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Original article

The impact of various diets on HDL levels and body weight

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Abstract

Obesity represents a global epidemic with serious implications in public health due to its increasing prevalence and its known association with a high morbidity and mortality burden. Obesity is a gateway to ill health, and it has become one of the leading causes of disability and death, affecting not only adults but also children and adolescents worldwide. Diets continue to be the most often used option and some of the most significant clinical therapies for obesity. The present study was designed to find which is more effective in decreasing body weight, whether complete carbohydrate deprivation or decreasing the quantity of food intake to half the content or minimal dose HCG intake.24 Rats were divided randomly into 4 equal groups (Male and Female): Normal control group, Low caloric group, Maximal CHO deprivation group, HCG small dose group. All groups show significant improvement in Body Weight, and serum HDL especially those for low-caloric diets.

1. Introduction:

When energy input (nutrient intake) consistently matches energy output (energy expenditure and energy waste), the organism is in a condition of energy balance, allowing for the maintenance of body weight mass. Some people can more easily maintain their body weight even over the course of a lifetime than others, but some people are more likely to acquire or lose a significant amount of weight, even in shorter periods of time [1].

Multiple factors can influence the development of obesity. Genetic make-up, financial standing, and cultural influences are only a few examples of the intricate relationships between biological, psychological, and behavioural components. In addition to these factors, the development of obesity has also been connected to microbes, epigenetics, advanced maternal age, insufficient sleep, endocrine disruptors, pharmaceutical iatrogenesis, comorbid disorders, and their therapies [2].

There are significant health hazards connected with obesity. The risk of consequences from obesity, such as coronary heart disease and end-stage renal disease, is further increased by severe obesity. Adults with severe obesity had an age-adjusted prevalence of 9.2%, which was greater in women than in men [3].

The main tenets of comprehensive lifestyle change, such as food, exercise, and behaviour therapy, are discussed in the guidelines for managing overweight and obesity in adults. Researchers are currently working to make lifestyle change more accessible by offering it through community-based initiatives and online platforms (e.g., Internet and Smartphone) [4].

To treat adult obesity, a variety of dietary strategies with various calorie and macronutrient compositions have been suggested. Although their effectiveness and safety profile have been evaluated in multiple reviews, meta-analyses, and randomised clinical studies, the best nutritional weight reduction strategy's qualities are still up for debate [5].

Human Chorionic Gonadotropin (HCG) is part of the glycoprotein hormone family and an important biomarker for the detection of pregnancy and its related disorders. The HCG diet is a popular weight loss plan that has received a lot of promotion. However, there is little proof that the HCG diet reduces hunger or changes how fat is distributed [6].

The ideal diet for treating obesity should, as a general rule, be secure, effective, healthful, and nutritionally adequate, as well as socially and culturally acceptable and reasonably priced. It should also guarantee long-term compliance and maintenance of weight loss.

The aim of the current study is to find which is more effective in decreasing body weight whether complete carbohydrate deprivation, or minimal dose HCG intake or decreasing the quantity of food intake to half the content and

to find the effect of the three mechanisms on the serum HDL level and the mechanisms by which they act to decrease body weight.

2. Materials And Methods:

2.1 Experimental Animals

Twenty- four adult male and female albino rats, eight weeks of age, weighing 150 ± 10 g were used in the current study. Rats were obtained from the animal house of Kasr Al Aini Faculty of Medicine, Cairo University, Egypt.

Rats were kept under observation for about 15 days before the onset of the experiment for adaptation and to exclude any inter-current infection. They were housed in plastic cages (three per cage) with well-aerated covers at normal temperature (25±5°C) with 12 hours light/dark cycles. Rats were given free water access and supplied daily with laboratory rat diet.

All protocols used were approved by the Beni-Suef University Ethical Committee and were conducted in accordance with National Institutes of Health Guidelines for the Care and Use of Laboratory Animals.

Approval number 012.129

2.2 Induction of obesity

Obesity was induced in the rats of this study by hypercholesterolemic diet for six weeks [7]. Rats were fed the standard commercial rodent chow, high fat (synthetic semi-purified diet with 40% of the calories from fat, primarily butter fat) (200 g /day) for induction of obesity [8].

