

Evaluation of the Impact of a Therapeutic Education Program on the Nutritional Status of 20 Volunteers with Common Obesity at the Medical Clinic II/CHN Abass Ndao in Senegal

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Abstract

Introduction: Obesity, a major risk factor for type 2 diabetes and a major public health problem, contributes to the rise of cardiovascular disease worldwide, with an increasing prevalence in developing countries, particularly in Senegal. Previous studies have shown that a reduction in body mass index leads to a significant reduction in the risk of non-communicable chronic diseases and mortality. **Objective:** To evaluate the impact of a pilot multidisciplinary therapeutic education program on the nutritional and behavioural status of 20 obese volunteers. **Methodology:** This was a prospective, interventional study conducted from 1 June to 31 August, 2021 on 20 volunteers with general obesity at the Medical Clinic of Abass Ndao Hospital in Senegal. Biological parameters were measured before and after the intervention using a bioimpedance device to assess the impact of the program. **Results:** The median age was 32.5 years, the median weight was 99 kg, and the median body mass index was 34 kg/m². Associated risk factors included sedentary lifestyle (95%), type 2 diabetes (30%), dyslipidaemia (5%), hypertension (5%) and eating disorders, which were present in almost all volunteers. At the end of the intervention, a 27% reduction in visceral fat, a 60% reduction in fat mass, and a 73% reduction in body mass index were observed between T0 and T3, resulting in a 73% reduction in body mass index. There was also a 67% increase in muscle mass and an 80% increase in basal metabolic rate. There was also a 58% reduction in eating disorders. **Conclusion:** The largely positive results encouraged us to integrate this program into the daily activities of the Marc Sankalé Center as a preventive measure against diabetes.

Keywords

Obesity, Therapeutic Education Program, Type 2 Diabetes, Senegal

1. Introduction

Obesity, as defined by the World Health Organization (WHO), is a chronic progressive disease characterized by an abnormal or excessive accumulation of body fat, as indicated by a Body Mass Index (BMI) of 30 or greater. BMI is a key indicator for assessing the health risks associated with being overweight or underweight and for guiding appropriate therapeutic approaches. The WHO has established a specific classification for the interpretation of this index [1]. Individuals with class I obesity (BMI between 30 and 34.99) have an increased mortality estimated at 44%. This risk rises to 88% in class II obesity (BMI between 35 and 39.99) and reaches 151% in class III obesity (BMI over 40) [2] [3]. Obesity affects all age groups, although its prevalence varies between age groups.

In 2016, WHO estimated that nearly 650 million adults were affected by obesity, and 1.9 billion were overweight [2]. The younger population is not spared, with 38.2 million children under 5 years of age and 340 million children and adolescents aged 5 to 19 years are overweight or obese [4]. Globally, overweight and obesity are associated with more deaths than underweight [4] [5]. They are associated with the onset of many chronic non-communicable diseases such as diabetes [6] [7], cardiovascular diseases, especially stroke [8]-[10], musculoskeletal diseases such as osteoarthritis [11], certain cancers (breast, ovarian, prostate, liver, kidney, etc.) [12] [13] and immune dysfunction (CD127+ memory T cells and CD14+, HLA-DR, CD11b+, CXCR3+ monocyte cells) in patients with morbid obesity [14]. In addition, studies have shown an association between obesity and COVID-19 (a communicable infectious disease) [15].

Numerous studies have shown that an increase in BMI significantly increases the risk of developing non-communicable chronic diseases [16]-[21]. As a result, a 5% reduction in body weight has been shown to be particularly beneficial to health, significantly reducing the risk of the above diseases [22] [23], including diabetes [24], with benefits for the heart, liver, and adipose tissue [22] [25].

In Africa, obesity is the result of a combination of factors such as socio-economic development, Westernization of lifestyles, strong urbanization and eating habits, as well as the adoption of a more sedentary lifestyle [26]. However, the crucial factor that healthcare professionals often come up against is the deep-rooted cultural barriers that make the management of obesity complex, if not obsolete. Indeed, the weight of habits and customs, often linked to aesthetic representations and beliefs, remains a major handicap. Numerous studies and observations have shown that obesity is perceived not only as a criterion of beauty, but above all as a model of social success and, paradoxically, a sign of good health [27]-[29]. In this way, the philosophy of “the bigger the belly, the better” is promoted in many

African regions with a high prevalence of obesity. In their view, this confers on men a certain status and membership of a particular social class, giving them a particular level of financial success. Women are not to be outdone, either, as they are discriminated against in the image of the “perfect, ideal woman”, who must be in good shape if not overweight [27]. These entrenched ideals encourage deliberate weight gain, even prompting women from certain ethnic groups to engage in force-feeding, which consists of ingesting large quantities of new food [30].

In Senegal, the causes of obesity growth seem to be the same as in many other African countries. A WHO report showed a progressive increase in the prevalence of overweight, estimated at 26.7%, and obesity estimated at 8.3%, between 1975 and 2016 [31], with notable gender differences [32]. According to the World Obesity Federation projections for Senegal, the prevalence of obesity will increase by 2030, particularly among women [33].

This disparity is partly explained by the fact that being overweight and obese are also perceived as beauty features, but also as indicators of fertility and later, a sign of success in marriage. This leads women to embark on a frantic quest to gain weight, even to the point of stuffing themselves, with little knowledge of the consequences for their health. However, these aesthetic considerations linked to overweight and obesity are mostly valid only before and sometimes after marriage. After multiple pregnancies and the many kilos, they are slow to lose, most of them want to return to their former weight, under pressure from the same society that has paradoxically set a standard of “beauty weight” that must not be exceeded, on pain of looking older than their age. So begins the descent into restrictive diets, with the yo-yo effects they generate, which can lead them into the vicious circle of eating disorders (EDs) such as binge eating or compulsive eating, the consequences of which they are unaware of on their health. Added to this is the major “nutritional transition” observed in recent years, as in other regions of the world [34]. According to studies, we have gone from a low-calorie, quantitative diet, less diversified but very rich in fiber, to a high-calorie diet, low in fiber and essential nutrients due to industrialization [35]-[39], not to mention the sedentary lifestyle associated with the new lifestyle. All these factors have contributed to the development of overweight and/or obesity in Senegal.

In order to reduce the incidence of metabolic and/or cardiovascular complications, it is therefore essential to adopt an approach of education and prevention, based on a multidisciplinary and holistic approach to the patient, starting from the early stages of obesity. Therefore, a better understanding of obesity, its health consequences, and lifestyle changes remain key levers for action. This includes, in particular, tailor-made hygiene-dietary counselling, and psychological support combined with cognitive-behavioural techniques as recommended by expert societies such as HAS [40]-[42].

The primary objective of this study was to evaluate the impact of a multidisciplinary therapeutic education program, based on a holistic approach, on the nutritional and behavioural status of obese volunteers attending the Marc Sankalé

Center in Senegal.

