BLOOD KETOACIDS AND ITS RELATION TO RESPIRATORY QUOTIENT

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Summary: The total number of 43 young boys and girls of varying age group between 17-22 years were studied. The levels of blood ketoacids e.g., pyruvate and alphaketoglutarate were estimated spectrophotometrically. The RQ was determined by open circuit method of calorimetry by using Douglas bag for 13 boys and 13 girls and the BMR was estimated by closed circuit method of calorimetry using Collin's metabolex. With the increase of age the RQ and pyruvate were found to increase till the age of 20 years for both the sexes. The increased pyruvate level had a positive correlation with the age for the girls and the alphaketoglutaric acid had no such correlation with age for both the sexes.

Key words: ketoacids respiratory quotient closed circuit calorimetry

INTRODUCTION

During the studies on calorie requirements of Indian subjects using the closed circuit calorimetry, the question arose whether a respiratory quotient (RQ) of 0.82, a factor used for computation of the results of calorie requirements would be valid for the group of people under investigation in different dietary set up (15, 18, 19, 1,2,3,). A shift in RQ from 0.82 to 0.70 on one side and 1.0 and above on the other would make a difference in the calculation of total calorie requirement by $\pm$ 5-10 percent. This figure may not be a very crucial factor for an individual's assessment of calorie requirement, but when a country is planning theoretically for production and distribution of calories per capita, such considerations of RQ of the population groups become meaningful.

The pilot study here, was planned to find out the dispersity of RQ in a small group of student volunteers between 17-22 years of age.

Further, the relationship of the RQ and diet on one hand and the Krebs cycle intermediaries (index of metabolic activities) on the other, have been studied and discussed.

MATERIALS AND METHODS

Twenty six boys and girls of varying age groups between 17-22 years were selected for this study. The details of the parameters of this study are shown in Table I.

The subjects for this study were selected among the students used to stay in the hostel of the Institute of Medical Sciences, Banaras Hindu University. The selected subjects were free from obvious diseases. They were directed to take light meal at about 8 P.M. on the previous night of the experiment. The next morning at about 8 A.M., the experiment was started after giving a thirty minute rest in the laboratory. During this period of rest, the history of dietary intake was enquired by the oral questionnaire method (13). Most of them were vegetarian taking milk as the only animal protein source, though a few of them were accustomed to take occasionally eggs. The calories from carbohydrate source varied from 78-90 percent of the total calorie consumption.

The basal condition in each case was ascertained by the record of pulse rate, respiration rate, oral temperature and arterial blood pressure measurement at intervals of ten minutes. When the last two recordings were close enough to each other, the Basal Metabolic Rate (BMR) estimation was performed by using Collin's Metabolex (closed circuit method) (8). For the determination of the RQ, the open circuit method of calorimetry was done by using the Douglas bag. Four samples of expired air were collected in the Bailey's air sample bottles from each Douglas bag and analyzed for O_2 and CO_2 percentage in the Lloyd's gas analyzer and the mean of these results were noted (12). The room temperature, humidity and atmospheric pressure were also recorded and the results were converted to STPD (7). The height and weight of the subjects were noted for the calculation of surface area according to Du-Bois chart.

The haemoglobin content of the subjects were noted to exclude anaemia. The estimation of blood ketoacids viz., alpha-ketoglutarate and pyruvate were carried out in 20 boys and 23 girls by enzymatic method using Carl Zeiss Spectrophotometer (5).

RESULTS AND DISCUSSION

The summary results of the present study showing various parameters are given in Table I.

TABLE I: Showing the BMR, RQ and blood ketoacids of the boys and girls.

