Effect of diet and exercise on weight reduction and lipid profile in adults

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INTRODUCTION

Dietary approaches to weight loss generally take one of three forms *viz.*, starvation, very low calorie diets (VLCDS) and conventional reducing diets. Inactivity is often associated with obesity. An increase in physical activity is an important component of weight loss therapy. Hence an intervention study to know the effect of diet and exercise on weight reduction and lipid profile was conducted for obese subjects who were voluntarily willing to participate in the weight reduction programme.

METHODOLOGY

Study groups included a low calorie diet group, low calorie diet group with programmed exercise group and a control group. Six subjects participated in each group. An orientation programme that included initial group instruction separately for low calorie diet group and low calorie diet and exercise group was conducted for the subjects to know about exercise and dietary methods of weight control.

To prescribe total energy per day, computation of caloric requirement for obese subjects was done on ideal body weight (IBW). IBW was calculated using "BROKAS INDEX" (Raghuram *et al.*, 1998)

The low calorie diets were formulated in the range of 1000 to 1500 Kcal, based on caloric requirement for weight reduction of selected obese subjects and were explained to them. Details of one week menu and methods of preparation were given for the low calorie diet group.

For low calorie diet and exercise group, apart from explaining about the diet to be followed based on the calorie requirement, the exercise to be followed was stressed. The exercise included daily walking for 5 km/d or walking on a treadmill for 30 m/d or riding an ergocycle.The subjects were monitored at monthly intervals to facilitate and clarify any problems related to adherence to low calorie diets and / exercise.

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All the selected obese subjects were monitored at monthly intervals, in terms of change in anthropometric measurements *viz.*, weight (kg), waist circumference (cm) and hip circumference (cm).

Before the intervention period and after its completion, biochemical analysis *viz.*, fasting blood glucose, total serum cholesterol, triglyceride, high density lipoprotein (HDL) cholesterol levels, was carried out. All the biochemical parameters were assessed by using Span Diagnostic Kit (Span Diagnostion Ltd., India).

The difference in initial and final value of anthropometric and biochemical parameters during low calorie diet intervention period of six months with or without exercise of selected obese volunteers were analysed by paired 't' test.

OBSERVATIONS AND ASSESSMENT

The change in anthropometric parameters of selected obese volunteers is depicted in Table 1. In control group out of six subjects, five subjects gained body weight that ranged between 1 to 4 kilogram, which was statistically significant at

five per cent level. The same five subjects also exhibited an increase in body mass index that varied between 0.42 to 1.53. However, increase in waist to hip ratio was observed in only two subjects (0.01 to 0.02).

In low calorie diet intervention group, all the six subjects recorded reduction in body weight that ranged from 1 to 6.5 kg. All the subjects also exhibited reduction in body mass index that varied between 0.41 to 2.28 whereas, the reduction in waist to hip ratio was noticed only in four subjects (0.01 to 0.02).

In contrast to low calorie diet group, out of six subjects of low calorie diet and exercise group only five subjects experienced a reduction in body weight that ranged from 3 to 4.5 kg. The reduction in body mass index was also found in the same five subjects (1.11 to 1.98). However, all the subjects reduced in waist to hip ratio which varied between 0.01 to 0.02.

The minimum reduction (3kg) in weight was higher in low calorie diet and exercise group compared to the low calorie diet group. However, in both the groups different calorie levels prescribed had not much differential effect on change in body

Table 1. Anthropometric parameters of selected obese volunteers before and six months after intervention

Intervention groups	Anthropometric measurements								
	Weight (kg)			Body mass index			Waist to hip ratio		
	Initial	Final	Difference	Initial	Final	Difference	Initial	Final	Difference
Control group (N=6)									
1	73	77	+4	27.81	29.34	+1.53	0.94	0.95	+0.01
2+	65	68	+3	28.13	29.43	+1.30	0.77	0.77	No change
3	68	68	No change	31.04	31.04	No change	0.80	0.82	+0.02
4+	64	66	+2	28.44	29.33	+0.89	0.81	0.81	No change
5	70	72	+2	30.30	31.16	+0.86	0.75	0.75	No change
6	68	69	+1	28.67	29.09	+0.42	0.90	0.90	No change
't' value	3.51*			1.95NS			3.38*		
Diet group (N=6)									
1	72	68	-4	35.21	33.25	-1.96	0.90	0.88	-0.02
2	87	86	-1	30.46	30.11	-0.35	0.96	0.94	-0.02
3	82	76	-6	31.24	28.96	-2.28	0.84	0.83	-0.01
4	80.5	74	-6.5	27.85	25.60	-2.25	0.95	0.93	-0.02
5	66	60	-6	27.47	24.97	-2.50	0.92	0.92	No change
6	76	75	-1	31.23	30.82	-0.41	0.89	0.89	No change
't' value	3.96*			1.95NS			1.80NS		
Diet +exercise group (N=6)									
1	75	70	-5	29.67	27.69	-1.98	0.72	0.71	-0.01
2	71.5	67	-4.5	30.54	28.62	-1.92	0.81	0.80	-0.01
3	72	69	-3	26.45	25.34	-1.11	0.85	0.83	-0.02
4	60	56.5	-3.5	26.67	25.11	-1.56	0.84	0.83	-0.01
5	61	61	No change	25.39	25.39	No change	0.86	0.85	-0.01
6	62	59	-3	26.81	25.56	-1.25	0.78	0.77	-0.01
't' value	4.46**			4.33**			7.00*		

