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A SHORT-TERM COGNITIVE GROUP TREATMENT SUBSTANTIALLY IMPROVED THE SNACKING BEHAVIOUR OF OVERWEIGHT INDIAN WOMEN – A RANDOMIZED CONTROL TRIAL

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ABSTRACT

Obesity, a global health challenge, particularly affecting Asian populations due to inappropriate snacking behaviour and food choices, prompted this study. The research aimed to evaluate the impact of a 10-week cognitive group treatment on snacking behaviour among overweight women aged 30-60 years. In a randomized control trial with 66 female working participants (BMI > 25 kg m^{-2}), the groups were categorized as control (n = 34) and experimental (n = 32). Initially, snacking contributed significantly to daily energy (29.39%), carbohydrates (21.11%), protein (35.53%), and fat (50.61%) intake in the experimental group. After the cognitive group treatment, there was a substantial ($p \leq 0.01$) reduction in the contribution of these nutrients through snacking, with percentages dropping to 11.62, 14.60, 10.04, and 7.67, respectively. Post-treatment, significant ($p \leq 0.01$) reductions were observed in body weight (4%), fat mass (2%), waist circumference (4.9%), and hip circumference (2.7%) among the subjects. The study emphasized that the behavioural changes leading to healthier snacking can be a sustainable approach for weight management and that making healthier snack choices can aid in the battle against overweight and obesity.

Keywords: Cognitive, fat mass, muscle mass, nutrients, overweight, snacking, women

INTRODUCTION

The rise in lifestyle diseases, notably obesity, has become a global health challenge, with their increasing prevalence among Asian populations, who exhibit a propensity for central weight gain (Li *et al.,* 2023). Food choices are influenced by sensory characteristics, culture, and emotional states (Fayet-Moore *et al.,* 2017). Overeating due to prolonged exposure to oversized portions contributes to weight gain, especially among middle-aged individuals (Hetherington and Blundell-Birtill, 2018). The cognitive behavioural therapy (CBT) has proven effective for weight management, however, the research has primarily been focused on energy intake, weight, and eating disorders (Zendegui *et al.*, 2014), leaving a gap in understanding the impact of CBT's on snacking behaviours. To overcome gap, critical examination of CBT's effects on snacking behaviours, energy intake, macronutrient consumption, and anthropometric composition is essential. Changes in eating patterns, with snacking evolving into a regular "fourth meal," have reshaped meal routines in India, impacting the daily food intake and potentially leading to the elevated energy intake and obesity risk. This shift in dietary culture, driven by enjoyment, social factors, and emotional satisfaction, necessitates addressing the complex nature of snacking behaviour and the intentional behaviour gap.

Understanding and modifying snacking behaviours is crucial for preventing obesity and related health issues in the evolving dietary landscape of urban India.

With the acknowledgment of the influence of emotional states on snacking patterns, particularly among working women, there is a growing need to intervene and modify these behaviours. Unhealthy snacking can lead to alterations in body composition, increasing adiposity and the risk of metabolic diseases (Barnes *et al.*, 2015). Hence, a short-term cognitive treatment program focusing on promoting healthier snacking habits holds promise for combating overweight and obesity, especially among working women (Richard *et al.*, 2017). The present study targeted the working women, who face professional and family-related stresses contributing to unhealthy snacking habits. The study aimed to bridge the research gaps by exploring the impact of CBT on snacking behaviour and its consequences, offering insights into addressing unhealthy snacking patterns among working women.

MATERIALS AND METHODS

Selection of participants

Voluntary recruitment of working women was done for the randomized control trial. Sixty-six volunteer female university teachers aged 40-55 years with body mass index (BMI above 25 kg m^{-2} participated in the study. The group represented a category of working women engaged in a similar type of career, i.e., teaching work for 6-8 h day^{-1}. The study was planned on a smaller group with similar background. It was a volunteer study. There was an open invitation to all working women. Total strength of faculty of Punjab Agricultural University, Ludhiana, India is 400 out of which 50% are female. Amongst these females we selected the working women who volunteered to participate in the study. The selection of subjects was not random but purposive with a criterion of BMI more than 25 kg m^{-2}. The subjects were divided into two groups *viz*., control and experimental groups. The subjects in experimental group (n = 32) followed cognitive group treatment programme for 10 weeks, while the matched control group (n = 34) was not given any treatment.

