

“Vitality and Significance of Basal Metabolic Rate in Perspectives of Healthy Life”

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Abstract

In everyday life, the area of energy expenditure by the humans, the knowhow and measurement of the basal metabolic rate (BMR) is very much prominent element to measure and calculate the energy requirement estimates for a person, a specific group or any given section of the population. In this study review of the available literature has been made to examine the prevailing position in this regard. Literature reveals that the situation represents diverse position. On one hand the high ratio of the increased obesity and on the other the growing trend of being slim can equally be seen in the population at large. Age, gender, physical activity, diet and temperature are the main actors playing their role in increasing and decreasing the BMR of a person. These factors need to be taken into account in working out energy requirements of the group, section or for the entire population.

Key Words: Basal Metabolic Rate, Energy, Physical, Gender, Health, Function.

Introduction

This study is primarily aimed at to know the significance of Basal Metabolic Rate (BMR) in perspectives of its vitality in the overall upkeep and maintenance of health and its importance in leading a healthy life. Prior to going into the detail of this discussion it would be worth mentioning to add that what BMR means and in which paradigm it is used in health related discussion. BMR, or basal metabolic rate, is the measure which determines the amount of calories a person burns while doing no physical or mental activity. This is based on many different factors, including age and gender of the person. As a general principle, for a female having 28 year age and for a 30 years aged male the average BMRs may be between 1580-1650 and 2120-2250 respectively. *“In a clinical setting, BMR may be considered as the energy requirement to maintain a structural and functional homeostasis at rest, in fasting and thermoneutral conditions. BMR represents up to 60%–70% of total energy expenditure and is generally assessed by indirect calorimetry”* (Ferrannini, 1988; Ravussin et al; 1986).

The role of BMR with reference to weight management and maintenance of the good physique is very vital particularly in the growing age of youth (Willcox et al, 2007). Paying due attention on part of the health care centre and health authorities is the primary requirement with reference to the maintenance and promotion of health of the masses. Youth is the most stormy and crucial stage of life in terms of putting the life on certain track and starting the practical life (Keniston 1970). Good health, proper weight, sound mentality is some of the pre requisites of a successful practical life. The entry into the adulthood stage of life is a crucial time for weight management in the youth population (Ford & Torok 2008). But in fact, we do injustice and pay least attention to this important aspect of our routine life and let the things go by their self. This type of approach is entirely based on ignorance, carelessness and lack of proper awareness. Resultantly the average health standard and weight management standard have deteriorated considerably. Obesity, being overweight, and other structural and bodily malformations are the common manifestations of our least attention to this aspect of life. Studies have proved that 27% to 35% of the adult are overweight or obese (Hajhosseini et al., 2006), and nearly 20% participate in regular physical activities of moderate intensity (Kilpatrick, Hebert, & Bartholomew, 2005). This has been the alarming situation with reference to least amount of care and attention paid to this important aspect of life.

Unfortunately in the prevailing scenario, the growing trend of smartness and being slim among the young female folk, has greatly affected health and fitness level of the masses. Generally, dieting is regarded as the best practical tool for controlling and management of the body weight. But in fact, it is a mistaken belief and has negative impact in this regard. *“It is remarkable that in both animals and humans caloric restriction causes a reduction of BMR that is independent of changes in body composition”* (Lane et al.; 2004, Mattson & Wan; 2005, Heilbronn LK, de Jonge L, Frisard MI, et al. 2006). *“It is well established from longitudinal studies of human starvation and semistarvation that weight loss is accompanied by a decrease in basal metabolic rate (BMR) greater than can be accounted for by the changes in body weight or body composition”* (Apfelbaum, Bostsarron, and Lacatis 1971 and Leibel, Rosenbaum, and Hirsch 19950). There is nothing wrong with maintaining a healthy lifestyle and losing a few extra pounds, there is a growing trend in North America and Europe of women resorting to extreme measures in order to lose weight (Nulty, 1997).

On the other hand, a considerable section of the population habitually use fats-rich diet and other types of fast-foods. This type of situation has caused health threatening state of affairs for the masses. Obesity is the certain result of the use of the fats-rich diet and other types of fast-foods and lack of physical. The prevalence of obesity has risen enormously over the past few decades. According to the WHO World Health Report (2002), obesity has increased 3-fold in some parts of North America, Eastern Europe, the Middle East, the Pacific Islands, Australasia and China since 1980.

With reference to practice, instead of BMR, resting energy expenditure (REE) is generally measured. REE is also measured, following the same way, at resting position in a room temperature environment, it too

after 8–12 hours of taking meal and not immediately after awakening. *It is established that REE doesn't differ by more than 10% from BMR* (Shulman and Phillips, 2003). Sleeping energy expenditure, a component of BMR generally remains to be equal to REE x 0.9 (Beghin, Michaud, Guimber, et al.; 2002). The BMR of a person may increase in some extraordinary conditions like fever, swelling, chronic disease and accordingly it may decrease in the event of taking poor diet with low energy allowances.

