

# Energy Intake, Expenditure and Balance among Female College Students Having Normal and Disordered Eating Behaviors in Delhi, India

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## ABSTRACT

**Context:** Disordered eating behavior among young individuals has been increasing rapidly in non-western countries in recent years, especially among females. As it includes abnormal behaviors such as diet restriction, skipping meals, binge eating, and excessive exercising, it is likely to have adverse consequences on the energy intake, expenditure, and balance of individuals indulging in such behavior.

**Aim:** This study was conducted to determine energy intake, energy expenditure and energy balance among 162 female students, aged between 18-21 years, and having normal and disordered eating behaviors from colleges in Delhi, India. **Methods and Material:** A three-day 24-hour diet and activity recall method was used to gather information about the energy intake and expenditure of the students, and energy balance was computed from the difference between these two parameters. **Results:** The energy intake of students having disordered eating behavior was found to be significantly lower while their energy expenditure was significantly higher as compared to students exhibiting normal eating behavior. Students displaying both normal and disordered eating behaviors had a negative energy balance, however, it was significantly more negative in the case of subjects having disordered eating behavior. **Conclusion:** Female students having disordered eating behavior followed greater dietary energy restrictions and expended more energy to lose weight and achieve thin body ideals, and such practices were likely to lead to adverse health and nutritional consequences among them.

**Keywords:** College students, Disordered eating behavior, Energy balance, Energy expenditure, Energy intake

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## INTRODUCTION

Disordered eating behavior characterised by inappropriate eating behaviors such as restricting diet, skipping meals, fasting, binge eating, purging, using laxatives, diuretics and diet pills, and exercising excessively in order to lose or control weight, is often related to dissatisfaction with one's body shape or size.<sup>[1-3]</sup> Such behavior, which depicts sub-clinical symptoms of eating disorders, was earlier considered as being peculiar to the west but is now showing increasing prevalence among the non-western populations also.<sup>[4-11]</sup>

During college life, young adults often deal with several social, biological, and psychological changes which can

influence their eating behavior adversely, leading to disordered eating behavior among them. Several symptoms of disordered eating behavior have a median age of onset between 18 to 21 years.<sup>[12]</sup> Moreover, Harris referred to college campuses as "breeding ground" for development of such disordered eating behavior and clinical forms of eating disorders.<sup>[13]</sup> Studies have reported that disordered eating behaviors are particularly common among young females and they assume "epidemic" proportions among adolescents and college-going females.<sup>[14-16]</sup>

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As diet restriction is one of the significant behaviors in disordered eating, it has been reported that individuals displaying such behavior often exclude foods containing simple carbohydrates and lipids that are associated with weight gain from their diets, and also reduce the number of meals consumed daily.<sup>[17-18]</sup> It has further been speculated that body mass index (BMI) and the desire to modify their weight plays an important role in deciding the energy intake, expenditure and balance among individuals.<sup>[19]</sup> Leet in her study found that college students were more vulnerable to negative energy balance due to their increased frequency of skipping meals and erratic schedules.<sup>[20]</sup>

As many of the young college-going females are on the threshold of the next important phase of their lives which includes bearing children, it becomes imperative that they have adequate energy intake and also expend appropriate amount of energy daily so as to maintain a healthy body weight and remain fit. However, if they have disordered eating behavior and consume inappropriate amount of energy and also do not expend it in appropriate amount, they are likely to have a negative or positive energy balance leading to undernutrition or overweight and obesity among them. As there were no known studies on energy intake, expenditure and balance in context of disordered eating behavior among college students in India, the present study was carried out to determine the energy intake, energy expenditure and energy balance among college-going females in Delhi, having normal and disordered eating behaviors.

## METHODS AND MATERIALS

The present cross-sectional study was carried out on 162 female college students from the University of Delhi, of which 81 students each exhibited normal and disordered eating behaviors. These subjects were a part of a larger study that was carried out on 734 students from 10 women's colleges of the University of Delhi, selected through multistage random sampling technique, to determine the prevalence and other aspects of disordered eating behavior among female college students in Delhi.<sup>[21]</sup> The subjects having normal and disordered eating behaviors were identified using Eating Attitude Test (EAT)-26. All subjects who agreed to give detailed information about their dietary intake and activities for the same 3 days were included in the present study. Informed consent was taken from the subjects and ethical procedures were followed for data collection.

