

A correlation of per day calorie intake with resting energy expenditure in healthy young adults

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ABSTRACT

Background: The energy requirement of an individual can be defined as the level of energy intake from food that will balance the energy expenditure. Dietary intakes lower or higher than the body requirements can lead to undernutrition (deficiency diseases) or overnutrition (diseases of affluence), respectively. Per day calorie intake influences various daily energy utilizing activities. The imbalance between intake and expenditure continues over long periods, changes in body weight or body composition will occur and may adversely affect health. The resting energy expenditure (REE), the largest portion (50–75%) of total energy expenditure, is the energy required to maintain the basic metabolic activities including maintaining the body temperature and keeping the functioning of vital organs such as brain, kidneys, heart, and lungs. Hence, REE plays the most important role in body functioning. **Objective:** The aim and objective of the present study were to access the effect of per day calorie intake on REE. **Materials and Methods:** One hundred subjects (age 18–25 years) were assessed for data collection. All the data were collected in the early morning hours. The study was approved by the Institutional Ethical Committee (EC/P-47/2018) of Rajasthan University of Health Sciences College of Medical Sciences, Jaipur. Demographic data including the anthropometric measurement of the participants such as weight, height, and body mass index (BMI). Calories intake (kcal) in 24 h was measured using food frequency questionnaire. Moreover, REE was measured using the gold standard method indirect calorimetry. Pearson correlation was calculated to seen correlation between per day calorie intake and REE. **Results:** A total of 75 males and 25 females with mean age of males and females were 19.97 ± 1.81 years and 19.32 ± 1.75 years, respectively. The mean BMI was 21.77 ± 4 kg/m² of males and 22.68 kg/m² of females. The mean calorie intake was 2532.082 ± 830.970 kcal in males and 1991.176 ± 783.291 kcal in females. The mean REE of male subjects was 2081.470 ± 587.661 kcal and of females was 1827.895 ± 469.671 kcal. The present study results showed the positive poor correlation ($r = +0.1572$) between calorie intake and REE in male subjects and negative poor correlation ($r = -0.1484$) in female subjects. **Conclusion:** The present study results concluded that there was a poor association between per day calorie intake and REE. Moreover, on the basis of the present study results, we can also say that most of our energy intake was expended to maintain body functioning at rest.

KEY WORDS: Resting Energy Expenditure; Total Energy Expenditure; Indirect Calorimetry; Food Frequency Questionnaire; Body Mass Index

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INTRODUCTION

Youth is the window of opportunity that sets the stage for a healthy and productive adulthood and to reduce the likelihood of health problems in later years. Young adulthood is generally considered healthy times of life, several important public health and social behaviors and problems

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either start or peak during these years. Nutritional status is an indication of the overall well-being of a population. Adequate nutritional status of young adults is important for good health and increased work capacity. The nutritional status of an individual is influenced by a variety of factors, including life stage, environment, food access, and socioeconomic status.^[1] Young adults face a variety of risk factors for poor mental health, including high stress and high rates of food insecurity.^[2] Food insecurity is defined as the lack of consistent access to a sufficient quantity of healthy affordable foods, at college campuses.^[2] Importantly, food insecurity has been shown to be associated with poor physical health and then affects the mental health.^[3] Nutrients that we obtain through food have vital effects on physical growth and development, maintenance of normal body function, physical activity, and health. Nutritious food is, thus, needed to sustain life and activity. Diet must contain all essential nutrients in the required amounts. Prolonged insufficient energy intake results in malnutrition, which is observed in many developing countries and is also a public health concern.^[4]

The energy requirement of an individual can be defined as the level of energy intake from food that will balance the energy expenditure when the individual has a body size, composition, and level of physical activity that is consistent with long-term good health.

