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Research Article

Action of Sport Practice and a Diet Rich in Fibers on the Reversal of Cardiometabolic Risk Factors in Sedentary Women of the "INJS-Sport-Loisirs-Santé" Club

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Abstract

Well-structured physical activity, combined with a balanced diet rich in fruits and vegetables, reduces cardiometabolic risk factors (CRFs) in individuals. However, the timeframe for the reversal of these cardiometabolic risk factors in obese women, considering their different life stages (menopausal or pre-menopausal), is not clearly defined. To reverse CRFs in sedentary women, both menopausal and pre-menopausal, participating in the "INJS-Sport-Loisirs-Santé" club, through a tailored exercise programme and a balanced diet rich in fruits and vegetables. Fourteen obese women, aged 25 to 55 years, voluntarily enrolled and consented to participate in the study. They were divided into two experimental groups: post-menopausal women (group 1, n=7) and pre-menopausal women (group 2, n=7). Their anthropometric and biochemical parameters were measured at baseline, after three months, and after six months of a tailored exercise programme combined with a diet rich in fruits and vegetables. Before the intervention, the Body Mass Indices (BMI) were 39.7 ±0.8 and 38.4 ±0.5 kg/m²; the total cholesterol/HDL ratios were 10.0 ±0.3 and 12.9 ±0.2, the LDL/HDL cholesterol ratios were 11.7 ±0.2 and 9 ±0.3, and blood glucose levels were 0.65 ±0.1 and 0.69 ±0.2 mg/dL, respectively, in groups 1 and 2 (P>0.05). At three months of the intervention, the inter-group comparison showed a decrease in the total cholesterol/HDL ratio of 54.6% and 51%, and the LDL/HDL cholesterol ratio of 77.1% and 70.3%, respectively, in groups 1 and 2. Six months later, there was a reduction in BMI of 5.1% and 11.5%, a reduction in the total cholesterol/HDL ratio of 71.1% and 75.2%, and a reduction in the LDL/HDL cholesterol ratio of 87.4% and 81.9%, with blood glucose levels remaining relatively constant in groups 1 and 2, respectively (P>0.05). The atherogenic and anti-atherogenic risks in obese women, regardless of their life stage, are significantly reduced after 3 months, while a reduction in their BMI of at least 5% is achieved after 6 months of this type of intervention.

Keywords

Reversal, Cardiometabolic Risk Factors, Sedentary Women, Tailored Exercise Programme, Balanced Diet

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1. Introduction

Non-communicable diseases (NCDs) constitute a significant global public health challenge, accounting for 41 million deaths annually, or 74% of all deaths [1]. Of these fatalities, 17 million people die prematurely, before the age of 70, with 86% of these deaths occurring in low- and middle-income countries [2]. The World Health Organization's Report [3], indicates that African island nations experience 50-88% of deaths attributable to these diseases, emphasising the urgent need for a targeted response to address this public health crisis. In Cameroon, a study conducted by the Ministry of Public Health in 2020 revealed that NCDs are responsible for approximately 30% of deaths in the country [4]. Among these diseases, hypertension, diabetes, and obesity are particularly concerning, with 30% of adults suffering from hypertension, 5% of the adult population affected by diabetes, and 43% suffering from obesity [4, 5]. These statistics highlight the necessity to understand the risk factors associated with these conditions, including a lack of physical activity and unhealthy diets, which play a crucial role in the development of cardiometabolic diseases.

