AIM OF THE WORK

The aim of the work is to assess the nutritional status of Hepatitis C Virus infected patients in association with schistosomal hepatic periportal fibrosis.

SUBJECTS AND METHODS

Subjects:

This study was carried out on 93 male adults subjects. They were recruited from patients attending the Parasitology Department Clinic and the Hepatology Clinic of the Medical Research Institute, Alexandria University.

All participants were asked to freely volunteer to the study and informed written consent was gathered prior to their inclusion in the study protocol, according to the ethical guidelines of the Medical Research Institute. Alexandria University (Appendix I, Informed Witten Consent for Patient Participation in a Clinical Research, 2001).

Sample Size Calculation:

A sample size of 31, 31 and 31 (total 93) produces a power of 80% to detect difference between the mean Body Fat (BF) in HCV infected patients (15±10) and mean BF in HCV with schistosomiasis (12±7) and controls (20±3), at a level of significance of 0.05, using one way ANOVA test.

The study subjects included three groups:

Group I: 31 patients having HCV.

Group II: 31 patients having mixed schistosomiasis and HCV.

Group III: 31 healthy controls.

Inclusion criteria:

- Chronic HCV infected liver disease.
- Adults
- Males
- *Shistoaoma mansoni* infected patients
- Nutritional history

Exclusion criteria:

- Pre-existent malnutrision
- Hepatocellular carcinoma
- Active alcohol abuse
- Co-infection with HBV or HIV
- Chronic renal failure (GFR < 50 ml/min)
- Females
- Children

Methods:

All subjects were subjected to the following then assigned to the corresponding group:

I- Clinical examination:

1- An information sheet was prepared for each patient.(Appendix II)

2- Full history was obtained, including signs and symptoms of *Schistosoma mansoni*, HCV infections, weight history and food history.

3- HCV infection was diagnosed by ELISA technique.[193]

- HCV ELISA Technical procedure (Murex Co.):

Step 1: Reconstitute the Conjugate

Diluent and prepare Substrate Solution, and dilute the Wash Fluid.

Step 2: Use only the number required for the test.

Step 3: Add 180 µl of sample diluent into each well.

Step 4: Add 20 µl of serum samples or controls to the wells.

Add the controls to the designated wells on each plate after dispensing the samples. The use of a white background will aid visualization of sample addition. Samples and controls must be thoroughly mixed with the sample diluent.

Step 5: Cover the wells with the lid and incubate for 1 hour at 37°C ± 1°C .

Step 6: At the end of the incubation period wash the plate.

Step 7: Immediately after washing the plate add 100 µl of Conjugate to each well.

Step 8: Cover the wells with the lid and incubate for 30 minutes at 37°C ± 1°C

Step 9: At the end of the incubation period wash the plate.

Step 10: Immediately after washing the plate add 100 µl of the Substrate solution to each well.

Step 11: Cover the wells with the lid and incubate for exactly 30 minutes at 37°C ± 1°C while colour develops. Keep away from direct sunlight. A purple colour should develop in wells containing positive samples.

Step 12: Add 50 µl Stop Solution (0.5M to 2M sulphuric 50 µl acid) to each well.

Step 13: Within 15 minutes read the absorbance at 450 nm 450 nm using 620nm to 690 nm as the reference wavelength if available.

Calculations of the Results:

- Each plate must be considered separately when calculating and interpreting results of the assay.
- Approved software may be used for calculation and interpretation of results.
- Negative Control
- If using duplicate Negative Controls calculate the mean.
- Example: Well 1= 0.086, Well 2 = 0.094
- Total = 0.180
- Mean = 0.180/2 = 0.090
- Discard any Negative Control value which is >0.25.
- Cut-off Value
- Calculate the Cut-off value by adding 0.6 either to the Negative
- Control or to the mean of the Negative Control replicates (see above).
- Example: Mean Negative Control = 0.090
- Cut-off value = 0.090 + 0.600 = 0.690

II- Abdominal ultrasonography to all subjects:

Abdominal ultrasonography was performed to detect the degree of fibrosis of schistosomiasis according to the WHO scoring system. [194]

III- Parasitological studies:

1- Stool examination by sedimentation and Kato-Katz techniques.[195]

- **Principle of Kato thick smear technique:**

a- Materials:

- A nylon mesh that retains debris, as the latter makes it difficult or even impossible to recognize helminths eggs.
- A pre-soaked cover slip (cellophane) in a translucent and fixing solution (glycerol), which preserves the eggs and makes the smear translucent.
- Specially designed (template), which assures that always the same amount of feces (41.7 mg) was examined, allowing excellent uniformity and observation of sufficient material.
- Gloves.

b- Technical procedure:

- A small amount of fecal material was placed scrap paper and a piece of nylon mesh is pressed on top so that some of the feces sieve through the mesh and accumulate on top.

- A flat sided spatula was scraped across the upper surface of the mesh to collect the sieved feces.
- A template which delivers 41.7 mg stool, was placed on the slide and the sieved feces were added with the spatula so that the hole in the template is completely filled.
- The spatula was then passed over the filled template to remove excess feces from the edge of the hole.
- The template was removed carefully so that a cylinder of feces is left on the slide.
- The fecal material was covered with a pre-soaked cellophane strip.
- The slide was then inverted and the fecal sample was pressed firmly against the hydrophilic cellophane strip to spread evenly.
- The slide was placed on the bench with cellophane upwards to enable water evaporation while glycerol clears the feces.
- The slide was left for one or more hours at room temperature to clear the fecal material, prior to microscopic examination.
- Three slides were examined for each sample.
- The intensity of infection was calculated as follows=

$$\frac{\text{Number of eggs} \times 24}{\text{3 (number of slides examined/specimen)}}$$

2- Serology for Schistosomiasis using ELISA technique (Biodiagnostics Co.).[196]

- Schistosomiasis Enzyme linked immunosorbent assay (ELISA):

This test was used for the detection and quantification of serum specific IgG antibodies against *schistosoma mansoni* antigen

Principle:

This technique is used for the determination of *S. mansoni* antibodies in the collected sera. The antibodies in the patients' serum bind to the antigens during incubation. The next incubation allows the enzyme complex to bind to the antigen-antibody complex. After washings to remove unbound enzymes, a substrate is added that develops a blue color. The stop solution ends the reaction, turning the blue assay color to yellow.

a- Reagents:

1- Test Strips: microwells containing schistosoma soluble egg antigen (SEA).

2- Washing buffer: 0.05% Tween 20.

3- Serum diluent: 1:40 with buffered protein solution with Thimerosal.

4- Enzyme conjugate: protein A peroxidase (HRP) in a stabilizing buffer with thimerosal.
5- Substrate: tetramethylbenzidine (TMB).
6- Stopping solution: 1M phosphoric acid.

b- Equipments:

- Disposable microtitration plates.
- Adjustable uni and multichannel micropipettes.
- Squeeze bottle for washing.
- Tubes for serum dilutions.
- Distilled water.
- ELISA plate reader.

c- Technical procedure

1. The needed wells were broken and placed in strip holder.
2. 100µl of negative control was added to well no.1, 100µl of positive control to well no.2, and 100 µl of the diluted (1:40) test samples to the remaining wells.
3. The wells were then incubated at room temperature (15^{o}C - 25^{o}C) for 10 minutes.
4. The contents in the wells were shaken out, and washed by emptying, filling with wash buffer and left for few moments then inverted over filter paper. This process was repeated 3 times.
5. Two drops of enzyme conjugate were added to each well.
6. The wells were incubated at room temperature for 10 minutes.
7. The wells were then washed 3 times as before.
8. Two drops of the chromogen were added to each well.
9. The wells were incubated at room temperature for 5 minutes.
10. Two drops of stop solution were added to each well to terminate the reaction.
11. The absorbance was read at 450 nm with a reference filter at 620-650 nm.

Reading and interpretation of results:

- The results were expressed as absorbance value for each determination (optical density "OD").
- Test results were considered positive if absorbance reading is greater or equal to 0.2 OD units and considered negative if absorbance reading is less than 0.2 OD units.

IV- Nutritional assessment:

1- Anthropometric measurements:

- Age.
- Height.
- Weight.
- Body Mass Index (BMI). Bodyweight in kilograms divided by height in meters squared.
- Waist and Hip circumference.

2- Body-Composition Measurement:

Body Fat (BF) was measured using Bioelectrical Impedance Analysis. The BF loss monitor OMRON HBF-306 C (Omron health care, Illinois, USA) device was used. This measurement is performed after entering the age, height and sex into the device then the patient holds the device by his hands to calculate the fat percent. The Omron BF loss monitor may underestimate BF by about 3 % in comparison with measurement taken by calipers, as reported by the manufacturer.[197]

V- Biochemical examination:

Blood sample was withdrawn and the following investigations will be performed:

(I) Complete Blood Count (CBC) and Hemoglobin level [198].

Done By Sysmex XT-1800*i* Automated Hematology Analyzer

(II) Liver Enzymes (ALT, AST).[199]

Principle of Liver function tests:

Determination of Alanine aminotransferase (ALT)

Principle:

Alanine aminotransferase (ALT or GPT) catalyzes the transfer of the amino group alanine to 2-oxoglutarate, forming pyruvate and glutamate. The catalytic concentration is determined from the rate of decrease of NADH, measured at 340 nm, by means of the lactate dehydrogenase (LDH) coupled reaction [199].

$$\text{Alanine} + \text{2-oxoglutarate} \xrightarrow{\text{ALT}} \text{pyruvate} + \text{glutamate}$$

$$\text{Pyruvate} + \text{NADH} + H^+ \xrightarrow{\text{LDH}} \text{lactate} + NAD^-$$

Reagents:

Reagent A: Tris 150 mmol/L, L-alanine 750 mmol/L, lactate dehydrogenase > 1350 U/L, pH 7.3.

Reagent B: Nicotin adenine dinuclotide (NADH) 1.3 mmol/L, 2-oxoglutarate 75 mmol/L, sodium hydroxide 148 mmol/L.

Reagent C: pyridoxal phosphate 10 mmol/L.

Working reagent:

4 volume of reagent A+ 1 volume of reagent B + 0.1 volume of reagent C were mixed and used immediadtely.

Procedure:

- In a cuvette 50 µl sample (serum) was added to 1 ml working reagent.
- The cuvette was incubated for 1 min at 37 C then initial absorbance was recorded at 340 nm and at 1 min intervals there after 3 min.
- The difference between consecutive absorbance and the average absorbance difference/min (ΔA/min) was calculated.

Calculation:

$$\text{Activity} = \Delta A/\text{min} \times \frac{Vt \times 10^6}{\varepsilon \times 1 \times Vs} = U/L$$

Where:

The molar absorbance (ε) of NADH at 340 nm was 6300, the light path (1) was 1 cm, the total reaction volume (Vt) was 1.05 at 37^o C, the sample volume (Vs) was 0.05 at 37^o C.

