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Article

A pilot study of diet lifestyle on complete blood picture, elements, and biological profile in females

Shifa Felemban[1], Asmaa Fathi Hamouda[2,*]

[1] Department of Chemistry, Faculty of Applied Science, University College-Al Leith, University of Umm Al-Qura, Makkah 21955, Saudi Arabia
[2] Department of Biochemistry, Faculty of Science, University of Alexandria, Alexandria 21111, Egypt
*** Corresponding author:** Asmaa Fathi Hamouda, asmaakingdom1@yahoo.com, asmaakingdom1@gmail.com

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Abstract: Obesity, a prevalent global health issue, is characterized by elevated lipid levels, altered hematological parameters, inflammation, and other related symptoms. A biological profile and complete blood count (CBC) are essential tools for assessing overall health and detecting various dysfunctions, including anemia, infections, leukemia, and heart diseases. In obese patients of both sexes, a high white blood cell count is a reliable indicator of leukemia risk, coronary complications, and inflammation. Notably, dietary and lifestyle changes can significantly improve obesity-related conditions and hematological disorders. This study examines the effects of a six-month dietary program on anthropometric measurements, biological profiles, elemental composition, and complete blood counts in 43 obese females with white blood cell counts above the normal range. Participants underwent comprehensive hematological, biochemical, and anthropometric assessments at the beginning and end of the diet program. The findings revealed a significant weight loss and substantial improvements in laboratory parameters and blood profiles. These improvements are likely due to the nutrient composition of the diet program. The investigation confirmed that modifying dietary intake by reducing consumption of high-acidic foods, fast foods, animal-derived lipids, refined carbohydrates, red meats, and non-seasonal produce, in favor of a nutrient-dense regimen comprising fruits, vegetables (consumed raw or steamed), fish, poultry, and whole grains, resulted in significant enhancements in hematological indices and biological markers. These enhancements substantially surpassed baseline measurements for complete blood count and biological profiles. However, alterations in the elemental profile were not statistically significant. Further studies are being conducted to examine these outcomes with greater specificity. Ongoing research aims to further understand these effects according to personal medical history, age, and sex.

Keywords: anthropometric measurements; biological profile; complete blood count; obesity; diet; elements

1. Introduction

Obesity is a symmetrical in body shape, a medical condition recognized by an excess amount of body fat. It is essential characterization by a body mass index (BMI) of 30 or higher. Obesity results from chronic consumption of processed foods, diet high in unhealthy fats, genetic, underlining diseases, physical inactivity, psychological factors, and some medications such as hormones therapy. It has become a global health problem [1,2].

There are many effects has influence on obesity and a wide range of effects on the body, such as cardiovascular diseases, type 2 diabetes, asthma, and cancer. Obesity increases the risk of high blood pressure and high cholesterol, which are

significant risk factors for heart disease and stroke. As well as excess body weight is a major cause of insulin resistance, leading to type 2 diabetes. On the other hand, respiratory problems conditions such as asthma and sleep apnea are more common in individuals with obesity [3–6]. Also, obesity can lead to joint problems like osteoarthritis due to the extra stress on the joints. Furthermore, certain types of cancer, including endometrial, breast, and colon cancer, are associated with being overweight or obese. These health consequences increase the need and the importance of managing obesity through diet, exercise, and lifestyle changes to reduce these risks [3–6].

Moreover, obesity is associated with low-grade systemic inflammation such as elevations in adipose tissue-driven acute-phase response. This response includes cytokines such as interleukin, as consequence there are elevations of acute-phase proteins like C-reactive protein. These inflammatory parameters can lead to changes in hematological parameters indeed, resulting in increase in the number of leukocytes (white blood cells), red blood cells (RBCs), platelets, hemoglobin (Hb), and hematocrit (Hct) levels [7,8]. Furthermore, adipose tissue manufacturers adipokines like leptin, adiponectin, resistin, TNF-α, and IL-6, which involves immunity management regulation. The inflammation and alteration in hematological parameters may have implications for multiple diseases, including cancer. So, understanding lipid and CBC, biological profiles changes, is crucial for developing interventions that target obesity-related complications [7,8].

White blood cells perform a significant role in feeding adipose tissue inflammation, insulin resistance, and increased atherosclerosis, which can initiate heart attacks in patients with obesity [9–11]. Simultaneously, these issues, linked with a high-fat diet, have been studied in animal patterns and humans on bone marrow-derived cells and red blood cells. Previous studies report that a high-fat-diet produces red blood cell dysfunction [12,13]. High cholesterol is connected with changes in human red blood cells [1,2,9].

The novel aspect of this work is the reduction of bad cholesterol (LDL) through personal diet program and study the disturbance in CBC as it is change with mal nutritional body and many diseases [14,15], which is a significant factor in various diseases, including hereditary cancers like breast cancer, where LDL levels are elevated even within a normal body mass index range. Epidemiological studies have demonstrated that low-density lipoprotein (LDL) and oxidized low-density lipoprotein (ox-LDL) are closely associated with breast cancer, colorectal cancer, pancreatic cancer, and other malignancies, suggesting that LDL and ox-LDL play important roles during the occurrence and development of cancers [16–18]. Therefore, this study aims to develop a diagnosis strategy for health conditions associated with obesity and hypothesize the significance of diet in improving hematological levels and biological profiles for obesity.

Metal elements are indispensable for sustaining life [14,15]. An element is deemed essential if its deficiency leads to physiological impairment, which can be prevented or remedied by its supplementation at physiological levels. The human body requires approximately 23 mineral elements in trace amounts; deviations from the reference range can result in adverse effects as mentioned in details in our previous report such as liver, kidney, and neurotoxicity [1,2,14,15]. Dietary intake of

minerals depends on geographic location, biodiversity, and food choices, which may not always suffice to maintain health and prevent chronic conditions [1,19].

Therefore, there is a critical need for nutritionally balanced weight-loss strategies that are effective without adverse effects [11–13]. Many dietary programs that aim to reduce weight often result in short-term weight loss with various side effects, and long-term weight maintenance proves challenging [1,2]. This study assesses the impact of a six-month weight loss program on biochemical and hematological profiles, as well as body mass index (BMI), in adult obese female subjects, comparing the outcomes to baseline and reference values.

2. Subjects and methods

2.1. Subjects

The investigation encompassed 43 female volunteers, with inclusion criteria specifying an age range of 21–60 years and a Body Mass Index (BMI) of 37.1 ± 1.4 kg/m^2. The cohort was composed of individuals from various nationalities, including Egyptian, Tunisian, Sudanese, Indian, and Saudi Arabian. Pregnant women were excluded from the study. Menopausal females were not excluded from the study, as menopause influences fat deposition. All participants provided written informed consent, and the research was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol, code HAPO−02K−012–2022−06−1110, approved on 6 December 2022 by the relevant institutional review board, adhered to the 2013 revision of the Declaration of Helsinki. Supplementary **Figure 1** delineates the intervention design.