A cardiometabolic risk factor can be defined as a lifestyle habit, clinical or biological condition that increases the likelihood of developing cardiovascular disease (CVD) or type 2 diabetes [6, 7]. The relationship between physical activity level (PAL) and Cardiometabolic Risk Factors (CRFs) is crucial. A low level of physical activity disrupts cellular metabolism, leading to an energy imbalance where excess energy is stored as triglycerides in adipose tissue. This process contributes to obesity, which promotes the emergence of numerous CRFs, such as dyslipidaemia, chronic hyperglycaemia, high blood pressure, and insulin resistance [8]. The management of body weight through physical activity is thus an essential component of the prevention and management of CRFs, and the level of physical activity is an important public health indicator [9, 10]. The study conducted by [11] demonstrated that moderate to vigorous physical activity was associated with a significant reduction in the risk of cardiovascular disease. Kodama et al. [12] also showed that regular physical exercise reduced the risk of type 2 diabetes, while the longitudinal study by Ekelund et al. [13] found an inverse correlation between physical activity level and body mass index (BMI). These findings highlight the importance of encouraging active lifestyles to prevent cardiometabolic diseases. In Cameroon, the study by Sobngwi et al. [14] found a significant association between physical inactivity and high blood pressure as well as obesity in both urban and rural areas. More recently, Bilog et al. [15] observed that metabolic syndrome was more prevalent in urban dwellers, associated with low levels of physical activity. Among the strategies for preventing or managing CVD, [15] and Slavin [16] recommend calorie restriction, the consumption of herbal teas (green tea, mate, lemongrass, etc.), coffee, increasing physical activity levels, increased protein intake or thermogenic foods, and fruits and vegetables. In this vein, Guessogo et al. [17] demonstrated in their study that the beneficial effects of physical exercise on individuals' health were observed with a sports practice frequency of three times a week for three months. Pearson et al., [18] showed that dietary restriction combined with physical exercise, upon cessation, resulted in a doubled body mass gain or "yo-yo effect". The core of *Ananas comosus*, rich in bromelain, has been widely recommended to people suffering from being overweight due to its proteolytic, cholesterol-lowering, anti-inflammatory, and anti-oedematous properties, according to Xi et al. [19], and its lipolytic properties [20]. Overall, while aerobic physical activity combined with a balanced diet prevents the occurrence of CVD and/or improves the quality of life of those affected, the literature does not clearly specify the timeframe for the effectiveness of this type of intervention according to the different life stages of women. Hence, the interest of this study. The objective of the study was to explore the relationships between regular and moderate physical activity, good dietary habits, and cardiometabolic risk factors in a group of obese, sedentary women, both menopausal and pre-menopausal, newly enrolled in a management programme including tailored exercise and a balanced diet rich in fruits and vegetables from the "INJS-Sport-Loisirs-Santé" club. It aims to have a significant impact on the prevention or management of NCDs/CVDs and, specifically, to promote women's health in Cameroon through multidisciplinary approaches.

2. Material and Methods

2.1. Area of Study

This quasi-experimental, longitudinal, and prospective study was conducted at the National Institute of Youth and Sports (INJS) for the practice of Physical and Sports Activities (PSA), for the measurement of anthropometric and physiological parameters, and for dietary advice, and at the Biochemistry Laboratory of the University Hospital Centre (UHC) of Yaoundé for the determination of blood biochemical parameters. It lasted six months and took place from June 2023 to December 2023.

2.2. Participant Selection Criteria

Fourteen obese women, both menopausal and pre-menopausal, were selected from 30 women who expressed interest in the study. These sedentary women, classified as obese (BMI > 30 kg/m²), comprising 7 menopausal and 7 pre-menopausal individuals, aged 35 to 45, and newly enrolled in the "INJS-Women-Sport-Leisure-Health" programme, were selected based on several pre-defined criteria established for the conduct of this study. This sample of 14 women was divided into two working groups, according to their menopausal status: a first Group 1 of pre-menopausal obese women (7) and a second Group 2 of post-menopausal obese women (7). The various selection criteria included: (1) *Inclusion Criteria with the Common criteria*; be a woman, have a BMI > 30 kg/m²; have not participated in sports or been enrolled in a sports programme in the last 12 months at least, be in good health, Have no recent weight fluctuations, have no history of eating disorders, follow and adhere to the nutritional advice of the Weight Watchers diet, sign an informed consent form and not be taking medication, Be menopausal (having missed your period for at least one year) or pre-menopausal (having had a period in the last three months immediately before the study); (2) *Specific criterion (for those who are not menopausal)*; have a short, regular menstrual cycle, not be breastfeeding or pregnant; not yet menopause and not be taking contraception or medication; and (3) the *Exclusion Criteria*: which were excluded from the study: obese women who became ill at least once during the six months of the study, women who missed at least one physical activity and sports session or an evaluation during the six months of the study and women who did not follow the Weight Watchers dietary recommendations.

2.3. Measuring Devices, Reagents, Data Collection Sheets Used, and Food

A YAMATO brand weighing scale, with an accuracy of ±100 g, was used for measuring the participants' body mass; a wooden stadiometer, consisting of a vertical rod and a horizontal ruler, was used to measure the participants' height; a PURSUN PS-2060 stopwatch with 20 timing points was used to measure the duration of the exercises; an electronic blood pressure monitor, a food scale, a glucometer, a spectrophotometer, and a calculator were employed. Blood glucose test strips, appropriate reagents for lipid analysis (Kit HUMAN CHOLESTEROL liquicolor: Human Gesellschaft für Biochemica und Diagnostica mbH; HUMAN TRIGLYCERIDES liquicolor: Human Gesellschaft für Biochemica und Diagnostica mbH) were used. Additionally, a data collection sheet, a 72-hour dietary recall booklet, an individual dietary adherence sheet to track compliance with the Weight Watchers diet recommendations based on the participants' excess body weight, and a programme of tailored physical activities and aerobic sports were used for this study. The foods in each food group (dairy products, fruits and vegetables, bread/cereals/tubers, animal and vegetable proteins, fats/lipids/oils/sauces) were purchased from the market, both raw and cooked, for the various food weighings (100g).

