Research Article ISSN 2639-944X

Journal of Medical - Clinical Research & Reviews

Proposal for a Multidisciplinary Clinical Approach to Obesity

Ricardo J. Rosero[1*], Juan P. Polanco[1], Veronica Ciro[1], Alicia Uribe[1], Herlard Manrique[2] and Pedro E. Sánchez[1]

[1]*Obesity, Dysmetabolism, and Sports Center (COD2), AUNA- Las Américas Clinic, Medellín, Colombia.*

[2]*Endocrinology Department & Metabolism, AUNA- Clínica Delgado, Lima, Perú.*

***Correspondence:**

Ricardo J. Rosero Revelo, AUNA - Clínica Las Américas, Medellín, Colombia, Calle 36 D Sur No. 27 A – 105, Medellín, Antioquia, Colombia, Tel: (+574) 345-8480; (+57) 321 325 4860.

Received: 01 December 2020; **Accepted:** 21 December 2020

Citation: Rosero RJ, Polanco JP, Ciro V, et al. Proposal for a Multidisciplinary Clinical Approach to Obesity. J Med - Clin Res & Rev. 2020; 4(12): 1-11.

ABSTRACT

***Background**: The worldwide prevalence of people with overweight and obesity has doubled over the past three decades, with over 1.9 billon cases of people with overweight and 609 millions of people with obesity in adults aged 18 years and older. With this article we want to identify profiles according to body composition (morphotypes) –independently of weight-, with motivating or triggering factors (psychotypes) which may allow physicians to perform preventive healthcare geared towards the enthusiastic promotion of lifestyle changes strategies.*

***Methods**: We searched PubMed, Medline and clinicaltrial.gov for relevant clinical trials in English and Spanish with the search terms: Obesity, body composition, Behavior, Anthropometry, from 1990 to 2019. We reviewed references from key papers to identify additional articles. After this we developed an obesity proposal approach for a better diagnosis of metabolic health achieved by evaluating body composition together with its distribution patterns and fat and lean mass indexes, in combination with instruments to identify mental disorders provide proper tools to create therapeutic strategies that encompass multiple areas such as the emotional, nutritional, and sports spheres, which allow personalized therapeutic approaches specifically tailored to GPs, favouring a practical patient-centred approach.*

***Conclusion:** We present a new strategy of therapeutic orientation of the patient with overweight and obesity. We can optimize the treatment from a point of view not only oriented in the body composition but also from the mental sphere, allowing the treatment team an integral approach.*

Keywords

Obesity, Body composition, Life style, Anthropometry.

Abbreviations

BMI: Body Mass Index; BIA: Bioelectrical Impedance Analysis; MRI: Magnetic Resonance Imaging; TBK: Total Body Potassium; DXA: Dual energy X-ray Absorptiometry; LBM: Lean Body Mass; BF: Body Fat; VAT: Visceral Adipose Tissue; BFP: Body Fat Percentage; FMI: Fat Mass Index; AMLI: Appendicular Lean Mass Index; ASMI: Appendicular Skeletal Muscle Mass Index; MM: Muscle Mass; TBW: Total Body Water Content; HOMA-IR: Insulin Resistance; IR: Insulin Resistance; CVD: Cardiovascular Disease; NHANES: National Health and Nutrition Examination Survey; HBP: High Blood Pressure; DM: Diabetes Mellitus.

Introduction

The worldwide prevalence of overweight and obesity has doubled over the past three decades, with over 1.9 billon cases of overweight and 609 million obese adults aged 18 years and older [1]. Over the past decades, and up to 2008, the mean body mass index (BMI) in the adult population has increased discreetly; however, the increase has been greater over the last 10 years [2]. Jaacks et al. have proposed a conceptual division of obesity into developmental stages, in which different "evolutionary" characteristics were analyzed in different countries, and sociocultural factors were found to be similar according to these stages, and a higher prevalence of obesity was observed according to gender and socioeconomic status [3].

Unfortunately, the use of BMI as a measure of population weight gain is not ideal, since it generates measurement error as it does not differentiate adipose from muscular tissue, thus implying a poor approach to the diagnosis of a disease defined as excess of body fat mass [4], which favors adipose tissue dysfunction, promotes inflammation, and leads to the development of diseases such as high blood pressure (HBP), diabetes mellitus (DM), and dyslipidemia, among others [5].

For this reason, the study of body composition has contributed to the understanding of body compartments, and to the identification of characteristics that indicate an early health risk for the patient. Therefore, early interventions may have a greater impact, promote health and delay onset of disease, without the need for body weight to be the only measure to be monitored in preventive care.

Currently, several alternatives to measure body composition are available, among which are anthropometric measurements that estimate fat content by measuring skinfold width and body circumferences. Multicompartment models have been developed by evaluating additional variables such as total body water content (TBW), for which measurements techniques including hydrometry by isotope dilution, bioelectrical impedance analysis (BIA), magnetic resonance imaging (MRI), ultrasonography, and even estimation of total body potassium (TBK), which estimates lean mass by measuring the natural radioactive isotope potassium 40K, have been used. However, many of these techniques are restricted to a small number of laboratories or specialized centers.

In contrast, dual energy x-ray absorptiometry (DXA) equipment is widely available, and its measurements show a high correlation with the previously mentioned techniques [6-8], hence making it the most frequently used technique in research and clinical practice, closely followed by BIA [9].

Consequently, the study of body composition has been a growing field in medical research, with greater dissemination, support, and clinical applicability, leading to a better understanding of the different aspects to develop in each individual patient [10].

Age and gender differences in body composition

Throughout the human life, body composition is altered by genetically determined programmed aging processes, as well as by external factors such as nutrition, exercise, and disease [11]. Optimal body composition varies among individuals, but in general, high proportions of lean body mass (LBM), and a relatively low content of body fat (BF) are considered to favor health, functional capacity, and physical performance [12]. Aging involves changes in weight and body composition. Regarding weight, it gradually increases up to the sixth decade of life, followed by a gradual decrease thereafter [13]. With age, there is a redistribution of body composition, in which subcutaneous fat tends to decrease, while visceral and intramuscular fat tend to increase [14]. Increases in total adiposity may also occur independently of changes in body weight [15].