2. Materials and Methods

Study Population

The study population consisted of 20 adult volunteers, aged 18 years and older, who had decision-making autonomy and the capacity to freely and knowingly agree to participate in the study. This was the pilot phase of a prospective, interventional study conducted at the Marc Sankalé Diabetes Center of the Abass Ndao Hospital in Dakar (a national reference center specializing in the outpatient care of diabetics in Senegal and the sub-region) over a period of 3 months (June to August 2021), including 20 obese volunteers consulting at the center. Inclusion criteria were: free and informed consent to participate in the study; BMI ≥ 30 kg/m²; 16 - 60 years (young adult); and literacy, as the data collection methods used, such as the food diary, require a literate population. Excluded from the study were all those who did not meet the inclusion criteria, those who refused to participate, those who were lost to follow-up, those who did not attend the theoretical and practical workshops, and those who had secondary obesity of uncommon origin.

Data Collection

The socio-demographic and clinical profile of the volunteers was established on the basis of information collected through a questionnaire administered during a face-to-face interview. This questionnaire included several sections, including dietary data (anthropometric data, maximum weight...), information on eating practices and habits; nutritional knowledge; eating behaviour; and physical activity practices or sports.

Methods of Collecting Dietary Intake

Two methods were used to assess dietary intake: the food diary and the food frequency questionnaire [43] [44]. The food diary (FS2), considered the reference method because of its ability to provide accurate information on intake, consisted of asking the participant to record details of food and drink consumption in a notebook, without specifying quantities (without weighing to limit influence bias) [45]. This data collection was carried out over an average period of 3 to 4 consecutive days, including at least one weekend day, to cover weekly dietary variations [46]. This made it possible to determine the subject consumption profiles while avoiding the loss of compliance associated with recording that is too long. For the assessment of quantities (FS2), a qualitative self-assessment was performed with the volunteers using photographic models, which allowed them to best estimate the portions consumed. In addition, the Food Frequency Questionnaire allowed the assessment of habitual consumption of certain foods per week and/or per month [47]. After the data collection, each patient was given an adapted and personalized hypocaloric meal plan according to their specific needs.

Method for identifying eating disorders (ED)

As recommended by the HAS for screening for eating disorders, the SCOFF test was used to detect the existence of a potential eating disorder in volunteers. The

questionnaire administered included these five questions: “Have you ever made yourself vomit because you didn’t feel well on a full stomach? Are you afraid you’ve lost control over how much you eat? Have you recently lost more than 6 kilos in less than three months? Do you think you’re too fat while others consider you too thin? Would you say that food is something that occupies a dominant place in your life? According to the Diagnostic and Statistical Manual of Mental Disorders V (DMS-V), each of these questions refers to eating and eating disorders, including anorexia (10%), bulimia (20%) and hyperphobia (30% - 50%) [48].

Obtaining two or more positive answers to the five questions of the SCOFF-F questionnaire makes the diagnosis of TCA probable, with a sensitivity of 94.6% and a specificity of 94.8% [49]-[51].

Method for determining body indicators (Bio-impedance meter)

For an accurate and comprehensive analysis of body composition, we used a professional bio-impedance meter of the TANITA DC-360 S brand, which uses advanced dual-frequency technology (BIA) with a maximum weight capacity of 270 kg.

It was used to analyze body fat, muscle mass, basal metabolic rate, visceral fat and the degree of obesity of the participants. The scale is equipped with GMON PRO 3 software for trend analysis, health risk assessment and comprehensive customer data management. However, no objective, comparative tests were carried out on the scale in this study. We also ensured that weighing was never carried out after physical activity, and that women were not menstruating.

Operational definitions of key variables

The clinical status of the volunteers was assessed by a number of biological tests including: fasting capillary blood glucose, glycated haemoglobin, lipid profile, creatininemia, CRP, and CBC.

Thus, the volunteer was considered to be:

- diabetic with a fasting plasma glucose ≥ 1.26 g/l and/or a postprandial post-meal plasma glucose ≥ 2 g/l or in the case of previously diagnosed diabetes;
- sedentary with no moderate-intensity physical activity, or with less than 90 minutes of physical activity per week;
- hypertensive with blood pressure readings ≥ 140 mm Hg for systolic blood pressure and/or ≥ 90 mm Hg for diastolic blood pressure, measured at least twice at rest, or already known to be hypertensive;
- a smoker with active and regular cigarette consumption or consumption in the last three years;
- dyslipidemic with total hypercholesterolemia (>2 g/l); hypertriglycerideamia (>1.5 g/l); elevated LDL cholesterol (threshold of 1.6 g/l); or low HDL cholesterol (<0.5 g/l); or already known to be dyslipidaemic.

The physical examination allowed evaluation of the volunteers’ BMI, calculated as the ratio of weight (in kilograms) to the square of height (in meters), to determine their obesity status [22]. It also allowed the measurement of waist circumference using a tape measure to confirm the presence of abdominal obesity ac-

according to the IDF criteria (≤ 94 cm in men and 80 cm in women) [52].

Shared educational assessment

After volunteers were recruited, a Shared Educational Assessment (SEA) was conducted prior to the Therapeutic Patient Education (TPE) program to assess and define their level of knowledge about obesity (Table 1). This was done to identify their gaps, to understand their needs and long-term expectations, and to prioritize with them the skills to be acquired according to a priority order. This SEA allowed us to gather essential information, including: who they were, what they did, what they suffered from, what they felt, how they experienced their disease, what they knew, what they believed in, and whether they had life plans. At the end of the individual interview, each volunteer was given the Shared Educational Assessment, which included: the number of planned sessions, their duration, frequency, and rhythm, with a definition of the type of session (individual, group, alternating).

The SEA also included the procedure for individual evaluation procedure (achievement of objectives set jointly with the patient) and the modalities of educational follow-up (with the team or by the attending physician).

Table 1. Schedule of the various program activities.