2.4. Measurement of Anthropometric, Physiological, Biochemical Parameters and Determination of the Weight Status

2.4.1. Measurement of Anthropometric Parameters

The standing height was measured according to standard procedures [21]. The standing height of the participants was measured using a 250 cm high wooden stadiometer, from J&S MEDICAL, with a sensitivity of 0.01 millimetres and a horizontal bar. The participants' body mass was measured using a TANITA BC-2003A electronic scale. With bare feet together, arms at their sides, torso straight, and gaze horizontal, the participant stepped onto the scale, and the researcher then recorded the body mass displayed on the scale's screen. The results were checked, and the calibration was recorded in the logbook [22]. The participants dressed in light clothing, with no shoes or anything on their pockets were asked to stand fixed on the scale and their weight measured and recorded. The measurement of the participants' body segments (abdominal circumference, hip circumference) was performed using a measuring tape graduated in centimetres. The participant, dressed in light clothing, had her abdominal circumference measured at the level of her navel. The hip circumference was measured by passing the tape measure around the widest part of the buttocks, and the reading was taken at the level of the pubis. Measurements were taken in a private area at the meeting location according to standard procedures [21].

2.4.2. Determination of the Weight Status of the Participants

The Body Mass Index (BMI) of the participants was evaluated using the following formula by [23] reported by WHO [24]: BMI = body mass (kg) / (standing height) ^{2}(m²).

The interpretation of the participants' BMI values for selection was as follows:

1) BMI ≥ 30 kg/m²: Obesity;
2) 30 kg/m² ≤ BMI ≤ 35 kg/m²: Moderate obesity;
3) 35 kg/m² ≤ BMI ≤ 40 kg/m²: Severe obesity;
4) BMI ≥ 40 kg/m²: Morbid obesity.

2.4.3. Measurement of Physiological Parameters

Blood pressure (expressed in mmHg) and heart rate (expressed in beats/min) were measured using a BOKANGBK6002 electronic blood pressure monitor, which provided the blood pressure and heart rate values of the subjects at rest. Blood pressure was measured using the sound method. This was done by placing the bands of the tensiometer on the bare elbow of an immobile man’s arm for a few minutes. The tensiometer was a sphygmotensiophone VAQUEZ-LAUBRY. After placing the band of the tensimeter, the stethoscope horn (Laubry’s cardio phone) was then placed on the humoral artery, and the pulse of the humoral artery was detected at the elbow by palpation. A mug was used at a pressure higher than the systolic pressure to swell the cuff to be swollen and later on progressively released. These arterial pressure values were read on the nanometer face and were expressed in millimeters of mercury (mmHg) according to Bindefels [25]. The number of pulse (hearth beat) in 15 seconds was counted using the palpitation method on the humeral artery found at the wrist. The counted number was multiplied by 4 to convert the number per minute [26].

2.4.4. Measurement of Blood Biochemical Parameters

The blood serum obtained from the participants was collected by the laboratory technician in the infirmary to measure total cholesterol, HDL cholesterol, and triglycerides. For the blood Sampling, the participants, after fasting for at least 12 hours, were seated and rested for a few minutes before the sampling. Venous sampling consisted of applying a moderately tight tourniquet to the right arm. The sample was taken with a clenched fist, at the level of the veins in the antecubital fossa, with effective perception of the radial pulse despite the application of the tourniquet, and after previously swabbing the sampling area with an alcohol-soaked cotton pad. The sample was taken with a sterile syringe with moderate aspiration, during which 5 mL of blood from each participant was collected in a labelled dry tube bearing a specific identification number. The participants' arteriovenous blood was collected in 5 mL dry tubes numbered according to the participants' identification numbers. The collected blood samples were centrifuged for 10 minutes at 3000 rpm. The resulting blood serum was used to measure total cholesterol, HDL cholesterol, and triglycerides.