Short-term cognitive group treatment programme

The cognitive-behaviour therapy programme of Stahre (2016) was followed with modifications in dietary programme which was culturally suitable for Indian women. The programme included an introductory group meeting and 10 sessions for 10 weeks. Each session per week contained theme-based interactive sessions, video sessions, activity plan, compliance form, health-promoting foods and healthy snack recipes. The programme was performed in a group as a learning-based approach. The fundamental goal was to raise the awareness and knowledge concerning the triggers of their dysfunctional snacking and to provide tools to address these triggers.

Collection of baseline and post-programme data

Dietary intake was assessed by '24 Hour Recall Method' for 7 consecutive days at baseline and after completion of the programme in control group and at the baseline level for experimental group. The food intake recorded in 'food diary' was used to calculate the daily nutrient intake of experimental group during the programme. The daily intake of energy, carbohydrates, protein, fats, iron and calcium was assessed by using a software 'Diet Cal' (Kaur, 2018). The snacking pattern of subjects was studied. The type, frequency and quantity of common sweet and salty snacks consumed during mid-morning and evening time by the subjects at baseline and after the completion of programme in control group and at the baseline level for experimental group was recorded using 24 Hour Recall. The daily intake of energy, carbohydrates, protein, fats, iron and calcium from snacks was assessed by using 'Diet Cal' software in 12 weeks (one week before and after with 10-week of trial). The consumption of snacks recorded in 'food diary' was used to calculate the daily nutrient intake from

snacks by the experimental group during the programme. The percent contribution of snacks to daily nutrient intake was calculated. The weekly consumption frequency score (CFS) of common sweet and salty snacks was calculated using the formula:

$$CFS = \frac{\text{No. of days the food items consumed during a week}}{7}$$

Statistical analysis

The data was analysed using Statistical Package for the Social Sciences, IBM SPSS version 22.0 and MS Excel 2018. Mean and standard deviations for various parameters were computed. Paired t-test was used to compare the data at baseline and after completion of programme in both control and experimental groups using analysis of variance. Correlation coefficients (r) were computed to determine the relationship of energy and macronutrient intake from snack foods with anthropometric and body composition parameters.

RESULTS AND DISCUSSION

Snacking pattern and consumption-frequency of snack foods

The cognitive group programme in present study focused on changing the eating behaviour of subjects. It was observed that the studied group usually consumed snacks two times a day i.e. mid-morning (between breakfast and lunch) and evening (between lunch and dinner). The mid-morning snacking was prevalent in 63 and 67% of the subjects in control and experimental groups, respectively, while higher number of subjects i.e. 71 and 70% in both the groups used to snack after returning home from their jobs during evening time. After the programme of 10 weeks, the snacking pattern of subjects changed as the number of subjects in experimental group who used to take snacks reduced from 67 to 58% during mid-morning and 70 to 53% during evening time (Fig. 1).