TIMING	ACTIVITIES	OBJECTIVES	METHODS	EVALUATION
Activity 1	Workshop 1: “Understanding Obesity”	-Biomedical knowledge of obesity (causes and consequences) -Changing perceptions and attitudes toward obesity	-Presentation: roundtable discussion with photo language, video presentation on types of obesity, causes, and consequences—concept of BMI	Pre- and post-workshop evaluation questionnaire Roundtable discussion and summary of learning outcomes
Activity 2	Workshop 2 “Importance of physical activity for health”	-Knowledge of the impact of regular physical activity on health	-Theoretical presentation on physical activity followed by a demonstration by a coach	Pre- and post-workshop assessment questionnaire Roundtable discussion and summary of what has been learned
Activity 3	Workshop 3 “Diet and obesity”	-Knowledge of healthy eating guidelines -The importance of a good, balanced diet	-Presentation of food groups and their roles through the Food Pyramid, common misconceptions	Pre- and post-workshop assessment questionnaire Roundtable discussion and summary of what has been learned
Activity 4	Workshop 4 “Mindful eating”	-Awareness of eating behavior -Knowing how to assess and recognize hunger and satiety	-Mindfulness meditation script with food: chocolate and a bottle of water	Pre- and post-workshop assessment questionnaire Roundtable discussion and summary of what has been learned

Intervention

The Therapeutic Patient Education program was conducted in three phases: the patient enrolment phase of the study at T0, a semi-evaluation at T1 during which adjustments and corrective actions were implemented, and the mid-intervention evaluation at T3. The program was structured around four different workshops, each consisting of a theoretical and a practical part. These were:

- A workshop on “better understanding obesity, its types, its modifiable and non-modifiable risk factors, and its health consequences”. It was led by an endocrinologist and a nutritionist for 1 hour and 30 minutes.
- A workshop to raise awareness of “the importance of appropriate physical activity for general health, its effect on increasing muscle mass, and basal metabolism”. This workshop was conducted by a sports trainer specialized in obesity management and a nutritionist for 1 hour (including 15 minutes of theory and 45 minutes of practice with a demonstration of movements to be reproduced at home).
- A workshop designed to acquire “knowledge of the different food groups, their role in a daily diet, those to be consumed occasionally or limited, those to be avoided, as well as appropriate hygiene and dietary measures for obesity”. This workshop was led by a nutritionist for 1 hour and 30 minutes.
- A 1-hour workshop on mindful eating. This session aimed to help volunteers suffering from Eating Disorders (ED) to reconcile with their physiological signals of hunger and satiety, so that they could recognize and respond appropriately to their needs. It consisted of a 15-minute theoretical presentation followed by a demonstration using a meditation script.

An evaluation was conducted at the beginning and end of each workshop, and an evaluation was conducted to determine whether the pre-established skills had been acquired. This was done in order to adjust and/or refine the pre-defined key skills.

Data analysis

Data entry, analysis, and processing were carried out using Excel spreadsheets. Descriptive analyses were used to examine the different variables. Data were presented as percentages for qualitative variables and as means for quantitative variables. Statistical tests, performed at a 5% significance level within a 95% confidence interval, included statistical regression to identify possible correlations between

3. Results

Sociodemographic characteristics of volunteers

Table 2 shows the socio-demographic data and obesity-related characteristics at T0. The sex ratio (male/female) was 0.2, with 15% male and 85% female. The mean age was 32 years, with a 95% confidence interval of [26.13 - 37.40], ranging from 17 to 60 years, and the highest prevalence of obesity was in the [30 - 40] age group, which accounted for 40% of the study volunteers. A high prevalence of obesity

Table 2. Presentation of the sociodemographic data of the volunteers.

Age (years)	Sex	Address	Marital Status	Socio-professional Activity	Family History	Weight (Kg)	Height (m)	Known Duration of Obesity	Current Medication	Patient ID	BMI T0	T0	T1 and T3
17	F	Ouakam	Single	Student	NTR (Nothing to Report)	114	1.72	Adolescence	Antidiabetic	1	38.5	P	P
60	M	Liberté 3	Married	Retired	Diabetes and Obesity	120	1.72	Adult	Antidiabetic	2	40.6	P	LFU
38	M	Medina	Married	Engineer	Father with type 2 diabetes, deceased	103	1.74	Adult	Antidiabetic	3	34	P	P
32	F	Guédiawaye	Engaged	Seamstress	Patient Data	82	1.65	Adult	NTR	4	30	P	LFU
21	F	Liberté 6	Single	Student	Obesity, Diabetes	100	1.78	Adult	NTR	5	30	P	P
37	F	Mamelles	Divorced	Marketing Manager	Mother with diabetes, deceased; Father with hypertension and stroke	86	1.68	Adult	NTR	6	30.5	P	P
34	F	Kaolack	Married	Nurse	Mother with diabetes; Father with diabetes and hypertension with overweight	80	1.55	Adult	Implant Contraception	7	33.3	P	LFU
34	F	Sicap bab	Bao-Married	Medical Assistant	Mother with diabetes and hypertension, deceased from stroke	104	1.67	Adult	Anti-inflammatory	8	37	P	LFU
20	F	Cite Douane	Single	Student	Father with diabetes	87	1.75	Adolescence	NTR	9	30	P	LFU
22	F	Ouakam	Single	Student	Mother with diabetes, paternal obesity	127	1.7	Childhood	NTR	10	43.9	P	P
18	F	Sacré Cœur	Single	Student	Mother with diabetes, obese	98	1.65	Adolescence	Corticosteroid Therapy. Antidiabetics	11	36	P	P
22	F	Ouakam	Single	Seamstress	Father obese, diabetic, hypertension, and stroke	108	1.65	Adolescence	NTR	12	39.7	P	P
47	F	Parcelles Assainies	Married	Housewife	Mother with diabetes and obesity	78	1.57	Adult	NTR	13	31	P	P
28	F	Fass	Single	Seamstress	Diabetes and hypertension: father, mother, and grandfather	107	1.65	Adult	NTR	14	39.3	P	P
56	F	Liberté 6	Married	Bank Executive	Father and mother with diabetes, hypothyroidism, cholesterol, and hypertension	90	1.7	Adult	Antidiabetic	15	31	P	P
35	F	HLM Grand Yoff	Married	Bank Employee	Hypertension	86	1.66	Adult	NTR	16	31.2	P	P
33	M	Guédiawaye	Married	Bank Executive	Hypertension	93	1.65	Adult	NTR	17	34.16	P	P
19	F	Keur Massar	Single	Student	Father and grandmother with diabetes	100	1.67	Adult	NTR	18	35.86	P	P

Continued

22	F	Fass	Célibataire	Student	Familial obesity	108	1.65	Adolescence	NTR	19	39.6	P	P
40	F	ND	Mariée	Bank Executive	NTR	82	1.6	Adult	NTR	20	32.03	P	P

BMI: Body Mass Index; F: Female; M: Male; ND: Not determined; P: Present; LFU: Lost to follow-up; T0: Initial period; T1: First evaluation; T3: Second evaluation; NTR: Nothing to Report; ID Identification.

was observed among those living in the Ouakam area (15%). The proportion of married volunteers was 45%, while 55% were single (including divorced and engaged individuals). Students were the most represented group (35%; 7/20).

At T0, moderate obesity was observed in 55% of participants, severe obesity in 35%, and morbid obesity in 10%. In the cohort, 5% were aware of their obesity in childhood, 25% in adolescence, and 70% in adulthood. Morbid obesity was more common in adolescents (80%; 4/5) than in adults (21%; 3/14), although this difference was not significant $p=0.07$. In addition, 65% and 35% of volunteers had at least one diabetic and/or obese parent, respectively.