	Average age in years and months	*No. of subjects*	*Surface area* m^2	*BMR* $KCal/m^2/hr$	*Determined RQ*	*Blood pyruvate mg/100 ml*	*Blood alpha-ketoglutarate mg/100 ml*
	Range		*Mean±SE* *Range*	*Mean±SE* *Range*	*Mean±SE* *Range*	*Mean±SE* *Range*	*Mean±SE* *Range*
BOYS	19-1 (17-8 to 22-5)	13	1.59±0.03 (1.43-1.78)	35.38±0.92 (29.13-42.20)	0.85±0.01 (0.75-0.92)	0.51±0.01* (0.46-0.65)	0.18±0.004* (0.14-0.22)
GIRLS	18-1 (17-1 to 20-2)	13	1.42±0.03 (1.28-1.59)	34.28±1.25 (26.74-45.90)	0.83±0.03 (0.72-0.98)	0.51±0.01* (0.44-0.58)	0.19±0.005* (0.12-0.24)

Besides the 13 subjects for the BMR and RQ measurements in each group, blood samples from 7 more boys and 10 more girls belonging to the same age group were taken, making a total of 20 boys and 23 girls for obtaining the mean values of the blood ketoacids.

The pyruvate and alphaketoglutarate levels in blood of the different age groups of boys and girls were shown in Fig. 1 & 2. It was observed that the pyruvate levels in blood for boys

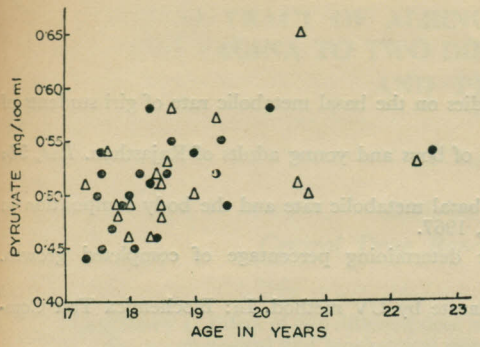

Fig. 1. Correlation of blood pyruvate level with age.
BOYS △
GIRLS ●

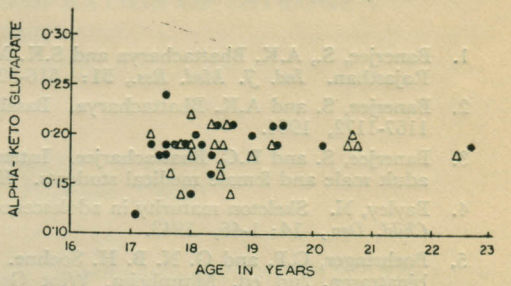

Fig. 2. Correlation of blood alpha-ketoglutarate level with age.
BOYS △
GIRLS ●

and girls continue to rise with age and ultimately plateaued out at or around the age of 20 years. The determined RQ values for both the sexes, found to follow a variation similar to that of pyruvate content of the blood. The correlation coefficient between the age and the pyruvate level of blood were worked out for boys and girls separately as also on the combined sample. That for the boys worked out to be significant at 10% level and that for the girls at 5% level. The combined sample gave a level of significance between RQ and age to be at 1% level. The low level of significance for the boys may arise as a result of a smaller sample size. The increasing RQ values with age might be interpreted as combustion of carbohydrate as the fuel including the process of lying down of fat from carbohydrate, as well as a reflection of metabolic activities commensurate with the processes of skeletal and soft tissue growth (11,20,4,14). However, with the decline of the skeletal growth spurt around the age of 20 years, the RQ did not show the increasing trend manifested in the earlier period of life. The normal adult value of RQ, however, was not attained till the 22nd year of life, suggestive of continuation of growth processes in the soft tissues (17,9).

The observed rise in the blood pyruvate levels for both the sexes were a variation within the normal range and probably reflect a high carbohydrate intake (16) of the subjects. This high level of blood pyruvate need not be construed as a pathological change which happens in relative deficiency of thiamine (6,10). The dietary assessment projected a very satisfactory intake of thiamine, for these volunteers. Clinically, all the subjects presented a fair to good nutrition suggestive of a reasonable amount of fat in the body. Further, the blood pyruvate can be metabolised into protein and fat. As the growth processes of the different tissues altered with age, the metabolic pattern also change. This may be a reason for close relation between the RQ at different ages and the corresponding levels of pyruvate in the blood.

The alphaketoglutarate level of blood did not show any relationship either with age or with the RQ values in different age groups. This further substantiates that the alphaketoglutarate is not a direct metabolic end product from fats and carbohydrates.

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