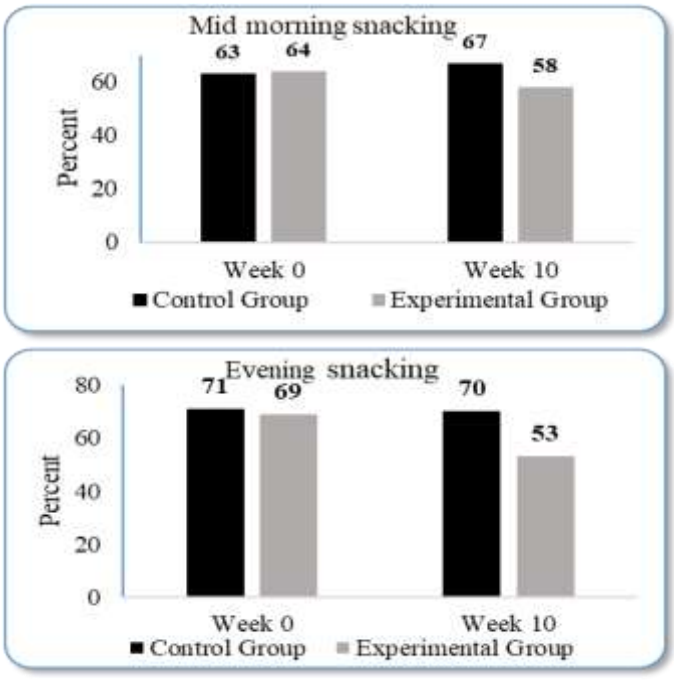

Fig. 1: Prevalence of mid-morning (above) and evening snacking (below) among the selected working women in control and experimental groups

The results of weekly consumption frequency score (CFS) of commonly consumed snacks among control and experimental groups during two snacking times i.e. mid-morning and evening time is given in Table 1. The commonly consumed snacks had weekly CFS in the range of 0.07 - 1.08 and 0.17 - 1.47 among the subjects in control and experimental groups, respectively; the corresponding CFS being maximum for seasonal fruits, while least for roasted grains. For rest snacks, the maximum consumption was for salty snacks > biscuits > *Mathi* > Indian sweets > *Samosa/Tikki* > cake > breads during morning time in experimental group. *Namkeen, Mathi*, *Samosa* and *Tikki* are popular fried savoury snacks commonly consumed in India. The cognitive group treatment programme of 10 weeks reduced the weekly CFS of above mentioned snacks significantly

Table 1: Weekly consumption frequency score (CFS) of snack foods in mid-morning and evening by the subjects in control and experimental groups

Snack food	Control group		p-value	Experimental group		p-value
	0 week	10 weeks		0 week	10 weeks	
Mid-morning						
Biscuits	1.60 ± 1.26	1.67 ± 0.96	0.66^{NS}	1.33 ± 0.94	0.33 ± 0.47	< 0.01***
Cake	0.87 ± 0.83	1.00 ± 0.72	0.10^{NS}	0.87 ± 0.85	0.13 ± 0.34	< 0.01***
Indian sweets	0.93 ± 0.84	0.90 ± 0.73	0.17^{NS}	1.00 ± 0.86	0.33 ± 0.47	< 0.01***
Bread	0.87 ± 0.83	1.07 ± 1.08	0.58^{NS}	0.33 ± 0.47	1.03 ± 0.95	0.03**
Namkeen	1.07 ± 1.05	1.20 ± 0.96	0.16^{NS}	3.80 ± 2.65	0.27 ± 0.44	< 0.01***
Mathi	1.07 ± 0.98	1.07 ± 1.08	0.10^{NS}	1.07 ± 1.06	0.20 ± 0.40	< 0.01***
Samosa/ Tikka	0.87 ± 0.83	0.83 ± 0.77	0.11^{NS}	0.93 ± 0.85	0.10 ± 0.30	< 0.01***
Seasonal fruit	1.80 ± 0.59	1.67 ± 0.69	0.29^{NS}	1.47 ± 0.96	4.30 ± 1.77	< 0.01***
Roasted grains	0.07 ± 0.25	0.10 ± 0.30	0.66^{NS}	0.17 ± 0.37	1.13 ± 1.06	< 0.01***
Evening						
Biscuits	4.93 ± 1.32	4.73 ± 1.48	0.11^{NS}	4.27 ± 1.97	0.80 ± 0.60	< 0.001***
Cake	0.87 ± 0.83	0.87 ± 0.79	1.00^{NS}	0.97 ± 0.80	0.10 ± 0.30	< 0.001***
Indian sweets	3.80 ± 2.61	3.77 ± 2.57	0.70^{NS}	2.20 ± 1.58	0.13 ± 0.34	0.03*
Bread	0.93 ± 0.84	0.93 ± 0.80	0.17^{NS}	0.93 ± 0.85	0.50 ± 0.62	< 0.001***
Namkeen	3.97 ± 2.01	4.13 ± 1.93	0.33^{NS}	1.53 ± 1.12	0.93 ± 0.77	< 0.001***
Mathi	1.07 ± 1.05	1.13 ± 1.13	0.16^{NS}	1.37 ± 1.05	0.30 ± 0.46	< 0.001***
Samosa/ Tikka	0.90 ± 0.93	0.87 ± 0.79	0.66^{NS}	0.87 ± 0.85	0.23 ± 0.42	< 0.001***
Seasonal fruit	2.00 ± 0.88	1.87 ± 0.97	0.29^{NS}	1.20 ± 0.91	2.83 ± 1.29	< 0.001***
Roasted grains	0.17 ±0.37	0.13 ± 0.33	0.33^{NS}	0.07 ± 0.25	4.23 ± 1.52	< 0.001***