Figure 1. Experimental design of diet program on complete blood picture and biological profile [1,2].

2.2. Methods

2.2.1. Anthropometrics

The weights and heights of the subjects were measured before and after six months using a calibrated scale (SR Scales, SR Instruments). The Body Mass Index

(BMI) was calculated using the formula: weight in kilograms (kg) divided by the square of height in meters (m^2) [1,2]. **Table 1** presents the descriptive statistics for the traits of the study participants.

Table 1. The descriptive statistics table of the study participants.

Trait	Normal range	Weight-loss program study description
Number of volunteers	-	43 females
Age range	-	(21–60) years
Nationalities	-	Egyptian, Tunisian, Sudanese, Indian, and Saudi Arabian
Exclusion criteria	-	Pregnant women, females on special medication or hormone medication
BMI (kg/m^2)	(18.0–29.0)	37.1 ± 1.4
Haemoglobin (g/dl)	(12.0–15.0)	11.2 ± 0.5
Hematocrit (%)	(37–47)	39.6 ± 0.1
RBCs ($\times 10^{12}$/L)	(3.8–4.8)	5.7 ± 0.0
MCV (fl)	(80–100)	80.5 ± 0.1
MCH (pg)	(27–32)	25.2 ± 0.1
MCHC (g/dl)	(32–36)	32.9 ± 0.1
RDW (%)	(13–15)	14.9 ± 0.2
Platelet ($10\times^9$/L)	(150–400)	261.1 ± 1.3
MPV (fl)	(7.5–12)	11.2 ± 0.1
WBCs ($10\times^9$/L)	(4.5–11)	31.6 ± 0.3
Basophils ($10\times^9$/L)	(0.02–0.1)	0.0 ± 0.0
Eosinophils ($10\times^9$/L)	(0.2–0.5)	0.62 ± 0.0
Neutrophils ($10\times^9$/L)	(2.0–7.0)	6.22 ± 0.01
Lymphocytes ($10\times^9$/L)	(1.0–3.0)	27.5 ± 0.0
Monocytes ($10\times^9$/L)	(0.2–1.0)	0.69 ± 0.1
AST (U/L)	(Up To 31)	28.2 ± 1.2
ALT (U/L)	(Up To 31)	14.2 ± 1.2
Albumin (g/dl)	(3.5–5.4)	4.4 ± 0.1
FBS (mg/dl)	(70–110)	139.0 ± 2.1
Creatinine (mg/dl)	(0.6–1.3)	0.9 ± 0.1
Uric acid (mg/dl)	(2–6)	5.2 ± 0.5
T-Cholesterol (mg/dl)	(Up to 200)	232.5 ± 2.9
Triglyceride (mg/dl)	(35–135)	210.5 ± 9.8
HDL (mg/dl)	More than 35)	40.3 ± 2.4
LDL (mg/dl)	(Up to 105)	152.2 ± 4.1
Ca (µg/dl)	$(8.7–10.2) \times 10^4$	11.4 ± 1.1
Fe (µg/dl)	$(15–150) \times 10^3$	4.4 ± 1.4
Zn (µg/dl)	$(6.6–11) \times 10^2$	9.4 ± 3.5
Na (µg/dl)	$(3.08–3.31) \times 10^6$	3.6 ± 0.3
K (µg/dl)	$(1.368–2.033) \times 10^5$	2.5 ± 1.2

Data are given as the mean ± SD. -Abbreviation: (RBCs) Red blood cells count; (MCV) Mean corpuscular volume;(RDW) Red cell distribution width; ([MPV) Mean platelet volume; (WBCs) White blood cells count. (AST), aspartate aminotransferase, (ALT) alanine aminotransferase, FBS), fasting blood sugar, HDL high-density lipoprotein, (LDL) low-density lipoprotein

2.2.2. Laboratory investigations

Biochemical analysis

Blood samples were collected after the patients fasted overnight (>9 hours). Serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), total albumin, fasting blood sugar (FBS), creatinine, uric acid, total cholesterol, triglyceride, high-density lipoprotein (HDL cholesterol), low-density lipoprotein (LDL cholesterol) was measured using standard Roche/Hitachi Cobas c 501 analyzers (Roche Diagnostics, Mannheim, Germany [1,2].

Serum samples were soaked in 1 M HNO_3 (1:10, W/V) for 4 hours prior to microwave digestion. After digestion with nitric acid (1:5 v/v) using the Ethos 1 microwave digestion system (Milestone, Fremont, CA, USA), we diluted the samples with nitric acid (1:5 v/v). This allowed us to determine the concentrations of Calcium (Ca), Iron (Fe), Zinc (Zn), Sodium (Na), and Potassium (K). Our recent method utilized inductively coupled plasma–mass spectrometry (ICP-MS; Agilent 7500 cx, Santa Clara, CA, USA) [15].

Hematological analysis

Complete blood count (CBC) includes that white blood cells (WBC), red blood cells (RBC), hemoglobin (HGB), hematocrit (HTC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelets, red cell distribution width (RDW), mean platelet volume (MPV). Measurements were performed by Sysmex K-4500 Haematology Analyzer TOA SYSMEX, Kobe, Japan) [15,20,21].

2.2.3. Statistical analysis

Data were analyzed using IBM SPSS software package version 20.0. A paired t-test was evaluated for comparison between two periods. A p-level of 0.05 was considered statistically significant, Pearson coefficient(r) was used to correlate between quantitative variables. Significance of the obtained results was judged at the 5% level [1,2].

2.2.4. The diet program

The subject attended separate PowerPoint lectures for one hour weekly for six months. No particular exercise program was suggested, despite the absence of prescribed physical activity, one could posit that even regular life movements, such as walking to the market or avoiding prolonged sitting. The participants were allowed to eat white meat and fish, unsaturated plant-based fats and oils, whole grain, fruits, and vegetables. They were instructed to avoid eating out during the study period. The studied diet program’s goal was to withdraw industrial food and improve nature food for reaching therapeutic nutrition goals with reducing hunger, energy density and increasing satiety, and reduce energy density [1,2]. Moreover, the present programs designed according to the requirement of each volunteer, Table 2.

Table 2. Volunteer diet before and within six months diet program [1,2].

Base Line (Life style)	Six months diet program
• Mainly high refine carbohydrates food. • Mainly high saturated fat food. • Mainly high manufactures food. • Less fresh fruits and vegetables. • Western diet	• Daily Mainly: ✓ Yeast with milk or water and 1/8 teaspoons of curcumin. ✓ One bowl of water each morning and 2 liters of water during the day. ✓ Eating 5–7 portions of fresh fruits and vegetables of all colors every day. ✓ One pomegranate or apple, kiwi, orange, or cold sweet potato with their skin in the morning and before each meal. ✓ Unroasted almond (9 to 15), mainly in the afternoon. ✓ Ginger or clove tea after lunch. ✓ Add 2–3 teaspoons of olive oil to food on cold with 1/8 teaspoons of curcumin on food. ✓ Watermelon or popcorn without fat for a snack. ✓ A cup of yogurt contains 1–2 teaspoons of bee honey plus banana or strawberry or apple and 1/8 teaspoons of cinnamon virtually before dinner. ✓ Whole grain (According to the patient's demand). ✓ Before sleep, two teaspoons of cocoa bean with milk. • Weekly Mainly: ✓ One medium-sized avocado per week. ✓ Baked or boiled fish three times per week.