Similarly, differences in body composition by gender are relevant to perform a proper analysis, since for a same BMI, men have greater LBM and women have more BF [16,17]. In men, adipose tissue commonly accumulates around the trunk, known as android region, while in women it tends to accumulate around the waist and femoral-gluteal region, known as gynoid region [18]. In men, a pattern of fat distribution that is predominantly abdominal has a greater negative impact on health, even more so than the excess of total adiposity [19,16].

In a previous study, using MRI and computed tomography (CT), healthy females were found to exhibit greater whole body adipose tissue and subcutaneous adipose tissue compared to BMI-matched healthy males; however, a lower content of visceral adipose tissue (VAT) was also found in females, which is associated with a lower risk metabolic profile [20].

In the National Health and Nutrition Examination Survey (NHANES), a DXA system (Hologic) was used to establish reference values for different body compartments [21], fat and lean mass indexes, as well as percentiles by age and gender groups were adopted in order to individually evaluate compartments [22] (Tables 1 and 2). In addition, based on the NHANES study, Coin et al. [17] performed measurements in European populations and

Table 1: NHANES Fat mass index (FMI) adjusted by body mass index (BMI) [18].

FMI	Severe deficit	Moderate deficit	Mild deficit	Normal	Excess fat	Obese class I	Obese class II	Obese class III
Male	<2	2 to <2.3	2.3 to <3	3 to 6	>6 to 9	>9 to 12	>12 to 15	>15
Female	<3.5	3.5 to <4	4 to <5	5 to 9	>9 to 13	>13 to 17	>17 to 21	>21

Table 2: Lean mass measurement.

MM	ALMI	ASMM	Manual grip test*
Males	<7.26 kg/m^2	25.87 +/- 3.6 kg/m^2	< 26 Kg
Females	<5.45 kg/m^2	17.37 +/- 2.5 kg/m^2	< 18 Kg

ALMI: Appendicular lean mass index (Adapted from: The Official Positions of the International Society for Clinical Densitometry: Body Composition Analysis Reporting. Journal of Clinical Densitometry: Assessment & Management of Musculoskeletal Health, vol. 16, no. 4, 508e519, 2013) and NHANES.

ASMM: appendicular skeletal muscle mass: Adapted from: Validation of a bioelectrical impedance analysis equation to predict appendicular skeletal muscle mass (ASMM) Clinical Nutrition (2003) 22(6): 537–543.

*Adapted from: The role of DXA in sarcopenia. Aging Clin Exp Res. DOI 10.1007/s40520-016-0589-3

showed similar distribution by age and gender, which are important to determine normal reference values (fat and fat-free mass), and thus proposed to follow volume, distribution and function of the different body segments or compartments, and define the risk or results of early intervention (Tables 3-6). Similarly, Janssen et al. [23] used MRI to evaluate the difference in skeletal mass distribution in healthy men and women, and found a significant difference in skeletal muscle mass between men and women, being 38 Kg and 31 Kg, respectively.

Finally, there is increasing evidence of the negative impact that VAT has on the health of the individual. Thus, several studies have provided normal reference values to establish ranges that indicate the need of intervention or health risk. For example, in the Latin American population the normal VAT reference value has been established to be less than 100 cm^2 [24], and values above 100 cm^2 indicate increased risk of cardiovascular disease [25], and even represent a risk factor for poor postoperative outcomes [26]. In order to assess metabolic risk, the cutoff points are stricter, being 91 cm^2 in men and 85 cm^2 in women as the values required to achieve "protection", and thus avoid risk of dyslipidemia, and insulin resistance, among others [27]. Altogether, these studies strongly support the need to follow-up the VAT compartment in our population, whose values are summarized in Table 7.

Comprehensive approach

As part of the comprehensive approach to the patient with obesity that enforces lifestyle changes, healthcare providers should implement clear tactics that identify the most relevant characteristics to define the subsequent intervention, which requires the creation of comprehensive programs with personalized strategies that will lead to better results, as well as treatment adherence –which is the most important goal to achieve. For this purpose, we propose to simultaneously approach three domains:

Table 3: Fat mass index percentile by dual-energy X ray absorptiometry (DXA).

Age group (years)	Fat mass index percentile						
	5th	10th	25th	50th	75th	90th	95th
Men							
20-80	2.5	3.1	4.2	5.6	7.0	8.8	9.6
20-29	2.3	2.5	2.9	3.7	4.8	6.2	6.9
30-39	2.4	2.5	2.9	5.0	6.0	7.9	8.7
40-49	3.6	3.8	4.3	6.2	7.2	8.8	9.6
50-59	3.6	4.2	5.0	6.0	7.4	8.7	9.8
60-69	4.1	4.7	5.8	6.9	8.5	9.4	10.2
70-80	4.1	4.8	5.6	7.0	8.6	9.8	10.3
Women							
20-80	4.7	5.7	6.9	8.6	10.6	12.3	13.3
20-29	4.0	4.2	4.9	6.4	8.2	10.8	11.5
30-39	3.9	4.6	6.1	7.0	9.3	12.6	13.7
40-49	4.3	4.7	5.9	7.6	9.7	12.4	13.5
50-59	4.9	5.9	6.9	8.5	10.5	11.7	12.6
60-69	6.1	6.5	8.0	9.4	11.5	13.0	13.9
70-80	5.3	6.4	7.7	9.6	11.3	12.9	13.9

Table 4: Body fat percentage percentiles by dual-energy X ray absorptiometry (DXA).

Age group (years)	Body fat percentage percentile						
	5th	10th	25th	50th	75th	90th	95th
Men							
20-80	11.1	13.3	18.4	22.6	26.5	30.4	31.2
20-29	10.3	10.6	13.0	16.0	20.0	23.8	27.6
30-39	10.5	11.7	15.1	22.7	23.7	30.1	32.2
40-49	15.3	16.7	19.1	23.4	26.6	29.9	31.0
50-59	13.4	18.2	20.6	23.0	26.8	29.9	31.0
60-69	18.4	20.1	22.5	25.9	29.3	32.6	33.6
70-80	18.2	20.5	21.2	26.2	30.6	31.8	32.9
Women							
20-80	21.9	25.1	29.3	33.8	38.4	41.7	44.0
20-29	20.9	22.6	26.1	29.8	34.9	39.8	42.2
30-39	19.5	24.0	28.3	32.3	37.2	41.5	42.5
40-49	21.9	23.6	27.8	32.4	37.6	41.6	44.5
50-59	23.4	27.3	30.5	34.4	37.8	40.2	42.3
60-69	27.5	29.5	32.5	36.4	39.6	42.3	43.8
70-80	26.0	28.3	32.8	36.9	40.7	44.6	45.6

*Clinical Nutrition (2008) 27, 87–94

Table 5: Lean body mass (Kg) percentiles by dual-energy X ray absorptiometry (DXA).