Risk factors associated with age

At T0, 30% (6/20) of volunteers were diabetic. Sedentary behaviour was observed in 95% (19/20), and ED was present in 100% of cases (40% (8/20) were aged between 15 and 24 years old). However, other obesity-related comorbidities were less common: Hypertension (HTN) 5% (1/20), dyslipidaemia 5% (1/20), menopause 5% (1/20), and advanced age 15% (3/20), with no smoking cases recorded (Table 3).

Table 3. Associated risk factors by patient age.

Age groups	Diabetes	Dyslipidaemia	Hypertension	Smoking	Physical inactivity	Menopause	Age	Eating behavior
15 - 24	2	0	0	0	7	1	-	8
25 - 34	0	0	0	0	5	0	-	5
35 - 44	1	1	1	0	4	0	-	4
45 - 54	1	0	0	0	1	0	1	1
55 - 65	2	0	0	0	2	0	2	2
Total	6	1	1	0	19	1	3	20

Five volunteers were lost to follow-up after T1. Thus, the mean age at T1 was 30.33 years, with a 95% confidence interval of [23.84 - 36.81], ranging from 17 to 56 years, and the sex ratio was 0.15. The educational program was carried out with 15 volunteers, and evaluations were carried out between T1 and T3. The development of targeted body parameters is shown in Figure 1. A reduction in BMI was observed in 73% (11/15) with a significant difference from baseline $p = 0.0004$. For visceral fat, a reduction was observed in 27% (4/15) but without a significant difference $p = 0.2$. Fat mass was reduced in 60% (9/15) with a significant difference

$p=0.003$. An increase in muscle mass was observed in 67% (10/15) with a significant difference $p = 0.001$ and a significant improvement in water mass in 73% (11/15) $p = 0.0004$. A positive but not significant improvement in metabolic age was observed in 20% (3/15) $p = 0.3$. A significant reduction in adiposity was observed in 73% (11/15) $p = 0.0004$ and a significant improvement in basal metabolism in 80% (12/15) $p = 0.0001$.

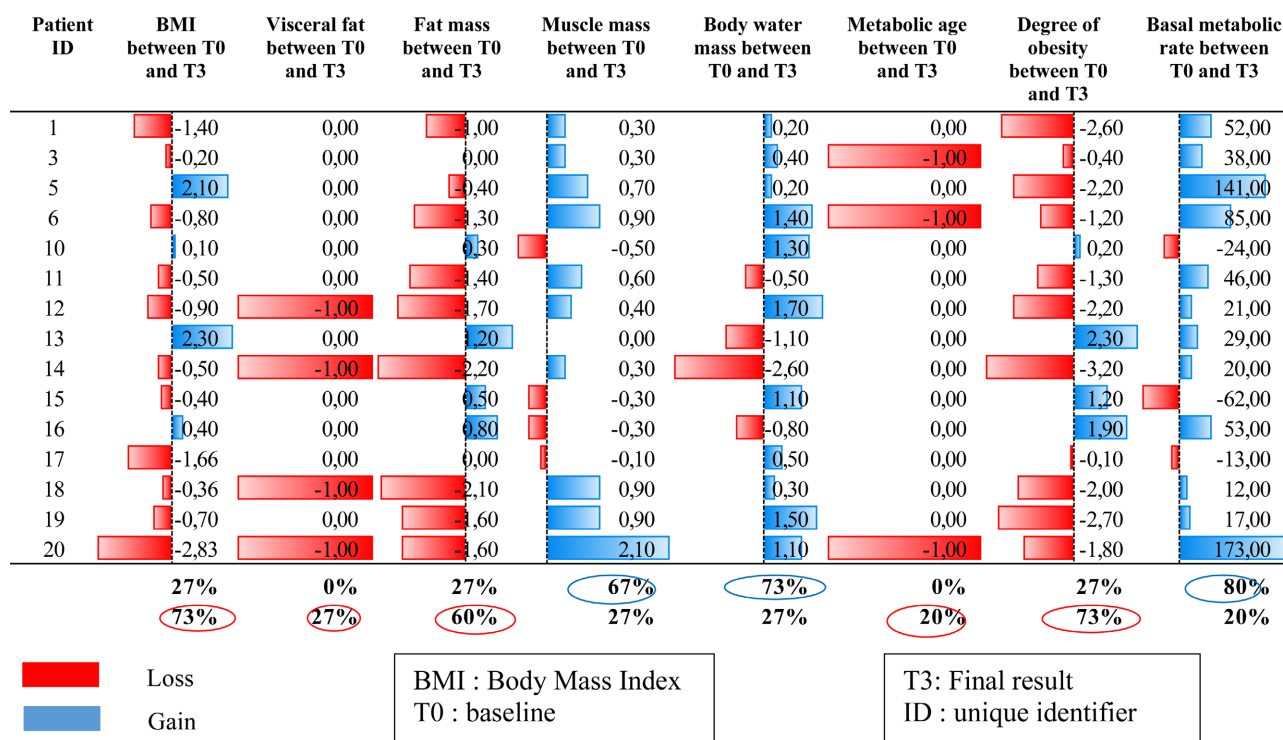


Figure 1. Variation of body parameters between T0 and T3.

Improvement of clinical and paraclinical parameters after intervention

After the intervention, we sought to evaluate the impact of the program on clinical and paraclinical parameters such as lipid, glycaemic, and glycated haemoglobin levels (for diabetics). A reduction in cholesterol and glycated haemoglobin was observed in some participants. However, due to financial constraints, not all volunteers were able to undergo the necessary tests during the interim evaluation, limiting our ability to obtain a comprehensive assessment of these parameters. Consequently, we focused more on the volunteers' nutritional status of the volunteers, with data collected using a TANITA DC-360 S bioelectrical impedance scale (body composition analyzer).

4. Discussion

This was the pilot phase of a prospective, interventional study with a descriptive and analytical objective, aiming to assess the impact of a multidisciplinary therapeutic education program on the nutritional status of obese individuals. The study had certain limitations due to the lack of financial resources necessary to cover

the cost of analyses at the mid-evaluation stage.

There was also a shortage of psychologists specializing in obesity management (considered unnecessary by specialists in the field, given the deeply rooted aesthetic and cultural considerations in Senegal). However, numerous studies highlight that obesity is not only about excess weight and metabolic comorbidities but also affects self-perception and social interactions [53]. Moreover, recurrent stigmatization, sometimes unconscious, associates obese people with a lack of intelligence, a tendency to gluttony, laziness [54] [55], or even a lack of willpower and self-control [56] [57]. It is therefore essential to integrate compassionate, non-judgmental psychological support, free from prejudice, to help these patients and improve their overall well-being [58]-[60].