3. Results

3.1. Correlation between BMI and different parameters n = 43

Pearson coefficient (r) was used to correlate between quantitative variables. Significance of the obtained results was judged at the 5% level. Upon analyzing the correlation between all measured variables, segregated into pre- and post-6-month intervals, we observed correlation exclusively between BMI and cholesterol, triglycerides, HDL and LDL levels only. However, the correlation's magnitude falling into a 'weak' category as per Evans (1996), who classified the absolute value of r as follows: 0.00–0.19 as "very weak," 0.20–0.39 as "weak," 0.40–0.59 as "moderate," 0.60–0.79 as "strong," and 0.80–1.0 as "very strong." Consequently, the relationship between cholesterol and BMI was deemed too weak to be of significance, where observed positive correlation equal to (at baseline) $r = 0.010$, and $r = 0.012$ after six months respectively. Conversely, there was a strong positive correlation observed between triglycerides, LDL, and BMI, as follows (r: 0.29, r: 0.31) and (r: 0.25, r: 0.29) after six months respectively alongside a negative correlation between HDL and BMI (r: −0.426) and (r: −0.601) respectively before and after the 6-month period. **Figure 2** show the subject's general features at baseline of listed 43 female subjects before and after 6-months of intervention. The data represented as M ± SD. BMI showed a significant difference before (37.1 ± 1.4 kg/m^2), and after the 6-month diet program (29.2 ± 1.2 kg/m^2) at $p \leq 0.05$, while World Health Organization's recommended BMI for adult normal range 18.5–25 kg/m^2, Overweight 25–30 kg/m^2, Obese Class I 30–35 kg/m^2, Obese Class II 35–40 kg/m^2, Obese Class III > 40 kg/m^2 sequentially.

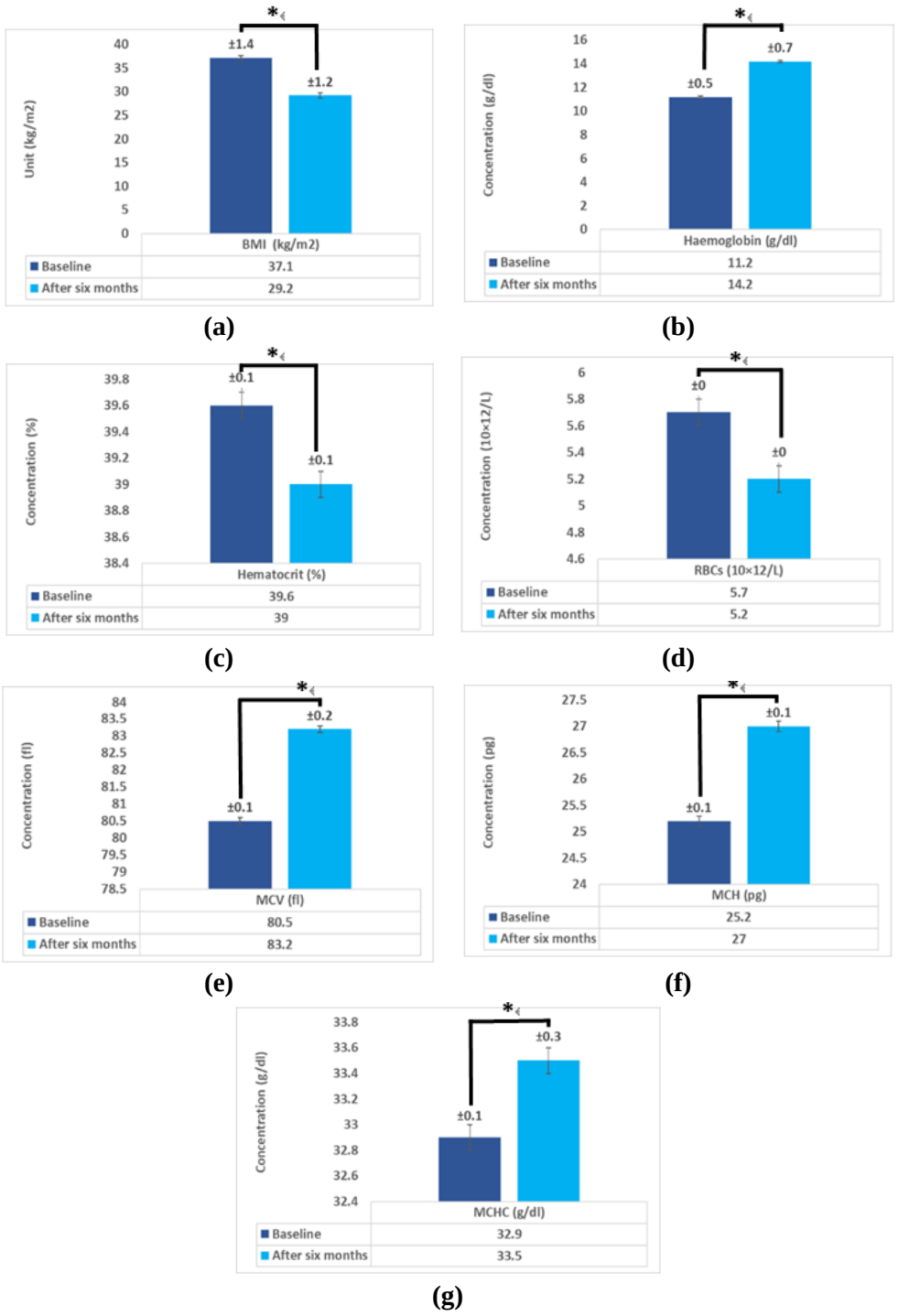


Figure 2. Comparison between baseline and six months weight-loss program (N = 43). **(a)** body mass index (BMI) (kg/m^2); **(b)** Haemoglobin (g/dl); **(c)** Hematocrit (%); **(d)** Red blood cells count (RBCs) (10×^{12}/L); **(e)** Mean corpuscular volume (MCV) (fl); **(f)** Mean Corpuscular Hemoglobin (MCH) (pg); **(g)** Mean Corpuscular Hemoglobin Concentration (MCHC) (g/dl).

Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different. Abbreviation: (RBCs) Red blood cells count; (MCV) Mean corpuscular volume;(RDW) Red cell distribution width; (MPV) Mean platelet volume; (WBCs) White blood cells count. (AST), aspartate aminotransferase, (ALT) alanine aminotransferase, FBS), fasting blood sugar, HDL high-density lipoprotein, (LDL) low-density lipoprotein.

