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Effect of Nutritional Counseling and Alfalfa Supplementation on Exercise Performance and Nutritional Anemia of Overweight and Obese Adult Females

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ABSTRACT Overweight and obesity are affecting the quality of life worldwide. Diet modification and exercise form an essential part of successful management strategy. However, low calorie diets might induce nutritional imbalances resulting in health problems such as anemia which impairs the body's ability to exercise thus making weight loss difficult. Research on the implication of anemia and its management on exercise performance is scarce, especially in India. Thus, the present study aimed to assess the effect of nutritional counseling and iron and folic acid rich alfalfa powder supplementation on exercise performance and anemia of adult overweight and obese females undergoing weight loss program. Seventeen overweight and obese anemic females (age 36.3 ± 10.75 years) were enrolled from gyms using purposive sampling technique purely based on their willingness to participate and were assessed for indices of obesity (WHR, MUAC, %BF), exercise performance (Cooper's test, sit-ups test) and anemia status at the start of the study, after 8 weeks of nutritional counseling, and then after supplementation with alfalfa powder (5g) for 4 weeks. A significant reduction in the anthropometric indices of obesity ($p \leq .01$), improvement in the cardiovascular fitness ($p \leq .01$) and few markers of anemia status like RDW, TIBC, serum iron and percent RBC saturation were noticed after 8 weeks of nutritional counseling (PNC). RDW and TIBC improved on supplementation with alfalfa. Thus, diet modification along with supplementation with micronutrient rich foods might control anemia and improve exercise ability of overweight and obese females, thereby help them achieve normal body weight.

I. INTRODUCTION

About 15 percent of Indian women are overweight and 1.4 percent are obese (WHO 2010). Obesity increases prevalence of related morbidities like cardiovascular disease, hypertension, stroke, high cholesterol level, gallstones, type 2 diabetes mellitus, cancer, osteoarthritis, work disability, sleep apnea, (Visscher and Seidell 2001; Field et al. 2001) and has an impact on psychosocial and reproductive health in women (Ryan 2007). Obesity is controlled by diet and exercise more effectively than by drugs, and has fewer side effects on women (Habib 2010). Besides aiding weight loss, exercise prevents bone loss in women (Wolff et al. 1999) and gallstones formation (Leitzmann 1999); controls hypertension, improves lipid profile, cardiac performance (Shephard and Balady 1999) and insulin sensitivity (Carroll and Dudfield 2004) and protects against depression (Teychenne 2008) and also some types of cancer (Batty and Thune 2000). Besides increasing the body metabolism exercise also increases the need for nutrients like protein, vitamins and iron; and sometimes results in deficiencies of the same.

Around 50% of Indian women suffer from nutritional anemia (Bentley and Griffiths 2003; Metha et al. 2007; de Benoist et al. 2008). Iron deficiency with or without anemia results in compromised aerobic and endurance exercise capacity (Haas and Brownlie 2001). This may be due to compromised cardiovascular response to physical exercise, as was observed in children with nutritional anemia (Mani et al. 2005). Anemia has been associated with obesity and increased BMI (Bentley and Griffiths 2003; Nead et al. 2004; Batista Filho et al. 2008). An obese anemic individual would not be able to exercise to the optimum level (Calbet et al. 2006).Thus, prevention of anaemia is essential in the management of obesity which involves suitable dietary modification. Since low energy diet may not be able to provide sufficient quantities of micronu-

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trients required for the recovery from anemia, supplements of micronutrients can be recommended.

Alfalfa leaves, with iron and folic acid content of 100mg% and 28.8mg%, respectively, (Bhalja and Subhadra unpublished 2008) has the potential to be used as a dietary supplement for the treatment of anemia. Thus, the present study has been undertaken with the aim of assessing the effect of nutritional counseling and alfalfa powder supplementation on exercise performance and anemia of adult overweight and obese females undergoing weight loss program.

II. METHODOLOGY

Seventeen overweight and obese anemic females (n = 17, age 36.3 ± 10.75 years, BMI 31.1 ± 3.6 kg/m², hemoglobin 10.6 ± 1.8 g%) actively engaged in weight-loss programmes in gymnasiums were selected by purposive sampling technique and enrolled in the study purely based on their willingness to participate. Women having a BMI over 40, consuming supplements, or not exercising for atleast 5 days in the gym were excluded from the study.

Degree of obesity was assessed by Mid Upper Arm Circumference (MUAC), Waist Hip Ratio (WHR) and Percent Body Fat (%BF) measured using skin fold measurements (Durnin and Womersley 1984). Exercise performance was assessed by Cooper's 1.5 mile test for cardiorespiratory fitness and the Sit-up test for muscular endurance (Scott and Stephen 1996).

The participants were provided with nutritional counseling for 8 weeks. Their diet was modified to provide 800 – 1200 kcal, 1.0gm/kg body weight protein constituting 20-25%of total energy, 18mg iron, 100µg of folic acid and 1.0µg of vitamin B12 as recommended by ICMR (1989). They were then supplemented with 5gm of alfalfa [powder (2gm) and tablets (6x500mg)] for 4 weeks. Subjects were reassessed for degree of obesity, exercise performance and severity of anemia at the end of 8 and 12 weeks. Data were analyzed using paired t test and general linear model on SPSS (version 15.0).