Age group (years)	Lean body mass percentile						
	5th	10th	25th	50th	75th	90th	95th
Men							
18-24	45.4	49.1	52.9	56.9	62.7	67.4	70.9
25-34	46.4	48.3	53.1	58.0	64.8	73.1	76.7
35-44	46.6	49.2	53.8	59.3	65.6	73.8	78.3
45-54	48.0	49.7	53.6	58.6	65.2	71.1	74.5
55-64	46.3	47.9	51.6	55.5	61.1	67.9	75.5
65-74	42.8	44.4	48.4	52.4	58.2	64.3	68.0
75-88	41.4	41.9	43.3	47.5	60.2	64.6	69.2
Women							
18-24	30.5	31.8	34.3	37.4	41.9	47.9	51.7
25-34	30.9	32.9	35.2	38.7	43.7	49.1	52.3
35-44	31.8	33.4	35.6	40.3	47.1	52.7	56.9
45-54	32.3	33.2	36.1	39.4	44.9	50.2	53.6
55-64	31.3	32.9	35.1	39.2	43.9	49.9	54.1
65-74	31.6	32.6	34.1	38.3	42.0	48.3	52.8
75-88	30.8	32.1	33.8	37.2	40.4	45.6	45.0

Adapted from: Lean body mass: reference values for Italian population between 18 to 88 years old. European Review for Medical and Pharmacological Sciences. 2018;22:7891-7898

Table 6: Lean body mass index percentiles by dual-energy X ray absorptiometry (DXA).

Age group (years)	Lean body mass index percentiles						
	5^{th}	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}	95^{th}
Men							
18-24	15.5	16.1	17.1	18.2	19.6	21.0	22.7
25-34	15.3	16.0	17.1	18.8	20.5	22.6	23.8
35-44	15.7	16.1	17.3	19.1	20.7	23.2	24.8
45-54	16.3	16.8	18.0	19.2	21.3	23.2	24.8
55-64	16.1	16.8	17.8	18.8	20.0	22.8	23.9
65-74	15.5	15.9	16.9	18.4	19.9	21.9	22.9
75-88	14.8	15.8	16.9	17.7	18.9	22.5	25.3
Women							
18-24	12.1	12.5	13.2	14.2	15.5	17.2	18.5
25-34	12.1	12.6	13.4	14.5	16.3	18.0	19.5
35-44	12.4	12.9	13.9	15.2	17.7	19.9	21.3
45-54	12.6	13.0	14.1	15.3	17.4	19.6	20.8
55-64	12.9	13.1	14.2	15.6	17.6	19.5	21.1
65-74	13.2	13.5	14.4	15.5	17.3	19.9	21.0
75-88	13.3	13.9	14.6	16.6	17.4	18.7	20.0

Adapted from: "Lean body mass: reference values for Italian population between 18 to 88 years old. European Review for Medical and Pharmacological Sciences. 2018;22:7891-7898"

Table 7: Visceral adipose tissue (VAT) measurement (cm^2).

	Normal	* CV risk	**Cardiometabolic risk	***Postoperative complications
Male	<100cm^2	> 103 cm^2	> 91 cm^2	> 115 cm^2
Female		> 105 cm^2*	> 85 cm^2	

In women, very high cardiovascular (CV) risk for VAT >163 cm^2

*Visceral Adipose Tissue Cutoffs Associated with Metabolic Risk Factors for Coronary Heart Disease in Women. *Diabetes Care* 26:1413–1420, 2003

**Impact of Abdominal Visceral and Subcutaneous Adipose Tissue on Cardiometabolic Risk Factors: The Jackson Heart Study. J Clin Endocrinol Metab, December 2010, 95(12):5419 –5426.

***Influence of Visceral Fat in the Outcomes of Colorectal Cancer. Dig Surg DOI: 10.1159/000486143

emotional health, metabolic health, and muscular health. Each of these domains represents an intervention area integrated into a general plan, and upon identification of the most compromised domain, its management is prioritized, and management of the remaining domains is adapted to a pace that leads to coherent actions and to favor treatment adherence (Figure 1).

Comprehensive approach to emotional health

Recent studies suggest that obesity is associated with specific personality characteristics that increase the risk of developing diseases and of obstructing medical treatment [28,29]. In that sense, the medical advice to "eat less and move more" is insufficient to treat patients with obesity [30] and other chronic

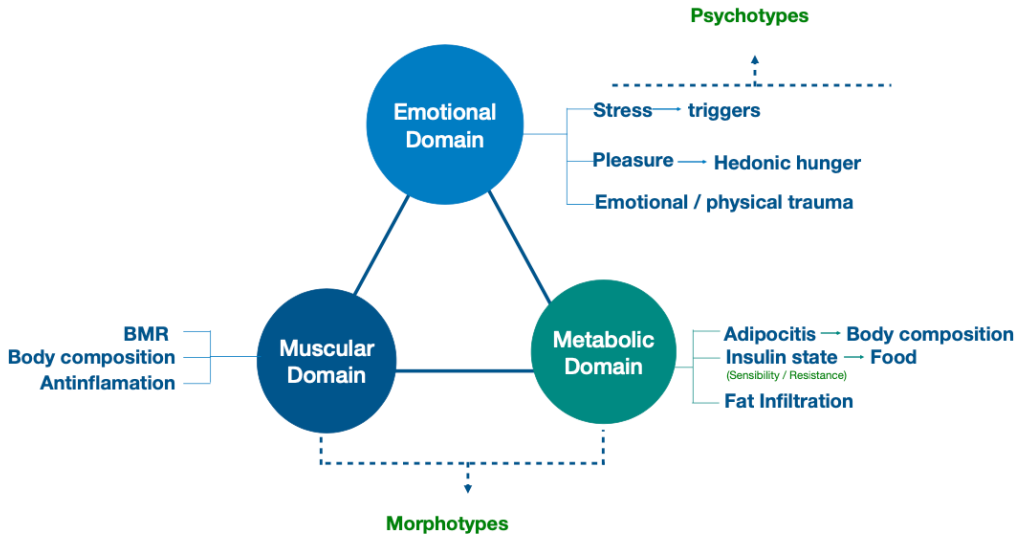

Figure 1: Multifactorial therapeutic approach to the patient with obesity.

noncommunicable diseases that are consequence of a combination of factors that go beyond the physiological dimension. While it is clear that care-oriented healthy behaviors reduce the risk of obesity [31] and facilitate treatment adherence [32], they are often challenging to implement.