Despite these limitations, the pilot phase of the study yielded significant results in terms of body parameters, with a positive impact on the nutritional status of the volunteers. We observed that the proportion of obese women was higher in our study population, which is consistent with the literature [3]. Furthermore, the prevalence of obesity was more pronounced in adolescents and young adults aged [15 - 24], although the onset of obesity was later in those aged [35 - 44], who reported the highest number of comorbidities.

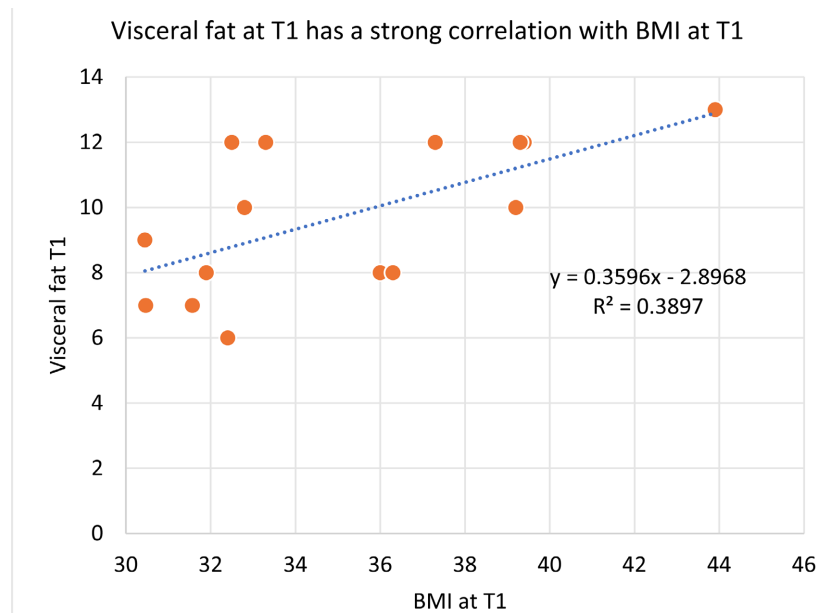
At baseline, nearly 90% of the study population was sedentary and reported no physical activity for two years. However, at mid-evaluation, a 67% increase in muscle mass was observed, demonstrating the positive impact of the adapted physical activity (APA) workshops and awareness sessions led by the sports coach (**Figure 1**). These results are consistent with the literature highlighting the multiple benefits of physical activity [40] [41].

Indeed, numerous studies have demonstrated its impact on reducing cardiovascular mortality (by 20% to 50%) with as little as 15 minutes of moderate-intensity activity per day, as well as its benefits on skeletal health, mental health, sleep, pain [61], and metabolic parameters by reducing adiposity, overweight and/or obesity, and visceral fat [62] [63]. These findings corroborate the results of the pilot phase of our study, which showed a 27% reduction in visceral fat, as measured by bioelectrical impedance analysis (**Graph 1**). However, no correlation was found between muscle mass and participants' BMI at T1, showing the lack of influence of muscle mass on BMI (**Figure 1; Graph 2**).

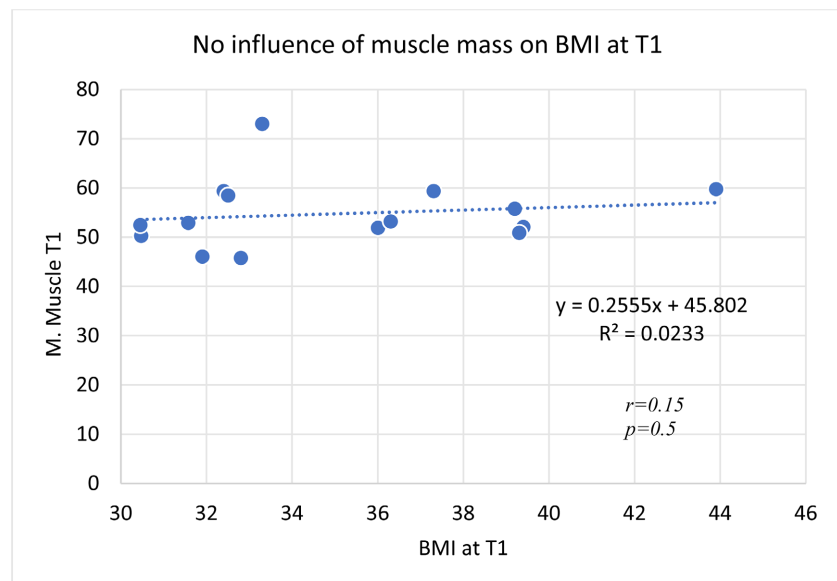
Visceral fat serves to surround and protect vital organs, but in excessive amounts, as seen in obese individuals, it becomes pathological and a source of metabolic diseases such as type 2 diabetes, hypertension, or cardiovascular disease. Studies have shown that a 5% reduction in body weight, combined with regular physical activity, effectively reduces visceral fat [64]. Researchers at the UT Southwestern Medical Center compared the effects of physical exercise and treatments on visceral fat reduction. MRI evaluation of changes observed after six months of intervention among 3,602 participants from 17 randomized controlled trials showed that exercise led to greater visceral fat loss than drugs [62].

At the same time, an increase in basal metabolic rate (BMR), also known as

Resting Energy Expenditure (REE), was observed in most volunteers (80%). It is important to note that REE is the estimated amount of energy required to maintain vital functions such as breathing, digestion, and brain activity. This expenditure is strongly influenced by variations in muscle mass and increases with muscle gain, as more muscle leads to a higher calorie requirement. Increasing the BMR therefore increases the body's ability to burn calories and facilitates weight loss. This observation is consistent with the 60% reduction in body fat mass and the 73% reduction in BMI seen in the volunteers, resulting in a 73% reduction in obesity severity and a 20% reduction in metabolic age (Figure 1).



Graph 1. Strong correlation between visceral fat and BMI at T1.



Graph 2. Correlation between muscle mass and BMI.

It is important to note that metabolic age is the average age associated with BMR and should be compared with actual chronological age. A metabolic age that is higher than the chronological age indicates premature ageing of the body, often associated with an unhealthy lifestyle. However, this situation is reversible through healthier habits, including a balanced diet and regular physical activity [65], as demonstrated in our program. The mindful eating workshop also helped to reduce the proportion of volunteers suffering from eating disorders to 60%, according to results from the SCOFF questionnaire [66]-[68].

The pilot phase of the multidisciplinary ETP program, in line with the recommendations of learned societies [69], had a positive impact on participants' nutritional status [70]. These results are in line with the literature, based on experimental studies such as those carried out in France, where the feasibility and effectiveness of training programs for healthcare professionals and patient education have been demonstrated, highlighting their positive impact on the quality of life of people with type 2 diabetes [71]. These results are in line with those found in a diabetes center in Abidjan [72].

