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Calorie Intake and Intelligence:
A STUDY AMONG BANTU SCHOOL-CHILDREN

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It has for long been established that intelligence has, to a large extent, an hereditary basis, but in this respect it is important to remember that what is inherited is not the phenotypically obvious characteristics and modes of reaction, but rather the capacity to develop, to attain to a certain level of intelligence. Because of this, under certain circumstances environmental factors can play an important part in encouraging or retarding the development of these latent factors. The aim of the present study was to determine what part calorie intake, as an environmental factor, played in determining the level of intelligence reached among children whose standards of nutrition fall well below what is regarded as the optimum. It must be recognised, however, that calorie intake is not entirely equatable with nutrition, for in determining the nutrition of an individual or community, not only do calories need to be taken into account, but also the ratio of protein to other food substances, especially carbohydrate, the intake of vitamins, minerals and the like. Nevertheless it is true to say that calorie intake does, to quite a large extent, reflect the nutritional status of those concerned.

Previous work in this field has largely been concerned with evaluating the effect of nutrition upon the more obvious characteristics of higher nervous activity, such responses as learning ability, modes of reaction and so forth. These are specific cortical activities and thus provide little information about intelligence *per se*, and in this respect it is important to distinguish clearly between intelligence and those various subsidiary qualities such as capacity for memory, ability to concentrate, self-expression and the like, which are related to intellectual ability and are necessary for the development of the latent potentialities of the individual, but which must be clearly separated from intelligence itself. Rozenthal (1922) demonstrated beyond reasonable doubt that mental processes in general and the ability to "learn" conditioned reflexes in particular are greatly influenced by the nutritional status of the animal. Rozenthal's work, which was inspired largely by the classic experiments of Pavlov (1906), was carried out under semi-famine conditions in Petrograd, and he found that in contrast with Pavlov's experiments with normally nourished dogs, when the animals were reduced to only half their normal weight it was impossible to obtain conditioned responses. Further, it was found that these results were closely paralleled in the human response to similar conditions. More recent work has confirmed these results (extensively reviewed by Brozek, 1962) and attempts have been made to link the mental responses to malnutrition with specific deficiencies. On the whole the results have been, if one may use the phrase, consistently inconsistent and difficult to interpret.

The present study was designed to relate specifically to intelligence, and for this reason the results of secondary selection non-verbal intelligence tests were used. Secondary selection in Zambia is dependent upon more than the results of these tests, but it is only the non-verbal type test which dispenses with specific abilities. The study was carried out on 48 randomly selected girl entrants to a Zambian secondary school. The intelligence test results used were those of their secondary selection examination, and these had been previously standardised by computer to give a nation-wide mean of 100 ($\pm$ 15). The mean score of *all* the entrants to the school, which included the group under study, was 108.8. Each girl was carefully questioned concerning her normal home diet, and on the basis of this questionnaire an estimate of the average daily calorie intake over the course of the year was made. Needless to say, such an estimate, based upon questions rather than actual observation, is likely to be highly inaccurate; but as we were concerned in only gaining a broad impression of calorie groups, these inaccuracies are not likely to affect the validity of the investigation. On the results of

this questionnaire the girls were divided into four groups, representing those with an average daily intake of less than 1,200 calories, between 1,200 and 1,600 calories, between 1,600 and 2,000 calories and above 2,000 calories. The mean intelligence score on the non-verbal tests was determined for each group and the results analysed in order to see whether there was any significant difference between the means. The results are set out in tabular form.

Table I

Intelligence Test Scores Related to Calorie Intake

Daily Calorie Intake	No. in Group	Intelligence Test Scores		
		Mean	Highest	Lowest
Below 1,200	10	104.0	112.0	96.0
1,200-1,600	18	109.5	120.0	98.0
1,600-2,000	13	109.7	116.0	96.0
Above 2,000	7	112.8	124.0	94.0

It will be apparent immediately that the general level of calorie intake per day among these children was very low. The mean age of the group was 14½ years, at which age the recommended calorie intake should be in the region of 2,500 calories per day (B.M.A. Report, 1950), and even allowing for a 10 per cent. reduction for the high mean annual temperature of this region (F.A.O. Nutritional Study, 1957), the daily requirement is still in excess of 2,000 calories. In point of fact only 7 (14.5 per cent.) had a daily intake approximating to the optimum requirement and 28 (58.3 per cent.) were in receipt of a dietary intake of less than 1,600 calories per day. The lowest daily intake lay between 1,000 and 1,100 calories and the highest was in the region of 2,500 calories. These figures, we believe, speak for themselves.

With regard to intelligence, it will be seen that in each of the four groups the range of scores is very similar, although there is a slight increase in the mean score from the lowest to the highest calorie levels. In view of the small size of the sample, dogmatism is out of place, but we feel the tendency to a higher mean score with improvement in calorie intake is suggestive, even though the difference between the means was not significant statistically (P was never below 0.7). It is hoped that these results may stimulate further studies using large groups and more accurate methods of determining calorie intake, since if poor diet does impede the full development of an individual intelligence potential, then it is a matter of considerable economic importance.

Summary

(1) The results of a study on the relationship between intelligence and calorie intake are detailed.

(2) The study was performed on 48 Bantu schoolgirls, new entrants to a secondary school in Zambia.

(3) Calorie intake was found to vary from as low as 1,100 calories per day to 2,500 calories per day. There were 28 girls (58.3 per cent.) with an intake of 1,600 calories or less and only 7 (14.5 per cent.) with an intake of above 2,000 calories per day.

(4) The mean scores in the intelligence tests varied from 104.0 among those with a calorie intake of 1,200 or less to 112.8 among those with a daily intake in excess of 2,000 calories.

(5) There was no significant difference between the means statistically, but it is felt that the tendency to higher scores in the groups with better diets is suggestive that poor diet may be a limiting factor in the development of intelligence potential.

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