In general, the classification of personality traits has been widely studied, however, in order to better understand the emotional dimension of patients with obesity, and based on the identification of repetitive patterns in the population that seeks medical advice at our institution in order to achieve lifestyle changes and/or to lose weight, we have develop psychotypes, which are defined as the clustering of different combinations of personality traits. By doing so, the creation of intervention strategies based on biomedical, sociocultural, and psychological factors that influence metabolic balance is facilitated [30], and the effectiveness of individual treatment is optimized.

For this purpose, we took into account the concept of archetype, defined as an emergent image of a complex dynamic system that is organized based on the affective experiences of each human being [33], rather than as an autonomous entity that structures the individual's psychic life. Such affective experiences are determined by three behavioral variables: response to experiences in the environment, the meaning awarded to such experiences, and the bonding style that determines the relationship dynamics with the experience. The therapeutic approach to these three variables, focused on eating and lifestyle habits, may facilitate treatment adherence and favor the maintenance of patient's wellbeing.

The five herein proposed psychotypes were constructed based on questionnaires administered to physicians, and interviews with patients attending our institution. The results were grouped into 5 categories (below described as a psychotypes C, D, S, V, N in Table 8), which were analyzed according to the different nutritional styles [34] (Table 9).

Comprehensive approach to metabolic and muscular health

By integrating body composition and related paraclinical tests we defined 3 morphotypes that correspond to the most predominant pattern of body composition with cardiometabolic impact: adipositary, muscular, and adipomuscular. The proposed morphotypes are associated with somatotypes in athletes initially defined by Heath & Carter in 1967 [35]. Currently, their use is limited to sports medicine, with an equally limited impact on clinical practice. (See graphic No1).

Considering the characteristics reported by the NHANES study, the key elements of body composition with clinical correlation as cardiometabolic risk factors are fat compartments (body fat percentage (BFP), fat mass index (FMI), VAT), and non-fat compartment (appendicular lean mass index (ALMI), appendicular skeletal muscle mass index (ASMI), muscle mass (MM)), and ideally complemented with manual grip testing. Altogether, this led to the definition of three morphotpypes that address the main patient's characteristics as follows:

Adipositary morphotype: fat tissue component is predominant, low MM (below 25 percentile); ALMI <7.26kg/m^2 and <5.45 kg/m^2 in men and women, respectively; BFP greater than 35% in women and then 25% in men; FMI greater than 75th percentile differentiated by gender, and VAT >100 cm^2.

Adipomuscular morphotype: while this pattern presents a greater fat tissue component (> 35% in women and >25% in men), FMI greater than 50th percentile, and VAT >100 cm^2, it is also associated to ALMI > 5.45 kg/m^2 in women and >7.26 kg/m2 in men, ASMI >25.8 kg/m^2 in men and >17.3 kg/m^2 in women, associated to manual grip strength >26 Kg in men and >16 Kg in women. Intramuscular fat component was evidenced as they may have large muscular volume, which is related with intramuscular fat infiltration, being more frequent in the male population.

Table 8: Psychotypes and categories.

	Psychotype				
	C	D	S	V	N
Category					
Motivation and Commitment	Recognizes the existence of a problem and accepts professional help. Authentic desire to change, which leads to a stable commitment.	Motivation is dependent on emotional state. Adherence to treatment depends on the obtained reinforcements. Responsibility for the process as secondary gain. May be dependent on medical staff or desert.	Motivation as personal challenge. Demands control over medical treatment. Needs to feel autonomous, to hide his vulnerability, and to receive recognition. Easily abandons treatment.	Motivation is dependent on a third party ("they made me") Commitment depends on what is obtained as secondary gain to perpetuate his disability status.	Motivation is dependent on the bond with the medical team. The patient will seek for a reference that plays the role of father or mother. The patient will be "obedient" in order to please and care the "love" of the chosen figure (which may be more than one), and will easily be disappointed if he feels that despite his efforts, the love he receives does not meet his expectations.
Emotional Stability	Emotional distress associated with health condition; psychological resources for emotional regulation or to learn new strategies; absence of psychological disorders.	High level of emotional distress. Emotional regulation through exercise seems healthy but may be at risk. Possible addictive tendency.	High emotional distress with compensatory strategies to not appear weak. Scarce tools for emotional regulation; may easily enter into a crisis.	High emotional distress, dependent personality. Difficulty in expressing and recognizing emotions. Role of disability. Scarce psychological resources to elaborate on disturbing emotional experiences. Pathological emotional cycle: secondary gains perpetuate their disability.	Moderate emotional distress, but with greater sensitivity to emotions and enhanced emotional response. Emotional dysregulation without tools; turn temporary emotions into permanent emotional states.
Relationship with The experience	Cognitive flexibility, acceptance capability, focused on achievement, and openness to the new experience	Competitive mentality and taste for challenges. Limited mental flexibility, difficulty accepting the existence of a problem of emotional origin and to make health-oriented changes without secondary gain.	Limited openness to the new experience and to changes. Needs to feel in control and superior to others. Patient may demerit medical care if feeling threatened.	Negative relationship with experience, no openness to change or new experiences. Inability to make a positive evaluation of lived experiences. The patient feels victims of his own experiences, and not active agents.	If patients receive medical follow-up, they may be open to change, although they may initially be fearful and distrustful, and will doubt their possibilities and the physician's intentions.
Impulse Control and Lifestyle Habits	Possible failure to control impulses and unhealthy habits, but ease in treatment adherence and self-discipline	Excessive self-control, overdemanding and able to restrict and deprive himself of pleasure. Appears to be healthy due to lifestyle habits. Poor introspection and flaws in behavior regulation.	Self-control of emotions, sensations, impulses, acts, and thoughts. Resistance to proposal of change.	No self-control. The patient considers that caregiver or people close to them have control of their decisions.	Difficulties controlling impulses, and poor lifestyle habits, however they exhibit "obedient" behavior and easily learn to regulate and organize themselves.
Sociability and Proposed Bond	Moderate or high sociability, confident in their abilities, positive feelings prevail. The proposed bond is of mutual cooperation.	Apparently high level of sociability. Use sports as an escape from their social role. The proposed bond is of challenge, as the specialist may be a "threat" or and "accomplice".	Difficulties at the social level due to their inability to express emotions and their compensatory strategy. May make others feel less valuable or defective. The proposed bond is complex and paradoxical. Care must be taken not take the patient's attitude personally or to fall into his dynamics, while simultaneously making him feel in control.	Co-dependency relationship pattern. The proposed bond is from the patient's condition of disability, making others feel guilty or responsible of his fate. Others may experience pity and hopelessness. The patient will always search for an excuse for not adhering to treatment, but may continue attending visits due to his dependency pattern and to secondary gains.	Level of sociability will not depend on psychotype. Because of his dependence, the proposed bond is a demanding one, but if the physician is able to meet the patient's expectations of care, he will feel at ease and will positively respond to treatment. The physician should not confuse a patient having a fit with a dropout; medical staff should be patient and provide a safe and reliable bond.

