LGJDX ISSN No: 1008-0562 Journal Of Liaoning Technical University Natural Science Edition

CURRENT PRACTICES IN OBESITY MANAGEMENT: A REVIEW

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ABSTRACT

Obesity is a serious global problem affecting both developed and developing countries. Several diseases have obesity as a driving force. This includes cardiovascular diseases, type 2 diabetes, cancer, etc. The multifactorial nature of obesity makes it complex. Classification of obesity according to BMI aids in the prediction of risk levels of metabolic syndrome and other comorbidities. Current management practices go beyond dieting to use of anti-obesity medication and surgeries. The most common anti-obesity medication is Orlistat, which reduces fat absorption. Weight-loss surgery is often the last contingency to alleviate obesity and its related problems. Modern research into alternative medicine focuses on the use of plants and plant parts as nutraceuticals to prevent and treat obesity. The article reviews current management practices and plant research in the treatment of obesity.

Keywords: Obesity, treatment, anti-obesity, diet

INTRODUCTION

Obesity is a disease characterised by excess accumulation of fat in the body which occurs when more energy is consumed than is expended over a long period of time (Lin and Li, 2021). An individual is termed “obese” when the body mass index (BMI) equals to or exceeds 30 (Lin and Li, 2021). Obesity is a multifactorial disease, influenced by genetic and environmental factors (Wojcik et al., 2023). Individuals with obese parents are genetically more susceptible to obesity (Albuquerque et al., 2017). Environmental factors such as decreased physical activities, increased consumption of junk foods, high in calories, fats and salt and over-dependence on technology; characteristic of urbanization, have been found to influence the development of obesity (Marques et al., 2021).

According to Weir and Jan (2019), obesity can be classified into 3 categories based on their BMI ranges. This can be used to predict the risk levels of comorbidities as increase in BMI number is directly proportional to increased risks (Kivimaki et al, 2022). The classification of obesity is given in Table 1.

Table 1: Classification of obesity

CLASS	BMI RANGE	RISK LEVEL
Class I	30-34.9kg/m^2	Low risk
Class II	35-39.9 kg/m^2	Moderate risk
Class III	≥40kg/m^2	High risk

Comorbidities of obesity include hypertension, diabetes, non-alcoholic fatty liver, osteoarthritis, certain types of cancer, etc. (Jin et al., 2023). Covid-19 patients with obesity have longer recovery period than patients without obesity (Yu et al., 2021).

According to World Obesity Federation (WOF) (2023), the estimates for global levels of high BMI suggest that nearly 3.3 billion adults may be affected by 2035, compared with 2.2 billion in 2020. This reflects an increase from 42% of adults in 2020 to over 54% by 2035. For young people aged 5 to 19 years, the figure rises from 22% experiencing high BMI (430 million) to over 39% (770 million) by 2035. It is estimated that by 2035, about 54% of adults in the global population would be living with overweight or obesity if there is no intervention (WOF, 2023). It is predicted that by 2035, in Nigeria, adult obesity would increase by 24%, with an average of 4.9% yearly increase (WOF, 2023). Furthermore, childhood obesity would see an annual increment of 8.3%. With a global preparedness ranking of 164, Nigeria can be said to be poorly prepared to cushion against the impact of obesity on both the health and economic sectors (WOF, 2024).

METHODOLOGY

A search was conducted across databases; Google Scholar, Pubmed and Web of Science, using keywords such as “obesity”, “management”, “obesity treatment” and “treatment”.

Inclusion criteria: Diet-related treatment procedures and adult-focused regimens where included.

Exclusion criteria: Cases tailored to individuals with specific underlying health conditions such as PCOS, intellectual disability, etc. Surveys and country/region-specific cases were excluded.

TREATMENT OF OBESITY

There are several strategies used in the treatment of obesity which can be categorised into dietary and non-dietary (pharmacotherapy and surgeries) interventions (Endalifer and Diress, 2020).

Dietary intervention

Several dietary concepts such as the low-fat, the low-carbohydrate, Mediterranean, intermittent fasting and the Paleo diets have been used in the past decade to achieve weight loss (Aaseth et al., 2021).