2.3 Animals Grouping

The considered rats were divided into four groups containing six animals for each. These groups were:

1) The normal control group (Group I)

The rats in this group were given a normal rat diet composed of casein (15%), cotton seed oil (10%), salt mixture (4%), vitamin mixture (1%), cellulose (5%) and corn starch (65%) El Gomhorya Company for 4 weeks [9].

Rats were given injected equivalent volume of the vehicles daily for four weeks and kept under the same laboratory conditions and were regarded as normal control group for other ones. Rats were divided into 2 sub-groups as follows:

Group Ia (Male rats): It includes 3 male rats.

Group Ib (Female rats): It includes 3 female rats.

2) Low caloric group (Group II)

The rats of this group were giving 100g/day (50% reduction of the daily amount fed) (high fat & carbs but reduce the amount to half) for 4 weeks [10]. Rats were given injected equivalent volume of the vehicles daily for four weeks and kept under the same laboratory conditions. Rats were divided into 2 sub-groups as follows:

Group IIa (Male rats): It includes 3 male rats.

Group IIb (Female rats): It includes 3 female rats.

3) Maximal CHO deprivation group (Group III)

Rats were fed the standard commercial rodent chow, high fat (synthetic semi-purified diet with 40% of the calories from fat, primarily butter fat) (200 g /day) for induction of obesity [8]. Rats were given injected equivalent volume of the vehicles daily for four weeks and kept under the same laboratory conditions. Rats were divided into 2 sub-groups as follows:

Group IIIa (Male rats): It includes 3 male rats

Group IIIb (Female rats): It includes 3 female rats.

4) HCG small dose group (Group IV)

The rats in this group were injected with 5 IU/day of HCG (Choriomon 5000 U.I) for 4 weeks [11]. Rats were divided into 2 sub-groups as follows:

Group IVa (Male rats): It includes 3 male rats.

Group IVb (Female rats): It includes 3 female rats.

The blood samples were collected retro-orbitally at the end of 6 th and 10 th week then centrifuged at 3000 rpm for 15 minutes, and serum was separated and stored at -20o C. The serum was divided into different tubes for further determination of biochemical markers.

2.4 Experimental Studies

a- Detection of the weight of the rats:

At the end of the experimental period, the weight of rats was measured. The measurements were taken (on the 6 th and 10 th week).

b- Rat Serum High density lipoprotein (HDL) ELISA Kit:

Serum HDL level was assessed by HDL (ELISA) kits according to [12].

3. Results:

Twenty-four rats were divided into four groups as follows:

1. The normal control group (Group I): Rats were divided into 2 sub-groups as follows:

Group Ia (Male rats): It includes 3 male rats.

Group Ib (Female rats): It includes 3 female rats.

2. Low caloric group (Group II): Rats were divided into 2 sub-groups as follows:

Group IIa (Male rats): It includes 3 male rats.

Group IIb (Female rats): It includes 3 female rats.

3. Maximal CHO deprivation group (Group III): Rats were divided into 2 sub-groups as follows:

Group IIIa (Male rats): It includes 3 male rats

Group IIIb (Female rats): It includes 3 female rats.

4. HCG small dose group (Group IV): Rats were divided into 2 sub-groups as follows :

Group IVa (Male rats): It includes 3 male rats.

Group IVb (Female rats): It includes 3 female rats.

1. Effect on weight

In male rats:

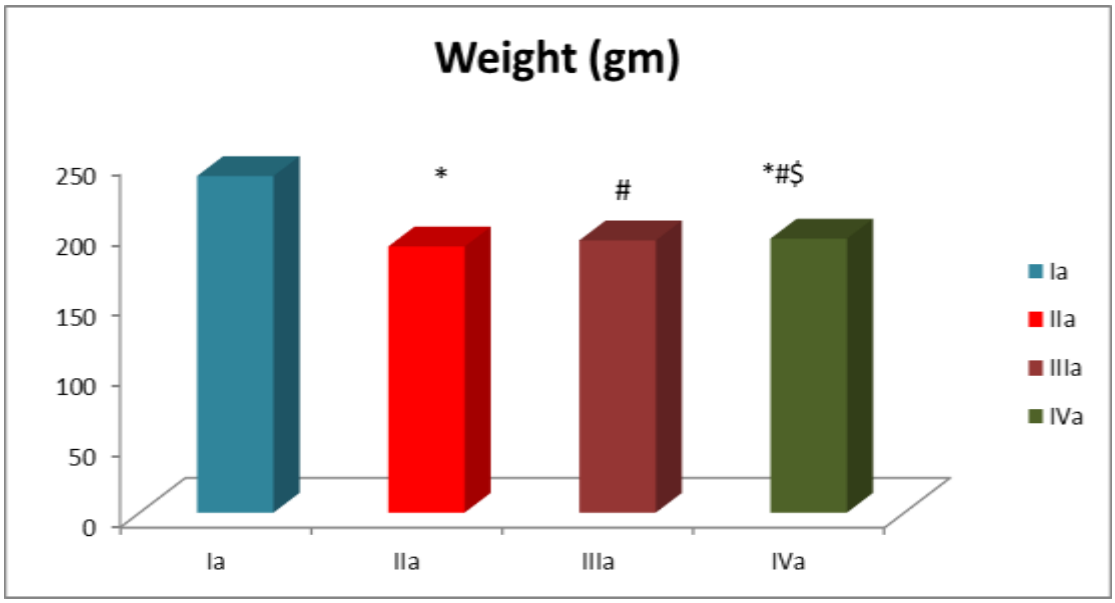
As shown in table (1) and figure (1), the results show significant decrease ($P<0.05$) in weight (gm) in group IIa (Low caloric group)

by -20.95 % when compared with group Ia (control group) .

Also, there was a significant decrease (P<0.05) in weight (gm) in group IIIa (Maximal CHO deprivation group) by -19.13 % when compared with group Ia (control group) .

In addition, there was a significant decrease (P<0.05) in weight (gm) in group IVa (HCG small dose group) by -18.59 % when compared with group Ia (control group).

Figure 1: Effect of treatment on weight in male groups.



**: statistically significant compared to corresponding value in Ia group (P<0.05)*
#: statistically significant compared to corresponding value in IIa group (P<0.05)
$: statistically significant compared to corresponding value in IIIa group (P<0.05)

Table 1: Effect of treatment on male groups.

	Ia	IIa	% Change	IIIa	% Change	Iva	% Change
Weight (gm)	238.66± 0.98	188.66± 1.28 *	-20.95%	193±0.92 *#	-19.13%	194.3±1.52 *#	-18.59%
HDL (mg/dl)	39.40± 0.62	56.39± 0.27 *	+43.12%	49.90±0.21 *#	+26.65%	55.60±0.87 *$	+41.12%

Values are presented as mean ±SD
**: statistically significant compared to corresponding value in Ia group (P<0.05)*
#: statistically significant compared to corresponding value in IIa group (P<0.05)
$: statistically significant compared to corresponding value in IIIa group (P<0.05)

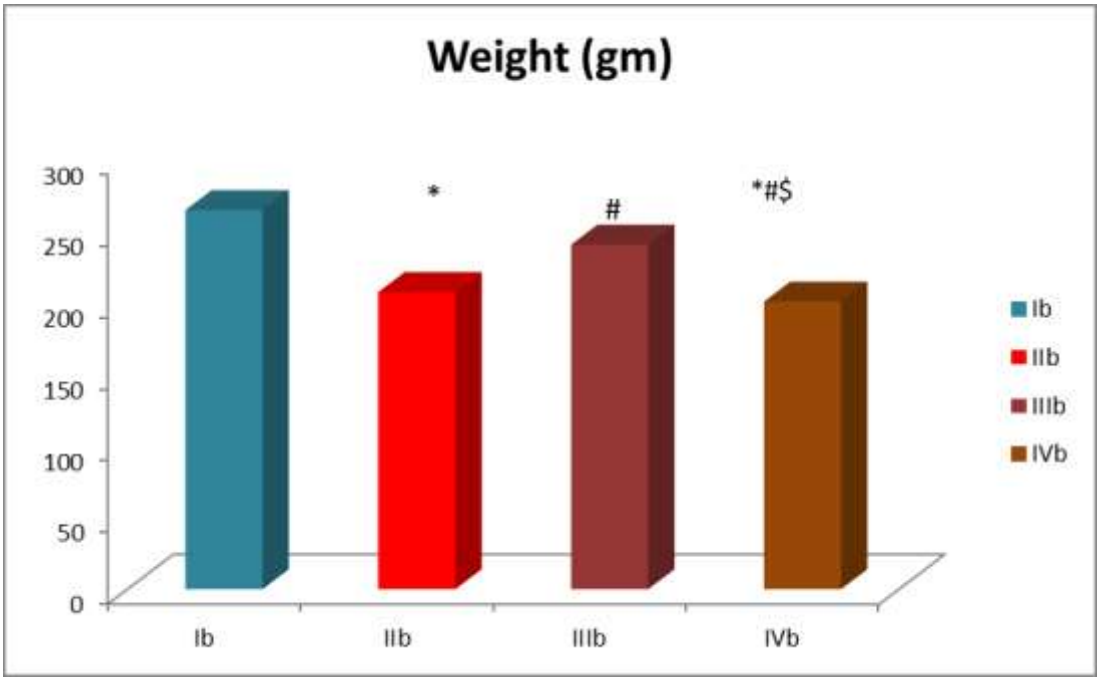
In female rats:

As shown in table (2) and figure (2), the results show significant decrease (P<0.05) in weight (gm) in group IIb (Low caloric group) by -21.63%when compared with group Ib (control group) .

Also, there was a significant decrease (P<0.05) in weight (gm) in group IIIb (Maximal CHO deprivation group) by -9.12 % when compared with group Ib (control group) .

In addition, there was a significant decrease (P<0.05) in weight (gm) in group IVb (HCG small dose group) by -24.15 % when compared with group Ib (control group).

Figure 2: Effect of treatment on weight in female groups.



**: statistically significant compared to corresponding value in Ib group (P<0.05)*
#: statistically significant compared to corresponding value in IIb group (P<0.05)
$: statistically significant compared to corresponding value in IIIb group (P<0.05)

Table 2: Effect of treatment on female groups.

	Ib	IIb	% Change	IIIb	% Change	IVb	% Change
Weight (gm)	264.56±0.98	207.33±1.54 *	-21.63%	240.44±0.66 *#	-9.12%	200.66±2.93 *#$	-24.15%
HDL (mg/dl)	55.29±0.18	38.41±0.21 *	-30.53%	55.96±0.99 #	+1.21%	38.89±0.09 *$	-29.66%

Values are presented as mean ±SD
**: statistically significant compared to corresponding value in Ib group (P<0.05)*
#: statistically significant compared to corresponding value in IIb group (P<0.05)
$: statistically significant compared to corresponding value in IIIb group (P<0.05)

Male Versus Female group

As shown in table (3) in (control group), Female group (Ib) show significant increase (P<0.05) in weight (gm) when compared with Male group (Ia).

As shown in table (4) in (Low caloric group), Female group (IIb) show significant increase (P<0.05) in weight (gm) when compared with Male group (IIa) .

As shown in table (5) in (Maximal CHO deprivation group), Female group (IIIb) show significant increase (P<0.05) in weight (gm) when compared with Male group (IIIa) .

As shown in table (6) in (HCG small dose group), Female group (IVb) show significant increase (P<0.05) in weight (gm) when compared with Male group (IVa).

Table 3: Male versus Female in control group.

	Ia	Ib
Weight (gm)	238.66± 0.98	264.56± 0.98 *
HDL (mg/dl)	39.40± 0.62	55.29± 0.18 *

Values are presented as mean ±SD

*: statistically significant compared to corresponding value in Ia group (P<0.05)

Table 4: Male versus Female in Low caloric group.

	IIa	IIb
Weight (gm)	188.66± 1.28	207.33± 1.54 #
HDL (mg/dl)	56.39± 0.27	38.41± 0.21 #

Values are presented as mean ±SD

#: statistically significant compared to corresponding value in II a group (P<0.05)

Table 5: Male versus Female in Maximal CHO deprivation group.

	IIIa	IIIb
Weight (gm)	193± 0.92	240.44± 0.66 $
HDL (mg/dl)	49.90± 0.21	55.96± 0.99 $

Values are presented as mean ±SD

$: statistically significant compared to corresponding value in III a group (P<0.05)

Table 6: Male versus Female in HCG small dose group.

