INFLUENCE OF NUTRITIONAL STATUS ON INTELLIGENCE OF CHILDREN IN NES BLOCK TRIVANDRUM

BY

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THESIS

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DECLARATION

I hereby declare that this thesis, entitled "Influence of nutritional status on intelligence of children in NES block, Trivandrum". is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other university or society.

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CERTIFICATE

Certified that this thesis entitled "Influence of nutritional status on intelligence of children in NES block, Trivandrum" is a record of research work done independently by Miss. Sandya V. Kamath under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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INTRODUCTION

INTRODUCTION

Children are valuable assets of a nation and they are the potential parents of tomorrow. The quality of life which they enjoy today would ultimately determine the quality of the future population. Therefore prime importance should be given to their health and nutrition, recreational and educational facilities. (Pathak and Saxena 1979).

According to Wells "intelligence is the properly of recombining our behaviour pattern so as to act better in a novel situation (Hurlock 1982). In Sterns opinion, "Intelligence is the general capacity of an individual consciously to adjust his thinking to new requirements (Hurlock 1982). It is a general mental adaptability to new problems and conditions of life". According to Wechsler, "Intelligence is the aggregate or global capacity of an individual to act purposefully, to think rationally and to deal effectively with his environment (Hurlock 1982).

The association between intellectual development and early childhood malnutrition has been the subject of recent investigations and interest. It has been demonstrated that in humans, severe protein calorie malnutrition in early childhood is associated with retarded brain growth development or disturbance in central nervous system function and cognitive functioning and myelination of cells in brain

(Riccuti 1982 and Rao 1982). Children suffering from malnutrition have a high probability of showing poor performance on intelligence test as well as other types of tests related to basic mechanism of learning.Vazi (1988 has reported that 'severe cases of malnutrition requiring hospital care constitute less than 5 percent of the poor rural preschool population in countries of the third world malnutrition was wide spread and mild to moderate forms of malnutrition in children was known to be prevalent among nearly 80 percent of preschool child population in India and other developing countries.'

Mental development in humans depend not only on physiological factors but also on psychological ones of which the most important is in the quality and quantity of environmental situations (Upadhyay and Agarwal 1984)

The results of several recent studies have indicated that non nutritional factors may also be relatively more important in the development of mental functions in the growing child (ICMR 1980).

It is well established that the combination of malnutrition and infectious diseases common in developing countries produce impairment of physical and mental growth. (Eiser 1986) similarly a low level of adaptive functioning, lack of knowledge, environmental inadequacies, insufficiency

of food, food habits and low income are various factors which result in malnutrition as well as poor mental abilities in growing children.

With better understanding of the relationship between nutrition and mental development in children it would be possible to institute appropriate measures for the prevention and correction of malnutrition among the preschool children.

Fortunately, in recent years increasing attention is being focussed on the manner in which the child's nutritional status and various aspects of his social environment may interact jointly in influencing the course of mental development. Hence the present study is an attempt to find the influence of nutrition on intelligence by studying their

(1) Socio-economic and family background

(2) Personal history

(3) Nutritional status and Intelligence.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. Nutrition and brain development.

It has been felt that undernutrition is the most common health problem in the world specially in the third world countries, which affects the physical and psychological development of a child. It is estimated that about 60 percent of the total preschool population of the world suffer from some degree of moderate to severe protein calorie malnutrition. It is most widely known that undernutrition, affects behavioural development (Sharma 1987).

In India 2-3 percent of preschool children belonging to poor communities suffer from severe forms of protein calorie malnutrition like Kwashiorkor and Marasmus while 60-70 percent suffer from mild and moderate forms which manifest themselves at varying degrees of physical and mental retardation (ICMR 1976). But it was found that there had been a consistent reduction in the prevalence of severe grade of malnutrition. The prevalence of mild and moderate forms had decreased by 41.3 and 32 percent respectively (Rao and Sastry 1986).

Undernutrition in early life delays brain development and cell growth. Poor mental performance is related to poor nutritional status and sociocultural factors (Monckeberg 1972).

Among physically growth retarded children of poor communities, evidence of impairment of both physical stamina and mental abilities was observed, and concluded that mild and moderate degrees of malnutrition could impair muscular efficiency and intellectual development of children. (NIPCO 1988).