Understanding the Theme of Basal Metabolic Rate

The energy produced in the body is measured in calories and the metabolic rate is generally expressed in kilocalorie (kcal/hour) per hour. *“Energy supply should aim at covering the nutritional needs of the patient (basal metabolic rate, physical activity, growth and correction of pre-existing malnutrition) including the support of anabolic function”* (Elia, 1995). As mentioned earlier, BMR is the amount of energy output or expenditure measured at the time when a person is in complete physical and mental rest, or is in the post absorptive period or after 12-14 hours after the last meal was taken because after taking the meal, the BMR rises for 4-6 hours by approximately 10-15%. Even during this resting and calm position, considerable amount of energy is required for promptly discharging the internal functions of different systems within the skeleton of the body. *“BMR represents up to 60%–70% of total energy expenditure and is generally assessed by indirect calorimetry”* (Ferrannini 1988; Ravussin 1986).

The normal male youth has an average BMR of 2,100 to 2,550 kcal per day, and that of the female is a little bit lower (Piek, Brachwitz, & Bock 1988). From the viewpoint of health, an additional daily allowance of 500 kilocalories for the person leading inactive and sedentary life and for the person doing hard physical work like farming, labour, sports exertion will need additional 400 to 500 kilocalories per day. This bulk of calories is daily spent simply to keep the normal internal bodily functions like blood circulation, respiration, digestion of the food, neuro-muscular activities etc. So far as consumption of different systems of the body is concerned, it varies from system to system, age to age, gender to gender and season to season. It is estimated that the average consumption of the nervous system is from 40% to 50% while muscular system daily consumes 20% to 30% of the total BMR in the body. For determining the BMR of a person, attention is always required to the environment and temperature of the testing site which should be normal and the recommended temperature for this purpose is from 20-25°C for a person with normal dress.

Factors Affecting BMR

There are a number of different factors that can directly or indirectly affect the metabolic rate of the body. Metabolic rate and BMR are interdependent and one can affect the other. The common factors that influence the BMR are the age, height, weight, gender, growth level, occupation, body composition of the person, temperature of the environment, and nutritional status of the person. Let us have quick look upon a few of them.

Age

Age is the primary factor that is directly associated with the BMR of a person. During the initial few years of life of a child, the BMR remains greater and with the passage of time it steadily falls down in the years to come. Muscles are considered to be the basic consumer of the major portion of the energy in the body. Age is the principal factor that causes increase and decrease in the volume of muscles and fats within the body. Accordingly decrease in the volume of the muscles is always responsible for the decrease in the BMR of a person.

Gender

Significant difference has been noted between the BMR of male and female and it is noted that females have 2% to 12% less BMR than their male counterpart. It is noted that female have 5 to 10% comparatively

low metabolic rate as compared to their corresponding male folk having the same height and weight. Male consumes more energy as compared to female on account of the fact that naturally in body composition of the male comparatively more muscles exist in their body. The difference of BMR level between male and female is greater in the older age. Changes in the BMR of women is mostly subject to the monthly cycle of menstrual flow. The BMR before is often more and less during the post menstrual cycle (Solomon; Kurzer; & Calloway, 1982).

Climate

Some studies have also shown difference in the BMR of the people belonging from Western and Eastern poles of the world. The Western people on going to tropics show a fall in BMR (Henry1992).

Body Temperature

The rise in the internal temperature of the body is proportional to the increase in the BMR. The rise of the temperature of the body by each degree Fahrenheit, the BMR may increase by 7%. On account of fever, for example, a patient having the body temperature of 105 degree Fahrenheit would have about 50% more BMR as compared to the normal temperature of the body i.e. 98 degree Fahrenheit.

Diet

Literature has revealed that vegetarians have 11% less BMR as compared to the non-vegetarians. In addition to that prolonged starvation also causes fall in the BMR. is always evident after considerably but on the other hand, Eskimos protein rich diet have very high BMR. And the disease associated with starvation or prolonged low intake of food results in certain low BMR.

Pregnancy

The role of pregnancy with reference to increase or otherwise in the BMR is vital in the maintenance and promotion of health. It is established that BMR increases in pregnancy particularly during the third trimester (Butte et al.; 2004).

Drugs

Drugs may cause chemical and biological changes in the neuro-muscular tone of the body. With reference to relationship between the use of drugs and variation in BMR, research has proved that caffeine, nicotine and benzedrine are the common drugs that increase the BMR level (Lachance, 1982).