2.4.5. Total Blood Cholesterol (TC) Test

Total cholesterol was measured according to the method of Naito [27] using the technique proposed by ELITECH laboratories (Ville Neuve, France). Cholesterol esterase (EC 3.1.1.3.) catalyses the hydrolysis of cholesterol esters into free cholesterol and fatty acids. [1] The free cholesterol, including that originally present, is then oxidised by cholesterol oxidase (CHOD) (EC 1.1.1.6.) to 4-cholesten-3-one and hydrogen peroxide. In the presence of peroxidase (POD) (EC 1.11.1.7.), phenol and 4-aminoantipyrine combine with hydrogen peroxide to form a red chromophore (quinoneimine) that absorbs between 500 and 550 nm. The intensity of the staining is directly proportional to the concentration of total cholesterol present in the sample.

2.4.6. Triglyceride (TG) Determination

Triglycerides were measured using the Trinder method [28] using the technique proposed by Bio direct laboratories (Ville-Neuve, France). Under the action of lipoprotein lipase (LPL), glycerol, produced by enzymatic hydrolysis of triglycerides, is phosphorylated by ATP to produce glycerol-3-phosphate and ADP through a reaction catalysed by glycerol kinase (GK). Glycerol-3-phosphate oxidase (GPO) then catalyses the oxidation of glycerol-3-phosphate to produce dihydroxyacetone-3-phosphate and H_2O_2. The latter combines with 4-aminoantipyrine and 4-chlorophenol to form quinoneimine.

2.4.7. Triglyceride (TG) Determination

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2.4.8. HDL Cholesterol (HDL-C) Test

The determination of HDL cholesterol was carried out using the method of Izzo [29], whereby lipoproteins (chylomicrons, VLDL, and LDL) are precipitated by the addition of phosphotungstic acid and magnesium chloride. After centrifugation, the clear supernatant containing the HDL fraction is tested with the reagent from the Chronolab kit for the determination of HDL cholesterol levels.

2.4.9. Blood LDL Cholesterol Determination (LDL-C)

The serum LDL concentration was determined by the difference method according to the equation of Friedewald [30]. LDL cholesterol (mg/dL) = Total cholesterol – (HDL + Triglycerides/n)

1) n = 2 when values are expressed in mmol/L.
2) n = 5 when values are expressed in g/L.

2.4.10. Measurement of Participants' Blood Glucose Levels

The blood glucose levels of the participants were measured using a test strip and a blood glucose meter (Accu-CHEK® Active meter), employing the method of Trinder [28]. Each strip was equipped with a reactive zone containing reagents. Using a sterile lancet, the tip of their finger was pricked, and the resulting drop of blood was deposited on the end of the strip inserted into the glucometer. The application of blood/serum to this reactive zone causes a chemical reaction resulting in a change in the colour of the reactive zone. The Accu-CHEK® Active meter detects the colour change and converts, through the batch-specific information on the calibration chip, the result corresponding to the staining obtained into a numerical value on the meter display.

2.4.11. Atherogenic and Anti-atherogenic Risk Assessment

The plasma atherogenicity index is a predictive parameter of cardiovascular risk in certain categories of patients. It consisted of applying simple calculation formulas based on the ratio of the following two atherogenic and anti-atherogenic parameters, respectively [31]: (1) assessment of the atherogenic risk by calculating the CT/CHDL ratio, which should normally be < 4.5, and (2) assessment of the anti-atherogenic risk by calculating the CLDL/CHDL ratio which should normally be < 3.22 in women.

2.4.12. Dietary Follow-up of Participants

During a medical visit serving as a diagnostic evaluation, the day before the start of the intervention, at the INJS infirmary, a 72-hour food consumption recall was immediately conducted for each participant by completing the pre-established semi-qualitative and semi-quantitative food frequency questionnaire that had been administered to them. Following this survey, each participant's data was used during the dietary consultation to identify any dietary errors. Once this was done, personalised dietary advice according to the Weight Watchers diet was given to each participant. This involved explaining the adherence sheet for this diet, including the objectives sought, the recommended foods with their point or calorie values per 100g, the structure of the three recommended meals per day, and the appropriate portion sizes, before distributing the sheets to them. The Weight Watchers diet recommendations were recorded in a dietary monitoring notebook kept by each participant. This notebook was filled in daily to record information concerning the quantities and types of food, meal times, any difficulties encountered, and sensations perceived by each participant during the intervention. A participant was considered compliant when, upon review of their dietary notebook, their diet respected the prescribed caloric intake (20 kcal/kg of body weight, representing a 10-15% reduction in intake) and included all the food groups to be consumed in the recommended amounts: dairy products and derivatives, fruits/vegetables, bread/cereals/tubers/proteins (animal or vegetable), oils/fats, and water/drinks. The restrictive caloric intakes recommended for the different participants according to their initial body weight are recorded in the following table.