Determination of aspartate aminotransferase (AST)

Principle:

Aspartate aminotransferase (AST or GOT) catalyzes the transfer of the amino group from aspartate to 2-oxoglutarate, forming oxalacetate and glutamate. The catalytic concentration is determined from the rate of decrease of NADH, measured at 340 nm, by means of the malate dehydrogenase (MDH) coupled reaction [(199)].

Reagents:

Reagent A: Tris 121 mmol/L, L-aspartate 362 mmol/L, malate dehydrogenase > 460 U/L, lactate dehydrogenase > 660 U/L, sodium hydroxide 255 mmol/L, pH 7.8.

Reagent B: NADH 1.3 mmol/L, 2-oxoglutarate 75 mmol/L, sodium hydroxide 148 mmol/L.

Reagent C: pyridoxal phosphate 10 mmol/L.

Working reagent:

4 volume of reagent A + 1 volume of reagent B + 0.1 volume of reagent C were mixed.

Procedure:

- In a cuvette 50 µl sample (serum) was added to 1 ml working reagent.
- The cuvette was incubated for 1 min at 37 C then initial absorbance was recorded at 340 nm and at 1 min intervals there after 3 min.
- The difference between consecutive absorbance and the average absorbance difference/min (ΔA/min) was calculated.

Calculation:

$$\text{Activity} = \Delta A/\text{min} \times \frac{Vt \times 10^6}{\varepsilon \times 1 \times Vs} = U/L$$

The molar absorbance (ε) of NADH at 340 nm was 6300, the light path (1) was 1 cm, the total reaction volume (Vt) was 1.05 at 37^o C, the sample volume (Vs) was 0.05 at 37^o C.

(III) Serum Albumin.[199]

Using Olympus AU 480 Chemistry System analyzer manufactured by Beckmancoulter Diagnostics Company

Principle of Serum Albumin Test:

1. Dilute standards in distilled water as follows. Dilute serum and plasma samples 2 fold. Transfer 5 µL diluted standards and diluted samples to wells of a clear bottom plate. Store diluted standards at -20°C for future use.
2. Add 200 µL working reagent and tap lightly to mix. Avoid bubble.
3. Incubate 5 min at room temperature and read optical density at 570-670nm (peak absorbance at 620nm).

Procedure using cuvette:

1. Transfer 20 µL Blank, Standards and samples to appropriately labeled tubes. Add 1000 µL working reagent and tap lightly to mix. Incubate 5 min at room temperature.
2. Transfer to cuvet and read optical density at 620nm.

Calculation:

Subtract blank OD from the standard OD values and plot the OD against standard concentrations. Use the standard curve to determine the sample albumin concentration.
Conversions: 0.1 g/dL albumin equals 15 µM, 0.1% or 1000 ppm.

(IV) Cholesterol and Triglycerides.[199]

Determination of triglycerides

The triglycerides level was determined by the enzymatic colorimetric method [199].

Principle:

Glycerol and fatty acids are first formed by the action of lipase on the triglycerides. Glycerol is then phosphorelated by adenosine triphosphate (ATP) to produce glycerol -3-phosphate and ADP in a reaction catalyzed by glycerol kinase. Glycerol- 3 - phosphate is oxidized by glycerol phosphate oxidase producing dihydroxy acetate phosphate (DAP) and hydrogen peroxide. The latter reacts with 4 aminoantipyrine and 4- chlorophenol under the catalytic influence of peroxidase to form quinoneimine.

Triglycerides $\xrightarrow{\text{Lipas}}$ glycerol + fatty acids.

Glycerol + ATP $\xrightarrow{\text{Glycerol Kinase}}$ glycerol-3 phosphate + ADP.

Glycerol-3phosphate + $\xrightarrow[\text{phosphate}]{\text{Glycerol}}$ DAP + H_2O_2

H_2O_2+4-aminoantipyrine+4-chlorophenol $\longrightarrow$ quinnoneimine+HCl + H_2O.

Reagents:

Enzyme/buffer reagent:

- Piperazine-N,N′-bis(2-ethanesulfonic acid) buffer(pH 7.5) 50 mmol/L
- 4 - chloro phenol 5 mmol/L
- 4 - Aminoantipyrine 0.25 mmol /L
- Magnesium ions 4.5 mmol/L
- ATP 2 mmol/L
- Lipase ≥ 1.3 U/mL
- Peroxidase ≥ 0.5 U/mL
- Glycerol kinase ≥ 0.4 U/mL
- Glycerol -3 - phosphate oxidase ≥ 1.5 U/mL
- Standard: Triglycerides 200 mg/dl

Procedure:

- One ml of enzyme reagent was mixed with 10 µl of serum sample or triglycerides standard in test tubes.

- Reagent blank was run through the same procedure.
- All tubes were incubated at 37 C for 5 minutes.
- The absorbance of standard (A standard) and the sample (A sample) were measured against reagent blank at 546 nm.

Calculation:

$$\text{Triglycerides concentration (mg/dl)} = 200 \times \frac{A_{\text{sample}}}{A_{\text{Standard}}}$$

Where, concentration of standard was 200 mg/dL

Determination of total cholesterol:

Serum total cholesterol level was determined on the basis of an enzymatic calorimetric method [199].

Principle:

Cholesterol esterase (CHE) hydrolyzes esters and H_2O_2 is formed in the subsequent enzymatic oxidation of cholesterol by cholesterol oxidase (CHO) according to the following reaction:

$$\text{Cholesterol ester} + H_2O \xrightarrow{\text{CHE}} \text{Cholesterol} + \text{fatty acids}$$

$$\text{Cholesterol} + O_2 \xrightarrow{\text{CHO}} \text{Cholestene –3–one} + H_2O_2$$

$$2H_2O_2 + \text{4-aminophenazone} + \text{phenol} \xrightarrow{\text{Peroxidase}} \text{Quinoneimine} + HCl + H_2O$$

Reagents:

Enzyme / buffer reagent

- Phosphate buffer (pH 6.5) 100 mmol/L
- 4 – Amino phenazone 0.3 mmol/L
- Phenol 5 mmol/L
- Peroxidase >5 KU/L
- Cholesterol esterase > 150 U/L
- Cholesterol oxidase > 100 U/L
- Standard: Cholesterol 200 mg/dl

Procedure:

One ml of working reagent was mixed with 10 µl of serum sample or cholesterol standard in test tubes. Reagent blank was run though the same procedure. All the tubes

were incubated at 37 °C for 5 minutes. The absorbance of standard (A standard) and the sample (A sample) were measured against reagent blank at 546 nm.

Calculation:

$$\text{Cholesterol concentration (mg/dl)} = 200 \times \frac{A_{\text{sample}}}{A_{\text{standard}}}$$

Where, concentration of standard was 200 mg/dl.

(V) Serum Leptin.[200]

Principle of the Leptin Test:

The DRG Leptin ELISA kit is a solid phase enzyme-linked immunosorbent assay (ELISA) based on the sandwich principle.The microtiter wells are coated with a monoclonal antibody directed towards a unique antigenic site on a Leptin molecule.An aliquot of specimen sample containing endogenous Leptin is incubated in the coated well with a specific biotinylated monoclonal anti Leptin antibody. A sandwich complex is formed. After incubation the unbound material is washed off and a Steptavidin Peroxidase Enzyme Complex is added for detection of the bound Leptin. Having added the substrate solution, the intensity of colour developed is proportional to the concentration of Leptin in the specimen sample.

Test Procedure:

- Each run must include a standard curve.
- Secure the desired number of microtiter wells in the holder.
- Dispense 15 µL of each Standard, controls and samples with new disposable tips into appropriate wells.
- Dispense 100 µL Assay Buffer into each well.
- Thoroughly mix for 10 seconds. It is important to have a complete mixing in this step.
- Incubate for 120 minutes at room temperature (without covering the plate).
- Briskly shake out the contents of the wells.
- Rinse the wells 3 times with diluted Wash Solution (300 µL per well). Strike the wells sharply on absorbent paper to remove residual droplets.
- Add 100 µL Antiserum to each well.
- Incubate for 30 minutes at room temperature.
- Briskly shake out the contents of the wells.
- Rinse the wells 3 times with diluted Wash Solution (300 µL per well). Strike the wells sharply on absorbent paper to remove residual droplets.
- Dispense 100 µL Enzyme Complex into each well.
- Incubate for 30 minutes at room temperature.
- Briskly shake out the contents of the wells.

- Rinse the wells 3 times with diluted Wash Solution (300 µL per well). Strike the wells sharply on absorbent paper to remove residual droplets.
- Add 100 µL of Substrate Solution to each well.
- Incubate for 15 minutes at room temperature.
- Stop the enzymatic reaction by adding 50 µL of Stop Solution to each well.
- Determine the absorbance (OD) of each well at 450 ± 10 nm with a microtiter plate reader.

Calculation of Results:

1. Calculate the average absorbance values for each set of standards, controls and patient samples.
2. Construct a standard curve by plotting the mean absorbance obtained from each standard against its concentration with absorbance value on the vertical(Y) axis and concentration on the horizontal (X) axis.
3. Using the mean absorbance value for each sample determine the corresponding concentration from the standard curve.
4. Automated method: The results in the IFU have been calculated automatically using a 4 PL (4 Parameter Logistics) curve fit. 4 Parameter Logistics is the preferred method. Other data reduction functions may give slightly different results.
5. The concentration of the samples can be read directly from this standard curve. Samples with concentrations higher than that of the highest standard have to be further diluted. For the calculation of the concentrations this dilution factor has to be taken into account.

RESULTS

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test or Monte Carlo correction. The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro-Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests was applied. If the data were abnormally distributed, non-parametric tests were used. For normally distributed data, comparisons between the studied groups were analyzed F-test (ANOVA) to be used and Post Hoc test (Scheffe). For abnormally distributed data, Kruskal Wallis test was used to compare between the studied groups and pair wise comparison was assessed using Mann-Whitney test. Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

I-Clinical presentation:

Table (I) shows the clinical presentation of the studied groups. In Group I, 100 % of the patients had abdominal pain, 9.7 % had constipation, 48.8 % had hyperacidity, 22.6 % had regurgitation, and 6.6 % had piles.

In Group II, 100 % of the patients had abdominal pain, 19.4 % had constipation, 29 % had hyperacidity, 19.4 % had regurgitation, and 3.2 % had bleeding per gum.

There was no statistical difference between the studied groups according to the clinical presentation.