Dietary intakes lower or higher than the body requirements can lead to undernutrition (deficiency diseases) or overnutrition (diseases of affluence), respectively. Eating too little food during certain significant periods of life such as infancy, childhood, adolescence, pregnancy, and lactation and eating too much at any age can lead to harmful consequences. An adequate diet, providing all nutrients, is needed throughout our lives. The nutrients must be obtained through a judicious choice and combination of a variety of foodstuffs from different food groups.^[5] Thus, when one gets a balanced diet have good physical and mental health. The National Sample Survey Office's 2011–2012 data on nutritional intake show that per capita calorie consumption has risen to 2099 kcal/day in rural areas and 2058 kcal/day in urban areas. Both numbers are still below India's Planning Commission benchmark of 2400 kcal/day for Indian young adults.^[5] The amount of energy that is required by an individual depends on age and physiological status. Adults need nutrients for maintaining constant body weight and ensuring proper body function. The factors which influence energy needs are age, size, and altered physiological status such as pregnancy and lactation. The total quantity of food intake is a measure of the total energy expenditure (TEE). If the imbalance between intake and expenditure continues over long periods, changes in body weight or body composition will occur and may adversely affect health.^[6,7]

The resting energy expenditure (REE), the largest portion (50–75%) of TEE, is the energy required to maintain the

basic metabolic activities including maintaining the body temperature and keeping the functioning of vital organs such as brain, kidneys, heart, and lungs.^[8]

REE is a component of energy expenditure that is measured by indirect calorimetry (IC).^[9,10] The REE of adult humans is determined by the sum of the metabolic rates of the tissues in the body. At present, the sum of energy expenditures of all metabolically active tissues can be estimated by IC.^[11] Determining REE is essential for nutrition and exercise professionals in providing nutritional advice. Still, there are no studies which evaluate the effect or correlation of per day calorie intake on REE. Hence, the aim of the present study was to evaluate a correlation of per day calorie intake with REE in healthy young adults.

MATERIALS AND METHODS

One hundred healthy young subjects (age 18–25 years) were taken for this present study. All the participants were screened based on the inclusion and exclusion criteria before their enrolment into the study. Subjects who had a history of smoking alcoholism, hypertension, diabetes, cardiac, respiratory, and musculoskeletal disorders or not willing to participate were excluded from the study. Moreover, the data were collected in better research setting conditions after taking consent. The study was approved by the Institutional Ethical Committee (EC/P-47/2018) of Rajasthan University of Health Sciences College of Medical Sciences, Jaipur. All the data were collected in the early morning hours. Demographic data including the anthropometric measurement of the participants such as weight, height, and body mass index (BMI). Calories intake (kcal) in 24 h was measured using food frequency questionnaire (FFQ). The FFQ is an advanced form of the checklist in dietary history method and asks respondents how often and how much food they ate over a specific period.^[12] In the present study, FFQ used to consist the list of 111 food items eaten in West India (Rajasthan). This questionnaire takes 20–30 min to complete and can self-administered or collected through interview. This method enables the assessment of long-term dietary intakes in a relatively simple, cost-effective, and time-efficient manner. Thus, various FFQs have been widely employed as a practical instrument since the 1990s.^[13,4,14] FFQs should be developed specifically for each study group and research purposes because diet may be influenced by ethnicity, culture, an individual's preference, economic status, etc.^[15] For each item on the FFQ, the average frequency of consumption over the previous 24 h and normal size typically eaten by the respondent were noted down. Portion size estimation was undertaken using volume measure, circular measure, numbers, and linear measures. A set of metal cups, spoon were used to estimate the volume.^[16] FFQ was filled on the basis of responses of respondent. All the food items were asked in their local or standard language and then asked them about the frequency and proportion

of food items that were taken to showing the dimension of utensils. Records were taken as per day dietary intake and proportion of that food is eaten in references of portion size of cup, spoon, and glass and through this record, the total energy intake was calculated. As calorific value of food, energy content (kilocalorie) of food items has been summed up and total energy intake was calculated.^[17]