3.2. CBC Comparison between baseline and six months weight-loss program (N = 43)

There was a significant difference also in the mean of hemoglobin (g/dl), Hematocrit (%), RBCs ($10\times^{12}$/L) before (11.2 ± 0.5, 39.6 ± 0.1, 5.7 ± 0.0) sequentially, and after the 6-month intervention (14.2 ± 0.7, 39.0 ± 0.1, 5.2 ± 0.0) respectively, at $p \leq 0.05$ while reference range (hemoglobin (12.0–15 g/dl), Hematocrit (37%–47%), RBCs 3.8–4.8 ($10\times^{12}$/L), **Figure 2**.

There was also a significant difference in the mean of MCV (fl), MCH (pg), MCHC (g/dl) before (80.5 ± 0.1, 25.2 ± 0.1, 32.9 ± 0.1) respectively, and after the 6-month intervention (83.2 ± 0.2, 27.0 ± 0.1, 33.5 ± 0.3) respectively, at $p \leq 0.05$ while reference range (MCV (80–100 fl), MCH (27–32 pg), MCHC (32–36 g/dl), **Figure 2**.

There was also a significant difference in the mean of RDW (%) and Platelet ($10\times^{9}$/L) before (14.9 ± 0.2, 261.1 ± 1.3) respectively, and after the 6-month intervention (14.5 ± 0.2, 241.4 ± 1.2) respectively, at $p \leq 0.05$ **Figure 3** while there was non-significant difference in the mean of MPV (fl) before 11.2 ± 0.1 and after the 6-month intervention 11.4 ± 0.2. While reference range (RDW (13%–15%), Platelet (150–400) ($10\times^{9}$/L), MPV (7.5–12) (fl), **Figure 3**.

There was significant difference in the mean WBCs ($10\times^{9}$/L), Basophils ($10\times^{9}$/L), Eosinophils ($10\times^{9}$/L), Neutrophils ($10\times^{9}$/L), Lymphocytes ($10\times^{9}$/L), Monocytes ($10\times^{9}$/L) before (31.6 ± 0.3, 0.0 ± 0.0, 0.62 ± 0.0, 6.22 ± 0.01, 27.5 ± 0.0, 0.69 ± 0.1) respectively, and after the 6-month intervention (29.1 ± 0.1, 0.28 ± 0.1, 0.28 ± 0.0, 5.32 ± 0.01, 24.6 ± 0.02, 0.30 ± 0.1) respectively, at $p \leq 0.05$ **Figure 4** while reference range of WBCs (4.5–11) ($10\times^{9}$/L), Basophils (0.02-0.1) ($10\times^{9}$/L), Eosinophils (0.2–0.5) ($10\times^{9}$/L), Neutrophils (2–7) ($10\times^{9}$/L), Lymphocytes (1.0-3) ($10\times^{9}$/L), Monocytes (0.2–1.0) ($10\times^{9}$/L), **Figure 4**.

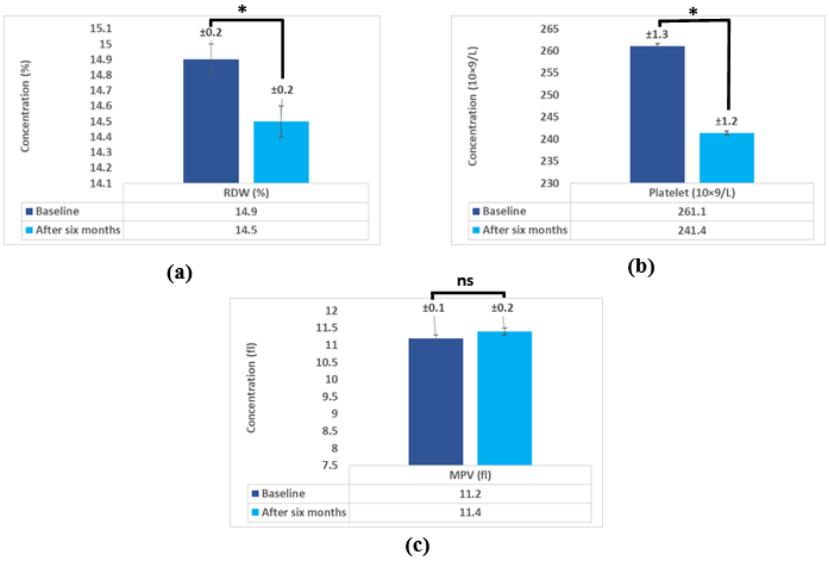
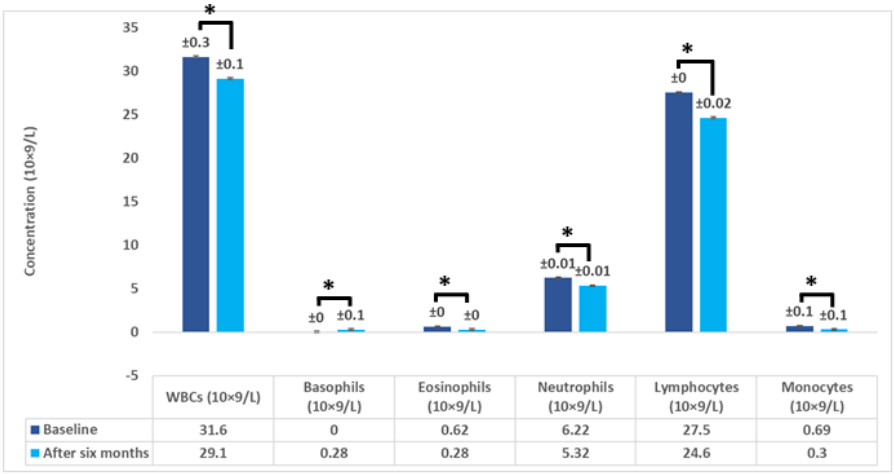


Figure 3. Comparison between baseline and six months weight-loss program (N = 43). **(a)** Red cell distribution width (RDW) (%); **(b)** Platelet ($10\times^{9}$/L); **(c)** Mean platelet volume (MPV) (fl).

Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different; ns means non-significant.



	WBCs (10×9/L)	Basophils (10×9/L)	Eosinophils (10×9/L)	Neutrophils (10×9/L)	Lymphocytes (10×9/L)	Monocytes (10×9/L)
Baseline	31.6	0	0.62	6.22	27.5	0.69
After six months	29.1	0.28	0.28	5.32	24.6	0.3

Figure 4. Comparison between baseline and six months weight-loss program (N = 43).

White blood cells count (WBCs) (10×^{9}/L), Basophils (10×^{9}/L), Eosinophils (10×^{9}/L), Neutrophils (10×^{9}/L), Lymphocytes (10×^{9}/L), Monocytes (10×9/L). Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different.