Table (I): Clinical presentation of the studied groups

	Group I (n=31)		Group II (n=31)		χ^2	*P-value*
	No.	**%**	**No.**	**%**		
Symptoms						
Abdominal pain	31	100.0	31	100.0	-	-
Constipation	3	9.7	6	19.4	1.170	^{FE}p=0.473
Hyperacidity	15	48.4	9	29.0	2.447	0.118
Regurgitation	7	22.6	6	19.4	0.097	0.755
Piles	2	6.5	0	0.0	2.067	^{FE}p=0.492
Bleeding per gum	0	0.0	1	3.2	1.016	^{FE}p=1.000

Group I: HCV
Group II: HCV+ schisto
χ^2: Chi square test
FE: Fisher Exact test

II-Ultrasound Findings:

Table (II) shows the ultrasound findings between the studied groups. In Group I, 45.2 % of the patients had normal liver, 25.8 % had liver cirrhosis, and 29 % had fatty liver. In Group II 29 % of the patients had normal liver, 48.4 % had liver cirrhosis, and 22.6 % had fatty liver. The P-value was 0.001. There was a high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the liver structure between Group II -Group III and Group II -Group III.

In Group I, the mean right lobe liver diameter was 12.81 cm with a standard deviation of 1.08. The minimum right lobe liver diameter was 11 cm and the maximum right lobe liver diameter was 16 cm. In Group II, the mean right lobe liver diameter was 12.26 cm with a standard deviation of 1.0. The minimum right lobe liver diameter was 11 cm and the maximum right lobe liver diameter was 15 cm. In Group III, the mean right lobe liver diameter was 12.45 cm with a standard deviation of 0.51. The minimum right lobe liver diameter was 12 cm and the maximum right lobe liver diameter was 13 cm. The P-value was 0.056. There was a no statistical difference between the three studied groups according to right lobe liver diameter.

In Group I, the mean portal vein diameter was 13.35 mm with a standard deviation of 1.64. The minimum portal vein diameter was 11 mm and the maximum portal vein diameter was 17 mm. In Group II, the mean portal vein diameter was 14.74 mm with a standard deviation of 1.18. The minimum portal vein diameter was 12 mm and the maximum portal vein diameter was 17 mm. In Group III, the mean portal vein diameter was 12.48 mm with a standard deviation of 0.51. The minimum portal vein diameter was 12 mm and the maximum portal vein diameter was 13 mm. The P-value was 0.001. There was a high statistical difference between the three studied groups according to portal vein diameter. Pair-wise comparison test denotes that here was a difference in the portal vein diameter, Group I less than Group II, Group I greater than Group III and Group II greater than Group III.

In Group II, 74.2 % had Grade I liver fibrosis and 25.8 % had Grade II liver fibrosis. Pair-wise comparison test denotes that here was a difference in the degree of liver fibrosis between Group I -Group III and Group II -Group III.

In Group I, 90.3 % had normal gall bladder, 6.5 % had cholecystitis and 3.2 % had gall stones. In Group II, 87.1 % had normal gall bladder, 12.9 % had cholecystitis. The P-value was 0.124. There was no statistical difference between the three studied groups.

In Group I, the mean spleen diameter was 13.35 cm with a standard deviation of 1.18. The minimum spleen diameter was 12 cm and the maximum spleen diameter was 16.8 cm. In Group II, the mean spleen diameter was 15.90 cm with a standard deviation of 3.11. The minimum spleen diameter was 12 cm and the maximum spleen diameter was 18 cm. In Group III, the mean spleen diameter was 12.61 cm with a standard deviation of 0.50. The minimum spleen diameter was 12 cm and the maximum spleen diameter was 13 cm. The P-value was 0.001. There was high statistical difference between the three studied groups according to the spleen diameter. Pair-wise comparison test denotes that here was a difference in the spleen diameter, Group I greater than Group II and Group II greater than Group III.

Table (II): Ultrasound findings between the studied groups

	Group I (n=31)		Group II (n=31)		Group III (n=31)		Test of sig.	*P-value*
	No.	%	No.	%	No.	%		
Liver								
Normal	14	45.2	9	29.0	31	100.0		
Cirrhosis	8	25.8	15	48.4	0	0.0	χ^2=37.848*	<0.001*
Fatty liver	9	29.0	7	22.6	0	0.0		
Pair-wise comp.$	I-II***,II-III***							
Rt. Lobe								
Mean ± SD.	12.81±1.08		12.26±1.0		12.45±0.51		F= 2.979	0.056
Min. – Max.	11.0-16.0		11.0-15.0		12.0-13.0			
PV								
Mean ± SD.	13.35±1.64		14.74±1.18		12.48±0.51		F= 27.669*	<0.001*
Min. – Max.	11.0-17.0		12.0-17.0		12.0-13.0			
Pair wais comp.#	I-II***, I-III*,II-III***							
Fibrosis								
Absent	31	100.0	0	0.0	31	100.0		
Grade I	0	0.0	23	74.2	0	0.0	KWχ^2=89.155*	<0.001*
Grade II	0	0.0	8	25.8	0	0.0		
Pair wais comp.#	I-III***, II-III***							
GB								
Normal	28	90.3	27	87.1	31	100.0		
Cholecystitis	2	6.5	4	12.9	0	0.0	χ^2=6.302	MCp=0.124
Gall stones	1	3.2	0	0.0	0	0.0		
Spleen								
Mean ± SD.	13.35±1.18		15.90±3.11		12.61±0.50		F= 24.492*	<0.001*
Min. – Max.	12.0-16.80		12.0-18.0		12.0-13.0			
Pair wais comp.#	I-II***,II-III***							

Group I: HCV Group II: HCV+ schisto Group III: Control
p: p value for comparing between the studied groups
F: F test (ANOVA)
χ^2: value for Chi square
MC: Monte Carlo test
KWχ^2: Chi square for Kruskal Wallis test
$: Pair-wise comparison was done using Monte Carlo test
#: Pair-wise comparison was done using Post Hoc Test (Scheffe)
* :Statistically significant at p ≤ 0.05 ** :Statistically significant at p ≤ 0.01
***: Statistically significant at p ≤ 0.001

III-Age distribution

Table (III) shows the age distribution among the studied groups. The mean age in Group I was 43.65 years with a standard deviation of 10.63, the minimum age was 20 years and the maximum age was 65 years. In Group II the mean age was 46.19 years with a standard deviation of 8.88, the minimum age was 25 years and the maximum age was 59 years. In Group III the mean age was 41.23 years with a standard deviation of8.61, the minimum age was 28 years and the maximum age was 65 years. The P-value was 0.122. There was no statistical difference between the three studied groups according to age.

Table (III): Age distribution among the studied groups

	Group I (n=31)	**Group II (n=31)**	**Group III (n=31)**	**F**	***P-value***
Age					
Mean ± SD.	43.65 ± 10.63	46.19±8.88	41.23 ± 8.61	2.158	0.122
Min. – Max.	20.0 – 65.0	25.0-59.0	28.0 – 65.0		

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)

IV-Anthropometric measurements:

Table (IV) shows the anthropometric data of the different studied groups. In Group I, the mean height was 172 cm with a standard deviation of 5.89. The minimum height was 160 cm and the maximum height was 188 cm. In Group II, the mean height was 170.71 cm with a standard deviation of 7.57. The minimum height was 155 cm and the maximum height was 189 cm. In Group III, the mean height was 172.26 cm with a standard deviation of 5.37. The minimum height was 160 cm and the maximum height was 182 cm. The P-value was 0.550.There was no statistical difference between the three studied groups according to height.

The mean weight in Group I was 79.23 Kilograms with a standard deviation of 16.26. The minimum weight was 57 Kilograms and the maximum weight was 120 Kilograms. The mean weight in Group II was 75.35 Kilograms with a standard deviation of 11.97. The minimum weight was 55 Kilograms and the maximum weight was 102 Kilograms. The mean weight in Group III was 87.35 Kilograms with a standard deviation of 12.77. The minimum weight was 64 Kilograms and the maximum weight was 111 Kilograms. The P-value was 0.003.There was a statistical difference between the three studied groups according to weight. The highest mean weight was in the controls and the lowest mean weight was in Group II. Pair-wise comparison test denotes that there was a difference in the mean weight, Group II less than Group III.

The mean waist circumference in Group I was 91.65 cm with a standard deviation of 8.50. The minimum waist circumference was 77 cm and the maximum waist circumference was 111 cm. The mean waist circumference in Group II was 88.29 cm with a standard deviation of 5.14. The minimum waist circumference was 80 cm and the maximum waist circumference was 99 cm. The mean waist circumference in Group III was 100.87 cm with a standard deviation of 8.92. The minimum waist circumference was 85 cm and the maximum waist circumference was 118 cm. The P-value was 0.001.There was a high statistical difference between the three studied groups according to waist circumference. The highest mean waist circumference was in the controls and the lowest mean waist circumference was in Group II. Pair-wise comparison test denotes that there was a difference in the mean waist circumference, Group I less than Group III and Group II less than Group III.

The mean hip circumference in Group I was 105.87 cm with a standard deviation of 8.83. The minimum hip circumference was 90 cm and the maximum hip circumference was 125 cm. The mean hip circumference in Group II was 107.23 cm with a standard deviation of 5.59. The minimum hip circumference was 98 cm and the maximum hip circumference was 122 cm. The mean hip circumference in Group III was 111.71 cm with a standard deviation of 7.92. The minimum hip circumference was 97 cm and the maximum hip circumference was 126 cm. The P-value was 0.008. There was a statistical difference between the three studied groups according to hip circumference. The highest mean hip circumference was in the controls and the lowest mean hip circumference was in Group I. Pair-wise comparison test denotes that there was a difference in the mean hip circumference, Group I less than Group III.

The mean waist hip ratio in Group I was 0.87 with a standard deviation of 0.04. The minimum waist hip ratio was 0.78 and the maximum waist hip ratio was 0.96. The mean waist hip ratio in Group II was 0.82 with a standard deviation of 0.04. The minimum waist hip ratio was 0.77 and the maximum waist hip ratio was 0.89. The mean waist hip ratio in Group III was 0.90 with a standard deviation of 0.04. The minimum waist hip ratio was 0.79 and the maximum waist hip ratio was 0.97. The P-value was 0.001. There was a high statistical difference between the three studied groups according to waist hip ratio. The highest waist hip ratio was in the controls and the lowest waist hip ratio was in Group II. Pair-wise comparison test denotes that there was a difference in the waist hip ratio, Group I greater than Group II, Group I less than Group III, and Group II less than Group III.

