Impact of Micronutrient Intake on Weight Reduction in Women

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Abstract

Introduction: Excess body weight is the sixth mostimportant risk factor contributing to the health burden of the world.Micronutrients (fat and water soluble vitamins, minerals and traceelements) although required in small amounts, are vital for importantphysiological functions. They play significant role in energymetabolism which may indirectly affect the body weight and body fatof an individual. Direct association of all micronutrients withadiposity has not been scientifically established but there areplausible mechanisms which might affect body weight.

Objectives: Tostudy the impact of micronutrient intake on weight reduction in womenundergoing a comprehensive weight reduction program in Jaipur city.

Methodology: Purposive sampling technique was used to enrol women in the agegroup of 20-60 years visiting a commercial weight reduction centrewith the purpose of weight loss. Baseline data included 314 femaleswith the BMI ≥25kg/m^2. Total 100 women participated in the study with 52 visiting a commercial weight reduction centre and48 visited a Gymnasium. In the comprehensive study these subjectswere assessed at both pre and post intervention stages for various parameters such as nutritional status - anthropometric indicators, body composition and diet recall.

Results: Micronutrients were found to have a significant impact on weight loss as well as on body composition changes in both the groups. Calcium, zinc, folic acid and vitamin B_{12} had significant correlation with amount of weight loss (ΔWt.).

Introduction: The riskfunctions for obesity(defined as the quantitative relation between degree of obesity throughout its range and the risk of health problems) have been used to define 'obesity' as an excess storage of fat in the body to such an extent that it causes health problems leading to increased mortality (Sorenson, Virtue and Vidal-Puigb 2010). Recentscientific research has linked obesity with presence of variousmicronutrient deficiencies such as calcium, magnesium, vitamin D,Vitamin $B_6$and iron to name a few. Cause effectrelationship with obesity and process of weight loss for eachmicronutrient has not been studied completely, till date. In thepresent study we have tried to establish an association betweenmicronutrient intake and success in weight reduction.

Methodology: The studywas conducted in Jaipur city**.** Purposive sampling techniquewas used to enrol women in the age group of 20-60 years visiting acommercial weight reduction centre (CWRC) with the purpose of weightloss. Baseline data included 314 females with the BMI ≥25kg/m^2.Success rate of any commercial weight reduction programme have beenpredicted to be 20%. Therefore, a sample size of 80 (40 in eachgroup) women was computed, at 1% confidence interval and 10%confidence limit; for the comprehensive study on the basis ofwillingness to participate in the study. Total 100 women participatedin the study with 52 visiting a commercial weight reduction centreand 48 visited a Gymnasium (GYM). In the comprehensive study thesesubjects were assessed at both pre and post intervention stages forvarious parameters such as nutritional status – anthropometricindicators, body composition and diet recall. Anthropometricindicators such as height, weight, waist circumference (WC) and hip circumference (HC) were measuredusing standard WHO protocols. Body composition was assessed byOMRON HBF-362 body composition analyser based on biological Impedance analysis. Diet and nutrient intake was assessed by 24 hour foodrecall. Written consent was acquired from all participants and thestudy was approved by Sanjeevani ethical committee in Jaipur.

Results andDiscussions: Mean age of thewomen was 34.70 ± 10.15 years and mean height was 1.58± 0.07 m. Table 1 depicts the mean values of anthropometricindicators for the baseline group.

Table 1: MeanValues of Anthropometric Indicators for Women

Variable	Pre Intervention			Post Intervention			Difference Between Pre and Post Intervention	
	CWRC (n=52)	Gym (n=48)	t-test	CWRC (n=52)	Gym (n=48)	t-test	CWRC (n=52)	Gym (n=48)
Weight (kg)	79.02 ± 12.05	74.38 ± 11. 43	4.72**	75.68 ± 10.76	72.34 ± 10.43	4.71**	9.032**	4.32**
BMI (kg/m^2)	31.58 ± 4.27	30.15 ± 5.38	1.39^{NS}	30.10 ± 3.86	29.35 ± 5.17	0.812^{NS}	9.28**	4.45**
WC (cm)	91.24 ± 7.97	88.52 ± 9.76	1.42^{NS}	87.66 ± 8.35	84.90 ± 9.29	1.50^{NS}	6.58**	4.30**
HC (cm)	107.71 ± 10.07	109.28 ± 7.65	0.87^{NS}	105.40 ± 9.52	106.13 ± 8.75	0.40 ^{NS}	6.30**	5.17**
WHR	0.85 ± 0.11	0.81 ± 0.06	2.50*	0.84 ± 0.05	0.80 ± 0.05	2.36*	4.32**	2.45*