John et al. (1978) revealed that retarded behaviour and mental development were observed in children malnourished in early life and brains of children who died with protein energy malnutrition were reported to contain too few cells and too little myelin for their chronological age which means lesser brain growth and brain function.

Study conducted by Devadas et al. (1971) who agreed with the above findings revealed that food intake directly influences intellectual development in children, they had also found that undernutrition in early period of life caused retardation in brain development and functioning. Similarly, Dobbing et al. (1971) revealed that poor nutrition in early life affected the brain metabolism and mental performance. According to their opinion, malnutrition in early life decreased the ability to learn in animals because of decreased number of brain cells.

Klein et al. (1972) was of the view that there was a close relationship between malnutrition and cognitive

development. They reported that in malnourished children the cognitive development was found to be slower and the growth of brain was retarded, besides affecting the alround physical growth of the child.

Studies conducted on school going children of Guatemala by Freeman et al. (1977) revealed that malnutrition was the mediating variable in the development of brain and that in the condition of poor nutrition, the brain development and cell myelination delayed and led to poor intellectual development, poor physical growth and retarded mental development.

Nwuga (1977) conducted studies on effect of Kwashiorkor on intellectual development among Nigerian children. He compared three groups of children-urban Kwashiorkor, rural Kwashiorkor and upper class controls. According to the study urban Kwashiorkor scored less in intellectual tests compared to the controls but had scored better than the rural participants. Nwuga (1977) also pointed out that boys tended to be affected more by severe Kwashiorkor with regards to mental development than girls and environmental and socio-economic factors influenced the intellectual development of the child.

Birch et al. (1972) conducted studies on severely malnourished children in Jamaica and reported that these

children scored less in the intellectual performances compared to the controls of same age group. According to Birch et al. children experiencing severe malnutrition before one year of age were at particular risk of brain damage and lowered intellectual level. In this study, the children were also reported to exhibit worse attention, memory, and more easily distracted than other class mates.

Toshio et al. (1973) confirmed that undernourished infants and children who were in a state of mild to moderate protein calorie malnutrition showed poor cognitive growth and brain development, and when they were supplied with protein tablets their development both physically and mentally improved. According to Toshio in children over three years, the rise in I.Q might be less pronounced as compared to those under three years. Through his studies Toshio suggested that nutritional improvement of under-nourished children might some how influence intellectual development while it was certain that social and environmental factors had a very important influence on the brain function. Swaminathan (1974) concluded that children who suffered from severe malnutrition in childhood had inferior intellectual development and learning capacity as compared with normal well nourished children of the same socio-economic class.

Christiansen et al. (1977) examined the association of mild to moderate deficits in body length with cognitive performance of young children and found that there was a close association with poor nutrition, cognitive functioning, physical development and their intellectual ability. They also showed that retarded physical growth was associated not only with malnutrition but also with many facets of a poor socio-economic environment. Freeman et al. (1977) lso found that height for weight and weight for height was a variable associated with intellectual development.

Das (1987) found that there was a significant difference in I.Q levels of children who were malnourished and children who were given supplementary feeding to overcome malnutrition. He found that supplementation i.. an early stage to malnourished children improved their physical development as well as intellectual performance.

Bartel et al. (1977) and Das and Soysa (1978) compared the children suffered from marasmus and marasmic kwashiorkor with well nourished siblings, yard mates and neighbourhood children and reported that there was no difference in I.Q or in other measures of intellectual function between malnourished and wellnourished childre But studies conducted by Galler et al. (1983) and Richardson (1980) among Barbados school children and Jamaican children respectively gave different results. The Barbados study

showed that malnourished children in comparison to control children had more significant problems in atleast three academic related areas viz. cognition, social interaction and emotional stability. The Jamaica study also showed that in comparison to control children, malnourished children had lower IQ scores and lower academic achievements.

Stoch and Smythe (1976) reported that there was a large difference in intellectual performance between undernourished children and their controls. As per this study the mean IQ of the boys with a history of undernutrition was as low as 55.