Values are mean ± Standard Deviation; *p ≤ 0.05, **p ≤ 0.01, ***p < 0.001;
Namkeen, Mathi, Samosa/ Tikka are fried Indian savoury food items.

(p ≤ 0.001) during morning time. The healthy snacking among the subjects in the experimental group improved significantly (p ≤ 0.001). The CFS increased from 1.47 to 4.30 for seasonal fruits while roasted ains showed an increase from 0.17 to 1.13 in CFS score. Similar trend was noticed in CFS during evening snacking. The CFS was highest for biscuits > Indian sweets > salty snacks > *Mathi* > roasted grains prior to the start of programme. A significant (p ≤ 0.001) reduction in consumption of all the snacks was observed after the completion of programme, except for seasonal fruits and roasted grains. The observed shift towards healthier snacking aligns with research conducted by Barrington and Beresford (2018), who concluded that night time snacking was associated with a higher BMI, an obesogenic dietary index, and a higher proportion of time spent eating whilst distracted on contrary morning snacking was linked with greater consumption of fruits and vegetables. Furthermore, the number of daily snacking occasions, depending on the definition of a snack, varied between 1.2 and 3.0 snacks per day, as noted by Cowan *et al.* (2020). The findings revealed that healthy snacking was improved while a decrease in high energy and high fat snacks was observed post cognitive group treatment in the present study.

Contribution of snacks to daily nutrient intake

The subjects in control and experimental groups maintained daily 'food consumption diary' for 10 weeks. The results revealed that the subjects in experimental group reduced their energy intake to an average value of 1334 kcal during 10-week intervention period in comparison to the average of 2030 kcal before the start of cognitive group treatment. No significant change in energy intake was observed in control group. The cognitive group treatment for obesity was significantly effective in reducing the carbohydrate intake from 343 to 166 g (p ≤ 0.01) and fats from 53.3 to 49.01 g (p = 0.03), however a significant increase in protein intake from 43.87 to 63.07 g (p ≤ 0.01), calcium from 792.5 to 1725.2 mg (p ≤ 0.01) and iron from 14.37 to 17.46 mg (p ≤ 0.01) was observed (Table 1).

Table 2: Contribution of snacks to daily intake of major nutrients among selected working women in control and experimental groups