Review of the Literature

Energy Balance of the Body with Reference to BMR

In perspectives of health, energy balance refers to the state of the "Balance" between the intake and its use in the body for the maintenance of the normal body functioning and during hard physical exertion. A person in perfect balance position will be in position to maintain his/her weight of the body and in addition to affectively sustain the body in proper shape and tone and promptly keep the routine activities in progress.

Ailments Causing Increase in the BMR

There are many different diseases that can deteriorate and affect the normal BMR level of a person. Those diseases include Hyperthyroidism, which has got very worst impact upon the BMR, is on the prominent ailments affecting the BMR of a person. Hyper Pituitrism and Hyper Adrenalism are also amongst the

BMR affecting diseases taking high toll in this regard. In addition to the above, Common Fevers, Blood diseases as Polycythemia & Leukemia Heart diseases, and Diabetes are also playing important role in this regard.

Ailments Causing Decrease in the BMR

The diseases that are known to contribute in decreasing the BMR are Hypothyroidism, Hypo Pituitrism, Hypo function of adrenal cortex, Under Nutrition & starvation Shock & Nephrosis. Further that Hypothermia also has significant impact upon the level of BMR in terms of decreasing it. The ultimate result of these diseases is deterioration of health and poor performance of the body in promptly carrying out mental and physical engagement.

Discussion

Technically the term metabolism is defined as the sum of chemical variations taking place in the cell with reference to the breakdown or catabolism and synthesis or anabolism of the different nutrients of food. In perspectives of health and absorption of food elements and becoming part of the body, metabolism is most commonly used term. The metabolic rate of a person refers to the volume or amount of chemical energy released or produced in the body per unit time. And to measure the chemical energy, the universally used term or unit is calorie. Calorie delineates the amount of energy or heat required to raise the temperature of 1 gram of water through 1 degree Celsius. But with reference to food, the unit of kilocalorie is used which has 1000 calories.

The metabolic rate of a person can be measured through using the Spirometer and taking his/her breathe, so that to measure the know about the intake of Oxygen. Spirometer is the scientific machine which measures oxygen consumption in the body. Consumption of oxygen is directly associated with the intake and use of oxygen in the body. Consumption of one liter of Oxygen yields energy or heat more or less than 4.80 to 4.85 kcal. However this ratio of oxygen consumption and energy production mostly varies from food nutrient to food nutrient, nature of physical engagement and structure of the body.

Universally, the BMR is measured at the time only when the person has not taken any food from 12 to 14 hours and who is calm stable condition. In fact, during sleep, the metabolic rate of a person is lower than his/her BMR. So the total metabolic rate (TMR) of a person will be, in addition to the BMR, the additional energy expenditure incurred as a result of carrying out other physical activities. There are a number of factors that may enhance the metabolic rate of a person including physical activities, intake of food, body temperature, and pregnancy. Depression, malnutrition and hunger are a few factors that may decrease the TMR level of the body. It has generally been observed that in growing children, the BMR remain as compared to the aged ones. This is all because of the age factor.

On account of having lower percentage of fat and higher percentage of muscles in the body, male generally have higher BMRs on average as compared to the female counterpart. However, irrespective of the gender either male or female, the person who is leaner and more active will have higher BMRs than the one who leads a sedentary and idle life. Increase in the BMR is proportional to the increases in the body weight for both the genders. After the age of 20, the decrease in the BMR tends to occur with increase in the age, slowing down at the rate of about 2 percent every 10 years.

Recommendations

This study was an effort to bring the ordinary reader to the level of understanding to know about the meaning, significance and role of BMR in the everyday life. After going through the available literature review, following recommendations are put forth for guidance of the health sensitive common readers.

- a. Dietary need of one person may differ from the other. So due attention should be paid to the dietary menu and schedule of the different people with the focus upon the individual age factor of each member.
- b. Gender differences are also vital in working out the BMR related considerations. The dietary requirements of female slightly differ from male. It should also be taken into account while making the nutritional chart for different genders.
- c. Climatic changes and body temperature also have significant role in the variation of BMR of a person and these should be kept in mind while taking measurement of the BMR or metabolism of a person.
- d. Bodily physiological internal changes particularly in the female folk in terms of pregnancy and monthly menstrual cycle affect the BMR level. These two factors need to be taken into consideration with reference to determining the BMR or metabolism of a person of a person.
- e. Age and weight are the two most influential factors with reference to measuring the BMR of a person and should be taken into account while working out the BMR or metabolism of a person.