	IVa	IVb
Weight (gm)	194.3± 1.52	200.66± 2.93 @
HDL (mg/dl)	55.60± 0.87 *$	38.89± 0.09 @

Values are presented as mean ±SD

@: statistically significant compared to corresponding value in IV a group (P<0.05)

2. Effect on serum HDL (high density lipoprotein) level

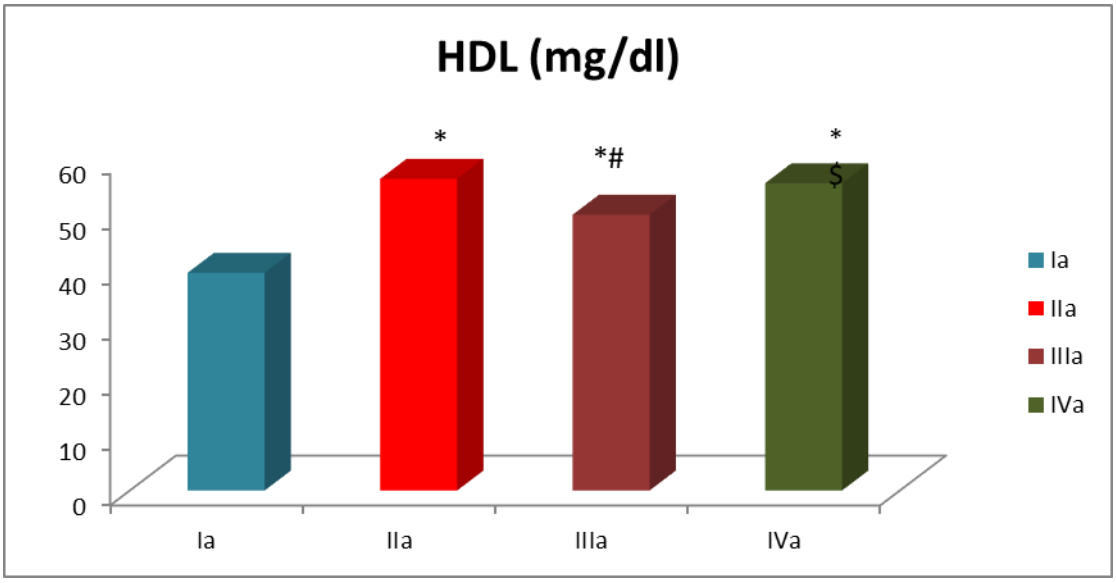
In male rats:

As shown in table (1) and figure (3), the results show significant increase (P<0.05) in HDL serum level (mg/dl) in group IIa (Low caloric group) by +43.12 % when compared with group Ia (control group) .

Also, there was a significant increase (P<0.05) in HDL serum level (mg/dl) in group IIIa (Maximal CHO deprivation group) by +26.65 % when compared with group Ia (control group).

In addition, there was a significant increase (P<0.05) in HDL serum level (mg/dl) in group IVa (HCG small dose group) by +41.12 % when compared with group Ia (control group).

Figure 3: Effect of treatment on HDL serum level in male groups.



**: statistically significant compared to corresponding value in Ia group (P<0.05)*
#: statistically significant compared to corresponding value in IIa group (P<0.05)
$: statistically significant compared to corresponding value in IIIa group (P<0.05)