III. RESULTS

Iron intake of the participants increased (see Table 1) from 9.88 ± 4.87mg to 18.10 ± 3.24mg Post Nutritional Counseling (PNC) and then to 23.30 ± 7.88mg on Alfalfa Supplementation (PAS); and folic acid intake increased from 127.59 ± 64.85µg to 165.18 ± 56.42 µg PNC and then to 14,576.10 ± 64.23 µg PAS. However, there was no significant difference in the intake of energy and vitamin C.

Significant improvements in almost all anthropometric indices of obesity were noticed (see Table 2). The reduction in the waist circumference (from 90.58 ± 7.64cm to 84.40 ± 6.50cm PNC to 83.75 ± 7.06cm PAS) and hip circumference (from 113.03 ± 8.37cm to 108.85 ± 8.25cm PNC to 108.75 ± 7.26cm PAS) was more marked than that in BMI (from 31.34 ± 3.28 to 30.19 ± 3.11 PNC to 30.27 ± 3.24 PAS).

As can be inferred from Table 3, there was significant improvement in the cardiorespiratory fitness (from 31.34 ± 3.28 to 30.19 ± 3.11 PNC to 30.27 ± 3.24 PAS), but not in muscular endurance.

Hemoglobin (Hb) level improved from 10.96 ± 1.15 to 11.12 ± 1.46 PNC, red blood cell distribution width (RDW) improved from 18.57 ± 2.57 to 16.27 ± 2.08 PNC, and serum iron improved from 76.70 ± 11.67 to 77.50 ± 11.98 PNC (see Table 4). But surprisingly, the mean cell volume (MCV), mean cell hemoglobin (MCH), and hematocrit (HCT) of the subjects did not improve. After 4 weeks of supplementation, the

Table 1: Nutrient intake of the anemic subjects during the study

Nutrient intake	*Reference value for sedentary women* [1]	*At baseline (n=17)*	*Post nutritional counseling (PNC) (n=17)*	*Post alfalfa supplementation (PAS) (n=17)*	*F value*	*p value*
Energy (kcal)	1875	1210 ± 412	933 ± 164	1007 ± 194	3.196	.068
Protein (gm)	60 (1.0g/kg BW)	34.5 ± 11.2	47.1 ± 8.4	49.7 ± 11.6	23.348	.000*
Iron (mg)	18	9.88 ± 4.87	18.10 ± 3.24	23.30 ± 7.88	65.684	.000*
Folic acid (µg)	100	127.59 ± 64.85	165.18 ± 56.42	14,576.10 ± 64.23	643662.9	.000*
Vitamin B_{12} (µg)	1.0	0.35 ± 0.24	0.73 ± 0.22	0.81 ± 0.32	43.693	.000*

* Significant at p≤ .05

[1] ICMR, 1989

Table 2: Effect of nutritional counseling and alfalfa supplementation on the degree of obesity

Anthropometric measures	*Normal values*	*At baseline (n=17)*	*Post nutritional counseling (PNC) (n=17)*	*Post alfalfa supplementation (PAS) (n=17)*	*F value*	*p value*
Weight (kg)		74.5 ± 9.9	72.1 ± 10.1	72.4 ± 10.4	15.635	.000*
BMI (kg/m^2)	18.5–24.9[1]	31.34 ± 3.28	30.19 ± 3.11	30.27 ± 3.24	14.884	.000*
WC (cm)	80[2]	90.58 ± 7.64	84.40 ± 6.50	83.75 ± 7.06	22.442	.000*
HC (cm)		113.03 ± 8.37	108.85 ± 8.25	108.75 ± 7.26	5.735	.012*
WHR	0.8[3]	0.80 ± 0.06	0.78 ± 0.05	0.77 ± 0.04	5.177	.017*
%BF (%)	23[4]	41.39 ± 4.19	42.32 ± 5.12	42.81 ± 5.10	2.779	.087
MUAC (cm)		32.83 ± 2.55	31.10 ± 2.90	31.03 ± 2.66	13.652	.000*

* Significant at p≤ .05
[1] International Diabetes Institute, 2000
[2] World Health Organization, 2000
[3] Dobbelsteyn C et al., 2001
[4] WHO 2006

Table 3: Effect of alfalfa supplementation after nutritional counseling on exercise performance

Exercise performance	*At baseline (n=17)*	*Post nutritional counseling (PNC) (n=17)*	*Post alfalfa supplementation (PAS) (n=17)*	*F value*	*p value*
Cooper's test (minutes)	23.38 ± 3.11	22.30 ± 3.22	22.10 ± 3.80	10.621	.001*
Sit ups	14.85 ± 11.37	18.15 ± 10.79	18.00 ± 9.24	1.115	.350

* Significant at p≤ .05

Table 4: Effect of alfalfa supplementation after nutritional counseling on biochemical markers of anemia