Table 9. Food intake patterns.

	Food intake patterns			
	Physiological	**Emotional**	**External**	**Food addiction**
Psychotype C	If there is no interoceptive awareness, it is easy to teach the patient to recognize feelings of hunger and satiety, and to properly respond to them.	Has adequate strategies of emotional regulation, or has the willingness and psychological resources to quickly learn them.	Adequate impulse control that allows to avoid automatic behaviors and to not respond to external stimuli.	No risk of food addiction
Psychotype D	It is not a priority. While the patient may or may not experience it, it does not guide behavior	May occur. If patient feels he/she overate (binge or social event), exercise is used as purging.	Due to high self-control, the patient does not obey external stimuli.	High probability of addictive tendency.
Psychotype S	Due to excessive emotional control and fear of feeling vulnerable, the patient may deny or avoid the feeling of hunger.	Possible secret binge eating, similar to how the patient hides his vulnerability he hides his desire and compulsive behavior, which is perpetuated by a constant emotional effort.	Responds easily to external stimuli with unnecessary excuses and explanations such as: "I never eat sweets, but today…" or "I will have to eat this even though I don't want it, so I just take out the bread".	Addictive behavior is uncommon due to high self-control.
Psychotype V	Lack of interoceptive awareness and of responsible behavior regarding their food intake	Seeks to regulate emotionally through the intake of sugary and hyperpalatable foods. May find in food the only source of pleasure, which leads the person to use it as self-medication for his emotional discomfort (SHARMA,2010)	Responds to external stimuli with emotional intake or addiction in order to manipulate his environment.	Food addiction is common.
Psychotype N	Hypersensitivity to the feeling of hunger, and is expressed magnified: "I will die of hunger"	Emotional regulation through food intake and compensation with hyperpalatable foods.	Easily responds to external stimuli, especially if emotionally disturbed, or fights and desires the opposite ("I don't want to eat"), or is influenced by his environment	May present risk of food addiction

Muscular morphotype: the muscular component is predominant, with MM greater than the 75 percentile, and ASMI >75 in both men and women, associated to manual grip strength >26 Kg in men and >18 Kg in women, with low or normal fat mass component, in women BFP <25% and men <20%; VAT <85 cm^2 in women and <91 cm^2 in men.

Biochemical tests (blood work test)

Currently, a wide variety of diagnostic tests to evaluate patients' metabolic health are available, ranging from lipid profile and blood glucose to inflammatory peptides. However, in the patient with adiposopathy and unremarkable previous medical history, the therapeutic approach can be challenging since during primary care evaluation the true cardiometabolic risk must be established before the occurrence of serious events.

Based on the above, one of the main objectives of such evaluation is the early identification of insulin resistance (IR), which has been shown to be sufficient to trigger alterations that lead to diseases associated with adiposopathy [36]. Currently, while the gold standard test to identify IR is the euglycemic clamp, it is more frequently used in research than in clinical practice since it has been shown to have low clinical reproducibility [37]. On the other hand, the homeostatic model assessment for insulin resistance (HOMA-IR), and the oral glucose tolerance test are more commonly used in clinical practice for the identification of IR, and in addition may contribute to the diagnosis of prediabetes and diabetes [38], which exhibit wide ranges of interpretation according to the type of population.

Nonetheless, the HOMA-IR relies on elevated basal glucose or insulin levels to reach abnormal levels, suggesting that it is rather a late IR detection tool, without having direct correlation with adipose tissue, which is also the case for the oral glucose tolerance test. Therefore, practical and efficient methods for early detection of insulin resistance should be implemented, such as pre- and post-75 gr sugar load blood glucose and insulin levels, which identify alterations in insulin secretion earlier than the above mentioned tests, and in addition show greater reciprocity with visceral fat and total body fat independently of BMI [39] also helps the guidance of food recommendations [40], Therefore provide a better adjusting to the morphotype, this could be seen as the use of glycated hemoglobin as a screening test for diabetes [41].

Unquestionably, the lipid profile is a critical feature for the assessment of individual risk of cardiovascular disease (CVD), since, on one hand, it is an individual risk marker, and on the other hand it also allows the analysis of residual risk and hereditary familial factors that are often occult [42]. A single altered value of the lipid profile already classifies the patient as being at moderate risk, which together with the patient's morphotype may suggest that the patient is at an even greater risk [43].

Similarly, low-density lipoprotein cholesterol (LDL) levels may sometimes be unaffected, however with the increase in triglycerides and reduction of high-density lipoprotein cholesterol (HDL) cholesterol, the presence of small dense-LDLs may be suspected, which is an essential element in patients with residual risk [44]. Moreover, in some studies, low HDL cholesterol levels

and high triglycerides are the first risk factors to emerge before obesity, pure hypercholesterolemia, high blood pressure, diabetes, and as first risk factor in young adults that gained weight [45].

There is sufficient evidence indicating the coexistence of hepatic infiltration alterations in patients with high adiposity and/or insulin resistance, therefore among the paraclinical tests in our approach is the diagnosis of fatty liver and its functional compromise, which may determine possible CVD risk factors [46], and in addition its coexistence with high visceral fat, and finally consider its progression to stages of greater impact on health and morbimortality such as cirrhosis.