Nutrients	Control group		p-value	Experimental group		p-value
	week 0	week 10		week 0	week 10	
Intake of nutrients from daily diet						
Energy (kcal)	2050 ± 191	2061 ± 193	0.66^{NS}	2030 ± 121	1334 ± 123	≤ 0.01***
Carbohydrate (g)	350 ± 18.9	354 ± 19.0	0.10^{NS}	343 ± 23.8	166 ± 16.5	≤ 0.01***
Protein (g)	49.3 ± 2.31	53.1 ± 2.49	0.54^{NS}	43.9 ± 4.01	63.1 ± 7.46	≤ 0.01***
Fat (g)	53.5 ± 8.62	54.0 ± 8.71	0.12^{NS}	53.3 ± 6.07	49.0 ± 6.68	0.03**
Calcium (mg)	668.5 ± 98.6	663.6 ± 98.4	0.24^{NS}	792.5 ± 268	1725.2 ± 288.1	≤ 0.01***
Iron (mg)	13.7 ± 3.15	12.7 ± 2.93	0.40^{NS}	14.4 ± 3.27	17.5 ± 4.68	≤ 0.01***
Intake of nutrients from snacks						
Energy (kcal)	642 ± 199.25	633 ± 213.45	0.62^{NS}	595 ± 187.94	156 ± 59.01	≤ 0.01***
Carbohydrate (g)	75.5 ± 27.11	80.7 ± 29.14	0.11^{NS}	71.8 ± 24.34	24.3 ± 8.27	≤ 0.01***
Protein (g)	16.3 ± 4.99	15.9 ± 5.65	0.73^{NS}	15.5 ± 4.91	6.4 ± 3.19	≤ 0.01***
Fat (g)	30.3 ± 10.9	27.1 ± 11.26	0.26^{NS}	27.0 ± 10.47	3.7 ± 3.1	≤ 0.01***
Calcium (mg)	84.0 ± 55.2	85.7 ± 56.3	≤ 0.01*	88.4 ± 59.0	142.6 ± 95.3	≤ 0.01***
Iron (mg)	0.86 ± 0.41	0.88 ± 0.42	≤ 0.01*	0.94 ± 0.46	1.9 - 0.92	≤ 0.01***
Percent contribution of snacks to daily intake of major nutrients						
Energy (kcal)	31.6 ± 10.68	33.4 ± 8.28	0.05**	29.4 ± 9.35	11.6 ± 4.30	≤ 0.01***
Carbohydrate (g)	21.5 ± 7.63	22.1 ± 7.36	0.87^{NS}	21.1 ± 7.46	14.6 ± 4.53	≤ 0.01***
Protein (g)	39.2 ± 12.62	38.5 ± 14.36	0.26^{NS}	35.5 ± 11.98	10.0 ± 4.62	≤ 0.01***
Fat (g)	58.2 ± 23.55	55.1 ± 16.49	0.45^{NS}	50.6 ± 18.15	7.7 ± 6.81	≤ 0.01***
Calcium (mg)	13.3 ± 9.55	13.8 ± 8.06	0.34^{NS}	12.2 ± 8.44	8.4 ± 5.71	≤ 0.01***
Iron (mg)	6.5 ± 3.40	6.3 ± 3.59	0.63^{NS}	9.1 ± 4.06	11.1 ± 5.41	≤ 0.01***

Values are mean ± SD; ^{NS} = Non significant; **Significant at 5%; ***Significant at 1%

The results clearly indicated a positive behavioural change in eating pattern of the subjects in cognitive group treatment which resulted in decreased intake of energy (-696 kcal), carbohydrates (-177 g) and fat (-4.29 g), and enhanced intake of protein (19.2 g), calcium (932.7 mg) and iron (3.06 mg). As the result of cognitive group treatment, energy and carbohydrates decreased by 19.6 and 23.9%, respectively, while protein and calcium intakes increased by 38.2 and 72.5%. Tsiros *et al.* (2008) observed a decrease in energy intake (-558 kcal), carbohydrate intake (-62.1 g) and fat intake (-17.9 g) by CBT intervention.