A questionnaire-cum-interview schedule was used to obtain information about general profile of the subjects. Information about energy intake of the subjects was gathered using 24-hour diet recall method for 3 days, comprising two college days and one holiday. DietCal software, 2016 version, which

is based on the Indian Food Composition Tables<sup>[22]</sup> was used to compute the energy intake of the subjects from the data gathered on their dietary intakes.

For assessing energy expenditure, information on time spent by the subjects in performing different types of activities daily was obtained for the same three days for which their dietary intake information was gathered. The subjects were asked to recall the time spent by them in past 24 hours on various activities that were categorized as sleep, occupational (related to their studies), and non-occupational such as personal care (bathing, dressing, plaiting hair, etc.), eating, commuting by bus/vehicle/walking, general household or other activities, walking at various speeds without load (including activities such as dancing, aerobics, doing gym exercises, playing sports, etc.), and light leisure activity such watching television, painting, listening to music, talking on phone, playing cards or board games, etc. If the subjects were unable to recall their activities for a total of 24 hours, the balance time duration was taken as residual activity.

Factorial approach was used for computation of energy expenditure. Basal Metabolic Rate (BMR) of the subjects was first calculated for 24 hours using the equation given by Indian Council of Medical Research (ICMR) Expert Group for Indians<sup>[23]</sup> and then the energy cost of BMR per minute was computed. The Physical Activity Ratio (PAR) values of different activities for sedentary adult Indian population<sup>[24]</sup> were used to calculate the total energy expenditure per day for different categories of activities performed by the subjects. The formula for this was:

Total time spent on the activity (in a specific category) in the day (in minutes) x PAR value for that category of activity x Energy cost of BMR per minute

Finally, the energy expenditure for all categories of activities was summed up to obtain total energy expenditure for the day for all subjects. Average intake and expenditure of energy were computed for three days for all the subjects and their energy balance was determined from the difference between these two parameters. Thereafter, mean/median energy intake, energy expenditure and energy balance for the two study groups showing normal and disordered eating behavior, and the total sample were calculated. The subjects were also categorized on the basis of their average energy balance for the three days under study.

The obtained data was statistically analyzed using the software, Statistical Package for Social Sciences (SPSS), version 21.0. Normality of data was ascertained, and unpaired t-test was used in case the data were normally distributed, otherwise Mann-Whitney U test was used for continuous data. Chi square test was used for the analysis of categorical data. Level

of significance used in the present study was  $p \leq 0.05$ .

## RESULTS AND DISCUSSION

The subjects were referred to as those belonging to Normal Eating Behavior (NEB) group and Disordered Eating Behavior (DEB) group in the present study.

The subjects were unmarried female college students aged between 18-21 years. Most of them had 1-2 siblings (70%) and were first born (44%) among them. Majority of them resided at home in nuclear families (84.2%) and had been living in the National Capital Region of Delhi since birth (68.8%). Maximum percentage of subjects also belonged to upper and upper middle income socioeconomic status categories (76.7%) as per Kuppuswamy's Socioeconomic Status Scale 2017.<sup>[25]</sup>

Energy expenditure in various types of activities<sup>[24]</sup> performed by the subjects from NEB and DEB groups has been presented in Table 1. The subjects were found to expend maximum energy daily in sleeping followed by occupational activities related to their studies. They spent the least amount of energy on eating activities followed by walking at various speeds without load and some similar sports-related activities. Energy expenditure in all activities except general household activities was higher among the DEB group subjects as compared to NEB group subjects, however, the difference in energy expenditure between the two study groups was statistically significant only for sleeping, occupational activity, personal care, eating, and light leisure activity.

Data on energy intake, energy expenditure and energy balance of the two groups of subjects and the total sample have

**Table 1: Energy Expenditure (kcal/d) in Various Activities Performed by the Subjects**

Activity	NEB Group		DEB Group		p-value
	(n=81)		(n=81)		
	Mean±SD	Median	Mean±SD	Median	
	(Range)	(IQR)	(Range)	(IQR)	
Sleep	391±67	382	415±72	415±72	0.047*
	(228-557)	(351-438)	(280-621)	(280-621)	
Occupational activity	311±119	286	357±114	355	0.006*
	(118-598)	(224-383)	(137-583)	(276-435)	
Personal care	163±56	153	182±48	177	0.013*
	(54-306)	(120-202)	(92-309)	(146-215)	
Eating	124±38	118	138±36	139	0.014 <sup>†</sup>
	(45-272)	(98-148)	(72-249)	(107-157)	
Commuting to place of occupation by bus or by vehicle or by walking	194±81	183	196±98	187	0.803
	(39-451)	(128-247)	(49-547)	(111-254)	
General household or other activities	221±101	221	210±101	213	0.506
	(21-527)	(154-268)	(0-443)	(133-284)	
Walking at various speeds without load and similar activities	143±95	144	164±117	135	0.431
	(0-588)	(75-191)	(0-669)	(100-213)	
Light leisure activity	231±70	215	259±85	254	0.007*
	(103-497)	(185-259)	(62-498)	(201-311)	
Residual activity	36±42	20	31±42	0	0.305
	(0-163)	(0-55)	(0-177)	(0-57)	