***Significantat 5% **Significant at 1% level NS–Not significant**

Meanweight loss of CWRC group was 3.75 ± 2.96 kgs and 2.03± 3.15 kgs for Gym group and the difference in weight loss wasfound to be statistically significant (t= 2.82; $p<0.05$). At preand post intervention stages no significant differences were observedin body mass index (BMI), waist circumference (WC) and waist to hip ratio (WHR) betweenthe two groups except for weight and WHR. There were significantreductions in all parameters within each group.

Table 2: Mean Mineral Intake for Women

Minerals	RDA	CWRC (n=52)			Gym (n=48)		
		Pre	Post	T	Pre	Post	Pre
Calcium(mg/d)	600.00	896.68 ± 271.18	1207.58 ± 214.85	8.27**	1093.69 ± 273.52	1242.42 ±338.55	3.77**
T		7.89**	20.39**		12.50**	13.15**	
Iron(mg/d)	21.00	19.79 ± 7.21	14.78 ± 8.44	5.01**	15.87 ± 7.64	17.75 ± 9.76	1.70 ^{NS}
T		1.21 ^{NS}	5.31**		4.65**	2.31**	
Magnesium(mg/d	310.00	503.00 ±103.66	358.06 ± 97.52	10.08**	330.82 ± 177.32	104.14 ± 42.17	8.56**
T		13.43**	3.55**		0.85 ^{NS}	33.82**	
Zinc(mg/d)	21.00	7.89 ± 2.31	5.65 ± 1.90	6.99**	4.67± 1.16	1.095 ± 2.10	21.35**
T		30.93**	28.26**		47.53**	45.67**	

***Significantat 5% **Significant at 1% level NS–Not significant**

Table 2 presentsmean mineral intake of women visiting both the centres. Mean Calciumintake was significantly higher than the RDAs for both the groups inboth pre and post intervention stages. Further there was asignificant increase in mean calcium intake in both the groups whencompared for pre and post intervention stages. Mean intakes of ironand zinc were significantly lower than RDA for both the groups inboth pre and post stages. Magnesium intakes were higher in CWRC groupas compared to Gym group and there was a significant reduction inpost intervention stage especially in Gym group.

Table-3represents mean vitamin intake for both the groups. Mean retinolintake had a significant increase for CWRC group whereas no suchchange could be observed in the Gym group. Mean intakes for all othervitamins had a change in both groups. Mean folic acid and vitamin B_{12}intakes were lower than the RDAs for both the groups.

Table 3: MeanVitamin Intake for Women

Vitamins	RDA	CWRC (n=52)			Gym (n=48)		
		Pre	Post	T	Pre	Post	t
Retinol(µg/d)	600.00	302.01 ± 123.41	1976.92 ± 682.90	17.69**	1251.25± 433.86	1252.28 ± 320.02	0.19 NS
T		7.41**	14.54**		10.40**	10.42**	
Thiamine (mg/d)	1	2.24 ±1.56	1.63 ± 0.99	2.82**	1.22 ± 0.53	0.55 ± 0.23	8.76**
T		5.73**	4.56**		2.99**	13.56**	
Riboflavin (mg/d)	1.10	1.12 ± 0.67	1.29 ± 0.45	1.83	1.04 ± 0.75	0.80 ± 0.24	2.22**
T		0.22 NS	3.04**		0.55 NS	2.57**	
Niacin (mg/d)	12	14.61 ± 4.06	11.09 ± 3.06	6.25**	9.98 ±2.51	5.50 ± 1.99	15.59**
T		4.64**	2.14*		5.56**	17.63**	
Folic Acid (µg/d)	200	267.94 ± 104.74	112.32 ± 87.65	10.71**	141.55 ± 95.27	83.32 ± 54.23	4.23**
T		4.68**	7.21**		4.25**	14.91**	
Vitamin C (mg/d)	40.00	162.97 ± 78.96	330.32 ± 112.34	15.28**	76.01± 42.37	78.01 ± 34.01	0.327
T		11.23**	18.64**		5.89**	7.74**	
Vitamin B12 (µg/d)	1.00	0.40 ± 0.19	0.42 ± 0.23	0.63	0.31 ±0.14	0.41 ± 0.17	4.08**
T		22.77**	18.18**		34.15**	24.04**	