Table 1. *Participants' restrictive calorie intakes based on their baseline body weight.*

Usual caloric intake (Cal/d)	Body Weight (Kg)	Recommended Restrictive Caloric Intake (100 Cal=1Pt)
2200	≤ 70	18
2500	[31]	20
2500 à3000	>80	22

2.4.13. Administration of the Physical Activity and Sport Programme to Participants

The participants underwent an aerobic training programme at a frequency of four sessions per week, with each session lasting one hour and thirty minutes, for a total of seventy-two sessions grouped into nine sequences. Each sequence had a specific objective (to facilitate psychological and sensorimotor adaptations, to enable cardiovascular, respiratory, musculo-tendon, and joint rehabilitation, to improve cardiovascular, respiratory, musculo-tendinous, and joint capacities, and to reduce.).

2.5. Statistical Analysis

The collected data were presented as a mean (M) ± the standard error of the mean (±SEM). The rate of change (T) of the various parameters was calculated using the following formula:

$T(\%) = \frac{(Cf - Ci)}{Cf} x100$ Where Cf is the concentration or final value of the parameter under study, and Ci is the concentration or initial value of the parameter under study. After checking the normality of the results by the graph of the distribution histograms, a "Student’s t" test was applied. The comparison of parameter evolution was performed using two-way ANOVA analysis of variance. P values <0.05 were considered significant. A rate of change T ≥ to 15% of the measured parameters was considered significant.

3. Results

3.1. Characteristics of the Anthropometric, Biochemical and Physiological Parameters at the Beginning of the Experiment

The following Table 2 illustrates the different parameters studied in the two experimental groups. Table 2 records the initial values of the various anthropometric, biochemical, and physiological parameters measured in the two participating experimental groups, in comparison with the usual reference values. Upon review of this table, it is observed that experimental groups G1 and G2 both consist of obese women, with the key difference between the two being their life stage (menopausal for Group 1 and pre-menopausal for Group 2). This is evidenced by the fact that anthropometrically, they are characterised by severe obesity (35 kg/m $^2 \leq$ BMI ≤ 40 kg/m ^{2}) of the android type (abdominal circumference ≥ 88 cm and waist-to-hip ratio (WHR) ≥ 0.85), and exhibit dyslipidaemia accompanied by abnormally high total and LDL cholesterol levels, normal triglyceride levels, and elevated biochemical atherogenic and anti-atherogenic risks ($P > 0.05$). Physiologically, the blood pressure readings of both groups are within the normal range ($P > 0.05$).

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Table 2. *Initial anthropometric, biochemical and physiological parameters of the different experimental groups constituted in comparison with the usual reference values.*

Measured parameters	**Group 1 (Postmenopausal women)**	**Group 2 (Premenopausal women)**	**Diagnostic**
Body weight in Kg	105 ±10^{a}	103±15^{a}	
BMI IN Kg/m2	38,9 ±4,19^{a}	39,8±5,9^{a}	Severe obesity
Circumference of the Abdomen in Cm	106 ±18^{a}	105 ±13^{a}	Android Obesity
Waist circumference in cm	127±11^{a}	127±10^{a}	
RAH x 100	0,86±0, 1^{a}	0,86±0, 1^{a}	RAH≥0.85: android or central obesity
Fasting blood glucose mg/dL	0, 62 ±0, 2^{a}	0, 72 ±0,8^{a}	Normal Glucose
Total blood cholesterol in mg/Dl	2, 65±0, 5^{a}	2,8±0,9^{a}	Hypercholesterolemia
Triglyceridemia in mg/dL	0,87±0, ^{a}	1,04±0, 6^{a}	Normal triglyceridemia
HDL cholesterol in mg/dL	0,2 ±0,1^{a}	0, 3±0, 1^{a}	Abnormally low HDL cholesterol
LDL cholesterol in mg/dL	2, 33±0,6^{a}	2, 7±0,5^{a}	Abnormally high LDL cholesterol
CT/HDL	12,75 ±0,5^{b}	10 ±0, 7^{b}	High atherogenic risk
LDL/HDL	11,65±0,7^{b}	9 ±0,66^{b}	High Anti-atherogenic risk
PAS (mmHg)	135 ±5^{a}	132±6^{a}	Normal values
PAD (mmHg)	80±4^{a}	82±5^{a}	Normal values
Pulse (Bats/min)	85±3^{a}	82±2^{a}	Pulse slightly increased.
Body weight in Kg	105 ±10^{a}	103±15^{a}	

Results were presented as the mean (M) ±the standard deviation (SD).
Results within the same row of the table, sharing the same letter, are not significantly different at the 5% significance level with "Student's t" test
G1: post-menopausal obese women, Group 2: pre-menopausal obese women.