REE was measured using the gold standard method IC.^[18] Human energy stems from chemical energy, which is released from nutrients through the oxidation of food substrates. Carbon-based nutrients (i.e., fuels) are converted into CO₂, H₂O, and heat in the presence of oxygen (O₂). IC assesses the amount of heat generated indirectly according to the amount and pattern of substrate used and byproducts generated. Specifically, REE can be calculated by measuring the amount of O₂ used (VO₂), and carbon dioxide released (VCO₂) by the body. The calculation of VO₂ and VCO₂ forms the inherent principle of IC. Total average daily REE in kcal is usually calculated using the modified Weir equation^[18] as follows:

$$REE = 16.318 VO_2 + 4.602 VCO_2 \text{ (AD instrument Gas analyzer [model-ML206])}$$

$$\text{Weir Equation} - REE = (3.9 [VO_2] + 1.1 [VCO_2]) 1.44 \text{ (kcal/day)}$$

$$REE \text{ (kcal/day)} = ([VO_2 \times 3.941] + [VCO_2 \times 1.11]) \times 1440.$$

Procedure

All the measurements were taken in strict adherence of resting conditions for accurate results. Measurements were performed in a quiet environment with the individual resting for 10–15 min before the measurement. The subject was fasting for at least 5 h, avoids exercise for at least 4 h, and avoids nicotine, caffeine, and stimulatory nutritional supplements for at least 4 h before the calorimetric assessment. They were allowed to void and were then asked to lie down on beds in a quiet special study room. Overall, the study conditions were in accordance with recommended best practice guidelines.^[19] The room temperature was 20–22°C, and blankets were available when requested. After a resting period (10 min), the mask of the metabolic carts was positioned over the participant’s head and IC measurement was started with an initial 10 min period to accustom the participant to the device and for equilibration. Subsequently, a 20 min recording period followed while the subject remained under strict resting conditions.

RESULTS

A total of 100 subjects (75 males and 25 females) with a mean age of males and females were 19.97 ± 1.81 years and 19.32 ± 1.75 years, respectively. The mean BMI was 21.77 ± 4 kg/m² of males and 22.68 kg/m² of females [Table 1].

Table 2 shows the mean values of calorie taken by individuals in the past 24 h and calories expended in resting conditions of males and females.

Pearson’s correlation [Table 3] was calculated to assess the association between calorie intake and REE in males and females. The relation between calories taken (kcal) in 24 h prior data collection and REE was calculated and showing positive poor correlation in male subjects [Figure 1]. However, this relation was negative poor correlation in female subjects [Figure 2].

DISCUSSION

In this cross-sectional study, we examined the association between calorie intakes in the past 24 h and REE in healthy

Table 1: Mean age and BMI

Gender	Age (years)	BMI (kg/m ²)
Male	19.97±1.81	21.77±4.12
Female	19.32±1.75	22.68±4.50

BMI: Body mass index

Table 2: Mean values of calorie intake (kcal) and REE (kcal)

Gender	Calorie intake (kcal) 24 h	REE (kcal)	% of REE of total calorie intake
Male	2532.082±830.970	2081.470±587.661	82.2
Female	1991.176±783.291	1827.895±469.671	91.79

REE: Resting energy expenditure

Table 3: Correlation of per day calorie intake (24 h) with REE

Variables	Calorie intake (kcal) 24 h
REE (kcal)	
Male	r=+0.1572
Female	r=-0.1484

REE: Resting energy expenditure

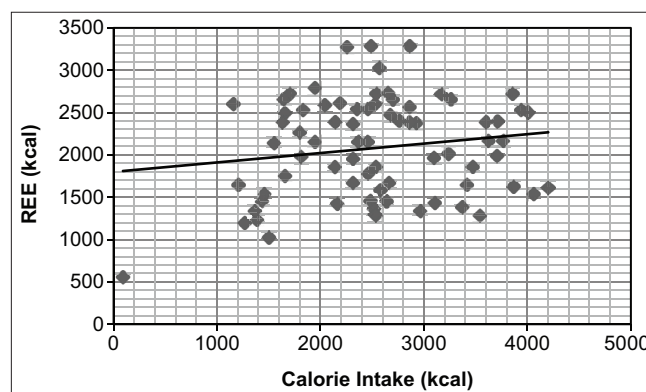


Figure 1: Pearson’s correlation coefficient (r) between per day calorie intake (kcal) and resting energy expenditure (kcal) showing positive poor correlation (r = +0.1572) in males