Similarly a study by Mc Gregor (1982) focussing on preschool children, analysed the relationship between the degree of growth redardation, and other clinical signs associated with severe protein deficiency and the severity of poor intellectual performance among children recently rehabilitated from severe malnutrition. The strongest predictor of intellectual deficit was the degree of growth retardation. Conversely Richardson (1980) failed to find an association between type and severity of malnutrition and degree of cognitive deficit in the school age period. Height, weight and social background were correlated with I.Q and he found that socioeconomic background of the children was the only variable that made a significant contribution to I.Q.

2. Brain growth and Intelligence.

Winick (1971) conducted studies on cellular growth during early malnutrition and revealed that the brain growth was retarded due to decreased cell division which resulted in lesser number of brain cells. According to the study, retarded brain development adversly affected mental development, learning capacity and intelligence. Similar results were reported by Babson and Henderson (1974). They revealed that low brain development, cell number, and cell division were the results of undernutrition which in turn lowered the intelligence. They argued that retarded brain growth would always delay the intellectual development.

Sood (1977) reported that brain of a healthy child weighed 25 percent the weight of an adult man and grew at a faster rate completely in 5 years. He also reported that any adverse environmental, social, economic or nutritional condition might have serious irreversible consequence on child's brain growth and hence on intelligence. The smaller size and lesser cell number of brain would always affect the intellectual performance. Hansen (1977) found that the motor function of undernourished children were very low compared to controls. Retarded brain growth was reported to influence the intellectual ability. In undernutrition, the brain suffered a low level of protein which delayed cell division, and hence lesser growth.

3. Nutritional status and intelligence

/ The results of the studies conducted by Kalra et al. (1980) reported that the difference in perfo_ of children having poor nutritional status and good nutritional status were statistically significant. According to Kalra in the malnourished group there was no case with normal I.Q. (above 90) and 57 percent had mental subnormality (below 70). With increasing severity of malnutrition there was a significant fall in the performance on intelligence scale.

The results of the work done by Usha et al. (1973) On "Nutritional growth failure and mental development" revealed that there was a close relationship between I.Q. height, and weight. According to these authors greater the deficit in height and weight, lower was the I.Q. In this study the head circumference of these children correlated well with I.Q. and the growth failure was reported to have an adverse effect on physical development and intelligence.

Shukla (1982) reported that infants belonging to under previleged sections were found to have retarded brain growth, body weight and inferior intellectual performance. Kaplan (1972) pointed out that poor nutritional status always affected physical growth and cognitive development in children. Poor nutritional status resulted in decreased height and weight and less intellectual capacity.

The results of a study conducted by Ghosh et al.(1979) showed that nutritional status of the child affected the cognitive development. He concluded that growth of head was slower when compared to height and weight. He had al found that cognitive development was directly related to socioeconomic status, nursery schooling and nutritional status. Research findings and theoretical informations supported the theory that brain growth directly influenced the intellectual development of a person and any damage caused to the brain under poor nutrition would retard the intellectual development.

Bartel et al. (1978) revealed that children who suffered from early malnutrition scored less in their intellectual performances due to delayed psychomotor development. They had also found that children who suffered from marasmus, had obtained lesser scores than those suffered from Kwashiorkor after treatment and this was mainly due to increased retardation in brain development and cell division.

A study conducted by Lasky et al. (1981)in Guetemala children indicated that in school going children, height and physiological maturity were positively correlated with measures of intelligence. According to these authors in malnutrition, there was a substantiative decrease in velocity of brain and body growth. They observed a significant difference in I.Q. levels of undernourished and well nourished children.

Similarly, Pollit et al. (1982) pointed out that under conditions of poor nutritional status the physical growth as well as brain development was retarded and hence the children obtained low scores in intellectual performance. They argued that low brain development was the reason for poor mental functioning. According to them, height was the most significant variable related to I.Q than any other anthropometric indices.

A study conducted by Caprara et al. (1977) to investigate the relationship between nutritional and Psychological paramenters concluded that there was a close relationship between quality of diet and anthropometric indices on one side and mental efficiency on the other. In this study the nutritional parameters used were Height, weight and head circumference and intelligence being the psychological parameter. The study further revealed that a decrease in nutritional parameter resulted in decreased intellectual performance.