Table (IV): Anthropometric data of the different studied groups

	Group I (n=31)	Group II (n=31)	Group III (n=31)	F	*P-value*
Height					
Mean ± SD.	172.023±5.89	170.71±7.57	172.26±5.37	0.603	0.550
Min. – Max.	160.0-188.0	155.0-189.0	160.0-182.0		
Weight					
Mean ± SD.	79.23±16.26	75.35±11.97	87.35±12.77	6.114*	0.003*
Min. – Max.	57.0-120.0	55.0-102.0	64.0-111.00		
Pair-wise comp.	II-III**				
Waist					
Mean ± SD.	91.65±8.50	88.29±5.14	100.87±8.92	22.153*	<0.001*
Min. – Max.	77.0-111.0	80.0-99.0	85.0-118.0		
Pair-wise comp.	I-III***,II-III***				
Hip					
Mean ± SD.	105.87±8.83	107.23±5.59	111.71±7.92	5.050*	0.008*
Min. – Max.	90.0-125.0	98.0-122.0	97.0-126.0		
Pair-wise comp.	I-III*				
W/H					
Mean ± SD.	0.87±0.04	0.82±0.02	0.90 ± 0.04	43.247*	<0.001*
Min. – Max.	0.78-0.96	0.77-0.89	0.79 – 0.97		
Pair-wise comp.	I-II***,I-III***,II-III***				

Group I: HCV Group II: HCV+ schisto Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
* :Statistically significant at $p \leq 0.05$
***: Statistically significant at $p \leq 0.001$

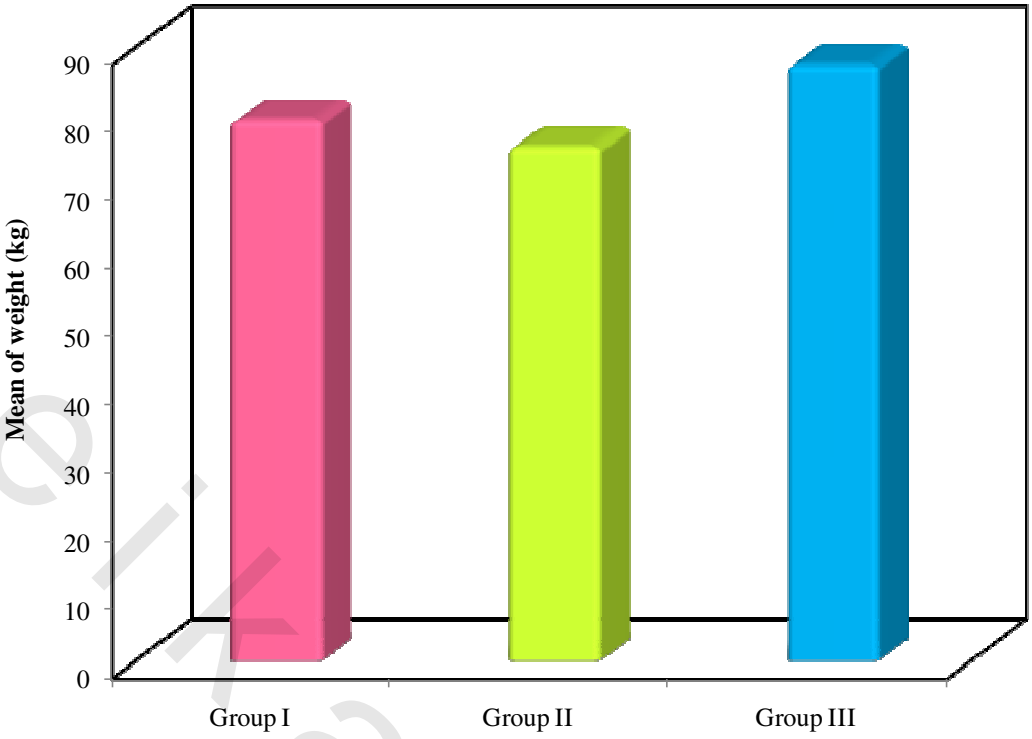

Figure (1): Comparison between the studied groups according to weight

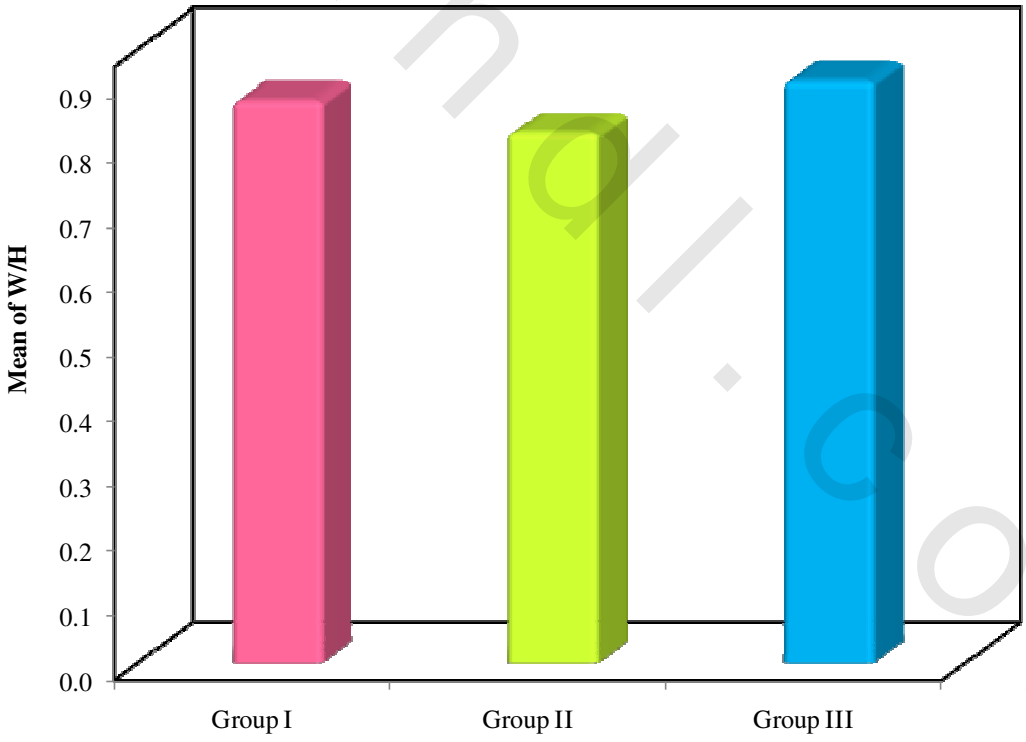

Figure (2): Comparison between the studied groups according to W/H

V- Fat percentage and Body Mass Index:

Table (V) shows Fat percent and Body Mass Index in the different studied groups. The mean Fat percent in Group I was 17.56 % with a standard deviation of 2.74.The minimum Fat percent was 11.80 % and the maximum Fat percent was 24.60 %. The mean Fat percent in Group II was 14.95 % with a standard deviation of 2.91.The minimum Fat percent was 10.40 % and the maximum Fat percent was 25.90 %. The mean Fat percent in Group III was 24.69 % with a standard deviation of 3.41.The minimum Fat percent was 20 % and the maximum Fat percent was 34.80 %. The P-value was 0.001. There was a high statistical difference between the three studied groups according to Fat percent. The highest Fat percent was in the controls and the lowest Fat percent was in Group II. Pair-wise comparison test denotes that there was a difference in the Fat percent, Group I greater than Group II, Group I less than Group III, and Group II less than Group III.

The mean Body Mass Index in Group I was 26.81 with a standard deviation of 5.10.The minimum Body Mass Index was 20.20 and the maximum Body Mass Index was 38.70. The mean Body Mass Index in Group II was 25.94 with a standard deviation of 3.37.The minimum Body Mass Index was 19.0 and the maximum Body Mass Index was 32.70. The mean Body Mass Index in Group III was 29.21 with a standard deviation of 3.79.The minimum Body Mass Index was 23.20 and the maximum Body Mass Index was 37.60. The P-value was 0.008. There was a statistical difference between the three studied groups according to Body Mass Index. The highest Body Mass Index was in the controls and the lowest Body Mass Index was in Group II. Pair-wise comparison test denotes that here was a difference in the Body Mass Index, Group II less than Group III.

Table (V): Fat percent and Body Mass Index of the different studied groups

	Group I (n=31)	**Group II (n=31)**	**Group III (n=31)**	**F**	***P-value***
Fat %					
Mean ± SD.	17.56±2.74	14.95±2.91	24.69±3.41	85.607*	<0.001*
Min. – Max.	11.80-24.60	10.40-25.90	20.0-34.80		
Pair wais comp.	I-II**,I-III***,II-III***				
BMI					
Mean ± SD.	26.81±5.10	25.94±3.37	29.21±3.79	5.1753*	0.008*
Min. – Max.	20.20-38.70	19.0-32.70	23.20-37.60		
Pair wais comp.	II-III*				

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
* :Statistically significant at $p \leq 0.05$
** :Statistically significant at $p \leq 0.01$
***: Statistically significant at $p \leq 0.001$