3.2. Evolution of the Anthropometric and Biochemical Parameters of the Participants During the Experiment

3.2.1. Change in BMI

The following figure shows the evolution of BMI over time. The results show a decrease in BMI over time, with index values between 35.5 and 38.5 Kg.m^2 after 6 months of activity compared to Month 0 (Figure 1). It is evident from Figure 1 that the BMI of the participants, regardless of the experimental group, decreases with the duration of the experiment. The pre-menopausal women group exhibited the highest BMI reduction rate (7.5%) compared to the menopausal women (5.1%) at the end of the study (6 months), $P > 0.05$. Within each group, the decrease in BMI was not statistically significant.

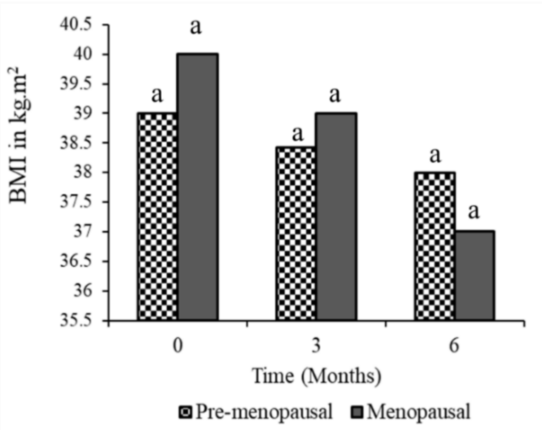

Figure 1. *Variation in BMI (kg/m²) of the participants as a function of the duration of the experiment. Histograms marked with the same letter are not significantly different at the 5% significance level for intergroup comparisons.*

3.2.2. Atherogenic Risk Assessment Following the Total Cholesterol to HDL Cholesterol Ratio

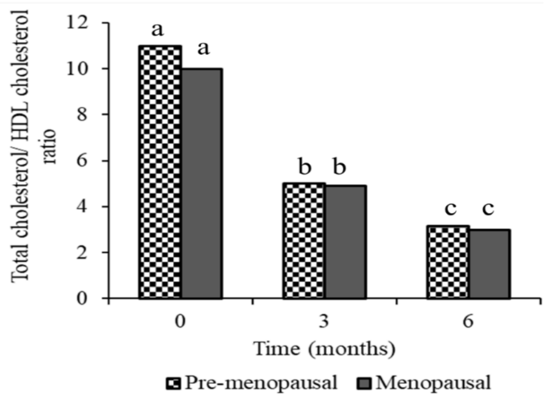

Figure 2. *Variation in the total cholesterol/blood HDL cholesterol ratio of the participants as a function of the duration of the experiment. The results were expressed as mean ± the standard error of the mean (M ± SEM). Histograms marked with the same letter are not significantly different at the 5% significance level for intergroup comparisons.*

The following Figure 2 represents the evolution of the participants' total cholesterol to HDL cholesterol ratio over time. From Figure 2, the results present that the total cholesterol/HDL cholesterol ratio in the participants' blood, which represents the atherogenic risk, decreases with the duration of the experiment. Pre-menopausal women recorded a reduction in the total cholesterol/blood HDL cholesterol ratio (70%), almost similar to that of menopausal women (66.36%) at the end of the study (6 months), $P > 0.05$. Within each group, the reduction in atherogenic risk is highly significant for each of the experimental groups between the start and the end of the experiment ($P < 0.001$) (for an intergroup comparison between the beginning and the end of the experiment).

3.2.3. Assessment of Anti-atherogenic Risk Following the LDL cholesterol/HDL Cholesterol Ratio

The LDL cholesterol/HDL cholesterol ratio observed in the blood of the different participants varied over time (Figure 3). A decrease in this ratio was recorded in all participants from month 3 onwards. At month 6, it was found to be less than 2 in both premenopausal and menopausal women. It appears from Figure 3 that the LDL cholesterol/HDL cholesterol ratio in the participants' blood, which constitutes the anti-atherogenic risk, decreases depending on the duration of the experiment. Pre-menopausal women recorded a decrease in the ratio of LDL cholesterol/blood HDL cholesterol (81.88%), almost similar to that of menopausal women (87.38%) at the end of the study (06 months), $P>0.05$. Within the same group, the reduction in anti-atherogenic risk is very significant for each of the experimental groups between the start and the end of the experiment ($P<0.001$).