3.3. Liver function comparison between baseline and six months weight-loss program (N = 43)

The data of AST and ALT showed a difference in the mean significant difference before (28.2 ± 1.2U/L, 14.2 ± 1.2U/L) respectively, and after the 6-month intervention (21.9 ± 1.4U/L, 19.1 ± 1.8U/L) respectively, at $p \leq 0.05$ **Figure 5** while reference range (AST: Female = up to 31.0 U/L, ALT: F= up to 31.0 U/L). Also, there was a non-significant output in the mean albumin result before (4.4 ± 0.1 g/dl), subsequently, and after the 6-month intervention (4.2 ± 0.1 g/dl) respectively, at $p \leq 0.05$ while reference range (albumin: 3.5–5.4 g/dL). FBS level showed a significant difference before (139.0 ± 2.1 mg/dl), and after the 6-month intervention (112.1 ± 1.8 mg/dl,) respectively, at $p \leq 0.05$ **Figure 5** while reference range for FBS: 70.0–110 mg/dl.

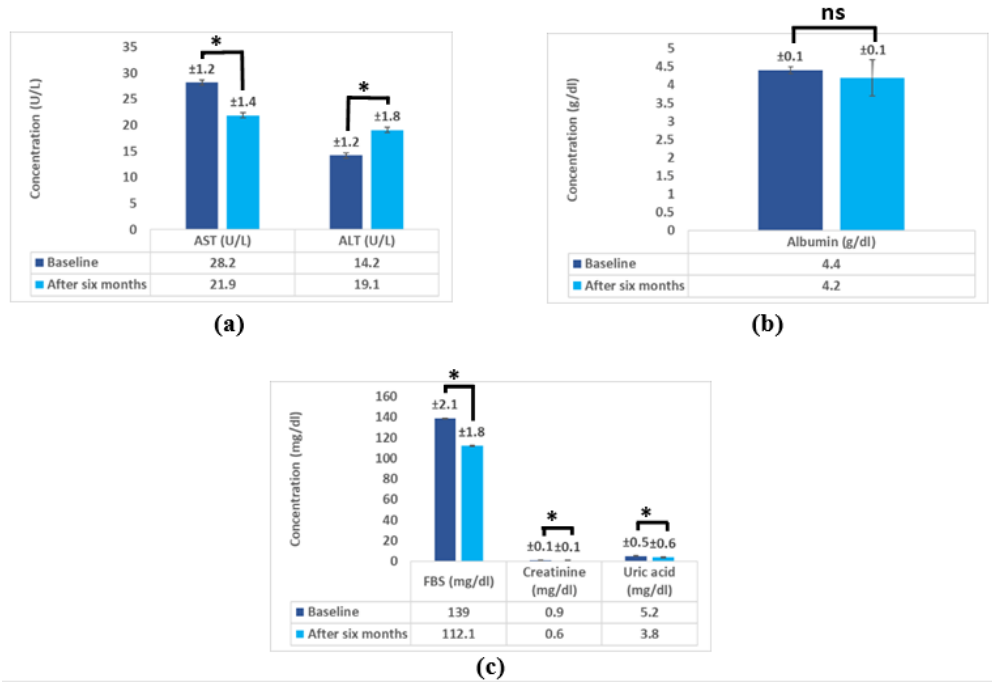


Figure 5. Comparison between baseline and six months weight-loss program (N = 43). **(a)** Aspartate Aminotransferase (AST) (U/L), Alanine Aminotransferase (ALT) (U/L); **(b)** Albumin (g/dl); **(c)** Fasting Blood Sugar (FBS) (mg/dl), Creatinine (mg/dl), Uric acid (mg/dl).

Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different; ns means non-significant.

3.4. Kidney function comparison between baseline and six months weight-loss program (N = 43)

There was also a significant output difference in the mean creatinine and uric acid before (0.9 ± 0.1 mg/dl, 5.2 ± 0.5 mg/dl) respectively, and after the 6-month intervention (0.6 ± 0.1 mg/dl, 3.8 ± 0.6 mg/dl) respectively, at $p \leq 0.05$ **Figure 5** while reference range (Creatinine: F = 0.6–1.3 mg/dL0 mg/dl, Uric acid: F = 2.0–6.0 mg/dl).

3.5. Lipids profile comparison between baseline and six months weight-loss program (N = 43)

Serum lipids profile showed a significant output difference in the mean T-cholesterol at $p \leq 0.05$, triglyceride, HDL cholesterol, and LDL cholesterol before (232.5 ± 2.9 mg/dl, 210.5 ± 9.8 mg/dl, 40.3 ± 2.4 mg/dl, 152.2 ± 4.1 mg/dl) sequentially, and after the 6-month intervention (176.8 ± 3.1 mg/dl, 100.1 ± 4.5 mg/dl, 63.2 ± 1.2 mg/dl, 104.1 ± 1.5 mg/dl) at $p \leq 0.05$ **Figure 6** while reference range (T-cholesterol: (Up to 200) mg/dl, Triglyceride: (35–135) mg/dl, HDL cholesterol: (More than 35) mg/dl, LDL cholesterol: (Up to 105)mg/dl).

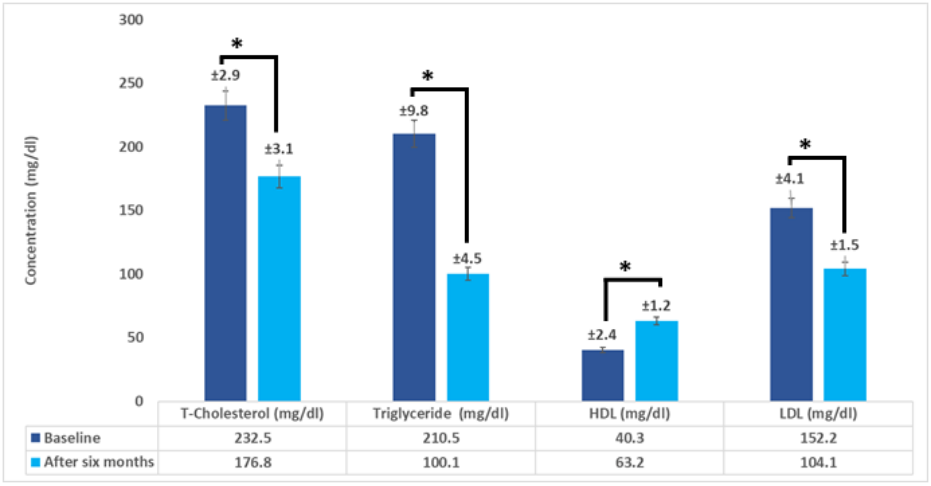


Figure 6. Comparison between baseline and six months weight-loss program (N = 43). T-Cholesterol (mg/dl), Triglyceride (mg/dl), high-density lipoprotein (HDL) (mg/dl), low-density lipoprotein (LDL) (mg/dl).

Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different.

