.

  It works in decreasing fat absorbed amounts from food (around a third of food fat). Orlistat has some side effects such as: flatulance, stomach ache, oily stools leakage and diarrhoea, otherwise rare cases of severe liver injury have been reported.

  Warning of orlistat use, orlistat has contraindication with cyclosporine and oral contraceptive pills, they mustn't be taken with each other at the same time. Multivitamin pill should be taken daily with orlistat pill to recover the unabsorbed vitamins.

  A balanced diet and physical activity should be started before beginning orlistat course, during and after orlistat course.

  Orlistat course is beyond 3 months, if the patient loses 5% of body weight and the drug needs around 1 to 2 days to start working on digested fat.

- **phentermine-topiramate (Qsymia)**

  Approved for adults and children over 12 years, phentermine decreases the appetite and topiramate treats seizures or migraine headaches, both work in decreasing hunger or feeling full sooner.Phentermine-topiramatehas some side effects: dry mouth, dizziness, constipation, taste changes, sleep apnea and hand and feet tingling.

  Drug warning: mustn't use the drug with glaucoma or hyperthyroidism patients, also not with pregnant women or women planning pregnancy because

  Phentermine-topiramate may lead to birth defects.

  Phentermine-topiramate is also contraindicated in breastfeeding.

- **Naltrexone-bupropion (contrave)**

  Approved for adults, naltrexone-bupropion is a mix of naltrexone which is used to treat alcohol and drug dependence and bupropion used in smoking cessation to treat depression, in obesity used to decrease hunger and increase feeling of fullness.

  Naltrexone-bupropion has some side effects such as: dizziness, constipation, diarrhoea, vomiting, nausea, dry mouth, insomnia, tachycardia, hypertension, headache, suicidal thoughts and liver damage.

  Use warning of naltrexone-bupropion is that:

  1. It is not used for patients with uncontrolled high blood pressure, seizures, anorexia history or bulimia nervosa.
  2. It isn't used also with patients dependent on opioid pain medications or have drugs or alcohol withdrawal.
  3. It mustn't be used with bupropion.

- **Liraglutide and semaglutide (saxenda and wegovy)**

  Approved for adults aged up to 70 years, Available as injection, Work in decreasing hunger and increasing the feel of fullness sooner in this mechanism, Liraglutide mimics a hormone called glucagon-like peptide-1(GLP-1) that decreases appetite and food intake centrally.

  Liraglutide should be taken once daily and semaglutide once weekly. A balanced reduced calorie diet and regular physical activity should be in parallel with liraglutide and semaglutide taking.

  Liraglutide is used when:

  1. BMI is 35 or more.
  2. in case BMI is 32.5 or more in Asian, Chinese, Black African, Middle Eastern or African-Caribbean patients.
  3. With patients of non- diabetic hyperglycaemia and patients have risk of heart problems such as: strokes and heart attacks.

  Semaglutide is used when:

1. BMI 35 or more
2. in case BMI is 32.5 or more in Asian, Chinese, Black African, Middle Eastern or African-Caribbean patients.
3. BMI 30 to 34.9 or 27.5 to 32.4 in Asian, Chinese, Black African, Middle Eastern or African-Caribbean patients and also have other weight management criteria.

After at least 5% body weight loss, Liraglutide is used for 3 months or after taking semaglutide for 6 months (semaglutide maximum taking duration is 2 years).
Liraglutide and semaglutide have some side effects such as
Headache, nausea, abdominal pain, constipation, diarrhoea, tachycardia and fatigue.
Liraglutide and semaglutide warning is that
They may cause pancreatitis and they have caused a rare type of thyroid tumour in animals in clinical studies.
Semaglutide should not be used with semaglutide or GLP-1 receptor agonists.

- **Setmelanotide (IMCIVREE)**
  Available as injection and approved for children over 6 years and adults suffering obesity due to only one of these rare conditions (confirmed by genetic testing):
  1. proopiomelanocortin (POMC) deficiency.
  2. leptin receptor (LEPR) deficiency.
  3. proprotein convertase subtilisin/kexin type 1 (PCSK1) deficiency.