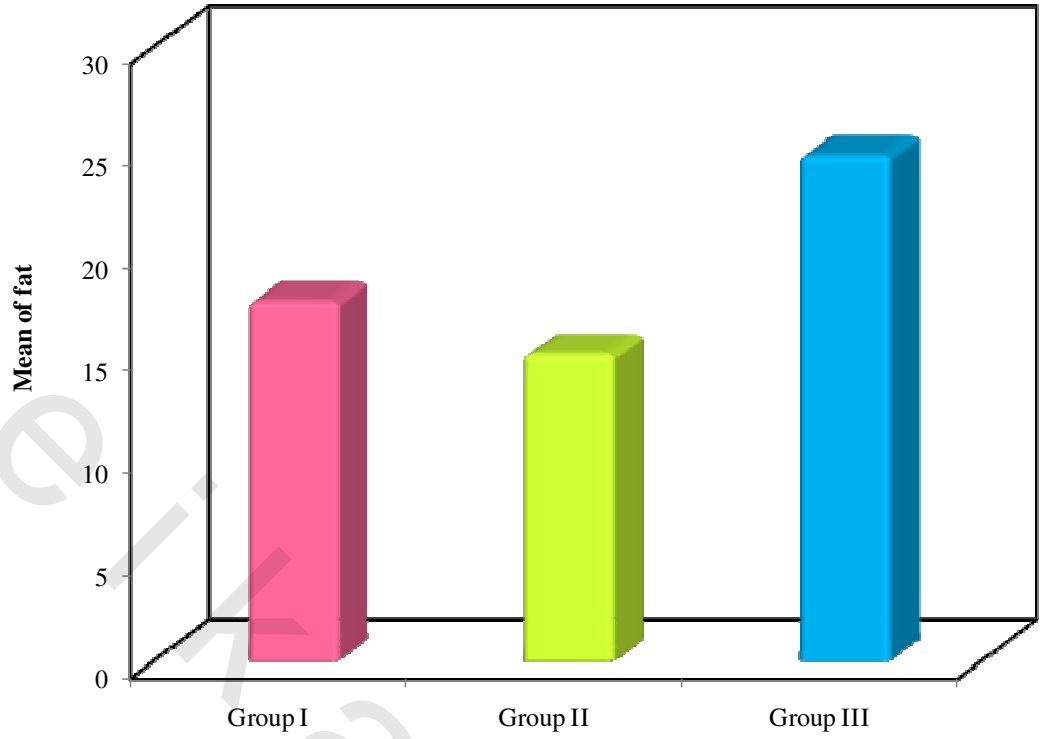

Figure (3): Comparison between the studied groups according to Fat percent

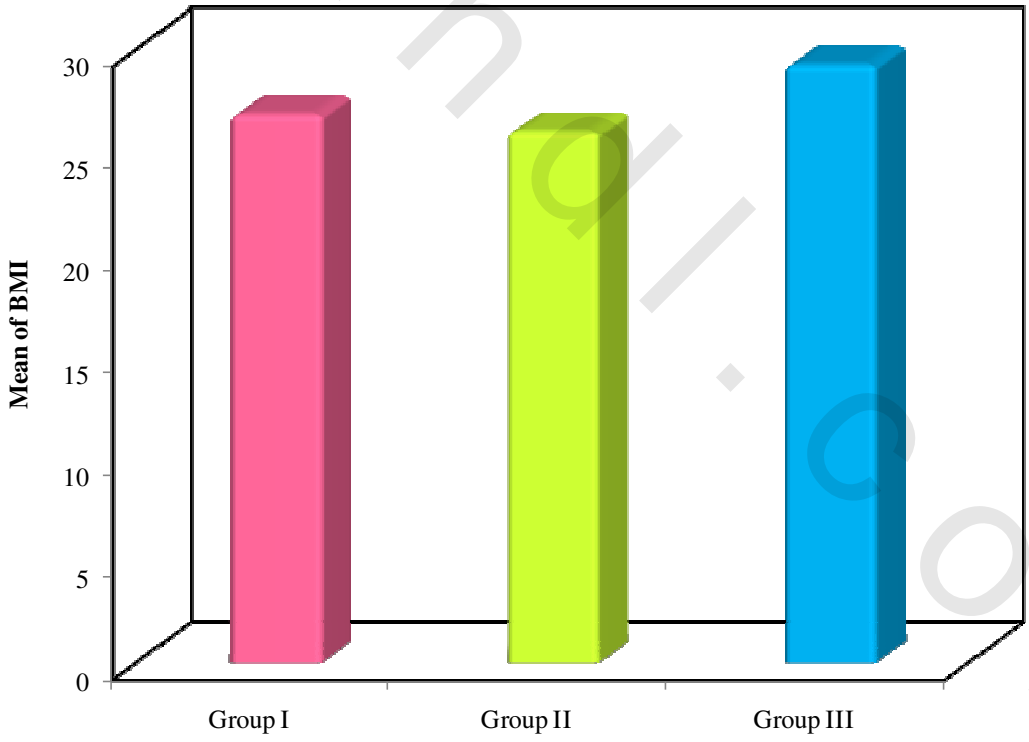

Figure (4): Comparison between the studied groups according to BMI

VI-Complete blood picture:

Table (VI) shows the complete blood picture of the studied groups. In Group I, the mean RBCs count was 4.70 with a standard deviation of 0.32. The minimum RBCs count was 4.20 and the maximum RBCs count was 5.30. In Group II, the mean RBCs count was 4.13 with a standard deviation of 4.90. The minimum RBCs count was 3.70 and the maximum RBCs count was 4.90. In Group III, the mean RBCs count was 5.25 with a standard deviation of 0.24. The minimum RBCs count was 4.80 and the maximum RBCs count was 5.60. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the RBCs count, Group I greater than Group II, Group I less than Group III and Group II less than Group III.

In Group I, the mean hemoglobin concentration was 12.23 gm/dl with a standard deviation of 0.50. The minimum hemoglobin concentration was 11.30 gm/dl and the maximum hemoglobin concentration was 13.20 gm/dl. In Group II, the mean hemoglobin concentration was 11.01 gm/dl with a standard deviation of 0.47. The minimum hemoglobin concentration was 10.30 gm/dl and the maximum hemoglobin concentration was 11.90 gm/dl. In Group III, the mean hemoglobin concentration was 14.33 gm/dl with a standard deviation of 0.55. The minimum hemoglobin concentration was 13.0 gm/dl and the maximum hemoglobin concentration was 15.50 gm/dl. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the hemoglobin concentration, Group I greater than Group II, Group I less than Group III and Group II less than Group III.

In Group I, the mean WBCs count was 6.52 with a standard deviation of 0.85. The minimum WBCs count was 4.50 and the maximum WBCs count was 8.20. In Group II, the mean WBCs count was 6.23 with a standard deviation of 0.80. The minimum WBCs count was 4.90 and the maximum WBCs count was 8.0. In Group III, the mean WBCs count was 6.50 with a standard deviation of 0.89. The minimum WBCs count was 4.50 and the maximum WBCs count was 8.20. The P-value was 0.332. There was no statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the WBCs count, Group I greater than Group II and Group II less than Group III.

In Group I, the mean platelets count was 195.13 with a standard deviation of 33.39. The minimum platelets count was 124.0 and the maximum platelets count was 284.0. In Group II, the mean platelets count was 127.58 with a standard deviation of 14.95. The minimum platelets count was 105.0 and the maximum platelets count was 155.0. In Group III, the mean platelets count was 343.55 with a standard deviation of 37.16. The minimum platelets count was 250.0 and the maximum platelets count was 398.0. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the mean platelets count, Group I greater than Group II, Group I less than Group III and Group II less than Group III.

Table (VI): Comparison between the studied groups according to CBC

	Group I (n=31)	Group II (n=31)	Group III (n=31)	F	*P-value*
RBCs					
Mean ± SD.	4.70±0.32	4.13±0.23	5.25±0.24	139.065*	<0.001*
Min. – Max.	4.20-5.30	3.70-4.90	4.80-5.60		
Pair-wise comp.	I-II***,I-III***,II-III***				
Hb					
Mean ± SD.	12.23±0.50	11.01±0.47	14.33±0.55	334.771*	<0.001*
Min. – Max.	11.30-13.20	10.30-11.90	13.0-15.50		
Pair-wise comp.	I-II***, I-III***,II-III***				
WBCs					
Mean ± SD.	6.52±0.85	6.23 ± 0.80	6.50±0.89	1.117	0.332
Min. – Max.	4.50-8.20	4.90 – 8.0	4.50-8.20		
Pair-wise comp.	I-II**,II-III*				
Platelets					
Mean ± SD.	195.13±33.39	127.58±14.95	343.55±37.16	417.410*	<0.001*
Min. – Max.	124.0-284.0	105.0-155.0	250.0-398.0		
Pair-wise comp.	I-II***, I-III***,II-III***				

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
* :Statistically significant at $p \leq 0.05$
** :Statistically significant at $p \leq 0.01$
***: Statistically significant at $p \leq 0.001$

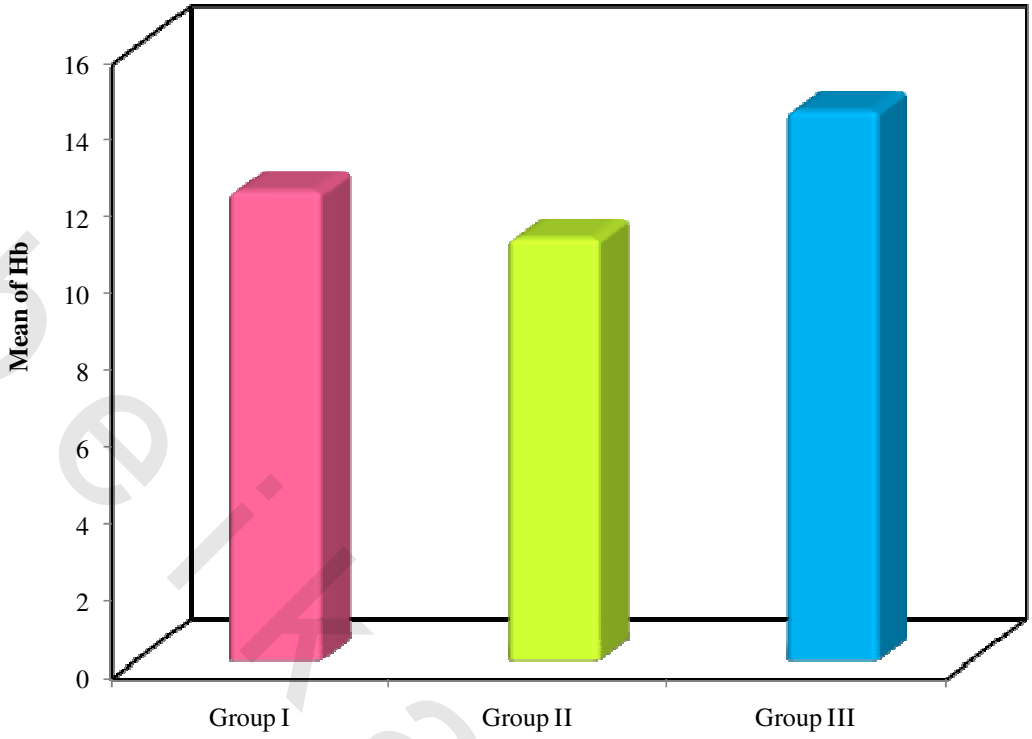

Figure (5): Comparison between the studied groups according to Hb

VII- Liver functions:

Table (VII) shows the liver functions of the studied groups. In Group I, the mean ALT level was 38.19, with a standard deviation of 2.90.The minimum ALT level was 34.0 and the maximum ALT level was 44.0. In Group II, the mean ALT level was 44.48, with a standard deviation of 2.69.The minimum ALT level was 41.0 and the maximum ALT level was 49.0. In Group III, the mean ALT level was 34.42, with a standard deviation of 2.35.The minimum ALT level was 31.0 and the maximum ALT level was 39.0. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the mean ALT level, Group I less than Group II, Group I greater than Group III and Group II greater than Group III.

In Group I, the mean AST level was 38.52, with a standard deviation of 4.07.The minimum AST level was 32.0 and the maximum AST level was 49.0. In Group II, the mean AST level was 45.71, with a standard deviation of 3.33.The minimum AST level was 34.0.0 and the maximum AST level was 49.0. In Group III, the mean AST level was 29.42, with a standard deviation of 2.35.The minimum AST level was 26.0.0and the maximum AST level was 34.0. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the mean AST level, Group I less than Group II, Group I greater than Group III and Group II greater than Group III.

In Group I, the mean Albumin concentration was 3.70 gm/dl, with a standard deviation of 0.25. The minimum Albumin concentration was 3.20 gm/dl and the maximum Albumin concentration was 4.20 gm/dl. In Group II, the mean Albumin concentration was 3.12 gm/dl, with a standard deviation of 0.28. The minimum Albumin concentration was 2.40 gm/dl and the maximum Albumin concentration was 3.60gm/dl. In Group III, the mean Albumin concentration was 4.40 gm/dl, with a standard deviation of 0.14. The minimum Albumin concentration was 4.10 gm/dl and the maximum Albumin concentration was 4.60 gm/dl. The P-value was 0.001. There was high statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the mean Albumin concentration, Group I greater than Group II, Group I less than Group III and Group II less than Group III.