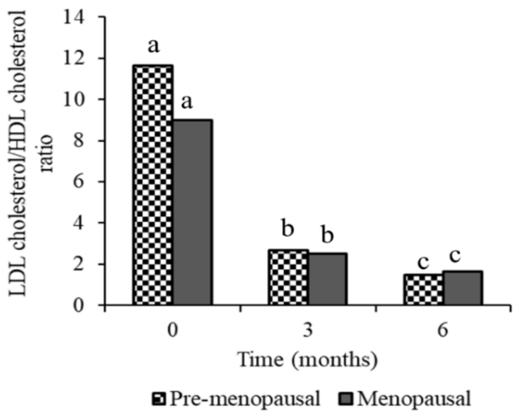

Figure 3. *Variation in the LDL cholesterol/blood HDL cholesterol ratio of the participants as a function of the time of the experiment. The results were expressed as mean ± the standard deviation of the mean (M ± Sem). Histograms assigned the same letter are not significantly different at the 5% threshold for an inter-group comparison.*

3.2.4. Variation in Blood Sugar

The following figure shows the evolution of the participants' blood sugar levels. The participants' blood sugar levels vary very little depending on the duration of the experiment. Group G1 (pre-menopausal women) recorded an increase in blood sugar levels of 5% at the end of the study (06 months), while that of group G2 remained constant, $P>0.05$.

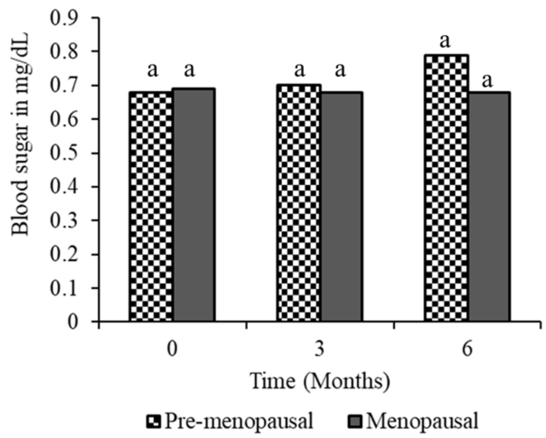

Figure 4. *Variation in participants' blood sugar levels as a function of the time of the experiment. The results were expressed as mean ± the standard deviation of the mean (M ± Sem). Histograms assigned the same letter are not significantly different at the 5% threshold for an inter-group comparison.*

4. Discussion

The aim of the study was to determine the ameliorative effects of adapted sports practice and a balanced diet on the quality of life of obese postmenopausal and non-menopausal women from the "INJS-Femmes-Sport-Loisirs-Santé". The results of the two experimental groups G1 and G2 formed before the start of the study (pretest) showed that these participants of a certain age were not only obese but also presented increased cardiovascular risks (high arterogenic and anti-artherogenic risk), P>0.05 (Table 2).