Similarly a study conducted by Padmavathy et al. (1970) on "nutritional status and mental ability of 5-7 years old children" revealed that as the child got higher score in physical aspects his mental ability also increased correspondingly. By comparing the nutritional status and intelligence for boys and girls correlation between height and mental ability and weight and mental ability for girls

was higher than that for boys and boys had a negative correlation in the case of weight and mental ability, but in the case of a correlation between haemoglobin and mental ability and clinical assessment and mental ability boys had higher correlation. They had also revealed that I.Q increased for the children of professional classes as the occupational status changed and this was least for children of unskilled labourers. In short the study revealed that there was a positive relationship between the occupational status of the parents and nutritional status as well as intelligence of the child.

Similar results were reported by Devadas et al. (1972) in the age group of 2½ - 5 years. They found but that those children who had the recommended haemoglobin level and anthropometric indices had higher I.Q and the difference between the mean I.Q of children who met and did not meet the requirement in height, weight and chest circumference was statistically significant. They had also pointed out that education,occupation and income level of parents wer also certain factors which led to the development of malnutrition.

Devadas et al. (1972) conducted a study on impact of nutritional status on emotional and mental ability and revealed that the better nourished children were superior in intellectual performance compared to malnourished children.

They also found that behaviour problems were exhibited more by malnourished children than better nourished and the number of better nourished children getting average and above average mental scores was twice as many as malnourished children.

The results of the work done by Mc Gregor (1984) revealed that children suffering from severe malnutrition showed a serious delay in the intellectual development in the acute stage or immediately following it. They argued that an episode of severe malnutrition contributed to the variance in mental development to a smaller or larger extent.

According to Gupta et al. (1975) well nourished children performed better and obtained higher mean I.Q. as compared to the malnourished group. According to these scientists more severe the malnutrition, poorer the performance and hence I.Q. They had also reported that as nutritional status went down, there was lowering trend in I.Q. distribution. According to them well nourished children had shown best performance and grade II malnourished, the worst.

Study done by Udani (1976) concluded that during the stage of active malnutrition, children had low I.Q. and during the short term follow up of this study, the I.Q remained significantly low eventhough there was marked

impairment in behaviour during recovery. He also found that low maternal I.Q might also have an adverse effect on intellectual development of children.

Ghai et al. (1973) conducted studies on children suffered from marasmus and concluded that they performed poorer in mental tests, and obtained a lesser I.Q. score compared to the controls of the same age groups.

Ghai (1975) conducted a similar study on 45 children of age 4-6 years who had early nutritional marasmus and obtained similar results. They concluded that their mean I.Q. was less, though they recovered from the disease. Dasen et al. (1977) conducted a study on children of same age group with different nutritional status. In this study anthropometric indices were taken as determinants of nutritional status, with values between 90 to 100 percent as normal; 85 to 90 percent as mild malnutrition, 85 percent as moderate and below 75 percent severe malnutrition. According to these as authors severly malnourished children scored least in their intelligence tests while normal children scored the highest. The scores obtained increased as the nutritional status improved.

Results of the study conducted by Usha et al. (1974) revealed that there was significant difference in intellectual performance in each grade of malnutrition. According to Usha et al. nutritional status affected the brain and its

functions significantly and the intellectual performance were poor among the children suffering from the protein calorie malnutrition and the children recovered showed a slightly better performance.

Similarly Kadam et al. (1984) pointed out that accumulation of malnutrition resulted in reduced mental development due to impairment in brain development. According to these authors the scores obtained by malnourished children were less than those of well nourished group and time taken for decision making was also higher in case of malnourished children.

Chavez and Bono (1979) conducted studies in Latin America and revealed that poor nutritional status affected social and intellectual development and moderate, chronic undernutrition caused by poor feeding practices and exposure to infectious diseases was common in underdeveloped countries. According to their opinion the insufficiency of nutrition might have had no direct effect on the formatio and development of brain but it did have a very important effect on the social behaviour and interaction with the environment which in turn affected the intellectual ability.