Table (VII): Comparison between the studied groups according to liver functions

	Group I (n=31)	Group II (n=31)	Group III (n=31)	F	*P-value*
ALT					
Mean ± SD.	38.19±2.90	44.48±2.69	34.42±2.35	113.381*	<0.001*
Min. – Max.	34.0-44.0	41.0-49.0	31.0-39.0		
Pair-wise comp.	I-II***, I-III***, II-III***				
AST					
Mean ± SD.	38.52±4.07	45.71±3.33	29.42±2.35	186.748*	<0.001*
Min. – Max.	32.0-49.0	34.0-49.0	26.0-34.0		
Pair-wise comp.	I-II***, I-III***, II-III***				
Albumin					
Mean ± SD.	3.70±0.25	3.12±0.28	4.40±0.14	238.190*	<0.001*
Min. – Max.	3.20-4.20	2.40-3.60	4.10-4.60		
Pair-wise comp.	I-II***, I-III***, II-III***				

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
* :Statistically significant at $p \leq 0.05$
***: Statistically significant at $p \leq 0.001$

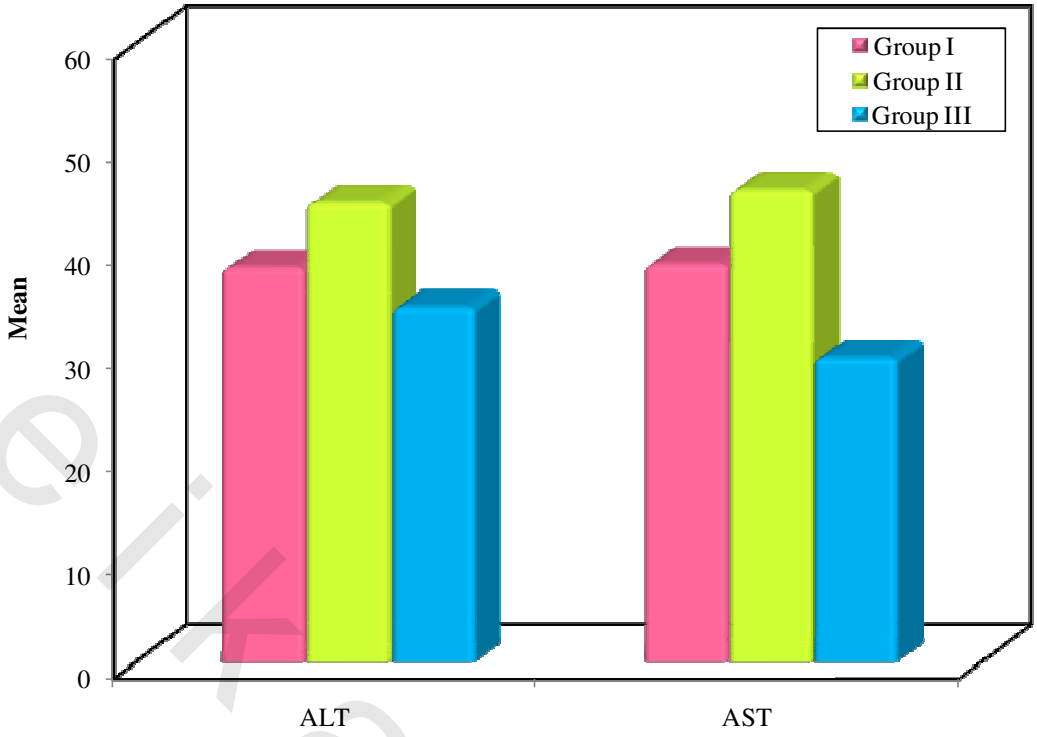

Figure (6): Comparison between the studied groups according to ALT and AST

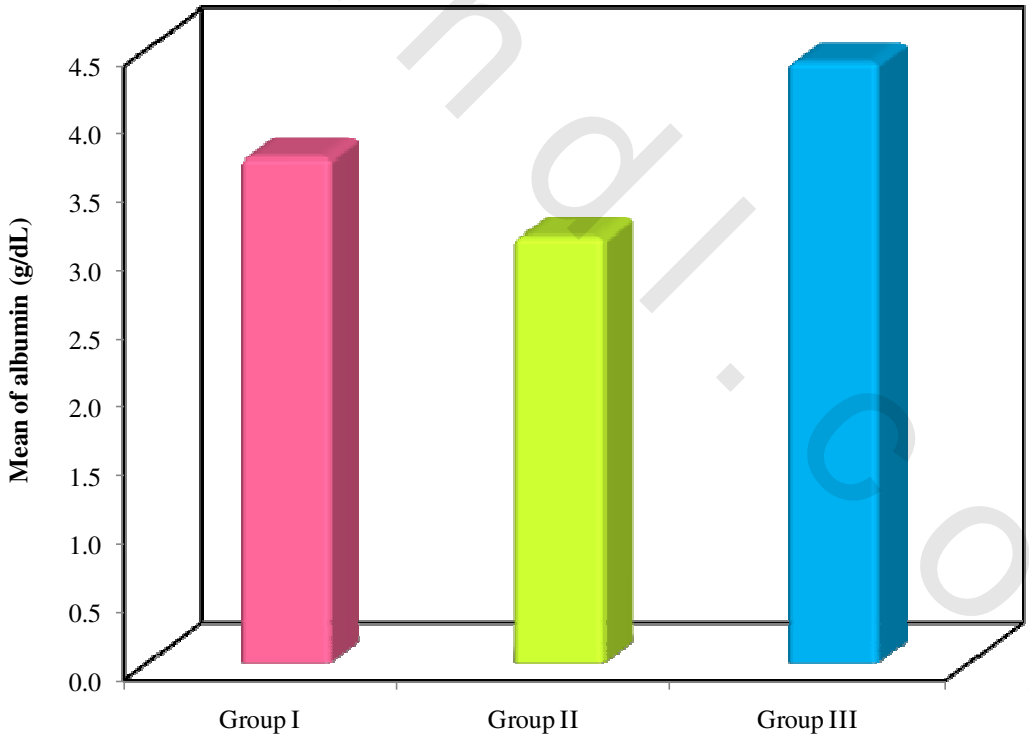

Figure (7): Comparison between the studied groups according to Albumin

VIII- Lipid profile:

Table (VIII) shows the lipid profile of the studied groups. In Group I, the mean Cholesterol concentration was 143.94 mg/dl, with a standard deviation of 31.04.The minimum Cholesterol concentration was 84.0 mg/dl and the maximum Cholesterol concentration was 210.0 mg/dl. In Group II, the mean Cholesterol concentration was 143.42 mg/dl, with a standard deviation of 20.17.The minimum Cholesterol concentration was 110.0 mg/dl and the maximum Cholesterol concentration was 190.0 mg/dl. In Group III, the mean Cholesterol concentration was 142.87 mg/dl, with a standard deviation of 31.95.The minimum Cholesterol concentration was 90.0 mg/dl and the maximum Cholesterol concentration was 197.0 mg/dl. P-value was 0.989. There was no statistical difference between the three studied groups.

In Group I, the mean Triglycerides concentration was 118.13 mg/dl, with a standard deviation of 31.92.The minimum Triglycerides concentration was 78.0 mg/dl and the maximum Triglycerides concentration was 200 mg/dl. In Group II, the mean Triglycerides concentration was 118.42 mg/dl, with a standard deviation of 35.01.The minimum Triglycerides concentration was 68.0 mg/dl and the maximum Triglycerides concentration was 187 mg/dl. In Group III, the mean Triglycerides concentration was 132.61 mg/dl, with a standard deviation of 42.12.The minimum Triglycerides concentration was 64 mg/dl and the maximum Triglycerides concentration was 220 mg/dl. P-value was 0.210. There was no statistical difference between the three studied groups.

Table (VIII): Comparison between the studied groups according to lipid profile

	Group I (n=31)	**Group II (n=31)**	**Group III (n=31)**	**F**	***P-value***
Cholesterol					
Mean ± SD.	143.94±31.04	143.42±20.17	142.87±31.95	0.011	0.989
Min. – Max.	84.0-210.0	110.0-190.0	90.0-197.0		
Triglycerides					
Mean ± SD.	118.13±31.92	118.42±35.01	132.61±42.12	1.586	0.210
Min. – Max.	78.0 – 200.0	68.0-187.0	64.0-220.0		
Pair-wise comp.	II-III**				

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
**: Statistically significant at $p \leq 0.01$
* :Statistically significant at $p \leq 0.05$

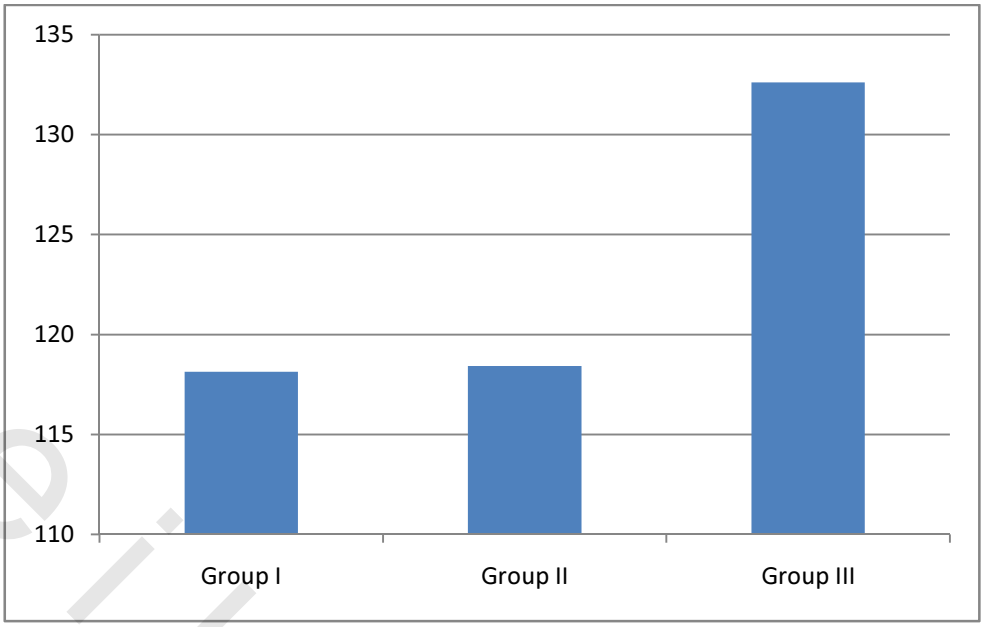

Figure (8): Comparison between the studied groups according to the mean Cholesterol concentration.