3.6. Serum metal profile Comparison between baseline and six months weight-loss program (N = 43)

Serum metal profile showed a non-significant output difference in the mean Calcium (Ca) , Iron (Fe), Zinc (Zn), Sodium (Na), and Potassium (K) at 0.005, before (11.4 ± 1.1 µg/dl, 4.4 ± 1.4 µg /dl, 9.4 ± 3.5 µg /dl, 3.6 ± 0.3 µg /dl, and 2.5 ± 1.2 µg/dl) sequentially, and after the 6-month intervention (11.7 ± 1.2 µg/dl, 4.3 ± 1.9 µg/dl, 9.2 ± 2.6 µg/dl, 3.5 ± 0.4 µg/dl, and 2.3 ± 0.1 µg/dl) at $p \leq 0.05$, while reference range (Calcium (Ca): (8.7–10.2) × 10^4 µg/dl, Iron (Fe): (15–150) × 10^3 µg/dl, Zinc (Zn): (6.6–11) × 10^2 µg/dl, Sodium (Na): (3.08–3.31) × 10^6 µg/dl), and Potassium (K): (1.368–2.033) × 10^5 µg/dl), **Figure 7**.

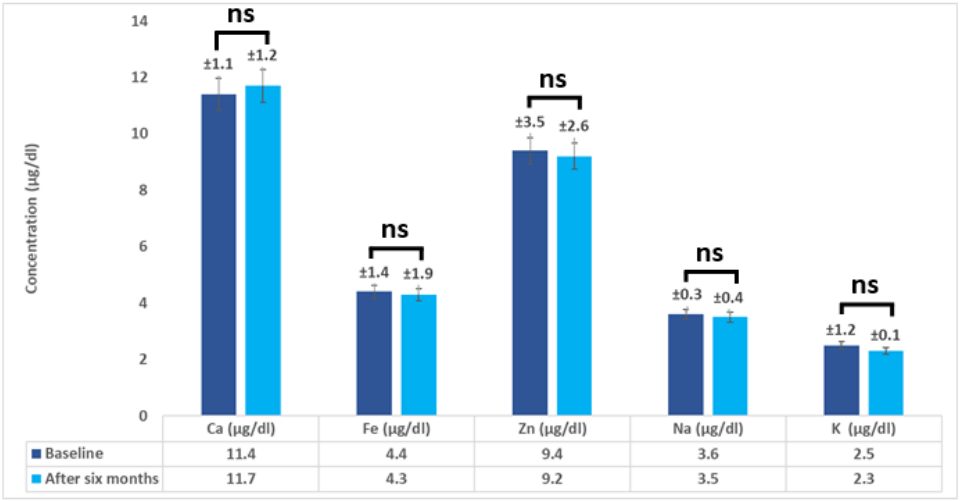


Figure 7. Comparison between baseline and six months weight-loss program (N=43). Calcium (Ca) (µg/dl), Iron (Fe) (µg/dl), Zinc (Zn) (µg/dl), Sodium (Na) (µg/dl), Potassium (K) (µg/dl).

Data are given as the mean ± SD. Statistical significance was set at * $p \leq 0.05$; the means reported with a star are significantly different; ns means non-significant.

4. Discussion

Obesity, now consider a global health epidemic, and commonly linked with increased lipid levels, hematological changes, inflammation, and a heightened risk for a variety of diseases. A thorough biological profile and complete blood count (CBC) are crucial for health assessment and the detection of conditions such as anemia, infections, leukemia, and cardiovascular diseases [1–5]. This study targeted 43 obese females exhibiting elevated white blood cell counts (**Table 1**), signaling potential risks for leukemia, coronary events, and inflammatory processes. A dietary program spanning six months was administered (**Table 2**) to measure its effects on anthropometric data, biological profiles, elemental composition, and CBC, **Figure 1** show experimental design. The intervention resulted in notable weight reduction and enhancements in laboratory parameters and blood profiles, which can be ascribed to the nutrient-dense nature of the diet, **Figures 2–6**. Dietary modifications entailed a decrease in consumption of high-acidic foods, fast foods, animal-derived fats, refined sugars, red meats, and out-of-season produce. Conversely, the diet was enriched with a variety of fruits, vegetables (either raw or steamed), fish, poultry, and whole grains. These dietary shifts led to significant improvements in hematological indices and biological markers that surpassed initial baseline measurements (illustrated in **Figures 2–6**). Changes in elemental profiles were observed but did not reach statistical significance, **Figure 7**. This investigation delineates the critical role of diet in managing conditions related to obesity and confirm the use of CBC inflammation indices as predictors for metabolic syndrome tied to obesity. The findings hold promise for informing diagnostic approaches for diseases linked with obesity and underscore the importance of dietary intervention in improving hematological and biological profiles on current participants, **Figures 2–5**. Abnormal rises or reductions in cell counts, as exhibited in a CBC, may show that the body has an underlying medical situation that calls for additional evaluation. The present work indicated a different CBC, differential WBC count, and biological profile at baseline in the studied subject compared to the reference range [20,21]. A low red blood count or disorder such as anemia can produce sensations of fatigue and disturbance.

In response to inquiries regarding the correlation between study outcomes and oxygen levels, despite the absence of prescribed physical activity, one could posit that even regular life movements, such as walking to the market or avoiding prolonged sitting, can contribute to variations in oxygen consumption and utilization. These everyday activities, albeit not structured exercise, may still influence metabolic processes and thereby affect the study's results. It is acknowledged that the subjects were not sedentary and their routine movements as part of daily living could have had an impact on their physiological parameters, including oxygen levels. The human body increases red blood cell products to neutralize any condition that results in low oxygen levels. These conditions include heart disease, such as congenital heart disease in adults [21–23]. A low hematocrit with low RBC count and diminishes in hemoglobin show anemia or bleeding. Nutritional problems and overhydration can lead to a low hematocrit blood test. A high hematocrit suggests that the percentage of RBC in human blood is above the upper limits of normal.

Various condition causes of a high hematocrit include dehydration, low availability of oxygen, high lipid profiles, and genetic congenital heart conditions that agree with present results at baseline compared to reference range [20,21,23].

MCV is raised or diminished depending on the average red cell size. Low MCV indicates microcytic (small average RBC size) and malnutrition, normal MCV indicates normocytic (standard average RBC size), and high MCV indicates macrocytic (large average RBC size). RDW determines if the amount that RBC vary in size. If both the RDW and MCV levels are elevated, there are numerous possible reasons such as liver disorder, hemolytic anemia, and malnutrition [9,20,21]. MCH levels relate to the average amount of hemoglobin found in the human body's RBC. MCHC is the mean concentration of hemoglobin in human RBC. Several sorts of anemia and malnutrition can give low MCH or MCHC and levels that agree with present results between baseline and intervention compared to a reference range. MCH elevation happens when the blood cells are too big, resulting from not having enough vitamins B12 or folic acid in the body. High MCH levels may also be the consequence of liver disorders, an overactive thyroid gland, drinking alcohol repeatedly, complications from particular cancers, difficulties from an infection, and getting too many medications, including estrogen. Diet included several vitamins, vitamin B12, vitamin C, folic acid, and iron can balance MCH, MCH, hemoglobin, and RBCs levels that agree with the present diet program [9,23].