  It works by decreasing appetite and increasing the feeling of fullness and increasing resting metabolism.
  Setmelanotide has some side effects such as: nausea, injection site inflammation, skin darkening, sexual arousal disturbance, depression and suicidal thoughts and benzylalcohol preservative in setmelanotide has severe adverse reactions in neonates and infants with low birth weight.
  Contraindications of setmelanotide are:
  It shouldn't be used in pregnancy or breastfeeding.

tirzepatide injection
U.S. Food and Drug Administration approved (tirzepatide) injection for chronic weight management in adults with obesity (body mass index of 30 kilograms per square meter (kg/ m2) or greater) or overweight (body mass index of 27 kg/m2 or greater) with at least one weight-related condition (such as high blood pressure, type 2 diabetes or high cholesterol) for use, in addition to a reduced calorie diet and increased physical activity. Tirzepatide, the active ingredient is already approved under the trade name Zepbound and Mounjaro to be used along with diet and exercise to help improve blood sugar (glucose) in adults with type 2 diabetes mellitus

- **Lorcaserin**
  FDA approved drug for obesity management, it works as 5HT2C R agonist. Evaluation response is 5% weight loss at 12 weeks.
  Lorcaserin use has some warning with cognitive impairment, depression, valvulopathy, priapism, hypoglycemia and serotonin syndrome. And it should be used with caution with MAOIs, SSRIs and SNRIs.
  Lorcaserin is contraindicated in pregnancy and breastfeeding.
  Lorcaserin side effects are dizziness, headache, gastrointestinal disturbance, somnolence, blurred vision and nausea.

Bariatric and Metabolic Surgery
The best treatment for morbid obesity is surgery, it results in rapid improvements in life quality and comorbidities.
Bariatric and metabolic surgery is recommended for patients aged 18-60 years with BMI 40 kg/m2 and more or when BMI 35 - 39.9 kg/m2 with comorbidities.
Studies clarified that bariatric surgery has benefits in type 2 diabetes remission.

Prevention of obesity
Patients with BMI 25-29.9 without comorbidities, prevention of further weight gain by healthy diet and physical activity rather than weight loss are a suitable target.
There is some strategies for obesity prevention:

- Depend on healthy food such as fruits, vegetables, whole grains, healthy fats and protein.
- Decrease unhealthy food such as potatoes, red meat, sugary drinks, refined grains, sweets and processed meat.
- Avoid the sit time by decreasing screen time and television time.
- Increasing physical exercises.

- Avoid stress.
- Sleeping well.

Study made on the importance of Diet-Lifestyle Index in obesity prevention in adolescence, Diet-Lifestyle Index supposed to be ranged from 11 to 57, and target the relation between this Index and body mass index in adolescence. The study was made on 2,008 adolescent students and the age and gender have been adjusted.
Results**:** The mean score of this relation was 30.9+\-5.2 for boys and 31.4+\- 4.7 for girls. And the study also resulted in the Diet-Lifestyle Index is inversely proportional with the odds of being obese/overweight, the results was: odds ratio= 0.93.95% and confidence interval= 0.90-0.96 with age and gender adjustment. If the Diet-Lifestyle index increased by 11/57-unit, the odds of being overweight/obese decreased by 6% and 9% in boys and girls.

CONCLUSION

Obesity disease affects around 42% of adults in the US, so its management and prevention become a global goal, lifestyle changes are the first guideline in obesity management.
Patients of obesity should understand that obesity is a chronic disease and needs lifelong weight management to decrease its risk and comorbidities.
Obesity management and prevention based on evidence-based interventions which should be individualized and multidisciplinary with determinant and realistic goals in weight loss and weight regain prevention.
Studies revealed that lifestyle changes cause around 5% to 10% weight loss, GLP-1 agonists and glucose-dependent insulinotropic polypeptide/GLP-1 receptor agonists cause around 8% to 21% weight loss and bariatric surgery cause around 25% to 30% weight loss.

REFERENCES

1. New WHO framework available for prevention and management of obesity
2. The Most Undertreated Chronic Disease: Addressing Obesity in Primary Care Settings - PMC (nih.gov)
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8300078/#CR12
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8300078/#CR13
5. European Practical and Patient-Centred Guidelines for Adult Obesity Management in Primary Care - PMC (nih.gov)
6. Economic impacts of overweight and obesity: current and future estimates for eight countries - PMC (nih.gov)
7. Causes of Obesity | Overweight & Obesity | CDC
8. Obesity and overweight (who.int)
9. Obesity - Symptoms and causes - Mayo Clinic
10. Pathophysiology of Obesity - PubMed (nih.gov)
11. Obesity and Comorbid Conditions - StatPearls - NCBI Bookshelf (nih.gov)
12. Adult obesity complications: challenges and clinical impact - PMC (nih.gov)
13. Childhood Obesity: Causes & Problems (clevelandclinic.org)
14. Truncal obesity: What it is, causes, and treatments (medicalnewstoday.com)
15. Obesity - Diagnosis and treatment - Mayo Clinic
16. Treatment for Overweight & Obesity - NIDDK (nih.gov)
17. Prescription Medications to Treat Overweight & Obesity - NIDDK (nih.gov)
18. European Guidelines for Obesity Management in Adults - PMC (nih.gov)
19. Obesity Prevention Strategies | Obesity Prevention Source | Harvard T.H. Chan School of Public Health
20. Obesity Management in Adults: A Review - PubMed (nih.gov) https://www.fda.gov/
    FDA Approves New Medication for Chronic Weight Management