Pollit and Read (1985) reported that undernutrition had an adverse effect on cognitive development and children having poor nutritional status performed poorly in

intellectual tests and scored less than those who had good nutritional status of same age group. Pollit and Read also found that besides food intake, the development of children was also associated with socioeconomic and cultural factors, and nutritional status was an out come of social, nutritional and environmental factors.

Singh and Sidhu (1987) revealed that there was a significant difference in I.Q of well nourished and malnourished school children and also reported that age and birth order had no influence on intellectual development.

Agarwal (1987) revealed that there was a relationship between malnutrition, home environment and intellectual developments. The effect of poor nutrition was significant on verbal performance. According to him boys were easily affected than girls, also these children showed poor personal independance and performed poorly in reasoning and comprehension.

Jovanovic et al.(1981) compared two groups of children, of which one group had been severely malnourished in early childhood. According to them the incidence of poor intellectual performance was higher in the younger age group who had suffered malnutrition and scored abnormally low I.Q when compared to the other well nourished group.

Both nutritional and non-nutritional factors had been implicated in the development of intellectual functions in the growing child. Non-nutritional factors may be relatively more important than nutritional factors, since these affect the nutrition and nutritional status of the subject indirectly (ICMR 1980).

Ashworth (1986) revealed that poor nutritional status retarded both physical and intellectual development and non nutritional factors like sociocultural background of the family, income and literacy level of the family members affected the nutritional status of children which inturn affected the overall development of the children.

Frisch (1971) revealed that in undernutrition or malnutrition the brain development was retarded and the cell member as well as cell volume was lowered. The intellectual performance of the poorly nourished children were very less compared to the normal well nourished children. Not only nutrition affected the intellectual development but also there were many factors like sociocultural and economic back ground of the child's environment which might influence intellectual development.

1. Various nutrients and their influence on intelligence.

In addition to general undernutrition the deficiency of some major nutrients was also found to have an adverse effect

on brain development and hence on intelligence. Pollit et al. (1986) pointed out that iron deficiency affected cognitive development of the children and children having iron deficiency with or without anaemia scored less in Bayley scale of intelligence test. According to these authors the children also paid less attention in problem solving and decision making.

Choudhary and Rao (1984) demonstrated that infants with iron deficiency, exhibited lower intellectual performances. They concluded that even iron deficiency with or without anaemia was detrimental to various functions of the brain and body as a whole. Similarly Needleman (1984) reported that high lead level in children tended to show significantly lesser performance in intelligence test especially on verbal scales of WISC-R scale and obtained a low I.Q score. Walter et al. (1983) also pointed out that iron deficiency affected the intellectual performance of the subjects and mild iron deficiency had an effect on infant behaviour that was rapidly reversible with iron therapy. They revealed that the intellectual performance was significantly lower in the anaemic children, before therapy.

Webb and Oski (1973) conducted study on iron deficiency anaemia and scholastic achievements and found that scores of the IOWA test of basic skills, a measure of scholastic performance, was found to be significantly lower in

anaemic, presumably iron deficient students than in non anaemic students test scores showed a progressive decline from 12-14 while performance remained consistently poor among the anaemic females.

Severe protein energy malnutrition is found to have adverse effect on brain growth, cell number and cell morphology which retarded physical and intellectual development (Udani and Emery 1982). Further, Goldman et al. (1974) studied on late effects of low protein intake on low birth weight infants and concluded that infants with birth weight below 1.3 kg and less protein intake had low I.Q scores than their siblings who had normal birth weight.

Riccuiti (1982) observed that poor nutritional status led to impaired learning and intellectual development with irreversible mental retardation. He also found out that children who had suffered obvious malnutrition tended to show reduced levels of intellectual functioning and school achievements.

In a study done by Howard (1970) it was found that low calorie intake was associated with low intellectual performance and poor diet limited the intellectual development of an individual.

5. Age of onset of malnutrition and intelligence.

Many studies have pointed out the influence of nutrition on the physiological, physical and mental development by giving importance to the period of occurrence of malnutrition. The study conducted by Hurley (1980) suggested that malnutrition in early life had permanent effect on brain size and function. The children who were malnourished in their early years of life were found to have low I.Q. than their siblings who were well nourished.