The cognitive group treatment programme resulted in decrease in energy and carbohydrates by 19.6 and 23.9%, respectively; while protein and calcium intakes increased by 38.2 and 72.5%. The daily fat intake was slightly higher (1.2%) but iron intake lesser (37.6%) than recommended dose. A significantly ($p \leq 0.01$) lesser snacking was observed during 10 weeks of cognitive group treatment, the energy from snacks was reduced from 595 to 156 kcal, carbohydrates from 71.81 to 24.31 g, protein from 15.46 to6.43 g and fat from 27.01 to 3.72 g, however there was a significantly ($p \leq 0.01$) higher intake of calcium i.e. 88.4 to 142.6 mg and iron from 0.94 to 1.90 mg from snack foods (Table 2). The results revealed a positive change in snacking behaviour among the subjects in experimental group, the energy intake decreased by 439 kcal, carbohydrates by 47.5 g, protein intake by 9.03 g and fat intake by 23.29 g; whereas, calcium and iron increased by 54.2 and 0.96 mg, respectively. No significant change. in nutrient intake from snack consumption was observed in control group. The results showed that snacking had important contribution to daily intake of energy (29.39%), carbohydrates (21.11%), protein (35.53%) and fat (50.61%) among the experimental group, however a significant ($p \leq 0.01$) reduction in contribution of these nutrients through snacking was observed after 10 weeks of cognitive group treatment. Cole and Fox (2008) reported that the snacks provided a significantly higher density of energy intake as compared to the three meals among school going children. Daily energy intake was significantly attributed by snacking, the range being12 to 35% has been reported among different countries around the globe by (Hess *et al.,* 2016).

Table 3: Anthropometric and body composition parameters of the selected working women in control and experimental groups

Anthropometric parameters	Control group (n = 34)		p-value	Experimental group (n = 32)		p-value
	week 0	week 10		week 0	week 10	
Basic anthropometric parameters						
Height (cm)	156.13 ± 6.32	156.13 ± 6.32	-	156.6 ± 6.39	156.6 ± 6.39	-
Weight (kg)	70.97 ± 5.96	71.24 ± 6.14	0.31^{NS}	72.10 ± 4.84	69.21 ± 4.99	≤ 0.01***
Waist circumference (cm)	95.02 ± 12.38	95.21 ± 12.05	0.89^{NS}	97.19 ± 9.55	92.42 ± 9.08	≤ 0.01***
Hip circumference (cm)	101.87 ± 17.56	104.34 ± 4.53	0.50^{NS}	105.41 ± 3.19	102.52 ± 2.55	≤ 0.01***
Body composition parameters						
Fat mass (kg)	27.95 ± 6.98	29.15 ± 6.66	0.05**	28.26 ± 4.42	26.69 ± 4.24	≤ 0.01***
Fat (%)	39.51 ± 9.91	40.99 ± 9.26	0.06*	39.13 ± 5.06	38.62 ± 5.76	0.37^{NS}
Muscle mass (kg)	41.43 ± 2.70	41.26 ± 2.66	0.48^{NS}	42.00 ± 2.16	41.61 ± 2.77	0.12^{NS}
Muscle mass (%)	58.68 ± 4.93	58.28 ± 5.32	0.28^{NS}	58.4 ± 3.2	60.24 ± 3.42	≤ 0.01***
Bone mass (kg)	2.22 ± 0.17	2.24 ± 0.12	0.41^{NS}	2.32 ± 0.18	2.27 ± 0.14	≤ 0.01***
Bone (%)	3.14 ± 0.33	3.16 ± 0.21	0.64^{NS}	3.23 ± 0.27	3.28 ± 0.22	0.04**

Values are mean ± SD; ^{NS} = Non significant; **Significant at 5%; ***Significant at 1%

Anthropometric and body composition parameters

There was a significant ($p \leq 0.01$) reduction in body weight after trial of 10 weeks, the percent reduction was 4% of initial body weight in the experimental group; while 0.4% increase was observed in control group (Table 3). Sbrocco *et al.* (1999) reported that the behavioural therapy intervention led to 10 kg weight loss within follow-up of a year. Similarly, Berg and Bertéus Forslund (2015) and Rogers *et al.* (2017) reported an average weight loss of 7.7 and 4.2 kg, respectively, during an intervention trial of 34 weeks among obese adults. A significant ($p \leq 0.01$) change was observed in waist and hip circumference among the subjects of experimental group, the reduction being 4.9 and 2.74%, respectively, however an increase of 0.2 and 2.38% was found in control group.