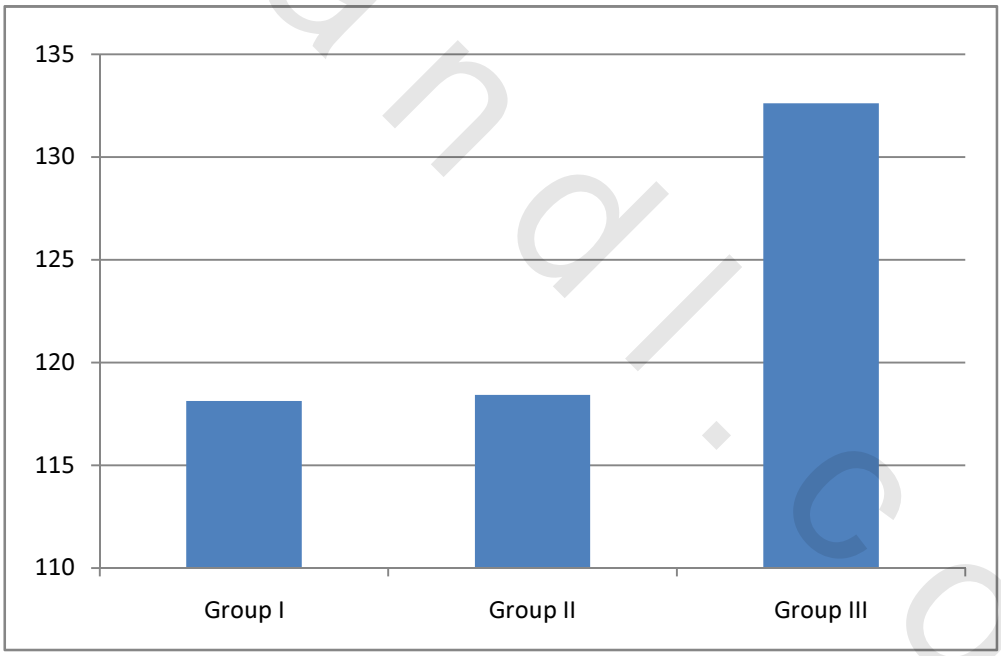

Figure (9): Comparison between the studied groups according to the mean Triglycerides concentration

IX- Leptin level:

Table (IX) shows the Leptin profile of the studied groups In Group I, the mean Leptin level was 5.54 ng/dl, with a standard deviation of 2.34.The minimum Leptin level was 2.90 ng/dl and the maximum Leptin level was 13.0 dl. In Group II, the mean Leptin level was 6.18 ng/dl, with a standard deviation of 1.88.The minimum Leptin level was 3 ng/dl and the maximum Leptin level was 13.0 dl. In Group III, the mean Leptin level was 4.31 ng/dl, with a standard deviation of 2.61. The minimum Leptin level was 0.50 ng/dl and the maximum Leptin level was 11.30dl. P-value was 0.007. There was a statistical difference between the three studied groups. Pair-wise comparison test denotes that here was a difference in the mean Leptin level, Group II greater than Group III.

Table (IX): Comparison between the studied groups according to Leptin level:

	Group I (n=31)	Group II (n=31)	Group III (n=31)	F	*P-value*
Leptin					
Mean ± SD.	5.54±2.34	6.18 ± 1.88	4.31 ± 2.61	5.317*	0.007*
Min. – Max.	2.90-13.0	3.0 – 13.0	0.50 – 11.30		
Pair-wise comp.	II-III**				

Group I: HCV
Group II: HCV+ schisto
Group III: Control
F: F test (ANOVA)
Pair-wise comparison was done using Post Hoc Test (Scheffe)
**: Statistically significant at $p \leq 0.01$
* :Statistically significant at $p \leq 0.05$

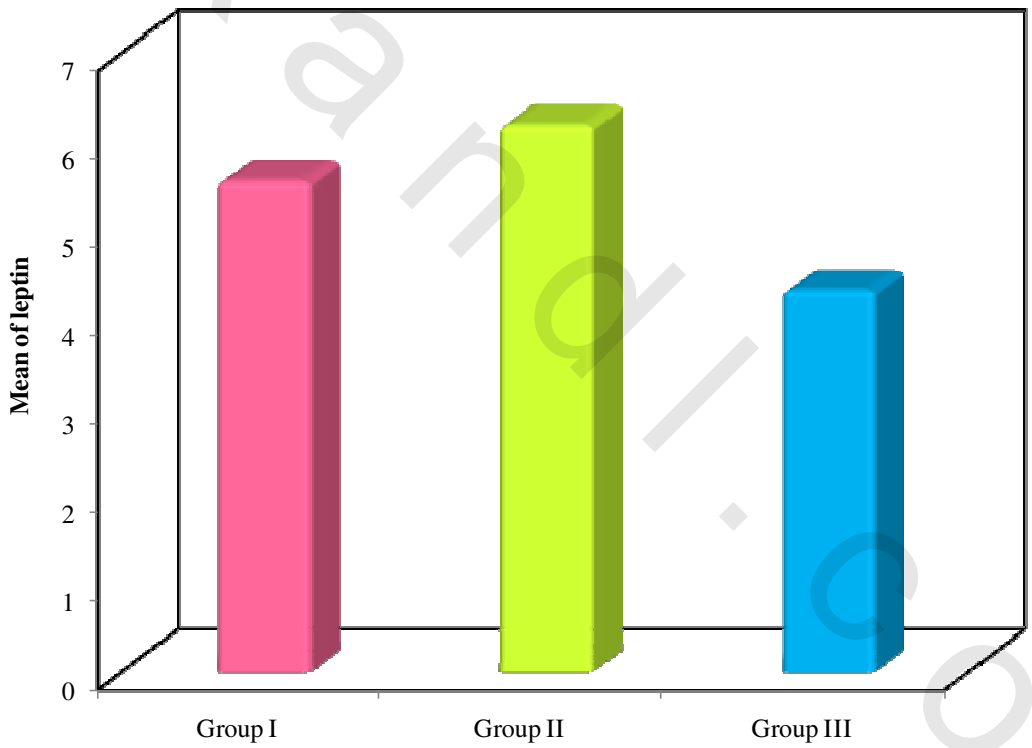

Figure (10): Comparison between the studied groups according to Leptin level

X- Nutritional Correlations:

Table (X)-Table (XV) shows the nutritional correlation between different studied parameters in each studied group In Group I, there was a positive correlation between Body Mass Index versus Waist circumference, with r-value = 0.672 and p-value = 0.001.In Group III, there was positive correlation between Fat percent versus waist circumference, with r-value = 0.519 and p-value = 0.003, a positive correlation between Body Mass Index versus Waist circumference, with r-value = 0.806 and p-value = 0.001, and a positive correlation between Body Mass Index versus Fat percent, with r-value = 0.685 and p-value = 0.001**.**In Group II, there was a positive correlation between waist versus height with r-value = 0.537 and p-value = 0.002.

Table (X): Correlation between different studied parameters in each studied group:

	Group I		Group II		Group III	
	r	**p**	**r**	**p**	**r**	**p**
Fat vs Waist	0.072	0.701	-0.005	0.981	0.519*	0.003
BMI vs Waist	0.672*	<0.001*	0.344	0.058	0.806*	<0.001
BMI vs Fat	0.233	0.208	0.100	0.592	0.685*	<0.001
Height vs Waist	0.191	0.303	0.537*	0.002	0.344	0.058

r: Pearson coefficient
*: Statistically significant at $p \leq 0.05$

Table (XI): Correlation between Fat percent with Waist in group III:

	Group III	r	*P*-value
Waist			
Mean ± SD.	100.87±8.92	0.519*	0.003
Min. – Max.	85.0-118.0		
Fat %			
Mean ± SD.	24.69±3.41	0.519*	0.003
Min. – Max.	20.0-34.80		

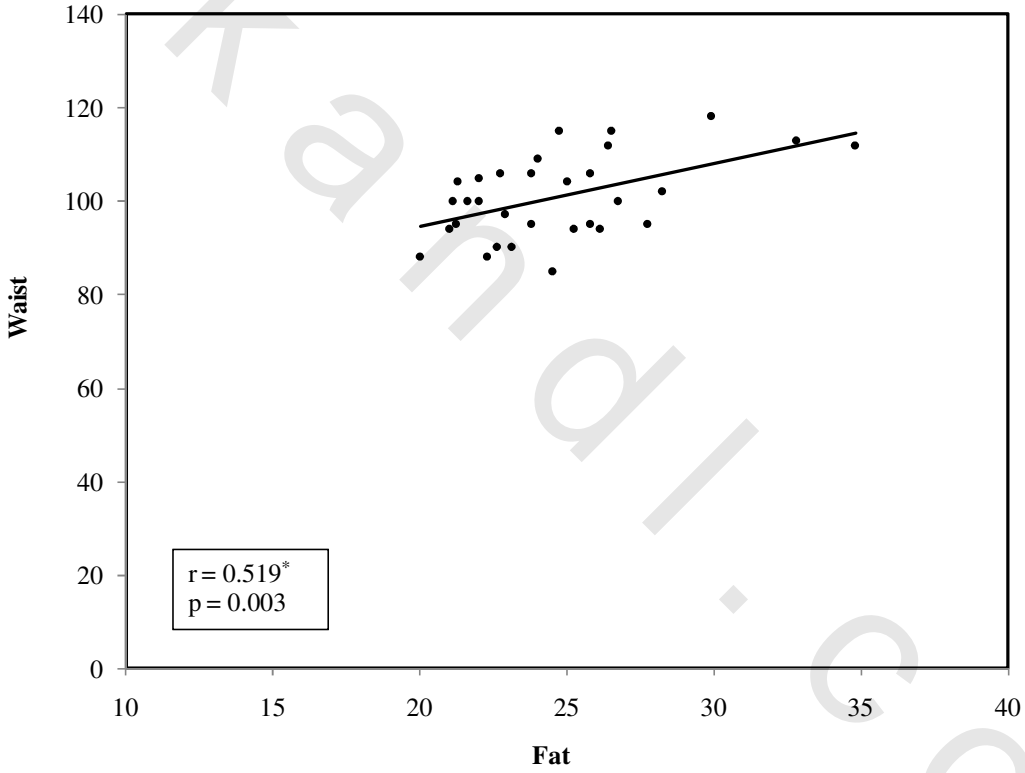

Figure (11): Correlation between Fat percent with Waist in group III

Table (XII): Correlation between BMI with waist in group I:

	Group I	r	*P*-value
Waist			
Mean ± SD.	91.65±8.50	0.672*	<0.001*
Min. – Max.	77.0-111.0		
BMI			
Mean ± SD.	26.81±5.10	0.672*	<0.001*
Min. – Max.	20.20-38.70		