MPV estimates the average size of blood platelets. It is closely related to a platelet count analysis that measures platelets' number in the human blood. Platelet abnormalities can be a symptom of a bleeding disorder or different health obstacles. A high or low MPV does not propose anything on its own. It should be evaluated within the circumstances of other CBC outcomes, such as platelet count. MPV test outcomes to determine whether or not to do further testing, such as a bone marrow biopsy. A high MPV indicates that the platelets are more extensive than average. That is a sign that the body was manufacturing too many platelets [24,25]. A low platelet counts and an elevated MPV level suggest that the bone marrow is rapidly generating platelets. That may be because the older platelets are damaged, so the bone marrow is trying to repay. Elevated MPV is linked with platelet activation, which can occur when platelets encounter tumor byproducts, high lipid profile, and heart issues that agree with present outcomes. Other causes depending on different CBC results, high MPV levels can sign particular circumstances, such as hyperthyroidism, heart disease, diabetes, vitamin D and nutrients deficiency, high blood pressure, and stroke [25,26].

WBC assists the body in the battle toward infections. There are connections between WBC count in the previous report [9,20,27].and weight, cholesterol, uric acid, creatinine, and blood sugar in men and women. Low WBC can be a symptom of an immune system and diminished bone marrow function at birth. Also, low white blood cell counts occur in leukemia, chemotherapy, radiation therapy, and drugs [9,20,27]. WBC count is raised in obesity and is a risk factor for atherosclerosis [27,28]. That agrees with the present studies where there is an increase of WBC, lipid profile, and BMI than the normal range baseline. Elevated WBC count issues in type 2 diabetes agree with present work [28,29]. The WBC counts and FBS increase over the reference range at baseline. Previous data indicate the importance of weight

loss in reducing WBC count in morbid obesity and type 2 Diabetes, which agrees with present work [29,30]. A high WBC count was also significantly correlated with cancer death and improper lifestyle. Lifestyle and diet can help a person decrease WBC number to near-normal, which agrees with the included diet program results [29,30]. The present diet was high in selenium, and zinc plays an essential role in the immune system. Zinc deficiency elevated the number of total WBC, granulocytes, and monocytes in mice without modifying the number of lymphocytes [31]. Also, reducing stress, carbs, unhealthy fats, and decreased calories dietary proteins can help modulate WBC that agrees with the present outcomes. Therefore, consuming less Western food should bring WBCs close to normal, consistent with the diet program in this study [9,30,32].

The lymphocyte count changes in the obese patients led to narrowing the blood vessels, which agree with the present finding where there is an elevation in lymphocyte count and BMI at baseline. Then lymphocyte modulation after the diet intervention program may result from a lower BMI [9,30,32]. Monocytes are the biggest of all WBC and perform an essential role in defense of germs and inflammation, and elevated in hematologic malignancies. It is also elevated in infections, autoimmune diseases, and obesity; that agree with the present work [30,32].

The previous finding clarified that the change in complete blood and differential WBC count was mostly due to anemia, malnutrition, and vitamin deficiency and it may be resolved with appropriate nutrition [9,30,32]. The present work agrees with all previous findings [1,2,14,15]. There is a significant reduction in weight and a vast improvement in the complete blood picture, differential WBC count, liver, kidney, lipid, and diabetic profile after a six-month weight loss diet compared to baseline and reference ranges. A decrease in AST levels following dietary intervention often signifies improved liver and cardiac health. AST, an enzyme involved in amino acid metabolism, is widely distributed in the body but predominantly indicates liver health. Elevated AST can indicate liver damage, as it enters the bloodstream from damaged liver cells [1,2,14,15]. Thus, reduced AST post-diet suggests beneficial dietary effects on liver inflammation and function, corroborated by changes in ALT, albumin, fasting glucose, creatinine, and uric acid levels. This is particularly pertinent for obese individuals at risk of non-alcoholic fatty liver disease (NAFLD), where dietary improvements may alleviate liver and renal stress factors, reflected by lowered enzyme levels [1,2,14,15]. The improvement may be due to the incorporation of nutrients in the diet program. Advice to add milk with yeast and curcumin in the present study is the primary factor in modulation and improves CBC results; nutritional yeast is a plant-based root of vitamin B-12. A vitamin B-12 deficiency can lead to abnormal RBC, called megaloblasts, and megaloblastic anemia. Curcumin, the primary active compound found in Curcuma, has antifibrotic, anticarcinogenic, hepatoprotective, anti-inflammatory, and antioxidant characteristics. Curcumin can shield the hepatic cell against activation by attenuating oxidative stress and inhibiting LDL -induced activation [1,9]. Also, cinnamon, ginger, curcumin, cocoa bean initiated patient metabolism, control blood sugar, decreased body fat, and modulated CBC and leukocytic counting in the volunteers. That may be due to cinnamon includes essential oils, cinnamic acid, cinnamaldehyde,

cinnamate, cinnzeylanine, and Eugenol with anti-inflammatory, antioxidant, and hypolipidemic potential that improves serum lipid and CBC and controls blood glucose levels. Ginger and its components (mainly gingerol and shogaol) stored in the gastrointestinal tract act antioxidant and anti-inflammatory, reduces LDL, triglyceride, and cholesterol, and improves lipid metabolism [1,2]. The pure cocoa bean has significant health effects, such as antioxidative, anti-inflammatory, antidepressant, anticancer, and LDL cholesterol-lowering effects [1,9,33]. In the current diet herb program, polyphenols can also show a modulation biochemical and hematological effect [34,35]. The investigators found that cinnamon and clove extract show natural antimicrobials and positively affect counting both total and differential leukocytes and erythrocytes nitric oxide production, lymphocyte, and weight loss that agree with the present study [34,35].

The present study results recommend incorporating all different colors of vegetables and fruits into the daily diet. Also, decrease red meat consumption and increase white meat intake, especially fish, whole grains with legumes, eggs, and milk, was more efficient in repressing hunger, reducing body weight, and enhancing biological, hematological, and anthropometric measures beneficial than those practiced at baseline. The improvement because of concentrated fruits and vegetable phytochemistry is anti-obesity, antioxidants, anti-inflammatory, anticancer, modulation immunity, and better cardiovascular health [1,9].