***Significantat 5% **Significant at 1% level NS – Not significant**

Associationof Micronutrient Intake with Anthropometric Variables

Table 4represents association of mineral intake with differentanthropometric variables. Mean calcium intake was found to have aninverse association with body weight, fat percentage and visceralfat. Positive association was observed with weight loss, body fitnessthat increased with increase in calcium intake. Iron intake also hada significant association with BMI and body fat per cent and fitness.Magnesium had an inverse association with WHR, body fat per cent andpromoted conservation of lean body mass. Zinc intake enhanced weightloss and reduced accumulation of body fat.

Table 4: Association of Mineral Intake with Anthropometric Variables

	Body Weight (kg)	Wt. Loss (kg)	BMI (kg/m²)	WC (cm)	WHR	BMR (kcal)	Fat%	% Fitness	Lean%	VF
Ca (Pre)	-0.180**	0.178*	-0.139	-0.010	0.074	-0.052	-0.360**	0.230**	-0.015	-0.191**
Ca (Post)	-0.199**	0.140*	-0.222	0.102	-0.168*	0.333*	-0.334**	0.217**	0.066	-0.200**
Fe (Pre)	0.080	0.003	-0.144*	0.016	-0.029	-0.020	-0.163*	0.127	0.042	0.021
Fe (Post)	0.057	-0.082	-0.175*	-0.045	-0.127	-0.025	-0.225**	0.166*	-0.048	-0.007
Mg (Pre)	-0.081	-0.082	0.012	-0.086	-0.139*	-0.133	-0.159*	-0.116	0.139*	0.129
Mg (Post)	0.104	0.066	0.074	0.024	-0.078	0.011	-0.155*	-0.032	0.188**	0.014
Zn (Pre)	0.073	0.180*	-0.175*	-0.038	-0.098	-0.080	-0.230**	-0.091	-0.054	0.018
Zn (Post)	0.037	0.139*	0.065	-0.034	-0.110	-0.093	-0.140*	0.151*	0.069	-0.004

***Significantat 5% **Significant at 1% level NS – Not significant**

In a study based on7569 individuals from the MONICA Study, a sample from the DanishDiet, Cancer and Health Study and the INTER99 study, with informationon diet; 54 single-nucleotide polymorphisms (SNPs) associated withBMI, WC, or WHR adjusted for BMI; and potential confounders. Asignificant reduction in body weight (ΔBW) of −0.076kg (P = 0.021; 95% CI: −0.140, −0.012) per 1000 mgCa. No significant association was observed between dietary calciumand change in waist circumference (ΔWC). However, a significantinteraction between a score of 6 WC-associated SNPs and calcium inrelation to ΔWC, was found. Each risk allele was associatedwith a ΔWC of −0.043 cm (P = 0.038; 95% CI: −0.083, −0.002) per 1000 mg Ca (Larsen *et a*l., 2014).

A cross –sectionalstudy on adults (N =2504); 1120 men and 1384 women) aged 18-74 yearsobserved an inverse association between dietary magnesium intake andwaist circumference. No other anthropometric indices have been reported in this study (Mirmiran *et a*l., 2012). Lowermagnesium intakes by obese women as compared to non-obese women have been reported by Jarvandi *et a*l., (2011).