Low-fat diet

Low-fat diet (LFD) has short-term efficiency with no significant results in long-term usage (Aaseth et al., 2021). LFD meals with high content of refined carbohydrates increases postprandial glucose and insulin secretion which directs fat into the tissue, triggering a mechanism known as carbohydrate-insulin model of obesity (Ludwig & Ebbeling, 2018).

Low-carbohydrate diet

The low-carbohydrate diet (LCD) is characterized by low contents of easily absorbable carbohydrate which comes in two variants: high-fat low-carbohydrate diet (HF-LCD) and high-protein low-carbohydrate diet (HP-LCD) (Aaseth et al., 2021). An example of a diet modification of HF-LCD is the ketogenic diet, which induces ketosis by restricting the quantity of carbohydrates in the diet to about 10% while increasing the quantity of fat to about 70% (D’Andrea Meira et al., 2019). Ketogenic diet facilitates rapid weight loss (Gibson et al., 2015).

An example of HP-LCD diet is the Atkins diet which promotes rapid weight loss in a short time span, by acting on relevant metabolic parameters, increasing satiety and energy expenditure (de Carvalho et al., 2020). It also induces thermogenesis (Moon & Koh, 2020). LCD diet should only be used in short term (<12 months) and not as a lifetime diet plan (Freire, 2020).

Mediterranean diet

The Mediterranean diet comprise a rich source of plant-based foods with high antioxidant levels, dietary fibre and low glycaemic load; and a healthy fatty acid composition of monounsaturated fatty acids (MUFAs) and n-3 polyunsaturated fatty acids (n-3 PUFA), which provides both short term and long- term benefits (Elhayany et al, 2010; Embree et al., 2017).

Intermittent Fasting

Intermittent fasting (IF) is a concept based on energy restrictions during certain periods in a day or certain days in a week (Sundfor et al., 2019). A meta-analysis of randomized control trials (RCT) summarized recent evidence to conclude that intermittent energy restriction is comparable to continuous energy restriction for promoting weight loss (Cioffi et al., 2018).

Paleo Diet

The Paleo diet is based on the concept of eating only foods available during the hunter-gatherer season on the claim that those foods are better suited to the human genome than modern foods (O'Keefe et al., 2010). This diet includes meat, nuts, berries, but excludes sugar, diary, cereal and other refined products. Paleo diet is rich in proteins and moderate in fats and carbohydrates (Manheimer et al., 2015). However, there are concerns surrounding costs and long-term use of this diet (Aaseth et al., 2021).

The recommended duration, benefits and effects of prolonged use is given in Table 2.

Table 2: Dietary Concepts, other benefits and recommended duration

Dietary concept	Other benefits	Recommended duration	Effects due to prolonged use
LFD	-	Short term	-
LCD	-	Short term	Headaches, general weakness, worsened lipid profiles (Yancy et al., 2004; Brinkworth et al., 2009). Increased CVD risk (Mansoor et al., 2016)
Mediterranean	Improves glycaemic load in T2DM patients (Esposito et al., 2015). Reduces inflammation and other biomarkers of CVD (Martinez-Gonzalez et al., 2019).	Long term	-
IF	Promotes modification of gut microbiome, increases butyrate	Short term	May require pharmacological support for adequate compliance (Aaseth et al., 2021).

	production (Su et al., 2021).		
Paleo	Reduction in insulin resistance, body and fat mass and beneficial modification of gut-microbiota (Spreadbury, 2012).	Short term	-

Non-dietary intervention

Non-dietary intervention strategies are pharmacotherapy (anti-obesity medication) and surgery.

ANTI-OBESITY MEDICATION

Anti-obesity drugs are recommended in situations where the BMI exceeds 30kg/m^2 or 27kg/m^2 in the presence of comorbidities (Jensen et al., 2014).

Liraglutide and Semaglutide

Liraglutide is an agonist of GLP-1 and was initially approved in 2010 for treatment of T2DM at doses of 1.8 mg s.c. daily (Aaseth et al., 2021). Liraglutide could decrease appetite and enhance satiety (Sisley et al., 2014). Early experimental studies showed that liraglutide influenced the arcuate nucleus in hypothalamus (Secher et al., 2014), imitating the effects of natural GLP-1, which led to the development of liraglutide for treatment of obesity (Astrup et al., 2009). Side effects of liraglutide include nausea, vomiting, and diarrhea. Liraglutide has to administered daily through subcutaneous injections while, semaglutide, with a similar effect profile, can be administered by weekly (Blundell et al., 2017). Semaglutide it is yet to be approved for clinical use against obesity (Aaseth et al., 2021).