Tests such as thyroid function, renal function, cortisol levels, among others, may allow to expand the initial patient evaluation, however, these tests should be considered as an initial screening tool which in the absence of clinical suspicion of coexistence of secondary or associated comorbidities, do not have strong evidence to favor their use, since they may contribute to increased healthcare costs and confusion, and ultimately delay physician's daily decision-making process.

Altogether, based on the proposed decision-making model this leads us to consider limiting paraclinical testing to lipid profile, and blood glucose and insulin levels.

Comprehensive intervention

Once the comprehensive characterization of the patient according to psychotype and morphotype has been performed, this information is correlated with the metabolic profile established by basic paraclinical tests, and the patient is directed to pertinent dietary and sports interventions. It is worth mentioning that while these may vary according to regions and cultural factors, this model is based on the nutritional calorie intake, beyond any specific dietary plans (Figure 2).

Intervention by psychotype and morphotype

Emotional dimension: to address the emotional sphere of a patient that seeks to improve his/her lifestyle or to lose weight, an intervention plan designed by the different specialists forming the interdisciplinary group is created based on the behavioral variables previously exposed, and that are specific to each individual:

- *Psychotype C*: requires psychological attention when lacking interoceptive awareness, exhibits emotional eating, or the patient asks for specific tools and permanent support in order to change lifestyle habits.
- *Psychotype D*: this patient requires healthy emotional regulation strategies and impulse control interventions.
- *Psychotype S*: The patient chooses the leader, and the psychology team must monitor the bond.
- *Psychotype V*: led by psychology. Before initiating dietary or physical activity plans, this patient requires elaborating on traumatic experiences, to make more flexible their belief system, and to feel empowered to make this change.
- *Psychotype N*: the process must be monitored by psychology in order to promote autonomy and emotional maturity.

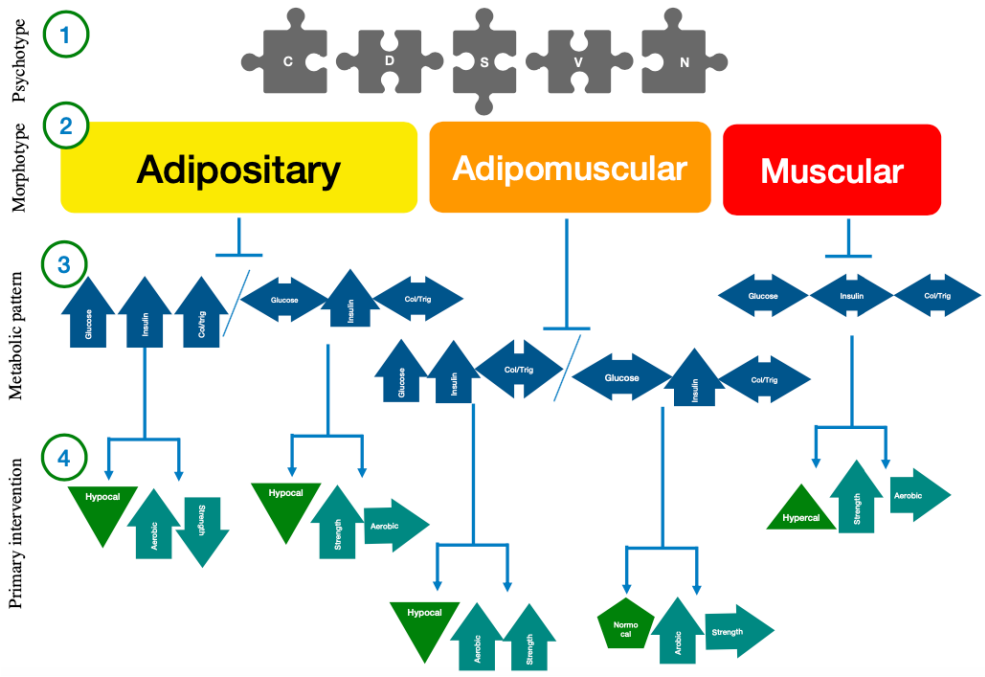

Figure 2: Comprehensive approach to the patient with obesity.

Step 1: Determine psychotype; Step 2: Determine morphotype. Step 3: Identify the predominant metabolic pattern, Step 4: Determine primary intervention with greatest benefit in regards to nutritional and sports aspects.

Changes in sleep patterns, smoking habits, and excess alcohol intake should be considered.

*** Special considerations, out of context disease.

Nutrition: the discussion on evidence and recommendations on types of diets or nutritional programs (e.g. plant-based diet, ketogenic diet, intermittent fasting, etc.) are beyond the scope of this paper. However, in order to provide guidance regarding nutrition, we proposed to divide food into 3 categories according to caloric value: hypocaloric, normocaloric, and hypercaloric; which in turn can be based on the caloric requirements of each population, while maintaining the macro- and micronutrient distribution. Thus, diets with greater evidence or use may be contained within one of the proposed categories.

Exercise*:* Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure and exercise is a subset of physical activity that is planned, structured, repetitive and has the objective of improving or maintaining physical fitness [47]. American College of Sports Medicine's guidelines for exercise testing and prescription makes some recommendations for exercise in people with obesity. For weight loss, aerobic exercise should be performed at moderate intensity, should be progressed to high intensity, for 250-300 minutes per week and combined with strengthening exercise to improve strength and muscle mass [48-50].

Although there is only limited evidence available on the effects of aerobic exercise on low muscle mass associated with obesity, aerobic exercise appears to be effective to lose excess fat mass and improve muscle performance in older adults with sarcopenic obesity [51]. On the other hand, resistance training increases muscle mass and strength, and endurance exercises maintains, and improves maximum aerobic capacity, improves muscle performance, decreases risk factors for chronic diseases and prevents future disability [52].

Multiple studies have shown that aerobic exercise, in combination with other strategies, such as resistance exercise or a nutritional regimen, could potentially be more effective at improving muscle function. The concurrent exercise is a combination of aerobic exercise with resistance training and it is an important strategy for improving skeletal muscle mass and function and increasing fat loss [51].