**Note:** NEB: Normal Eating Behavior, DEB: Disordered Eating Behavior, SD: Standard Deviation, IQR: Interquartile Range. \*Mann-Whitney U test Significant at  $p \leq 0.05$ , t-test Significant at  $p \leq 0.05$ .

**Table 2: Energy Intake, Energy Expenditure and Energy Balance of Subjects**

Parameter	NEB Group		DEB Group		p-value	Total	
	(n=81)		(n=81)			(N=162)	
	Mean±SD	Median	Mean±SD	Median		Mean±SD	Median
	(Range)	(IQR)	(Range)	(IQR)		(Range)	(IQR)
Energy Intake (kcal/day)	1714±326	1668	1410±335	1401	<0.001 <sup>¶</sup>	1562±363	1539
	(996-2459)	(1485-1982)	(658-2181)	(1149-1610)		(658-2549)	(1311-1827)
Energy Expenditure (kcal/day)	1813±197	1802	1952±245	1894	<0.001*	1882±232	1841
	(1472-2358)	(1649-1916)	(1454-2541)	(1757-2186)		(1454-2541)	(1714-2011)
Energy Balance (kcal/day)	-99±358	-134	-542±438	-509	<0.001 <sup>¶</sup>	-320±456	-286
	(-1241 to +934)	(-300 to +79)	(-1464 to +440)	(-840 to -250)		(-1464 to +934)	(-617 to -41)

**Note:** NEB: Normal Eating Behavior, DEB: Disordered Eating Behavior, SD: Standard Deviation, IQR: Interquartile Range. t-test Significant at p≤0.05, \*Mann-Whitney U test Significant at p≤0.05.

**Table 3: Distribution of Subjects According to their Energy Balance**

Energy Balance (kcal/day)	NEB Group (n=81)	DEB Group (n=81)	p-value	Total (N=162)
+501 to +1000	4 (4.9)	0 (0.0)		4 (2.5)
0 to +500	22 (27.2)	8 (9.9)		30 (18.5)
-1 to -500	47 (58.0)	31 (38.3)	<0.001*	78 (48.1)
-501 to -1000	7 (8.6)	30 (37.0)		37 (22.8)
> -1000	1 (1.2)	12 (14.8)		13 (8.0)

**Note:** NEB: Normal Eating Behavior, DEB: Disordered Eating Behavior. Figures in parentheses denote percentages, \*χ<sup>2</sup> Significant at p≤0.05.

been given in Table 2. Energy intake of the subjects in the study sample was found to be lower than their energy expenditure. DEB group subjects had significantly lower energy intake as compared to the NEB group subjects, while their energy expenditure was found to be significantly higher. The subjects from both groups showed a negative energy balance, however, this was significantly more negative in case of DEB group subjects in comparison with NEB group subjects.

The subjects were also categorized according to their average energy balance for three days under study (Table 3). Nearly half of the total subjects had a negative energy balance ranging between -1 to -500 kcal/day. Significant differences between the NEB and DEB group subjects were found in terms of their categories of positive and negative energy balance. Higher percentages of DEB group subjects, i.e., 51.8% versus 9.8%

in NEB group had a negative energy balance that was more than -501 kcal per day while more subjects from NEB group (32.1%) had a positive energy balance as compared to only 9.9% subjects from DEB group.