A total of 96 obeseChinese women (body mass index (BMI) 28 kgm^{-2}) aged18–55 years participated in a 26-week randomized, double-blind,placebo-controlled intervention study. Subjects were randomized intothree groups, receiving either one tablet of multivitamin and mineralsupplement (MMS), or calcium 162 mg (Calcium) or identicalplacebo daily during the study period. Body weight, BMI, waistcircumference (WC), fat mass (FM), fat-free mass, resting energyexpenditure (REE), respiratory quotient (RQ), blood pressure, fastingplasma glucose and serum insulin, total cholesterol (TC), low-andhigh-density lipoprotein-cholesterol (LDL-C and HDL-C) andtriglycerides (TGs) were measured at baseline and 26 weeks. A totalof 87 subjects completed the study. After 26 weeks, compared with theplacebo group, the MMS group had significantly lower BW, BMI, FM, TCand LDL-C, significantly higher REE and HDL-C, as well as aborderline significant trend of lower RQ (P=0.053) and WC (P=0.071).The calcium group also had significantly higher HDL-C and lower LDL-Clevels compared with the placebo group (Li *et a*l., 2010).

Table 5: Association of Vitamin Intake with Different Anthropometric Variables

	Body Weight (kg)	Wt. Loss (kg)	BMI (kg/m2)	WC(cm)	WHR (I)	BMR (kcal)	Fat%	% Fitness	Lean%	VF
Retinol (Pre)	-0.048 NS	-0.083 NS	-0.149*	0.029 NS	-0.006 NS	-0.121 NS	-0.141*	0.117 NS	0.082 NS	-0.208**
Retinol (Post)	0.019 NS	0.009 NS	0.050 NS	0.003 NS	-0.003 NS	-0.060 NS	-0.061 NS	0.041 NS	0.039 NS	-0.105 NS
Thiamine (Pre)	0.101 NS	0.086 NS	0.094 NS	-0.146*	0.131 NS	0.014 NS	0.002 NS	0.119 NS	0.123 NS	-0.073 NS
Thiamine (Post)	-0.088 NS	-0.090 NS	-0.015 NS	0.006 NS	0.008 NS	0.019 NS	0.017 NS	0.088 NS	0.066 NS	-0.034 NS
Riboflavin (Pre)	-0.189**	0.181*	-0.087 NS	-0.017 NS	0.000 NS	0.237**	-0.220**	-0.011 NS	-0.011 NS	-0.237**
Riboflavin (Post)	0.132 NS	0.121 NS	0.087 NS	-0.152*	-0.144*	-0.046 NS	-0.052 NS	0.199**	0.193**	-0.188**
Niacin (Pre)	0.196**	0.179*	0.133 NS	0.139*	0.117 NS	0.116 NS	0.090 NS	0.069 NS	0.072 NS	0.071 NS
Niacin (Post)	0.128 NS	0.130 NS	0.025 NS	0.131 NS	0.135 NS	0.003 NS	0.007 NS	0.204**	0.209**	-0.126 NS
Folic acid (Pre)	-0.114 NS	0.143*	0.103 NS	0.027 NS	0.000 NS	0.279**	-0.264**	0.074 NS	0.015 NS	-0.338**
Folic acid (Post)	0.147*	0.160*	-0.021 NS	0.056 NS	0.065 NS	0.069 NS	0.077 NS	0.209**	0.196**	-0.089 NS
Vitamin C (Pre)	-0.012 NS	-0.003 NS	-0.043 NS	-0.006 NS	0.003 NS	0.001 NS	0.010 NS	0.077 NS	0.085 NS	-0.066 NS
Vitamin C (Post)	0.079 NS	0.098 NS	-0.066 NS	-0.041 NS	-0.026 NS	0.097 NS	0.144*	-0.055 NS	-0.012 NS	0.139*
Vitamin B12 (Pre)	-0.256**	0.241**	-0.142*	-0.180*	-0.160*	0.225**	-0.194**	-0.280**	-0.255**	-0.023 NS
Vitamin B12 (Post)	0.119 NS	0.139*	-0.064 NS	-0.015 NS	0.002 NS	0.105 NS	0.109 NS	0.060 NS	0.063 NS	0.060 NS

***Significantat 5% **Significant at 1% level NS Not significant**

Table 5depicts association of mean vitamin intake with variousanthropometric indices. Pre intervention retinol intake has beenfound to have a negative association with BMI, body fat per cent andvisceral fat. Thiamine intake had a negative association with waistcircumference. Riboflavin intake had an inverse association with bodyweight, body fat per cent and visceral fat and positive associationwith weight loss and basal metabolic rate in pre intervention stage.In post intervention stage the riboflavin intake caused a decrease inWC, WHR and visceral fat and resulted in lean mass conservation andimprovement of fitness. Pre intervention niacin intake resulted inlower body weight, greater weight loss and lower waist circumference.Post intervention niacin intake resulted in improvement of lean massand body fitness.