In general, the program showed that morbid obesity was more frequent in adolescents than in adults (80% vs. 35%). This raises the question of the galloping rise of obesity in the young population at low crude levels, thus directing efforts towards the real target, *i.e.*, young people, thanks to a premature change in the perception of certain neglected so-called diseases of civilization.

Although the program was completed in a relatively short space of time, the knowledge acquired during the educational workshops relatively changed the participants' view of obesity, which was finally recognized as a disease rather than a beauty feature. In the process, the relationship and perception of food intake was also transformed, since it was no longer a matter of stuffing oneself, but of looking at oneself in a benevolent way and taking responsibility for one's own health. For better health, this means changing certain eating habits and behaviours that were hitherto neglected and trivialized, but more through ignorance than anything else.

The implementation of the pilot phase of such an ETP program, adapted to our realities and beliefs, has enabled us to identify needs that were previously thought to be of secondary importance. However, the crucial information to be retained from this pilot study is the urgent need to educate young people nutritionally, so that they grow up with the right reflexes and knowledge, and to re-educate adults to reduce the growth of obesity.

5. Conclusions

Obesity is a major chronic disease that has been identified as a public health priority due to its strong association with emerging co-morbidities. However, socio-cultural perceptions often prevent it from being recognized as a health problem. It is therefore essential to improve patient awareness and knowledge through therapeutic education. The pilot study demonstrated the importance of an early multidisciplinary therapeutic education program, paving the way for its integration

into other healthcare structures. The use of bioelectrical impedance analysis proved to be a key tool in assessing participants' progress by providing accurate data on body composition. These results confirm the fundamental role of impedance analysis in personalized follow-up for obese patients, enabling a more targeted and effective approach.

With obesity rates on the rise, particularly among young people, prevention programs, integrated into schools from an early age are needed to correct perceptions and promote healthy eating habits.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Organisation Mondiale de la Santé (2024) International Classification of Adult Under-Weight, Overweight and Obesity according to BMI. http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
- [2] OMS (2018) L'obésité dans le monde. Rapport OMS Février.
- [3] Di Angelantonio, E., Bhupathiraju, S.N., Wormser, D., Gao, P., Kaptoge, S., de Gonzalez, A.B., *et al.* (2016) Body-Mass Index and All-Cause Mortality: Individual-Participant-Data Meta-Analysis of 239 Prospective Studies in Four Continents. *The Lancet*, **388**, 776-786. [https://doi.org/10.1016/s0140-6736\(16\)30175-1](https://doi.org/10.1016/s0140-6736(16)30175-1)
- [4] OMS (2016) Obésité et surpoids. <https://www.who.int/fr/news-room/fact-sheets/detail/obesity-and-overweight>
- [5] Prospective Studies Collaboration (2009) Body-Mass Index and Cause-Specific Mortality in 900 000 Adults: Collaborative Analyses of 57 Prospective Studies. *The Lancet*, **373**, 1083-1096. [https://doi.org/10.1016/s0140-6736\(09\)60318-4](https://doi.org/10.1016/s0140-6736(09)60318-4)
- [6] Abdullah, A., Peeters, A., de Courten, M. and Stoelwinder, J. (2010) The Magnitude of Association between Overweight and Obesity and the Risk of Diabetes: A Meta-Analysis of Prospective Cohort Studies. *Diabetes Research and Clinical Practice*, **89**, 309-319. <https://doi.org/10.1016/j.diabres.2010.04.012>
- [7] Guh, D.P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C.L. and Anis, A.H. (2009) The Incidence of Co-Morbidities Related to Obesity and Overweight: A Systematic Review and Meta-Analysis. *BMC Public Health*, **9**, Article No. 88. <https://doi.org/10.1186/1471-2458-9-88>
- [8] Bogers, R.P. (2007) Association of Overweight with Increased Risk of Coronary Heart Disease Partly Independent of Blood Pressure and Cholesterol Levels: A Meta-Analysis of 21 Cohort Studies Including More than 300 000 Persons. *Archives of Internal Medicine*, **167**, 1720-1728. <https://doi.org/10.1001/archinte.167.16.1720>
- [9] Strazzullo, P., D'Elia, L., Cairella, G., Garbagnati, F., Cappuccio, F.P. and Scalfi, L. (2010) Excess Body Weight and Incidence of Stroke: Meta-Analysis of Prospective Studies With 2 Million Participants. *Stroke*, **41**, e41826. <https://doi.org/10.1161/strokeaha.109.576967>
- [10] McGee, D.L. (2005) Body Mass Index and Mortality: A Meta-Analysis Based on Per-

- son-Level Data from Twenty-Six Observational Studies. *Annals of Epidemiology*, **15**, 87-97. <https://doi.org/10.1016/j.annepidem.2004.05.012>
- [11] Anandacoomarasamy, A., Caterson, I., Sambrook, P., Fransen, M. and March, L. (2007) The Impact of Obesity on the Musculoskeletal System. *International Journal of Obesity*, **32**, 211-222. <https://doi.org/10.1038/sj.ijo.0803715>
- [12] American Institute for Cancer Research and World Cancer Research Fund (2007) Food, Nutrition, Physical Activity and the Prevention of Cancer. American Institute for Cancer Research.
- [13] Ackerman, S.E., Blackburn, O.A., Marchildon, F. and Cohen, P. (2017) Insights into the Link between Obesity and Cancer. *Current Obesity Reports*, **6**, 195-203. <https://doi.org/10.1007/s13679-017-0263-x>
- [14] Gihring, A., Gärtner, F., Mayer, L., Roth, A., Abdelrasoul, H., Kornmann, M., et al. (2023) Influence of Bariatric Surgery on the Peripheral Blood Immune System of Female Patients with Morbid Obesity Revealed by High-Dimensional Mass Cytometry. *Frontiers in Immunology*, **14**, Article 1131893. <https://doi.org/10.3389/fimmu.2023.1131893>
- [15] Oshakbayev, K., Zhankalova, Z., Gazaliyeva, M., Mustafin, K., Bedelbayeva, G., Dukenbayeva, B., et al. (2022) Association between COVID-19 Morbidity, Mortality, and Gross Domestic Product, Overweight/Obesity, Non-Communicable Diseases, Vaccination Rate: A Cross-Sectional Study. *Journal of Infection and Public Health*, **15**, 255-260. <https://doi.org/10.1016/j.jiph.2022.01.009>
- [16] Wharton, S., Lau, D.C.W., Vallis, M., Sharma, A.M., Biertho, L., Campbell-Scherer, D., et al. (2020) L'obésité chez l'adulte: Ligne directrice de pratique clinique. *Canadian Medical Association Journal*, **192**, E1757-E1775. <https://doi.org/10.1503/cmaj.191707-f>
- [17] Longo, M., Zatterale, F., Naderi, J., Parrillo, L., Formisano, P., Raciti, G.A., et al. (2019) Adipose Tissue Dysfunction as Determinant of Obesity-Associated Metabolic Complications. *International Journal of Molecular Sciences*, **20**, Article 2358. <https://doi.org/10.3390/ijms20092358>
- [18] Aune, D., Norat, T. and Vatten, L.J. (2014) Body Mass Index and the Risk of Gout: A Systematic Review and Dose-Response Meta-Analysis of Prospective Studies. *European Journal of Nutrition*, **53**, 1591-1601. <https://doi.org/10.1007/s00394-014-0766-0>
- [19] Janssen, I., Katzmarzyk, P.T. and Ross, R. (2002) Body Mass Index, Waist Circumference, and Health Risk. *Archives of Internal Medicine*, **162**, 2074-2079. <https://doi.org/10.1001/archinte.162.18.2074>
- [20] de Wit, L., Luppino, F., van Straten, A., Penninx, B., Zitman, F. and Cuijpers, P. (2010) Depression and Obesity: A Meta-Analysis of Community-Based Studies. *Psychiatry Research*, **178**, 230-235. <https://doi.org/10.1016/j.psychres.2009.04.015>
- [21] Luppino, F.S., de Wit, L.M., Bouvy, P.F., Stijnen, T., Cuijpers, P., Penninx, B.W.J.H., et al. (2010) Overweight, Obesity, and Depression: A Systematic Review and Meta-analysis of Longitudinal Studies. *Archives of General Psychiatry*, **67**, 220-229. <https://doi.org/10.1001/archgenpsychiatry.2010.2>
- [22] National Heart, Lung, and Blood Institute (2002) Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults.
- [23] de las Fuentes, L., Waggoner, A.D., Mohammed, B.S., Stein, R.I., Miller, B.V., Foster, G.D., et al. (2009) Effect of Moderate Diet-Induced Weight Loss and Weight Regain on Cardiovascular Structure and Function. *Journal of the American College of Cardiology*, **54**, 2376-2381. <https://doi.org/10.1016/j.jacc.2009.07.054>