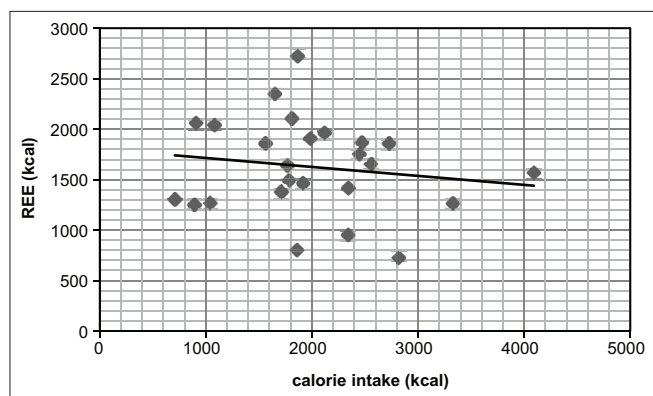


Figure 2: Pearson's correlation coefficient (r) between per day calorie intake and resting energy expenditure (kcal) showing negative poor type correlation ($r = -0.1484$) in females

young adults of age group 18–25 years. Youth is the window of opportunities and working energy of any country. The youth of this age group studied in colleges and to perform better in academics they have the need of proper daily calorie intake. The mean BMI was $21.77 \pm 4.12 \text{ kg/m}^2$ of males and $22.68 \pm 4.50 \text{ kg/m}^2$ of females, which comes under normal BMI range. In this present study, the mean calorie intake was $2532.082 \pm 830.970 \text{ kcal}$ in males and $1991.176 \pm 783.291 \text{ kcal}$ in females. Daily calorie intake from diet, a cutoff of 2800–2900 kcal for males and 2200–2300 kcal for females, was suggested as per the Indian Council of Medical Research (ICMR, 1990)^[4,20] guidelines. In the present study, calorie intake of male and female subjects was less than ICMR calorie intake cutoff values. It means that this study group's per day calorie intake was less than recommended. The mean REE of male subjects was $2081.470 \pm 587.661 \text{ kcal}$ and of females was $1827.895 \pm 469.671 \text{ kcal}$. The REE of male and female subjects was 82.2% and 91.79% of total calories intakes per day as food. Ours is the first study to assess the correlation per day calorie intake (kcal) and REE (kcal). Hence, Pearson's correlation was calculated to assess the association between per day calorie intake (kcal) and REE (kcal). The present study results showed the positive poor correlation ($r = +0.1572$) between calorie intake and REE in male subjects and negative poor correlation ($r = -0.1484$) in female subjects.

Varte and Pal^[21] observed mean REE $1349.13 \pm 185.73 \text{ kcal/day}$ in Indian young adults (mean age 20.14 ± 2.9 years) by IC. Moreover, Joseph *et al.*^[22] found mean REE in Indian population (age 21.5 ± 2.87 years) $2216.47 \pm 514.67 \text{ kcal}$. REE varied in different geographical regions, it may be due to ethnicity variation or conditions, in which recording was done in young adults.

Strength and Limitation

This is the first study which correlates per day calorie intake (kcal) and REE (kcal/day) in healthy young adults. The present study also demands the same type of research in future on large sample.

CONCLUSION

The finding shows that there was poor association between per day calorie intake and REE. Moreover, a large part of total calorie intake was expended to maintain body functioning at rest.