In the present program, adult obese subjects who followed guidance for incorporating natural healthy fats in subject's diets, such as almonds, olive oil, and avocado for six months, showed a decline in serum FBS, total cholesterol, triglyceride, and LDL cholesterol, as well as an increase in HDL cholesterol, after a six-month intervention compared to baseline and reference range that agrees with previous work [1,2,36,37]. Whereas almonds are abundant in fiber, vitamin E, folate, monounsaturated oleic acid, and linoleic acid, and olive oil is a healthy fat that "turns on" body metabolism through oleuropein [1,2,33]. Also, avocados contain oleic acid that has beneficial effects on blood lipids and could play a significant role in defending against chronic heart disease development, leading to a favorable impact on anthropometric measurements, biological profiles, and complete blood picture [1,2,38]. A previous study reported a significant potential benefit after the oral administration of olive oil for 20 continuous days in pregnant rats' hematologic and metabolic parameters [39]. The studies reported that an extract of Olea europaea L. leaves reported beneficial olive polyphenol antioxidants' beneficial effects on hematological and biological functions [40].

Patients who mixed yogurt and bee honey in a six-month diet program also modulated their metabolism triacylglycerol in BMI, biological, and hematological profile may be due to the probiotic benefits [1,2]. Indeed, probiotics have been associated with weight management, potentially influencing gut health and metabolism. Probiotics significantly impact gut health by restoring the gut's bacterial balance, particularly after disruptions caused by illness or treatment [1,2]. They enhance overall immunity and increase beneficial bacteria, contributing to the effective breakdown of food. This process includes converting fibers into short-chain fatty acids, vital for maintaining gut health [1,2,14]. Additionally, probiotics may help reduce obesity by targeting the gut microbiome, thereby improving the body's

nutritional uptake and alleviating symptoms associated with various diseases [1,2,41–46]. Previous findings concluded that probiotic, prebiotic, and symbiotic supplementation is advantageous in leucocyte count and hemoglobin content [41]; also, other investigators confirmed that probiotics and phytochemistry help improve the hematology lipid profile that agrees with present work [14,42–46].

The selected studied minerals such as macro-elements (K, Na, Ca) and micro-elements (Fe, Zn) elements involve a significant function in the balance of mental health, memory, immune system response, maintain metabolic enzymes function and help gut for nutrient absorption [14,47]. They also help to the preventing headaches, blood and muscles problems, weakness, and osteoporosis. In general, the balance consumption of minerals is important in the development of body bones, teeth, hormones, enzyme and tissues [14,19,47] except heavy metals such as Cadmium, Chromium, Aluminum, Lead [15].

Potassium and sodium are important electrolytes to maintaining blood pressure. Decreasing in sodium or increase in potassium in diet within normal ranges can protect against various chronic diseases such as heart, kidney disease and prevent high blood pressure [1,14,48,49]. Sodium present in high amounts in western diet and processed foods, while potassium mainly presents in vegetables and fruits and other varieties of natural foods. Furthermore, potassium can attenuate the effect of sodium on blood pressure [1,14,48,49]. While the current results report that there is no significant difference in the K and Na at baseline and after six months of diet program.

Dietary calcium is important micronutrients play role in bone heath and effective in obesity treatment. Furthermore, dietary calcium plays key factors in thermogenesis, fat metabolism and gut microbiota balance maintained [50]. The improvement in the calcium due to the current diet program are not significant this may be due to the time of program. Iron are important minerals that help in heathy blood and immune system, oxygen carrying and enzyme activity [14,51]. our pervious publication reported that blood iron not depend on BMI, many factors can affect the body iron concentration including lifestyle and genetic predispositions [14]. While previous scientists reported that diet-induced weight loss associated with a modulation in iron in human participation or decrease of animal protein [51]. Zinc are essential in body nutrition and health involves in metabolism, fertility, growth and immune modulator. Previous publication reported that consumption of zinc supplements should be advised in vegetarian diet [52,53]. Our previous publication reported that, the increase or decrease of macro-elements (Na, Ca) and micro-elements (Fe, Zn) in human body not depend on BMI or body weight except potassium that show positive correlative relationship with BMI [14], while the current results report that there is no significant difference (K, Na, Ca, Fe, Zn) concentration at baseline and after current diet program, this may be due to the short time of the diet program six months only. As delineated in **Table 2**, the current dietary intervention introduces several innovative elements that distinguish it from conventional programs. Notably, it features a unique concoction of yeast mixed with milk or water and augmented with curcumin, a pairing not typically observed in dietary regimens. The regimen mandates a regimented hydration protocol, advocating for the consumption of a bowl of water upon waking and an additional 2

liters distributed throughout the day. It also prescribes an assorted intake of fresh fruits and vegetables, aiming for 5–7 servings per day across a spectrum of colors. Distinctively, it advises the ingestion of specific fruits—pomegranate, apple, kiwi, orange, or sweet potato—complete with their skins to maximize nutritional intake. The intervention incorporates unroasted almonds and designated teas such as ginger or clove at specified intervals. Olive oil and curcumin are utilized as food enhancers for their reputed health advantages. For snacking, options like watermelon or non-fat popcorn are suggested as wholesome alternatives. The evening snack is carefully curated to include yogurt mixed with bee honey, a choice of banana, strawberry, or apple, and a dash of cinnamon. The program allows for flexibility in whole grain consumption tailored to individual preferences. Lastly, it endorses a bedtime ritual of cocoa bean with milk. These innovative components, through their synergistic combinations and precise timing, are posited to enhance the intervention's efficacy. Therefore, the results of this study contribute to developing a diagnosis strategy for diseases associated with obesity, and indicate significance of diet to improve hematological levels and biological profiles for obesity. in addition, the chemical composition of vegetables and fruits that mentioned in the current work have many health effect in our previous work [1,2,14,22,36,40,44,45,54].

5. Conclusions

This study determined that a dietary shift away from high-acidic foods, fast foods, animal fats, refined sugars, red meats, and out-of-season produce towards a diet rich in fruits, vegetables (either raw or steamed), fish, poultry, and whole grains led to marked improvements in hematological and biological markers, surpassing baseline and standard reference values. These improvements notably exceeded baseline levels for the complete blood count and biological profile, while changes in the elemental profile were not significant. Ongoing research is delving into more granular details of these findings.

6. Study limitation

(1) The gender scope of the research was confined to females due to its execution within a female-only university setting.

(2) The inclusion of participants from diverse national backgrounds, such as Egypt, Tunisia, Sudan, India, and Saudi Arabia, introduces variability in the reference ranges for metal analysis due to differing geographic locations.

(3) This self-funded pilot study had limited resources, which constrains the breadth of the investigation. However, it lays the groundwork for subsequent research that will be conducted with greater funding and potential.

(4) Menopausal females were not excluded from the study, as menopause influences fat deposition.

(5) Some data were lost over the six-month period; therefore, calculations were made based on the measurements taken before and after the six-month diet program.

Author contributions: Created and conceptualized the study idea, designed and performed all of the experiments, analyzed the data, wrote, revised and edited the

manuscript, and explained the results, AFH and SF. All authors have read and agreed to the published version of the manuscript.

Ethical approval: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the National Committee of Bio Ethics of UMM Al-Qura University, Al-Lith University College (protocol code: HAPO−02-K−012–2022−06–1110 and 12 June 2022).

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