- [24] Knowler, W.C., Barrett-Connor, E., Fowler, S.E., et al. (2002) Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *The New England Journal of Medicine*, **346**, 393-403. <https://doi.org/10.1056/NEJMoa012512>
- [25] Magkos, F., Fraterrigo, G., Yoshino, J., Luecking, C., Kirbach, K., Kelly, S.C., et al. (2016) Effects of Moderate and Subsequent Progressive Weight Loss on Metabolic Function and Adipose Tissue Biology in Humans with Obesity. *Cell Metabolism*, **23**, 591-601. <https://doi.org/10.1016/j.cmet.2016.02.005>
- [26] World Health Organization, Regional Office for Africa (2010) Nutritional Transition.
- [27] Correia, J., Pataky, Z. and Golay, A. (2014) Comprendre l'obésité en Afrique: Poids du développement et des représentations. *Revue Médicale Suisse*, **10**, 712-716. <https://doi.org/10.53738/revmed.2014.10.423.0712>
- [28] Sondji, S.-H. (2017) Etat des lieux de l'obésité en Afrique subsaharienne. *Annals of African Medicine*, **11**, e2753.
- [29] Ziraba, A.K., Fotso, J.C. and Ochako, R. (2009) Overweight and Obesity in Urban Africa: A Problem of the Rich or the Poor? *BMC Public Health*, **9**, Article No. 465. <https://doi.org/10.1186/1471-2458-9-465>
- [30] Puoane, T. and Hughes, G. (2005) Impact of the HIV/AIDS Pandemic on Non-Communicable Disease Prevention. *South African Medical Journal*, **95**, 228-230.
- [31] Organisation mondiale de la Santé (OMS) (2016) Rapport diabète au Sénégal, profils des pays pour le diabète.
- [32] Enquête STEPS 2015 (2016) Rapport préliminaire: Les indicateurs clés.
- [33] World Obesity Federation (2022) World Obesity Atlas 2022. World Obesity Federation, 289.
- [34] Popkin, B.M. (2001) The Nutrition Transition and Obesity in the Developing World. *The Journal of Nutrition*, **131**, 871S-873S. <https://doi.org/10.1093/jn/131.3.871s>
- [35] Popkin, B.M. (1993) Nutritional Patterns and Transitions. *Population and Development Review*, **19**, 138-157. <https://doi.org/10.2307/2938388>
- [36] Fondation Nicolas Hulot pour la nature et l'homme (2015) Le système alimentaire de la région de Dakar: Etat des lieux et perspectives face aux enjeux du changement climatique.
- [37] Ndao, M. (2009) Le ravitaillement de Dakar de 1914 à 1945. Editions Harmattan Sénégal, 290 p. https://books.google.sn/books?id=i_TR-4tZKTQC
- [38] Ndoye, F. (2001) Évolution des styles alimentaires à Dakar. Cirad.
- [39] Ndoye, F. (1996) Dévaluation et alimentation hors domicile à Dakar. Mémoire de Dess, Extraits d'entretien, Iedes.
- [40] Haute Autorité de Santé (2011) Recommandations de bonne pratique Clinique. Surpoids et obésité de l'adulte: Prise en charge médicale de premier recours.
- [41] HAS (2023) Obésité de l'adulte. Recommandation.
- [42] Mulvihill, C. and Quigley, R. (2003) The Management of Obesity and Overweight. An Analysis of Reviews of Diet, Physical Activity and Behavioural Approaches. Evidence Briefing. NHS Health Development Agency.
- [43] Freudenheim, J.L. (1993) A Review of Study Designs and Methods of Dietary Assessment in Nutritional Epidemiology of Chronic Disease. *The Journal of Nutrition*, **123**, 401-405. https://doi.org/10.1093/jn/123.suppl_2.401
- [44] Thompson, F.E. and Byers, T. (1994) Dietary Assessment Resource Manual. *The Journal of Nutrition*, **124**, 2245s-2317s. https://doi.org/10.1093/jn/124.suppl_11.2245s