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REFERENCES

1. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr* 2008;87:1107-17.
2. Cady CL. Food insecurity as a student issue. *J Coll Charact* 2014;15:265-72.
3. Tarasuk V, Mitchell A, McLaren L, McIntyre L. Chronic physical and mental health conditions among adults may increase vulnerability to household food insecurity. *J Nutr* 2013;143:1785-93.
4. National Institute of Nutrition. Dietary Guidelines for Indians. Vol. 2. Hyderabad: National Institute of Nutrition; 2011. p. 89-17.
5. National Sample Survey Organisation. NSS Report No. 554/68/10/1. National Sample Survey Organisation, Ministry of Statistics and Programme Implementation. New Delhi: Government of India; 2014.
6. U.S. Department of Health and Human Services. The Surgeon General's Report on Nutrition and Health. Washington, D.C.: U.S. Government Printing Office; 1988. p. 727.
7. National Research Council. Report of the committee on diet and health, food and nutrition board. In: *Diet and Health: Implications for Reducing Chronic Disease Risk*. Washington, D.C: National Academy Press; 1989. p. 7508.
8. Nelms M, Sucher KP, Roth SL. *Nutritional Therapy and Pathophysiology*. 2nd ed. Belmont, CA: Wadsworth Cengage Learning; 2011.
9. Guyton A, Hall J. *Energeticae metabolismo*. In: Guyton A, Hall J, editors. *Tratado De Fisiologia Mrdica*. 10th ed. Rio de Janeiro: Editora ABPDEA; 2002. p. 762-68.
10. Esteves de Oliveira FC, de Mello Cruz AC, Gonçalves Oliveira C, Rodrigues Ferreira Cruz AC, Mayumi Nakajima V, Bressan J. Energy expenditure of healthy Brazilian adults: A comparison of methods. *Nutr Hosp* 2008;23:554-61.
11. Grande F, Keys A. Body weight, body composition and calorie status. In: Goodhart RS, Shils ME, editors. *Modern Nutrition in Health and Disease*. 6th ed. Philadelphia, PA: Lea and Febiger; 1980. p. 3-34.
12. Illner AK, Freisling H, Boeing H, Huybrechts I, Crispim SP, Slimani N. Review and evaluation of innovative technologies for measuring diet in nutritional epidemiology. *Int J Epidemiol* 2012;41:1187-203.
13. Bhupathiraju SN, Wedick NM, Pan A, Manson JE, Rexrode KM, Willett WC, *et al.* Quantity and variety in fruit and vegetable intake and risk of coronary heart disease. *Am J Clin Nutr* 2013;98:1514-23.

14. Méjean C, Droomers M, van der Schouw YT, Sluijs I, Czernichow S, Grobbee DE, *et al.* The contribution of diet and lifestyle to socioeconomic inequalities in cardiovascular morbidity and mortality. *Int J Cardiol* 2013;168:5190-5.
15. Nam CM, Oh KW, Lee KH, Jee SH, Cho SY, Shim WH, *et al.* Vitamin C intake and risk of ischemic heart disease in a population with a high prevalence of smoking. *J Am Coll Nutr* 2003;22:372-8.
16. Teufel NI. Development of culturally competent food-frequency questionnaires. *Am J Clin Nutr* 1997;65:1173S-8.
17. Gopalan C, Rama SB, Balasubramanian SC. Nutritive Value of Indian Foods. Hyderabad, India: National Institute of Nutrition, Indian Council of Medical Research; 1978.
18. Weir JB. New methods for calculating metabolic rate with special reference to protein metabolism. *J Physiol* 1949;109:1-9.
19. Müller MJ, Selberg O, Süttmann U, Weimann A, Kruse ER. Estimation and measurement of energy expenditure: Methodological approach and clinical value. *Intensivmed Notfallmed* 1992;29:411-26.
20. Salve SB, Dase RK, Mahajan SM, Adchitre SA, Yadav VB. Nutritional assessment of medical students. *Int J Med Clin Res* 2010;1:6-10.
21. Varte LR, Pal M. Predictive equation for basal metabolic rate of young Indian soldiers. *AJMS* 2016;7:26-31.
22. Joseph M, Gupta RD, Prema L, Inbakumari M, Thomas N. Are predictive equations for estimating resting energy expenditure accurate in Asian Indian male weightlifters? *Indian J Endocrinol Metab* 2017;21:515-9.

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