In a clinical trial with 160 elderly adults with obesity, participants were randomly assigned to a weight-management program plus one of three exercise programs: aerobic training, resistance training, or combined aerobic and resistance training or to a control group (no weight-management and no exercise program). The physical performance test score increased more in the combination group (21% increase) than in the aerobic and resistance groups (14% in both); peak oxygen consumption increased more in the combination and aerobic groups (18% and 19%, respectively) than in the resistance group (8%); strength increased more in the combination and resistance groups (18% and 19%, respectively) than in the aerobic group (4%). Body weight decreased by 9% in all exercise groups but did not change significantly in the control group; lean mass decreased less in the combination and resistance groups (decrease of 3% and 2%, respectively) than in the aerobic group (decrease 5%) [53].

Exercises according to morphotype

Adipositary: due to their high fat content, this morphotype presents alterations associated with hyperinsulinemia. Thus, exercise loads should be segmented, with short initial and longer final aerobic exercise of low-to moderate-intensity and progress it to high intensity according to tolerance, with a duration of 250 to 300 min per week, associated with resistance loads using own body weight, and incremental resistance loads favoring the use of resistance bands.

Adipomuscular: this morphotype is associated with metabolic alterations. Suggested management is concurrent exercise, which includes aerobic exercise as mentioned earlier with resistance training aimed at different muscle groups, with 8 to 12 repetitions at least three sessions per week with a minimum duration of 30 minutes per session. The programs should last at least 6 months, progress regularly and adapt to the individual functional status and comorbidities [52].

Muscular: patients classified in this category rarely present metabolic alterations. Therefore, constant aerobic loads of moderate to high intensity are recommended, with maintenance resistance work where muscle work is performed with regular incremental loads monthly [54].

Conclusion

This model of comprehensive approach of the patient with weight gain is not exclusively oriented towards the patient with obesity, since waiting for the diagnosis of a disease in order to initiate its treatment is a first act of inertia. Likewise, identifying an altered or alerted state and refer the patient without any type of intervention is also considered as inertia. This proposal aimed to tackle two important aspects; the first is to identify profiles according to risk by body composition (morphotypes) -independently of weight-, which adjusted to motivating or triggering factors (psychotypes) may allow physicians to perform preventive healthcare geared towards the enthusiastic promotion of lifestyle changes strategies. The second aspect aims to provide physicians practical, simple, and general tools to initiate changes in individual or interdisciplinary clinical practice in which a common language can be built in order to provide better care to our patients.

Acknowledgments

The authors of this study gratefully acknowledge the help Dr. Bruno Geloneze, from Laboratory of Investigation on Metabolism and Diabetes (Limed), UnicCamp, Campinas, Brazil as well as Scientific Department of AUNA-Las Américas Clinic.

Funding Sources

This work received no specific grant from any funding agency or university in the public, commercial, or other sectors.

Author Contributions

R.J. conceptualized and designed the study, drafted the manuscript and approved the final version. P.E. drafted the manuscript, collected the data and approved the final version, J.P. collaborated

with the design and drafted the biochemical approach. drafted the muscular approach, V.C. conceptualized the muscular approach as well as characterization of morfphotypes approach, drafted the manuscript and approved the final version, A.U. collected survey data and designed the psychotypes and drafted the emotional approach as well as characterization of psychotypes and H.M. drafted the manuscript and approved the final version.

References

1. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019; 92: 6-10.
2. Kim R, Lee DH, Subramanian SV. Understanding the obesity epidemic. BMJ. 2019; 366: 2-3.
3. Jaacks LM, Vandevijvere S, Pan A, et al. The obesity transition stages of the global epidemic. Lancet Diabetes Endocrinol. 2019; 7: 231-240.
4. Schwartz MW, Seeley RJ, Zeltser LM, et al. Obesity pathogenesis An endocrine society scientific statement. Endocr Rev. 2017; 38: 267-296.
5. Bray GA, Heisel WE, Afshin A, et al. The science of obesity management An endocrine society scientific statement. Endocr Rev. 2018; 39: 79-132.
6. Bridge P, Pocock NA, Nguyen T, et al. Validation of Longitudinal DXA Changes in Body Composition From Pre- to Mid-Adolescence Using MRI as Reference. J Clin Densitom. 2011; 14: 340-347.
7. Bosch TA, Dengel DR, Kelly AS, et al. Visceral adipose tissue measured by DXA correlates with measurement by CT and is associated with cardiometabolic risk factors in children. Pediatr Obes. 2015; 10: 172-179.
8. Völgyi E, Tylavsky FA, Lyytikäinen A, et al. Assessing body composition with DXA and bioimpedance Effects of obesity physical activity and age. Obesity. 2008; 16: 700-705.
9. Sillanpää E, Cheng S, Häkkinen K, et al. Body composition in 18- to 88-year-old adults Comparison of multifrequency bioimpedance and dual-energy X-ray absorptiometry. Obesity. 2014; 22: 101-109.
10. Albanese CV, Diessel E, Genant HK. Clinical applications of body composition measurements using DXA. J Clin Densitom. 2003; 6: 75-85.
11. Bredella M. Sex Differences in Body Composition. In Sex and Gender Factors Affecting Metabolic Homeostasis Diabetes and Obesity Advances in Experimental Medicine and Biology. 2017; 9-27.
12. Janssen I, Ross R. Linking age-related changes in skeletal muscle mass and composition with metabolism and disease. J Nutr Heal Aging. 2005; 9: 408-419.
13. Starling RD, Ades PA, Poehlman ET. Physical activity protein intake and appendicular skeletal muscle mass in older men. Am J Clin Nutr. 1999; 70: 91-96.
14. Beaufrère B, Morio B. Fat and protein redistribution with aging Metabolic considerations. Eur J Clin Nutr. 2000; 54: 48-53.
15. Zamboni M, Armellini F, Harris T, et al. Effects of age on body fat distribution and cardiovascular risk factors in women. Am J Clin Nutr. 1997; 66: 111-115.
16. Snijder MB, Visser M, Dekker JM, et al. Low subcutaneous thigh fat is a risk factor for unfavourable glucose and lipid levels independently of high abdominal fat. The Health ABC Study. Diabetologia. 2005.
17. Alessandra Coin, Giuseppe Sergi, Nadia Minicuci, et al. Fat-free mass and fat mass reference values by dual-energy X-ray absorptiometry DEXA in a 20–80 year-old Italian population. Clin Nutr. 2008; 27: 87-94.
18. Lemieux S, Prud'homme D, Bouchard C, et al. Sex differences in the relation of visceral adipose tissue accumulation to total body fatness. Am J Clin Nutr. 1993; 58: 463-467.
19. Kissebah AH, Krakower GR. Regional adiposity and morbidity. Physiol Rev. 1994; 74: 761-811.
20. Machann J, Thamer C, Schnoedt B, et al. Standardized assessment of whole body adipose tissue topography by MRI. J Magn Reson Imaging. 2005; 21: 455-462.
21. Kelly TL, Wilson KE, Heymsfield SB. Dual energy X-ray absorptiometry body composition reference values from NHANES. PLoS One. 2009; 4: e7038.
22. Hinton BJ, Fan B, Ng BK, et al. Dual energy X-ray absorptiometry body composition reference values of limbs and trunk from NHANES 1999-2004 with additional visualization methods. PLoS One. 2017; 12: 1-17.
23. Janssen I, Heymsfield SB, Wang ZM, et al. Skeletal muscle mass and distribution in 468 men and women aged 18-88 yr. J Appl Physiol. 2000; 89: 81-88.
24. Aschner P, Buendía R, Brajkovich I, et al. Determination of the cutoff point for waist circumference that establishes the presence of abdominal obesity in Latin American men and women. Diabetes Res Clin Pract. 2011; 93: 243-247.
25. Nicklas BJ, Penninx BWJH, Ryan AS, et al. Visceral adipose tissue cutoffs associated with metabolic risk factors for coronary heart disease in women. Diabetes Care. 2003; 26: 1413-1420.
26. Goulart A, Malheiro N, Rios H, et al. Influence of visceral fat in the outcomes of colorectal cancer. Dig Surg. 2018; 36: 33-40.
27. Liu J, Fox CS, Hickson DMA, et al. Impact of abdominal visceral and subcutaneous adipose tissue on cardiometabolic risk factors The Jackson Heart Study. J Clin Endocrinol Metab. 2010; 95: 5419-5429.
28. Bourdier L, Orri M, Carre A, et al. Are emotionally driven and addictive-like eating behaviors the missing links between psychological distress and greater body weight. Appetite. 2018; 120: 536-546.
29. Braden A, Musher-Eizenman D, Watford T, et al. Eating when depressed, anxious, bored, or happy Are emotional eating types associated with unique psychological and physical health correlates. Appetite. 2018; 125: 410-417.