The percent fat mass of the subjects in control group increased significantly ($p = 0.06$), while percent fat mass in experimental group decreased by 2.0% over a period of 10 weeks. The percent muscle mass and fat free mass of experimental group increased significantly ($p \leq 0.01$ and 0.13) by 3.1 and 2.4%. A small but significant ($p = 0.04$) increase of 1.5% in bone mass was observed in experimental group (Table 3). A behavioural therapy regarding weight loss diets along with prescribed exercise schedule by Dhir *et al.* (2013) revealed that the weight loss programme including low calorie and high protein diets along with physical exercise was effective to bring reduction in fat mass and increase in fat free mass among adult women during 12 week programme. With the help of CBT intervention, a positive change i.e. decrease in fat mass (-4.8 kg) and increase in fat free mass (+1.1 kg) among adolescents has been reported by Tsiros *et al.* (2008).

Statistical analysis to derive relationship of snacking with adiposity among the working women in Table 4 revealed that the energy from snacks was positively and significantly associated with hip circumference ($p \leq 0.05$); carbohydrates from snacks with body weight, hip circumference ($p \leq 0.05$) and fat mass ($p \leq 0.01$); proteins from snacks with body weight, hip circumference and fat mass ($p \leq 0.05$) and fat intake from snacks with hip circumference and fat mass ($p \leq 0.05$). The fat from snacks was significantly ($p \leq 0.05$) but negatively correlated ($p \leq 0.05$) with muscle mass. The findings revealed that energy and macro-nutrients namely carbohydrates, protein and fat from snack foods had a strong association with fat mass, hence restricting these nutrients through snacks has been proved beneficial to reduce adiposity. The intervention of snack consumption elevates positively with the transition in body weight has been reported by Whybrow *et al.* (2007). Further, the intake of energy was raised when subjects were expending each of the three sorts of meals, although there was some proof that the high carbohydrate snacks created little increments than the blended snacks, which thus, delivered little increments than the fatty snacks. Barrington and Baresford (2019)

Table 4: Relationship of macronutrient intake from snacks with anthropometric and body composition parameters

Nutrients	Correlation coefficients (r)	
	Positive (+)	Negative (+)
Energy	Hip circumference (r = 0.219**)	-
Carbohydrates	Body weight (r = 0.304**) Hip circumference (0.212**) Fat mass (r = 0.397***)	-
Protein	Body weight (0.232**) Hip circumference (r = 220**) Fat mass (r=277**)	-
Fat	Hip circumference (r = 0.216**) Fat mass (r = 0.212**)	Muscle mass (r = -0.260**)

**Significant at 5%; ***Significant at 1%

reported that the greater morning and evening snacking were associated with a higher obesogenic dietary index and higher BMI. The evening snacking was more adverse as compared to the other times of day for healthy weight. The reduced intake of evening snacks can control obesity more promptly.

The study has limitations as small sample size of 66 overweight Indian women aged 30-60, which may limit broader applicability; a short 10-week cognitive group treatment duration, possibly missing long-term effects; reliance on potentially biased self-reported data; a lack of long-term follow-up; limited external validity due to cultural context and neglect of confounding variables; and a narrow focus on snacking behaviour, nutrient intake, and body composition. Future research should address these by using larger, diverse samples, longer follow-ups, objective dietary assessments, and considering confounding variables, while strengthening the theoretical framework with updated references. The study concluded that a positive behavioural change in snacking pattern of subjects through cognitive group treatment programme. Energy and macronutrients namely protein, carbohydrate, and fat from snack foods had a strong association with fat mass, hence restricting these nutrients through snacks has been proved beneficial to reduce obesity among subjects who received cognitive group treatment for 10 weeks, hence cognitive treatment targeting the eating behaviour is a useful strategy to overcome the ever-increasing public health issue of overweight/ obesity.

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