- [45] Bailay, R.L. (2021) Aperçu des méthodes d'évaluation diététique pour mesurer les apports en aliments, boissons et compléments alimentaires dans les études de recherche. *Current Opinion in Biotechnology*, **70**, 91-96.
- [46] Cade, J., Thompson, R., Burley, V. and Warm, D. (2002) Development, Validation and Utilisation of Food-Frequency Questionnaires—A Review. *Public Health Nutrition*, **5**, 567-587. <https://doi.org/10.1079/phn2001318>
- [47] Gersovitz, M., Patrick Madden, J. and Smicklas-Wright, H. (1978) Validity of the 24-Hr. Dietary Recall and Seven-Day Record for Group Comparisons. *Journal of the American Dietetic Association*, **73**, 48-55. [https://doi.org/10.1016/s0002-8223\(21\)05669-8](https://doi.org/10.1016/s0002-8223(21)05669-8)
- [48] https://www.academia.edu/11886511/DSM_IV_TR_Diagnostic_and_statistical_manual_of_mental_disorders
- [49] Luck, A.J., MorganLuck, J.F., Reid, F., O'Brien, A., Brunton, J., Price, C., et al. (2002) The SCOFF Questionnaire and Clinical Interview for Eating Disorders in General Practice: Comparative Study. *BMJ*, **325**, 755-756. <https://doi.org/10.1136/bmj.325.7367.755>
- [50] Morgan, J.F., Reid, F. and Lacey, J.H. (1999) The SCOFF Questionnaire: Assessment of a New Screening Tool for Eating Disorders. *BMJ*, **319**, 1467-1468. <https://doi.org/10.1136/bmj.319.7223.1467>
- [51] Garcia, F.D., Grigioni, S., Chelali, S., Meyrignac, G., Thibaut, F. and Dechelotte, P. (2010) Validation of the French Version of SCOFF Questionnaire for Screening of Eating Disorders among Adults. *The World Journal of Biological Psychiatry*, **11**, 888-893. <https://doi.org/10.3109/15622975.2010.483251>
- [52] Alberti, K.G.M.M., Eckel, R.H., Grundy, S.M., Zimmet, P.Z., Cleeman, J.I., Donato, K.A., et al. (2009) Harmonizing the Metabolic Syndrome: A Joint Interim Statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation*, **120**, 1640-1645. <https://doi.org/10.1161/circulationaha.109.192644>
- [53] Kirk, S.F.L., Price, S.L., Penney, T.L., Rehman, L., Lyons, R.F., Piccinini-Vallis, H., et al. (2014) Blame, Shame, and Lack of Support: A Multilevel Study on Obesity Management. *Qualitative Health Research*, **24**, 790-800. <https://doi.org/10.1177/1049732314529667>
- [54] Alberga, A.S., Edache, I.Y., Forhan, M. and Russell-Mayhew, S. (2019) Weight Bias and Health Care Utilization: A Scoping Review. *Primary Health Care Research & Development*, **20**, e116. <https://doi.org/10.1017/s1463423619000227>
- [55] Danne, A. (2009) Rapport au Président de la République: Commission pour la prévention et la prise en charge de l'obésité.
- [56] Basdevant, A., Bas-Theron, F., Combris, P., Ducimetiere, P., Frelut, M.-L., et al. (2006) Obésité: Bilan et évaluation des programmes de prévention et de prise en charge. Rapport de recherche, Institut national de la santé et de la recherche médicale (INSERM), 229 p. https://hal-lara.archives-ouvertes.fr/hal-01570670v1/file/INSERM_obesite_bilan.pdf
- [57] Sutin, A.R., Stephan, Y. and Terracciano, A. (2015) Weight Discrimination and Risk of Mortality. *Psychological Science*, **26**, 1803-1811. <https://doi.org/10.1177/0956797615601103>
- [58] Bloom, B.S., Banta, H.D., Gross, P.F., Peña-Mohr, J., Sisk, J.E. and Stocking, B. (1989)

- World Perspectives. *International Journal of Technology Assessment in Health Care*, **5**, 669-672. <https://doi.org/10.1017/s0266462300008539>
- [59] Corminboeuf, Y. and Giusti, V. (2014) Rôle de l'approche psychologique dans la prise en charge des patients obèses. *Revue Médicale Suisse*, **10**, 686-690. <https://doi.org/10.53738/revmed.2014.10.423.0686>
- [60] Canning, K.L., Brown, R.E., Wharton, S., Sharma, A.M. and Kuk, J.L. (2015) Edmonton Obesity Staging System Prevalence and Association with Weight Loss in a Publicly Funded Referral-Based Obesity Clinic. *Journal of Obesity*, **2015**, Article 619734. <https://doi.org/10.1155/2015/619734>
- [61] Costes, F. (2021) Effets physiologiques de l'activité physique. *Revue du Rhumatisme Monographies*, **88**, 183-186. <https://doi.org/10.1016/j.monrhu.2021.01.009>
- [62] Rao, S., Pandey, A., Garg, S., Park, B., Mayo, H., Després, J., et al. (2019) Effect of Exercise and Pharmacological Interventions on Visceral Adiposity: A Systematic Review and Meta-Analysis of Long-Term Randomized Controlled Trials. *Mayo Clinic Proceedings*, **94**, 211-224. <https://doi.org/10.1016/j.mayocp.2018.09.019>
- [63] INSERM (2019) Activité physique: Prévention et traitement des maladies chroniques.
- [64] Haute Autorité de Santé (2018) Prescription d'activité physique et sportive: Surpoids et obésité de l'adulte. HAS.
- [65] The Look AHEAD Research Group (2014) Eight-Year Weight Losses with an Intensive Lifestyle Intervention: The Look AHEAD Study. *Obesity*, **22**, 5-13. <https://doi.org/10.1002/oby.20662>
- [66] American Psychiatric Association (2005) Diagnostic and Statistical Manual of Mental Disorders. 4th Edition, American Psychiatric Association.
- [67] Boutillier, J. (2020) Les manuels d'hypnose et de thérapie brève: La boulimie. 85 p.
- [68] Vallis, M. (2015) Are Behavioural Interventions Doomed to Fail? Challenges to Self-Management Support in Chronic Diseases. *Canadian Journal of Diabetes*, **39**, 330-334. <https://doi.org/10.1016/j.jcid.2015.01.002>
- [69] SIGN Scottish Intercollegiate Guidelines Network, Part of NHS Quality improvement Scotland (2020) 115 Management of Obesity: A National Clinical Guideline.
- [70] Söderlund, A., Fischer, A. and Johansson, T. (2009) Physical Activity, Diet and Behaviour Modification in the Treatment of Overweight and Obese Adults: A Systematic Review. *Perspectives in Public Health*, **129**, 132-142. <https://doi.org/10.1177/1757913908094805>
- [71] Garbacz, L., Jullière, Y., Alla, F., Jourdain, P., Guyon, G., Coudane, H., et al. (2015) Impact de l'éducation thérapeutique sur les habitudes de vie: Perception des patients et de leurs proches. *Santé Publique*, **27**, 463-470. <https://doi.org/10.3917/spub.154.0463>
- [72] Purifine Ake-Tano, S.O., Ekou, F.K., Konan, Y.E., Tetchi, E.O., Kpebo, D.O., Sable, S.P., et al. (2017) Pratiques alimentaires des diabétiques de type 2 suivis au Centre Antidiabétique d'Abidjan. *Santé Publique*, **29**, 423-430. <https://doi.org/10.3917/spub.173.0423>