Biochemical marker	*Normal range [1]*	*At baseline (n=17)*	*Post nutritional counseling (PNC) (n=17)*	*Post alfalfa supplementation (PAS) (n=17)*	*F value*	*p value*
RBC (10^6/l)	3.8 – 4.8	4.46 ± 0.33	4.44 ± 0.37	4.41 ± 0.37	1.964	.169
MCV (fl)	83 – 101	83.37 ± 10.52	81.68 ± 6.05	80.68 ± 5.99	5.688	.012*
HCT (%)	36 – 46	37.45 ± 5.92	36.19 ± 3.44	35.48 ± 2.97	2.944	.078
MCH (pg)	27 – 32	27.16 ± 2.66	24.79 ± 2.44	25.08 ± 2.32	99.423	.000*
MCHC (g/dl)	31.5 - 34.5	32.79 ± 3.30	30.29 ± 1.17	31.05 ± 0.84	8.761	.002*
Hb (g/dl)	12 -15	10.96 ± 1.15	11.12 ± 1.46	11.03 ± 1.12	21.567	.000*
RDW (fl)	10 – 16	18.57 ± 2.57	16.27 ± 2.08	15.97 ± 2.09	29.796	.000*
Serum Iron (μg/L)	65 – 165	76.70 ± 11.67	77.50 ± 11.98	73.50 ± 10.27	1.000	.388
TIBC (μg/L)	250 - 400	406.75 ± 55.68	411.75 ± 46.18	409.75 ± 36.40	.092	.912
% TS (%)	25+	19.44 ± 5.03	19.19 ± 4.40	18.11 ± 3.39	1.087	.358

* Significant at p≤ .05
[1] Gadkar and Gadkar 2003

subjects showed small improvement in the RDW (from 16.27 ± 2.08 PNC to 15.97 ± 2.09 PAS) and TIBC (from 411.75 ± 46.18 PNC to 409.75 ± 36.40 PAS) levels. The initial high level of RDW indicated folic acid and/or vitamin B12 deficiency among the participants which might have resulted in macrocytic anemia. TIBC also showed slight improvement.

IV. DISCUSSION

The intake of iron and folic acid of the participants increased significantly during nutritional counseling as well as during supplementation as the alfalfa supplement contained 100mg% of iron and 288mg% of folic acid. The Recommended Dietary Allowance (RDA) for folic acid is 100μg (ICMR 1989). Folate deficiency leads to megaloblastic anemia, characterized by larger than normal red cell precursors (megaloblasts) in bone marrow, macrocytes in the peripheral blood and giantism in the morphology of proliferating cells. In the treatment of megaloblastic anemia folic acid, along with vitamin B12, can be administered up to a dose of 15 mg per day (Hillman 1996). Excess folic acid, up to 15 mg/day has not been associated with side effects (Butterworth and Tamura 1989). Moreover, excess folic acid can mask B12 deficiency (Savage and Lindenbaum 1995).

Reduction in the markers of obesity is certainly a positive outcome of nutritional counseling as the abdominal fat is often associated with several health problems such as CVD, diabetes etc. However, alfalfa supplementation could not further improve these parameters. This could be due to the short duration of the supplementation trial. Improvement in cardiorespiratory fitness of the participants (Table 3) might be due to improvement in anemia profile after the increased intake of iron and folic acid post nutritional counseling and alfalfa supplementation.

Overall, nutritional counseling was more effective in improving the anemia profile of the participants than alfalfa supplementation in spite of being its being a rich source of iron and folic acid. This might be either due to the short duration of supplementation or low bioavailability of iron from alfalfa which is a plant source. Rangarajan et al. (1998) reported that if supplied in high amount, even a rich source with low bioavailable iron can increase blood hemoglobin. Addition of 30 g kg-1 of amaranth to the individual diets of rats, *A. tricolor* supported the largest Hb gain, despite having the lowest relative bioavailability compared to *A .hypochondriacus* and *A. cruentus*. Longer supplementation with alfalfa which is a rich source of iron and folic acid in high quantity might also give similar benefits.

In the present study, improvement in RDW suggested transformation of RBCs from macrocytic to normocytic. The level may have improved due to the high folate content of alfalfa. Improvement in TIBC was suggestive of improved iron status. TIBC has higher accuracy in diagnosis of iron deficiency anemia than Transferrin Receptors (TfR) (Wians et al. 2001). The dietary supply of iron and folic acid together would be double beneficial. A study on adolescent girls in Jaipur, India showed that consuming leaf concentrate containing 5mg Fe and 13μg folic acid for 3 months is an effective and more palatable alternative to individual Fe and folic acid supplements for treating anemia (Vyas et al. 2010).

V. CONCLUSION

Eight weeks of nutritional counseling resulted in significant improvement in anthropometric indices. Four weeks of supplementation with alfalfa has sustained the same and also resulted in the improvement of TIBC, RDW, MCH and MCHC. Improvement in cardiorespiratory fitness with micronutrient rich alfalfa supplementation indicated that longer supplementation might further improve anemia status and exercise performance of overweight and obese anemic females and thereby help them achieve normal body weight.

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