References

- Apfelbaum M, Bostsarron J, Lacatis D. Effect of caloric restriction and excessive caloric intake on energy expenditure. *Am J Clin Nutr* 1971;24:1405–9.
- Beghin L, Michaud L, Guimber D, et al. Assessing sleeping energy expenditure in children using heart-rate monitoring calibrated against open-circuit indirect calorimetry: a pilot study. *Br J Nutr* 2002;88:533–43.
- Butte, N. F., Wong, W. W., Treuth, M. S., Ellis, K. J., & Smith, E. O. B. (2004). Energy requirements during pregnancy based on total energy expenditure and energy deposition. *The American journal of clinical nutrition*, 79(6), 1078-1087.
- Elia M. Changing concepts of nutrient requirements in disease: implications for artificial nutritional support. *Lancet* 1995;345: 1279–84.
- Ferrannini E. The theoretical bases of indirect calorimetry: a review. *Metabolism*. 1988;37:287–301.
- Ford, M.A., & Torok, D. (2008). Motivational signag e increases physical activity on a college campus. *Journal of American College Health*,57 (2), 2429243.
- Hajhosseini, L., Holmes, T., Mohamadi, P., Goudarzi V., McProud, L., Hollenback C.B. (2006). Changes in body weight, body weight composition and resting metabolic rate in first 9 year university students. *Journal of the American College of Nutrition*
- Heilbronn LK, de Jonge L, Frisard MI, et al. Effect of 6-month calorie restriction on biomarkers of longevity, metabolic adaptation, and oxidative stress in overweight individuals: a randomized controlled trial. *JAMA*. 2006;295:1539–1548.
- Henry, C. J. K. (1992). Estimates of metabolic adaptation in women living in developing countries: technical limitations. *Journal of biosocial science*, 24(03), 347-353.
- Hunter, G. R., Byrne, N. M., Sirikul, B., Fernandez, J. R., Zuckerman, P. A., Darnell, B. E., & Gower, B. A. (2008). Resistance training conserves fat free mass and resting energy expenditure following weight loss. *Obesity*, 16 (5), 104591051.
- Keniston, K. (1970). Youth: A " new" stage of life. *The American Scholar*, 631-654.
- Kilpatrick, M., Hebert, E., & Bartholomew, J. (2005). College students' motivation for physical activity: differentiating men's and women's motives for sport participation and exercise . *Journal of American College Health*, 54(2), 87994. , 25(2), 1239127.
- Lachance, M. P. (1982). The pharmacology and toxicology of caffeine. *Journal of Food Safety*, 4(2), 71-112.
- Lane MA, Mattison JA, Roth GS, Brant LJ, Ingram DK. Effects of long-term diet restriction on aging and longevity in primates remain uncertain. *J Gerontol Biol Sci Med Sci*. 2004;59A:405–407.
- Leibel RL, Rosenbaum M, Hirsch J. Changes in energy expenditure resulting from altered body weight. *N Engl J Med* 1995;332:621–8

- Mattson MP, Wan R. Beneficial effects of intermittent fasting and caloric restriction on the cardiovascular and cerebrovascular systems. *J Nutr Biochem*. 2005;16:129–137.
- Menstrual cycle and basal metabolic rate in women. *The American journal of clinical nutrition*, 36(4), 611-616.
- Nulty, M.C., 1997. Prevalence and contributing factors of eating disorder behaviors in active duty Navy men. *Mil Med.*, 162(11): 753-758.
- Piek, J., Brachwitz, K., & Bock, W. J. (1988). [The energy consumption of patients with craniocerebral trauma and spontaneous intracranial hemorrhage in the early postoperative post-traumatic phase]. *Anesthesie, Intensivtherapie, Notfallmedizin*, 23(6), 325-329.
- Ravussin E, Lillioja S, Anderson TE, Christin L, Bogardus C. Determinants of 24-hour energy expenditure in man. Methods and results using a respiratory chamber. *J Clin Invest*. 1986;78:1568–1578.
- Shulman RJ, Phillips S. Parenteral nutrition in infants and children. *J Pediatr Gastroenterol Nutr* 2003;36:587–60.
- Stiegler, P., & Cunliffe, A. (2006). The role of diet and exercise for the maintenance of fat free mass and resting metabolic rate during weight loss. *Sports Med*, 36 (3), 2399262.
- Epstkin, C. J., Martin, G. M., Schultz, A. L., & Motulskys, A. G. (1966). A Review of its Symptomatology, Natural History, Pathologic Features, Genetics And Relationship to the Natural Aging Process. *Medicine*, 45(3), 177-221.
- Willcox, B. J., Willcox, D. C., Todoriki, H., Fujiyoshi, A., Yano, K., He, Q., & Suzuki, M. (2007). Caloric restriction, the traditional Okinawan diet, and healthy aging. *Annals of the New York Academy of Sciences*, 1114(1), 434-455.
- World Health Organization. The world health report 2002: reducing risks, promoting health life. Geneva: World Health Organization, 2002