Orlistat

Orlistat functions as a pancreatic lipase inhibitor, reducing absorption of fat in the intestines by about one-third (Leblanc et al., 2011). The mechanisms of action of orlistat is not limited to reduced fat absorption, but also involves increasing postprandial secretion of GLP-1, which mediates satiety by gut-to-brain signalling. Orlistat has been approved for weight management of obese adolescents of age 12 years and above. Side effects of orlistat include diarrhoea and faecal incontinence. Fat-soluble vitamins supplements, particularly vitamin D3, are recommended to patients combining LFDs with orlistat treatment (McDuffie et al., 2002). Intake of lipase inhibitor e.g. Orlistat, alongside a low-fat diet leads to greater weight loss by inhibiting fat absorption and helping to maintain low-fat intake (Aaseth et al., 2021).

Bupropion and the bupropion-naltrexone combination

Bupropion is a norepinephrine and dopamine reuptake inhibitor (Gadde & Xiong, 2007). Bupropion activates pro-opiomelanocortin (POMC), that appears to decrease appetite by interfering with hypothalamic functions. Probably, the alpha-melanocyte-stimulating hormone produced by enzymatic cleaving of POMC effects food intake by acting on the melanocortin-4 receptor (Gadde & Xiong, 2007). Bupropion has been shown to promote clinically significant weight loss in obese individuals (Ikede et al., 2019). The combination of bupropion with the opioid antagonist naltrexone has been shown to reduce addictive over-eating (Guerdjikova et al., 2017). Naltrexone monotherapy has been observed to reduce food cravings in obese

individuals (Leroy et al., 2017). The combination of bupropion and naltrexone produces a synergistic effect on appetite suppression (Greenway et al., 2009). This may probably be because the addition of naltrexone enhances the activation of bupropion-induced POMC, thus strengthening its appetite-suppressing effect. Naltrexone/bupropion combination has adverse effects which include constipation, dry mouths, headache, insomnia, and anxiety (Aaseth et al., 2021).

Phentermine and phentermine-topiramate combination

Phentermine is an amphetamine analogue that is approved for medical use in USA, with a restricted term of 12 weeks. Dry mouth, constipation, agitation and insomnia are side effects of phentermine in some cases. Topiramate monotherapy was initially reported to lead to significant weight loss (Haddock et al., 2002), but the risks associated with its use in efficient doses did not allow further development for clinical use (Aaseth et al., 2021). Combining low-dosed topiramate (100 mg/day) with a low dose of phentermine (15 mg/day) was observed to reduce energy intake and led to a substantial weight loss in a 6-month treatment period (Gadde & Allison, 2009). This combination could also give rise to frequently occurring adverse effects such as paresthesia, and less frequently cognitive dysfunction and psychiatric events, explaining the refusal by European Medicines Agency as regards marketing authorization in the EU countries (Aaseth et al., 2021).

SURGERY

Weight-loss surgery (or bariatric surgery) is a great option for individuals with a BMI $\geq$ 40 or BMI $\geq$ 35 with comorbidities who are unable to lose weight by lifestyle modifications or pharmacotherapy (Telles et al., 2016). Examples of standard bariatric operations are Bilio-pancreatic diversion (BPD), sleeve gastrectomy (SG), Rouxen-Y gastric bypass (RYGB), and adjustable gastric banding (AGB) and they benefit individuals' metabolic profiles at varying degrees (Aminian et al., 2015). Reported benefit of bariatric surgery is not limited to losing weight, it also includes reduction in chronic inflammation and long-term remission for T2DM (Al-Rubaye et al., 2019; Kops et al., 2020). For example, after RYGB surgery in human subjects, overall gut microbial richness was increased (Kong et al., 2013). Furthermore, RYGB contributed to increase in the expression of some specific white adipose tissue genes, upregulation of genes central to the transforming growth factor-b signalling pathway, and downregulation of genes involved in metabolic pathways and inflammatory responses (Zhang et al., 2009). Typical results from bariatric surgery include decrease in serum leptin levels (van Leiden et al., 2002).