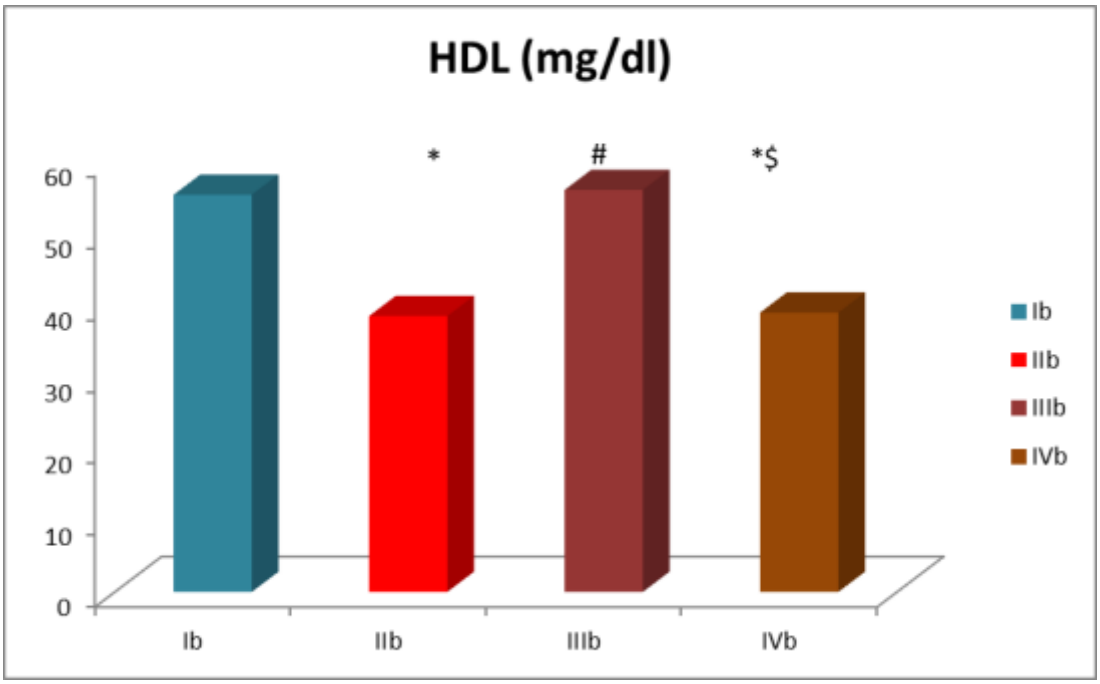
In female rats:

As shown in table (2) and figure (4), the results show significant decrease (P<0.05) in HDL serum level (mg/dl) in group IIb (Low caloric group) by -30.53 % when compared with group Ib (control group) .

Also, there was a significant increase (P<0.05) in HDL serum level (mg/dl) in group IIIb (Maximal CHO deprivation group) by +1.21 % when compared with group Ib (control group).

In addition, there was a significant decrease (P<0.05) in HDL serum level (mg/dl) in group IVb (HCG small dose group) by -29.66 % when compared with group Ib (control group).

Figure 4: Effect of treatment on HDL serum level in female groups.



**: statistically significant compared to corresponding value in Ib group (P<0.05)*
#: statistically significant compared to corresponding value in IIb group (P<0.05)
$: statistically significant compared to corresponding value in IIIb group (P<0.05)

Male versus Female group

As shown in table (3) in (control group), Female group (Ib) show significant increase (P<0.05) in HDL serum level (mg/dl) when compared with Male group (Ia).

As shown in table (4) in (Low caloric group), Female group (IIb) show significant decrease (P<0.05) in HDL serum level (mg/dl) when compared with Male group (IIa).

As shown in table (5) in (Maximal CHO deprivation group), Female group (IIIb) show significant increase (P<0.05) in HDL serum level (mg/dl) when compared with Male group (IIIa).

As shown in table (6) in (HCG small dose group), Female group (IVb) show significant decrease (P<0.05) in HDL serum level (mg/dl) when compared with Male group (IVa).

4. Discussion:

The accumulation of excess body fat causes obesity, a complicated multifactorial condition, which has a detrimental impact on one's health. A person is considered overweight if their BMI is between 25 and 29.9 and obese if their BMI is 30 or above [14].

Consuming a portion-controlled diet can result in significant short-term weight loss. High levels of physical activity and ongoing patient-provider communication are both key to long-term weight control. Many times, changing one's way of life causes a substantial drop in body weight, which significantly lowers the risk of cardiovascular disease [15].

In order to manage obesity, nutrition therapy is crucial. The main areas of nutrition treatment study right now are enhancing energy intake and macronutrient composition. Calorie restriction is known to be essential for establishing both glycemic control and desirable lipid profiles [16].

Additionally, clinically significant weight loss can be attained through calorie-reduced diets regardless of the macronutrient composition; however, a prior study showed a common overlap between behavioural eating factors and macronutrient compositions, with the majority of their study subjects losing nearly the same amount of weight by the end of the study period (2 years) despite dissolving differences in macronutrient compositions [16].

The HCG molecule is a very significant, multidimensional hormone that affects the foetal, placental, and maternal systems hormonally as well as the neuroendocrine and metabolic changes that take place in both the mother and the foetus during pregnancy and at parturition [17].

In a prior study, it was discussed how administering HCG affected the body weight of obese rats. The weight of the control group decreased significantly, but the weight of the group fed on quarter of the daily requirements and given HCG injections decreased even more, demonstrating that the HCG had a bigger impact on weight loss [11].