+ represent male subject   * and ** indicate significance of values at P=0.01 and P=0.05, respectively   NS: Non-significant

Table 2. Blood profile of obese volunteers in the control group six months after intervention

Intervention groups	Blood parameters(mg/dl)					
	Fasting blood glucose	Serum cholesterol	Triglyceride	HDL cholesterol	LDL cholesterol	VLDL cholesterol
1.	94.91(-2.69)	194.20(+13.90)	211.51(+11.09)	34.71(4.71)	117.46(+16.66)	42.30(+2.22)
2.	90.50(+9.1)	214.13(+15.63)	191.21(-4.99)	30.79(+0.18)	145.10(+16.45)	38.24(-1.00)
3.	94.56(+4.00)	184.12(-15.08)	258.13(+9.63)	28.93(-2.30)	103.56(-14.71)	51.63(+1.93)
4.	84.62(+6.02)	176.30(+6.00)	212.54(+12.09)	25.05(-4.00)	108.74(+7.58)	42.51(+2.42)
5.	80.50(-6.80)	152.40(+4.20)	219.45(+20.80)	35.11(+1.00)	73.40(-0.96)	43.89(+4.16)
6.	93.71(+3.41)	198.10(+7.8)	211.79(+10.79)	25.12(-5.00)	130.62(+10.60)	42.36(+2.20)
't' value	0.43NS	1.20NS	2.92*	0.61NS	1.21NS	2.93*

Figures in parentheses indicate difference from initial value
* and ** indicate significance of values at P=0.01 and P=0.05, respectively   NS: Non-significant

weight, as they were computed based on their ideal body weight and prescribed.

The formulation of low calorie diet was done from 1000 kcal levels, as it has been suggested that the diets providing less than 800 kcal have no clinical advantage (Foster *et al.*, 1992), under epidemiological conditions.

It was observed that the fasting blood glucose concentration of all the subjects were within the normal reference range in the control group even after intervention There was an increase in serum cholesterol(4.20-15.63mg/dL) and triglyceride concentration (9.63-20.80mg/dL) with an exception of one subject in each category. Three subjects each exhibited an increase or decrease in cholesterol concentration, respectively. Though increased low density lipoprotein cholesterol was observed in four subjects after intervention, values were within the normal reference range. Higher values of VLDL cholesterol concentration were observed in five subjects which were above the normal reference range with an exception of one subject (Table 2).

Table 3 shows the impact of low calorie diets on biochemical parameters of selected obese subjects. Fasting blood glucose concentration of the subjects in low calorie diet group were within the normal reference range after intervention .The reduction in total cholesterol was noted in four subjects

which ranged between 1.66 to 18.30 mg/dl, with an exception of two subjects. It was soothing to note that all the blood parameters *i.e.* lipid profile improved during the intervention period. All the subjects in low calorie diet group had a reduced triglyceride concentration (-1.04 to -24.99 mg/dL), LDL (-2.70 to -19.48 mg/dL) and VLDL (-0.21 to -5.00 mg/dL) cholesterol concentration except for one subject for LDL cholesterol. The increased HDL cholesterol concentration noted in four subjects (2.34 to 11.01 mg/dL), also marked beneficial effect of intervention. The change in fasting blood glucose, triglyceride and VLDL cholesterol concentrations were significant at one per cent level.