Positive and negative energy balance among individuals indicates whether they are likely to gain or lose weight if they maintain the same state of energy balance for a continued period of time. In the present study, it was found that the mean/median energy intake of subjects was lower than the recommended allowance of 1900 kcal/day of energy for adult Indian women doing sedentary work,<sup>[24]</sup> and this energy deficit was greater among the subjects displaying disordered eating behavior as compared to those having normal eating behavior. The Estimated Energy Requirement (EER) of 1660 kcal/day for Indian women doing sedentary work<sup>[26]</sup> was almost similar to the energy intake among the subjects having normal eating behavior, however, the energy intakes among females exhibiting disordered eating behavior were lower than the EER. There is lack of data on the actual/estimated energy intakes of college students who have normal and disordered eating behaviors. However, studies on female student population and women in the reproductive age group, in general, have indicated that their energy intakes are lower than the recommended allowances for the same.<sup>[27-29]</sup>

Almost all female college students between 18-21 years go through a transitory phase where they look forward to making good impressions on their prospective mentors, employers, partners, and other members of society in general. It is commonly believed by them that being overweight/obese does not make them appear good and hampers their chances to secure the attention of people they want to connect with. Therefore, they usually try to adopt practices that help them

appear good, and losing weight is considered one of the most important strategies for them to have a good and 'acceptable' appearance. However, some other female students who may not consciously be trying to have a thin appearance may still have lowered energy intakes due to changes occurring in their lives during this time related to academics, moving away from home, planning for the future, etc., and result in stress and anxiety among them. Further, the energy intake of DEB group subjects being significantly lower than NEB group subjects was not an unexpected finding in this study as females having disordered eating behavior usually try to restrict their diets, especially focusing on their calorie intake. These females have more concerns about their body weight and shape and are likely to adopt extreme forms of severe caloric restrictions to attain a thin body that they often idolize.

Significantly higher median daily energy expenditure was observed among the DEB group subjects in comparison with NEB group subjects in the present study. Most individuals usually spend about one-third of the day's duration in sleeping and another one-third doing their occupational activities. Subjects in this study were also found to be spending a major part of their day's total energy expenditure on sleeping and occupational activities. As the occupational activities of the female college students were mainly related to their studies, this made their lifestyles extremely sedentary. For most activities, subjects in the DEB group spent significantly more energy daily as compared to NEB group subjects. Energy spent in walking, doing simple exercises, and performing sports activities daily was not different for the NEB and DEB group subjects, as the focus seemed to be more on energy restriction in the diets to lose weight and not on performing more physical activity. Moreover, as energy expenditure in various activities also depends on the body weight, wherein the energy cost of BMR/minute increases with body weight, it could have also resulted in a higher energy expenditure estimation for doing similar activities among the DEB group subjects who had higher body weights.

The mean/median daily energy expenditure of subjects from both NEB and DEB groups was higher than their mean/median daily energy intake. It has also been suggested recently that BMR and Physical Activity Level (PAL) values used for determining energy expenditure of sedentary adult Indians may need to be revised to lower values, as the values currently used seem to be incorrect. The current overestimated values of BMR and PAL are perhaps leading to higher estimated daily energy expenditure.<sup>[30]</sup>

The mean energy balance of the subjects in this study varied widely, with DEB group subjects having a significantly higher negative energy balance as compared to NEB group subjects.

This could be attributed to significantly lower energy intake and higher energy expenditure among them in comparison with the subjects from the NEB group. It was further found that greater percentages of DEB group subjects had a significantly higher negative energy balance which could be due to their conscious intention to lose weight. It was a serious concern that about 15% of these DEB group subjects also had a very high negative energy balance of more than -1000 kcal/day and continued calorie restriction in such amounts could lead to serious health and nutritional consequences for the young females.

Though lower than subjects from the DEB group, a considerable percentage of subjects from the NEB group were also found to be in a state of negative energy balance. As most young females wish to have a good appearance which they normally associate with being thin, whether or not these women are obsessed with losing weight, they are still likely to consume lower calories than what they expend at this age. Ortega *et al.* reported in their study on female university students in Spain that subjects who had BMI above the 30<sup>th</sup> percentile and wanted to lose weight had 11.4% to 15.7% lower energy intake as compared to their energy expenditure.<sup>[19]</sup>

## CONCLUSION

Findings on energy intake, expenditure, and balance of the subjects in this study revealed that large numbers of female college students between 18-21 years of age were desirous of losing weight, and to achieve this goal rather than focusing on increasing their physical activity a little more, they tended to lower their energy intake. Moreover, females exhibiting disordered eating behavior had higher energy restrictions in their diet, which were unlikely to be very healthy and could also lead to several other nutritional deficiencies among them.

To our knowledge, this was one of the first studies that estimated energy intake, expenditure, and balance among female students displaying normal and disordered eating behaviors. However, as the study made these assessments based on diet and activity recalls for three days, the estimations were dependent on the memory of the subjects.

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