Body weight, one of the most readily available indicators of size, has long been the subject of intense examination and criticism as a measure of excess adiposity and a predictor of health status, morbidity, and mortality [1].

Changes in weight are accompanied by imbalances in calorie intake and usage. This fact is frequently taken incorrectly to imply that obesity is brought on by gluttony and laziness and can be cured by telling people to eat less and move more. Instead, there is a dynamic relationship between different energy balance components and weight loss [18].

Results of the present work showed a significant decrease in weight in both male and female groups (Low caloric group) when compared with (control group).

In the line with [16], who explained it by supporting a well-established concept that low caloric intake produces weight loss.

In coincidence with [18], the previous meta-analysis of 32 controlled feeding studies with isocaloric substitution of carbohydrate for fat found that both energy expenditure (26 kcal/d) and fat loss (16 g/d) were greater with lower fat diets.

Also, there was a significant decrease in weight in (Maximal CHO deprivation group) when compared with (control group).

In the agreement with [16] study, who claimed that LC diets might result in increased weight loss by their capacity to decrease calorie intake by suppressing appetite. This is mostly due to increased amounts of circulating ketones that play a role in suppressing appetite and possible consumption of higher protein in replacement of reduced carbohydrates, which plays a similar role in increasing satiety.

In addition, there was a significant decrease in weight in (HCG small dose group) when compared with (control group).

Similarity, in a study of [11] about the effect of injecting HCG on the body weight of obese rats. It hypothesized that the HCG hormone can lead to fat extraction from the cells, causing them to be empty then the body breaks down its cellular structure and absorbs it.

In the line with [6] study, which informed that HCG is a form of exogenous hormonal therapy which is claimed to cause weight loss by increasing metabolic consumption and fat redistribution.

Blood lipids, blood glucose, and blood pressure are all raised in obese people, which raises their risk of coronary heart disease. Estimating total cholesterol, HDL, and triglycerides has received a lot of attention among the lipid components, but additional substances such total lipids and LDL have also been studied [19].

The results show a significant improvement in HDL in both male and female groups (Low caloric group) when compared with (control group).

Similar results were achieved by [20] study, using a carbohydrate-restricted diet had greater improvements in lipid profile.

Also, there was a significant improvement in HDL in both male and female groups (Maximal CHO deprivation group) when compared with (control group).

Similar results were achieved by [16], as they reported that LC diets acutely induce desirable immediate effects, such as improvement in Lipid profile .

In the line with 12 months relative to baseline, both diets improved lipid profiles and lowered blood pressure, insulin, and glucose levels, with the exception of low-density lipoprotein cholesterol concentrations, which increased for participants in the healthy low-carbohydrate group [21].

In addition, there was a significant improvement in HDL in both male and female

groups (HCG small dose group) when compared with (control group).

In the current study, female groups show decrease in serum HDL level compared to male groups.

Undoubtedly, this is due to the different sex hormones in males and females. These effects may occur via androgen pathways modulating dopaminergic regions, thereby affecting behavior on longer timescales. On the other hand, female sex hormones, oestradiol and progesterone, whose levels are increased during the luteal phase [22].

5. Conclusion and Recommendations:

One of the main health issues in the world today is obesity. Diets continue to be the most often used option and some of the most significant clinical therapies for obesity.

In conclusion, treating obesity with a low-calorie diet, maximum CHO restriction, and the HCG diet resulted in significant improvements in HDL level and body weight reduction.

Though cutting calories daily is the most crucial element in weight loss, there is no one perfect weight management technique. Optimal CHO restriction, HCG, and low-calorie diets all improved lipid profiles.

This can be explained by the fact that the HDL level significantly improved, the body weight decreased significantly, and the blood insulin and leptin levels significantly increased.

We recommend that it is possible to use Low-caloric diet, Maximal CHO deprivation diet and HCG diets in correcting obesity, serum HDL level.

Although the recovery in Low-caloric diet, Maximal CHO deprivation diet and HCG diets, it was not complete. So, these data should be taken into account when treating obese patient.

However, the current work raises the need for further clinical studies to assess the benefits of Low-caloric diet, Maximal CHO deprivation diet and HCG diets in obese patients.

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