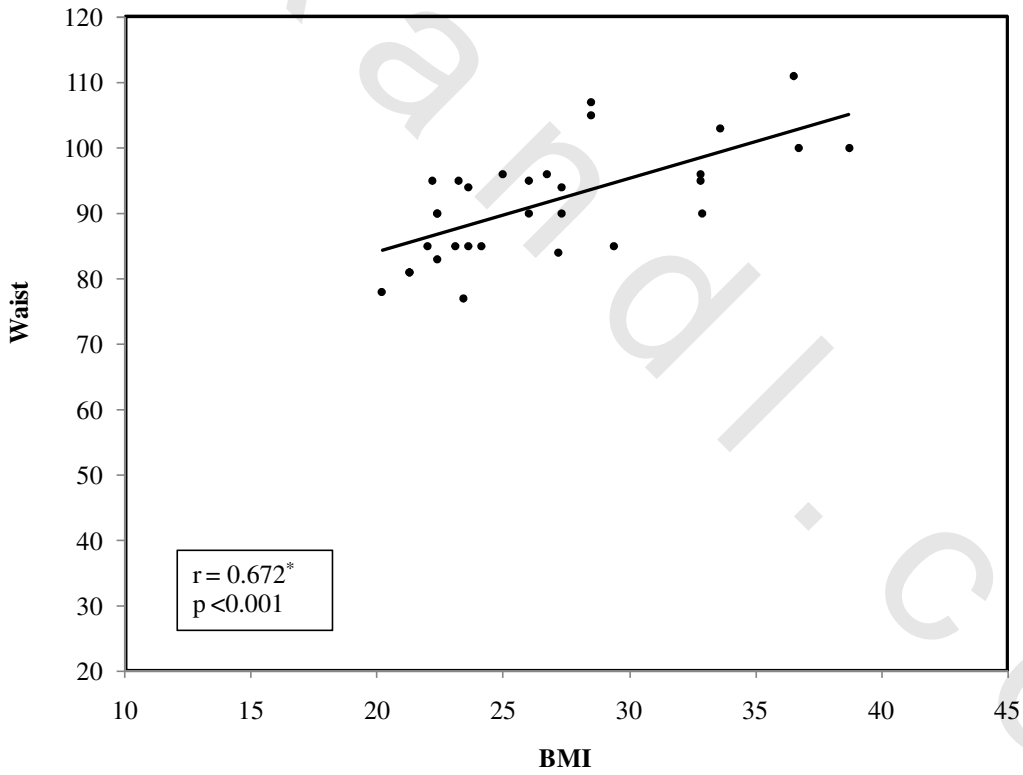

Figure (12): Correlation between BMI with waist in group I

Table (XIII): Correlation between BMI with Waist in group III:

	Group III	r	*P*-value
Waist			
Mean ± SD.	100.87±8.92	0.806*	<0.001*
Min. – Max.	85.0-118.0		
BMI			
Mean ± SD.	29.21±3.79	0.806*	<0.001*
Min. – Max.	23.20-37.60		

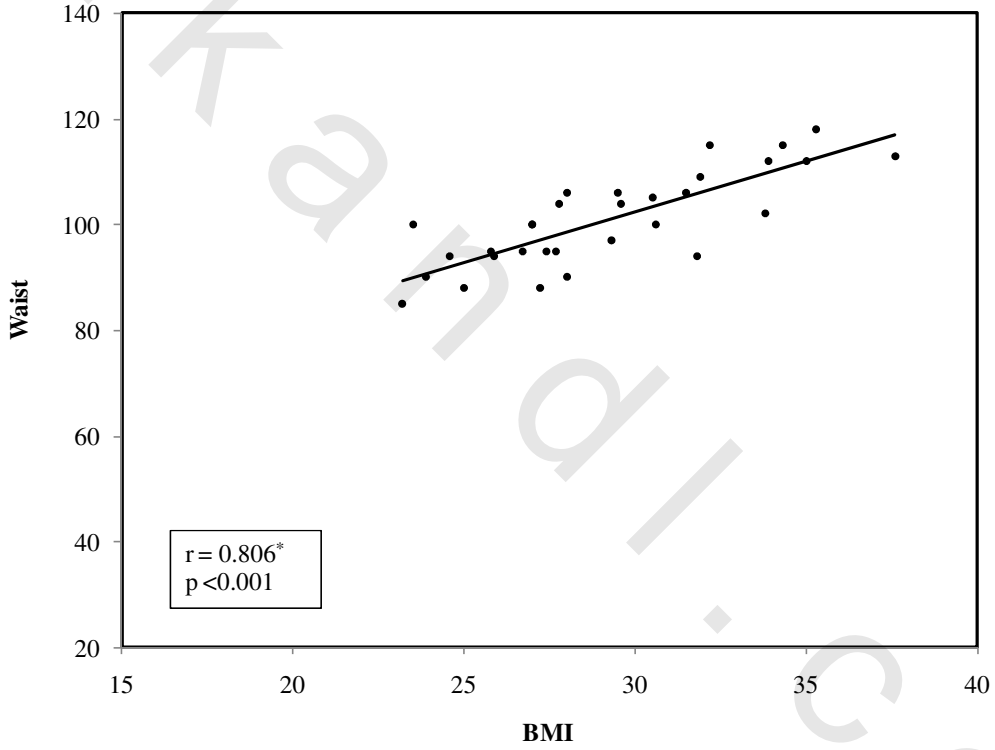

Figure (13): Correlation between BMI with Waist in group III

Table (XIV): Correlation between BMI with Fat percent in group III:

	Group III	r	*P*-value
Fat %			
Mean ± SD.	24.69±3.41	0.685*	<0.001*
Min. – Max.	20.0-34.80		
BMI			
Mean ± SD.	29.21±3.79	0.685*	<0.001*
Min. – Max.	23.20-37.60		

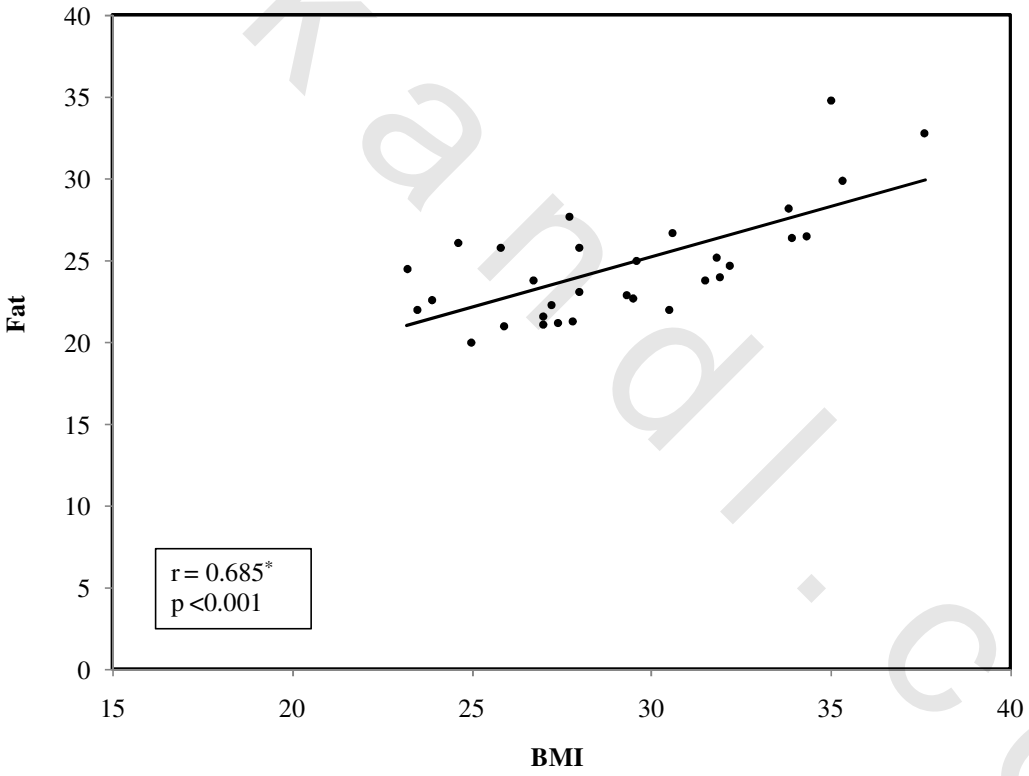

Figure (14): Correlation between BMI with Fat percent in group III

Table (XV): Correlation between waist and height in group II:

	Group II	r	*P*-value
Waist			
Mean ± SD.	88.29±5.14	0.537*	0.002
Min. – Max.	80.0-99.0		
Height			
Mean ± SD.	170.71±7.57	0.537*	0.002
Min. – Max.	155.0-189.0		

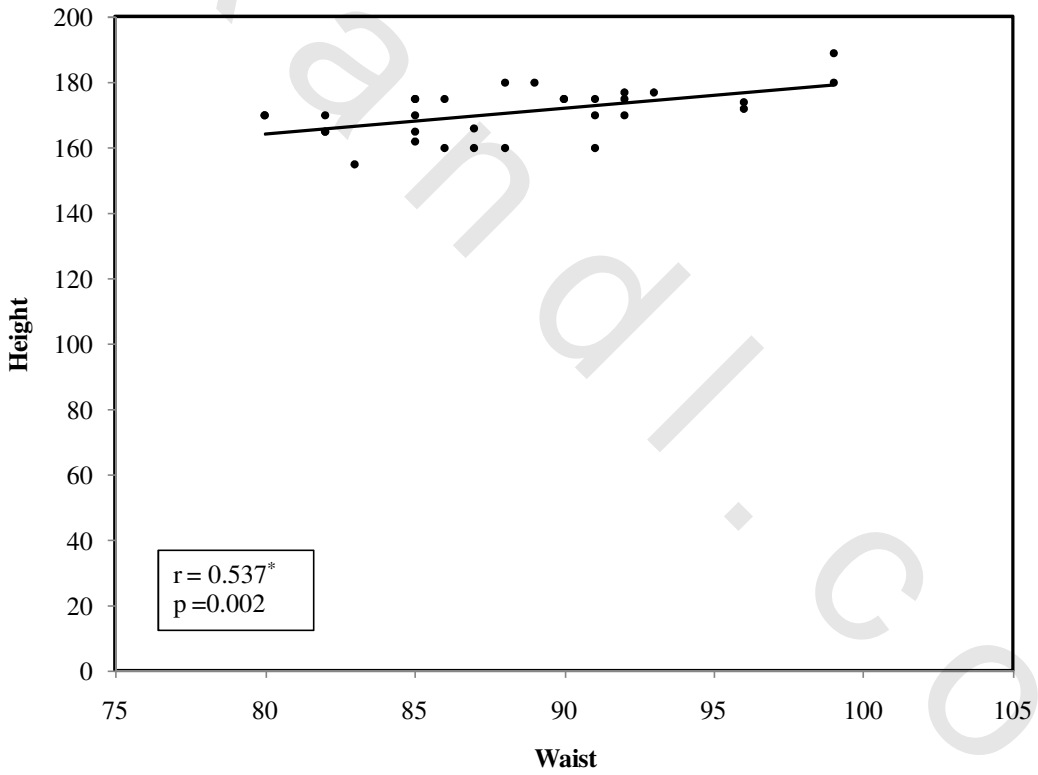

Figure (15): Correlation between waist and height in group II