30. Sharma AM, Padwal R. Obesity is a sign Over-eating is a symptom An aetiological framework for the assessment and management of obesity..Obes Rev. 2010; 11: 362-370.
31. Kim J. Personality traits and body weight Evidence using sibling comparisons. Soc Sci Med. 2016; 163: 54-62.
32. Butryn ML, Webb V, Wadden TA. Behavioral Treatment of Obesity Structures and principles of behavioral treatment. Psychiatr Clin North Am. 2011; 34: 841-859.
33. Merchant J. A reappraisal of classical archetype theory and its implications for theory and practice. J Anal Psychol. 2009; 54: 339-358.
34. van Strien T. Causes of Emotional Eating and Matched Treatment of Obesity. Curr Diab Rep. 2018; 18: 35.
35. Carter JEL. The Heath-Carter Anthropometric Somatotype. Instruction Manual. 2002; 1-26.
36. Reaven GM. Insulin Resistance The Link Between Obesity and Cardiovascular Disease. Med Clin North Am. 2011; 95: 875-892.
37. Qu HQ, Li Q, Rentfro AR, et al. The definition of insulin resistance using HOMA-IR for americans of mexican descent using machine learning. PLoS One. 2011; 6: e21041.
38. Association AD. Standards of Medical Care in Diabetes-2017 Abridged for Primary Care Providers. Clin Diabetes. 2017; 35: 5-26.
39. Rosero RJ, Polanco J. Anthropometric and biochemical markers of insulin resistance according to adipose tissue in overweight and obese patients. Int J Curr Res. 2019; 11: 2089-2093.
40. Hjorth MF, Astrup A, Zohar Y, et al. Personalized nutrition: pretreatment glucose metabolism determines individual long-term weight loss responsiveness in individuals with obesity on low-carbohydrate versus low-fat diet. Int J Obes. 2019; 43: 2037-2044.
41. Standards of Medical Care in Diabetesd 2019. Diabetes Care. 2019; 42.
42. Manninen V, Tenkanen L, Koskinen P, et al. Joint effects of serum triglyceride and LDL cholesterol and HDL cholesterol concentrations on coronary heart disease risk in the Helsinki Heart Study Implications for treatment. Circulation. 1992; 85: 37-45.
43. Sampson UK, Fazio S, Linton MF. Residual cardiovascular risk despite optimal LDL cholesterol reduction with statins: The evidence, etiology, and therapeutic challenges. Curr Atheroscler Rep. 2012; 14: 1-10.
44. Karaouzene N, Merzouk H, Aribi M, et al. Effects of the association of aging and obesity on lipids, lipoproteins and oxidative stress biomarkers: A comparison of older with young men. Nutr Metab Cardiovasc Dis. 2011; 21: 792-799.
45. Patil R, Sood GK. Non-alcoholic fatty liver disease and cardiovascular risk. 2017; 8: 51-58.
46. Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: A report of the American college of cardiology American heart association task force on practice guidelines and the obesity society. J Am Coll Cardiol. 2014; 129: S102-S138.
47. Caspersen CJ, Powell KE, Christenson GM. Physical Activity Exercise and Physical Fitness Definitions for Health-Related Research. Public Health Rep. 1985; 100: 126-131.
48. Americal College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription 10th Ed. 2017. Lippincott Williams & Wilkins. 2017.
49. Donnelly JE, Blair SN, Jakicic JM, et al. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc. 2009; 41: 459-471.
50. Shaw K, Gennat H, O'Rourke P, et al. Exercise for overweight or obesity. Cochrane Database of Systematic Reviews. 2006.
51. Trouwborst I, Verreijen A, Memelink R, et al. Exercise and nutrition strategies to counteract sarcopenic obesity. Nutrients. 2018; 10: 605.
52. Phu S, Boersma D, Duque G. Exercise and Sarcopenia. J Clin Densitom. 2015; 18: 488-492.
53. Villareal DT, Aguirre L, Gurney AB, et al. Aerobic or resistance exercise, or both, in dieting obese older adults. N Engl J Med. 2017; 376: 1943-1955.
54. US. Department of Health and Human Services. 2008 Physical activity guidelines for Americans. Pres Counc Phys Fit Sport Res Dig. 2008.