The subjects of low calorie diet and exercise group had fasting blood glucose concentration within the normal reference range. All the subjects had a reduction in serum cholesterol (-4.21 to -23.89 mg/dL), triglyceride (-15.97 to -190.05 mg/dL) and VLDL cholesterol concentration (-5.45 to 38.01 mg/dL).HDL cholesterol level was increased with a range of 0.06 to 30.66 mg/dL, with an exception of one subject, where in a slight reduction was noted which indicates added exercise regime has additional benefit to obese subjects. However, 50 per cent each of the subjects had an either decrease (-1.04 to -6.81 mg/dL) or increase (+4.88 to +7.69 mg /dL) in LDL cholesterol concentration, respectively. The change in serum cholesterol,

Table 3. Blood profile of obese volunteers in the low calorie diet group six months after intervention

Intervention groups	Blood parameters(mg/dl)					
	Fasting blood glucose	Serum cholesterol	Triglyceride	HDL cholesterol	LDL cholesterol	VLDL cholesterol
1.	79.00(+12.00)	160.54(-6.13)	181.01(-7.01)	41.56(-1.18)	82.78(-3.54)	36.20()-1.40
2.	92.01(-1.92)	154.71(-6.01)	68.11(-24.99)	74.59(-14.99)	66.50(-27.68)	13.62(-5.00)
3.	78.16(+9.16)	155.45(-1.66)	107.48(-6.54)	59.63(+2.34)	74.32(-2.70)	21.50(-1.30)
4.	79.16(+8.82)	146.97(+1.19)	112.98(-2.91)	35.71(+11.01)	88.66(-9.24)	22.60(-0.58)
5.	92.41(+7.97)	151.78(+9.04)	101.57(-1.04)	31.74(+4.00)	99.46(+4.98)	20.31(-0.21)
6.	89.13(-5.89)	215.45(-18.30)	135.78(-13.92)	32.01(+3.96)	156.28(-19.68)	27.16(-2.78)
't' value	3.57*	0.40NS	2.61*	0.24NS	0.10NS	2.61*

Figures in parentheses indicate difference from initial value   *indicates significance of value a
* Significant at one per cent level
NS : Non-significant

Table 4. Blood profile of obese volunteers in the low calorie diet+ exercise group six months after intervention

Intervention groups	Blood parameters(mg/dl)					
	Fasting blood glucose	Serum cholesterol	Triglyceride	HDL cholesterol	LDL cholesterol	VLDL cholesterol
1.	809.8(-12.00)	184.87(-5.45)	176.00(-76.74)	49.23(+10.94)	100.44(-1.04)	35.20()-15.35
2.	81.79(-17.00)	170.39(-10.52)	190.00(-15.97)	49.00(+0.06)	85.65(-5.13)	35.74(-5.45)
3.	102.00(+18.14)	211.00(-4.21)	111.00(-151.69)	53.00(+30.66)	146.00(+5.67)	22.00(-30.54)
4.	64.75(-23.47)	145.39(-14.77)	99.57(-102.42)	49.09(-1.97)	76.39(+7.69)	19.91(-20.49)
5.	74.46(-4.13)	135.06(-15.42)	64.68(-190.05)	41.11(+17.71)	81.01(+4.88)	12.94(-38.01)
6.	79.89(-15.91)	161.45(-23.89)	97.87(-153.87)	49.87(+13.70)	92.01(-6.81)	19.57(-30.78)
't' value	1.50NS	4.10*	4.47**	2.41NS	0.35NS	4.80**

Figures in parentheses indicate difference from initial value
* and ** indicate significance of values at P=0.01 and P=0.05, respectively   NS=Non-significant

triglyceride and VLDL cholesterol were significant at five per cent level (Table 4).

Exercise along with low calorie diet group had a marginal impact on magnitude of weight loss compared to low calorie diet group only. These findings are in agreement with Donnelly *et al.* (1991) who has reported no significant changes among low calorie diet with or without exercise groups for weight loss. However, there were improvements observed in lipid abnormalities *i.e.* reduction in bad cholesterol (LDL), triglyceride (TG) and an increase in good cholesterol (HDL).

Calorie restriction (i.e. dieting) decreases basal metabolism, which can be overcome by exercise. In addition, exercise has a beneficial effect on abnormalities in lipid metabolism associated with obesity. Exercise also has positive psychological effects. Increased physical activity has been associated with improvements in self image and increased feelings of self control (Pi-Sunyer, 1988). Subjects were willing to continue exercising even after intervention period.

Conclusion:

Different calorie levels suggested for weight reduction had no much differential effect, as calorie levels prescribed were based on ideal body weight of the subjects *i.e.*, 20 kcal per kilogram of ideal body weight. Hence, it is indicated that adherence to low calorie diet with or without exercise is possible for a period of six months. Low calorie diets are helpful in reducing the fat deposition and undesirable biochemical parameters.

But low calorie diet coupled with exercising daily for 30-45 minutes, six days in a week has an additional benefit in reduction of body weight, improving lipid profile and in increasing one's self image.

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