In a similar case controlstudy conducted in China, a total of 123 patients with metabolicsyndrome (including central obesity) and 135 controls participated inthis study at the Health Examination Centre of Heping District. Therewere 4 major dietary nutrient patterns in this study: “vitaminB group”, “protein and lipids”, “vitamin Eand minerals” and “antioxidant vitamins” Afteradjustment for potential confounders, the highest tertile of thenutrient pattern factor score for the “vitamin B group”(odds ratio: 0.16; 95% confidence interval: 0.05–0.47) wasnegatively associated with metabolic syndrome compared with thelowest tertiles. The “vitamin B group” included thiamine,riboflavin and niacin in this study (Bian *et a*l., 2013).

Initial folic acidintake resulted in greater weight loss, higher basal metabolic rate,lower body fat per cent and visceral fat. Higher post interventionfolic acid intake resulted in lower body weight, greater weight loss,higher lean per cent and fitness levels.Post interventionvitamin C intake was found to have negative association with body fat per cent and visceral fat. Johnston, (2005)has concluded in areview that vitamin C status is inversely related to body mass,individuals with adequate vitamin C status burn 30% more fat induring a moderate exercise bout than individuals with low vitamin Cstatus.

A study on womenaged 37±7.5 years (n=580) from 6 rural communities in Mexicowere evaluated. The prevalence of overweight and obesity was 36%(BMI>25 Kg/m^2) and 44% (BMI>30 Kg/m^2),respectively. Prevalence of zinc and vitamins C and E deficiencieswere similar in obese, overweight and normal weight women. No vitaminA deficiency was found. Vitamin C was negatively associated with BMI,waist-to-height ratio and leptin concentrations ($p<0.05$).Vitamin A was positively associated with leptin ($p<0.05$). Whenstratifying by BMI, % body fat and waist circumference, high leptinconcentrations were associated with lower zinc and lower vitamin C concentrations in women with obesity ($p<0.05$) and higher vitamin Aconcentrations in women without obesity ($p<0.01$) (García*et a*l., 2012).

In the present studypre intervention Vitamin B_{12} intakes were found to haveinverse association with body weight, BMI, WC, WHR and body fat percent and a positive correlation with weight loss, basal metabolicrate, lean per cent and body fitness. Post intervention vitamin B_{12}intake had a significant association with weight loss. In across-sectional and primary care-based study 976 patients (obesity:414, overweight: 212 and control: 351) were enrolled. The mean age ingroups of obesity, overweight and control were 35.9 ± 8.7,28.9 ± 6.3 and 33.1 ± 8.7, respectively (p = 0.142).Vitamin B_{12} level was significantly lower in patients withobesity and overweight than healthy individuals (178.9 ± 25.2;219.8 ± 78.5 and 328.5 ± 120.5, p less than 0.001,respectively). Vitamin B_{12} level was lower in patientswith Metabolic Syndrome (+/-) and IR (+/-), but insignificant (p =0.075 and 0.058, respectively). Significant and negative correlationwas observed between vitamin B_{12} and BMI (r =-0.221,p=0.001). No significant difference was observed between obese maleand female patients (247.8 ± 89.1 versus 235.5 ± 89.3pg/ml, respectively, p=0.090) (Baltaci *et a*l., 2013).

Conclusion:

Inthe present study it was observed that different micronutrients(vitamins and minerals) seem to play an important role in the processof weight reduction and most importantly have a significant impact onchanges in body composition. Some of these results have beensupported by other recent researches but not all. Also, the mechanismfor these effects is not clear for each micronutrient but theirimportance cannot be overlooked. Also, the deficiency caused duringthe weight reduction as a result of calorie restriction should betaken care off. Assessment of pre-intervention intakes may also helpin predicting the success of a weight loss program.

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