At the end of the six months of sports practice associated with a hypocaloric diet (post-test), the results in Figures 1, 2 and 3, whether in an inter or intra group comparison show the reduction in their BMI of at least 5% (with a loss of approximately 20% of the initial body weight using the reverse formula of the BMI), the cancellation of the anti-atherogenic and atherosclerotic risks in the experimental groups G1 and G2 constituted (P<0.05). Group G2 (pre-menopausal women) recorded a decrease in the ratios of LDL cholesterol/blood HDL cholesterol, total cholesterol/HDL cholesterol (81.88% and 70%) higher compared to group G1 (87.38% and 66.36% respectively), P>0.05. This result is particularly convincing since in the literature, it is said that excess fat in the body constitutes a risk factor for coronary heart and cardiovascular diseases [32]. Our results corroborate those of Buchner & Cress [33] who in their work showed that the practice of physical and sporting activities made it possible to reduce high blood cholesterol levels in obese women. This could also be justified by the diversion of excess blood cholesterol for the synthesis of steroid hormones (cortisol, cortisone, aldosterones), sexual hormones (progesterone, estrogens, testosterone), bile acid and vitamin D according to Raisonner [34] and the increased consumption of fruits and vegetables (5 fruits and vegetables per day) as recommended by the Weight Watcher diet administered to participants. This reduction in BMI could also be linked to the use of fats during the aerobic type exercise subjected to the participants throughout the experiment because triglycerides or fats are easily mobilized, metabolized or burned in the presence of oxygen during long duration efforts (more than 30 minutes). In addition, the elimination of atherogenic and anti-artherogenic risks would be attributed to the increased consumption of fruits and vegetables (rich in dietary fiber) which could fix lipids from food, have beneficial effects in increasing fecal mass and reducing the transit time of food during digestion [35]. Excess weight is a concern for middle-aged women, whether postmenopausal or not. This progressive weight gain with age reaches its peak at menopause and is accompanied by morphological and biochemical changes [36, 37]. Weight gain during menopause is associated with increased anxiety and depression, which makes this transition more difficult. Thus, Pechère-Bertschi & Stalder [38], working on quality of life, demonstrated that women suffering from obesity had a reduced quality of life caused by physical dysfunction and a drop in vitality compared to post-menopausal women of normal weight. Williams et al. [39] highlighted the difficulty of fighting obesity by implementing preventive behaviors. Several studies carried out explain instead that weight gain during menopause seems to be due more to age than to hormonal changes, although it is difficult to associate a single cause to this phenomenon. On the other hand, hormonal variations during this period of life would favor the increase in total and abdominal fat. Animal studies indicated that decreasing estrogen levels would promote and increase body fat percentage, particularly central abdominal fat and associated metabolic pathologies [38]. Still in animal models, the reduction in estrogen levels would also have an impact on the reduction of energy expenditure, eating behaviors and meal size. These findings are consistent with the conclusions of studies carried out on humans [40]. Pre-menopause appears to cause a shift of fat mass towards the abdomen, an increase in waist circumference and total fat mass. Indeed, post-menopausal women have more abdominal fat mass than pre-menopausal women [41]. Obesity is the result of an imbalance in the energy balance over a long period and at menopause it becomes more pronounced. During this period (menopause), energy intake is higher than the person's energy needs. However, biological, behavioral, social and environmental factors influence the regulation of energy balance [42]. The National Institute of Health and Medical Research (INSERM) also mentioned that the two main causes of obesity are a change in eating habits as well as an increase in sedentary lifestyle [43]. The CT/CHDL ratio defines the atherosclerosis risk. This ratio undoubtedly constitutes the best index of the risk of coronary heart disease. Above 5, the risk is major, below 3, it is low. This ratio decreases in both groups. The increase in portion size, the high energy density of foods, the almost continuous availability of foods as well as the evolution of food prices are the factors favoring excessive caloric consumption. The increase in sedentary lifestyle is influenced by a change in leisure activities towards television and video games, the use of public transport and the car for travel. In addition to these factors, some genetic and environmental factors are also involved [43].

For what concerns our study, these dietary fibers from the five fruits and vegetables consumed via the administration of the Weight Watcher diet contributed to making the energy balance negative by limiting energy intake since these reduce the assimilation of fatty acids resulting from the digestion of lipids in the intestinal villi. All in all, this type of three-way care with good follow-up eliminates the atherosclerotic and anti-artherogenic risk factors (Figures 2 and 3), P<0.05 and reduces the BMI of at least 5% of sedentary obese women at six months of this treatment (P>0.05) with certainly unavoidable benefits on their health.

5. Conclusion

Ultimately, the results obtained in this study after six months in relation to the management of CRF show that a low-calorie diet rich in fruits and vegetables and the practice of aerobic physical and sporting activity reduce the BMI by at least 5% and eliminate the atherosclerotic and anti-atherogenic risks of obese women, whether menopausal or not, from the third month of this follow-up. Obese postmenopausal women would be less amenable to this type of treatment because they experience a reduction in BMI, and lower atherogenic and anti-artherogenic risks than obese premenopausal women (P>0.05). The small size of the sample makes it impossible to generalize the results obtained and the non-significance of certain in-betweens (BMI). For further clarification, this study should be extended by increasing the sample size and the number of experimental groups.

Abbreviations

BMI	Body Mass Indices
CHOD	Cholesterol Oxidase
CRFs	Cardio Metabolic Risk Factors
CVD	Cardiovascular Disease
INJS	National Institute of Youth and Sports
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein
LPL	Lipoprotein Lipase
NCDs	Non-communicable Diseases
PSA	Physical and Sports Activities
PAS	Systolic Arterial Pressure
PAD	Diastolic Arterial Pressure
RAH	Ratio of Abdomen Over Hip
SEM	Standard Error of the Mean
TC	Total Blood Cholesterol
HDL-C	HDL Cholesterol
VLDL	Very Low-density Lipoproteins
WHR	Waist-to-hip Ratio

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Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this study.

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