USE OF PLANTS IN OBESITY

Treatment of obesity increases healthcare burden and an obese individual spends about 30% more on healthcare cost than a normal-weight individual (Lin and Li, 2021). The increasing rates of obesity across the globe beckons for measures that are not just curative, but also preventive. There has been increasing research in the use of plants as alternative medicine to reduce the healthcare burden and assuage the side-effects of modern medicine (Hussain et al., 2019).

The Food and Drug Administration (FDA) has approved several dietary supplements as means to control obesity and obesity-related risk factors (Hosny et al., 2022). This has made the use of edible fruits seeds with anti-obesity effects as food supplements to become common. Some plants that have been used in obesity research is given in Table

Table 4: Plant Research in Obesity

Plant	Part of plant	Type of study	Dose	Result	Reference
Quinoa (C. quinoa)	Seed	3T3-L1 cell culture Human (22 patients age range 188-45 years) Human (age range 18-45 years)	12.5mg/ml of total extract Seeds incorporated in cereal bar for 30 days 2.05 g/kg/day methanolic extract	Controls adipogenesis Improved lipid profile (decreased serum cholesterol and triglycerides) Decreased serum triglycerides, total cholesterol, and LDL	Yao et al 2015 (Graf et al., 2015) Ng and Wang, 2021)
Pumpkin (C. pepo)	Flesh	Rats Animal model (rats)	100mg/kg, 200mg/kg and 400mg/kg 100 mg/kg total extract	Triglycerides, low-density lipoproteins and liver enzymes were reduced while high-density lipoproteins were increased. Decreased body weight and enhanced lipid profile	Ghahremanloo et al (2017) (Kalaivani et al., 2018)
Saffron and Crocin	Stigma	Rats	40mg/kg and 80mg/kg		Mashmoul et al (2014)
Ocimum sanctum	Leaf	Mice	20mg/kg		Mohanty & Patttnaik (2021)
Chia (S. hispanica)	Chia seed powder	Animal model (rats) Human (77 participants) Animal model (rats)	50 mg/kg seeds Chia seed oil	Decreased serum lipid profile and rat's body weight Increased adiponectin levels, decreased C-reactive protein, and induced weight loss Improved lipid and glycemic profiles, decreased body weight	(Panchal, 2012) (Felemban et al., 2020) (Melo et al., 2019)
Hab El-Rashad (L. sativum)		Animal model (rats)	100 mg/kg methanolic extract Seed powder	Improvement of lipid and glycemic profiles along with decreased insulin resistance	(L'hadj et al., 2019) Shah et al., 2021)

				Improved lipid profile, decreased total cholesterol, and triglycerides, decreased body weight	
Fenugreek (T. foenum graecum)		Animal model (rats)	300 and 500 mg/kg alcoholic extract Aqueous extract	Decreased lipid profile and body weight Decreased fat accumulation and improved lipid profile through improving lipid metabolism and decreasing lipase enzyme	Gurunath, 2019) (Yao et al., 2020)

The effects of these seeds could lie in the interplay between the secondary metabolite content and their potential impact to modulate the oxidative stress and inflammation accompanying obesity. They also can reduce glycaemic load, decrease lipogenesis and increase lipolysis (Rodríguez-Pérez et al., 2019) The global nutraceutical industry is working towards more beneficial options using foods with known mechanisms to decrease the worldwide tragedy of obesity (Monteiro and Cannon, 2019).

CONCLUSION

It is necessary to implement strategies to prevent and treat obesity globally because the prevailing trends cause a significant economic burden. The use of plants in the prevention and treatment of obesity could go a long way to reduce the healthcare burden of a country and the cost of clinical treatment on individuals. Future research should focus on finding out more plants with anti-obesity potential and the mechanism of action.

FUNDING

No funding was received for this work.

AUTHOR CONTRIBUTIONS

OE and JT conceptualized the manuscript. OE prepared the tables and wrote the manuscript. JT reviewed and edited the manuscript. OE and JT approved the final version of the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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