This view was again supported by Mehta and Chakravarthy (1973) who revealed that undernutrition during post weaning period would lead to reduction in DNA and deficit in cell number which led to lasting deficits in mental development and intellectual capacity.

Similarly Dobbing (1970) revealed that post natal malnutrition adversly affected the development of brain. During the early period of life malnutrition delayed brain growth due to retarded cell division, and thus decreased the head circumference of the subject, which was an indication of low intellectual ability.

Similar study was done by Pereira et al. (1979) and he reported that severe protein energy malnutrition in infancy and childhood was known to affect adversly the later neurological and intellectual development. As per this study

children performed less in intelligence test and scored poorly compared to their well nourished siblings.

Hoorweg and Stanfield (1972) also supported the above idea. They reported that children who had an acute episode of malnutrition in early childhood showed an impairment in general intelligence, special abilities, memory and learning.

6. Other factors influencing intelligence:-

Apart from nutrition there are many factors which influence the mental development, nutritional status and hence intelligence in children. Many studies conducted on this aspect have showed a positive correlation. Malnutrition is an outcome of different sociocultural and environmental factors which affect indirectly the development of a person Upadhyay (1987).

Study conducted by Klein et al. (1972) revealed that sociocultural factors like housing, occupation, educational level of parents and health factors like height, weight, head and arm circumference influenced the intellectual abilities of children. He found a clear cut difference in intellectual performance between well nourished and malnourished children at same age. Similarly Cravioto (1974) compared the malnourished and well nourished children and their family background. He observed that malnourished children from homes with good intellectual stimulation and

non malnourished children from homes with poor intellectual stimulations were similar in their mental performance. He concluded that both home stimulation and good nutrition were important for intellectual development.

Another study conducted by Om Prakash and Sen (1986) to examine the relationship between intellectual ability and socio economic background, other than nutrition concluded that children from high socioeconomic status earned higher scores in tests than children of low socioeconomic status also they have high scholastic achievements, memory, I.Q., verbal experessions and general achievements.

The results of the work carried out by Devadas (1977) argued that malnutrition did not occur in single and pointed out that a low level of adaptive functioning, lack of modern knowledge, environmental inadequacies and insufficiency of food caused malnutrition and this resulted in poor mental abilities in children.

It was reported that adequate social and cultural environment was an essential prerequiste for normal intellectual development. Poor socioeconomic environment could lead to apparent mental deficiency (Biswas 1975).

According to Chandra (1975), apart from inadequate intake of food, infection, sociocultural factors, poor

educational level of parents, income, housing facilities etc. would also lead to malnutrition of the child. Again similar results were obtained by Shah (1979). He was of opinion that role of socio cultural socio economic factors were greater than mere nutritional and medical factors in development of malnutrition. Birch (1972) also revealed that malnutrition never occured alone, but occured in conjunction with low income, poor housing, familial disorganization, climate of apathy, ignorance and despair. He also argued that severe acute malnutrition and chronic submalnutrition from birth to school years resulted in defective growth and development and this contributed to a suboptimal level of intellectual functioning.

Again, the study conducted by Choudhary and Rao (1983) supported the above view. They concluded that prevalence of various forms of malnutrition were different for rural and urban children. Urban children tended to be better in nutritional status than rural children. The nutritional status of children were found to be associated with educational level of parents percapita income of family, educational level of eldest child etc.

Another study conducted by Choudhary and Rao (1984) indicated that in addition to socioeconomic status, environmental factors, nutrition and sex of the child too

influenced the intellectual development. They studied the association of growth status and intellectual development and revealed that male and urban children had better I.Q's than female and rural children respectively. According to this study taller children were found to have higher I.Q's than shorter and I.Q's were lower in children with chronic current severe or chronic moderate forms of malnutrition than those who were either normal or with current moderate forms of malnutrition.

Dhingra et al. (1977) studied the impact of social and environmental stimulations on the intellectual functions and found that public school children scored significantly higher I.Q's compared to corporation school children. Higher mean I.Q's and better performance were observed in higher social class children. They also observed that education and occupation of parents, living conditions, income, and the environmental surroundings had been identified as extrinsic factors influencing intellectual development.

The study conducted by Eiser (1986) revealed that chronic sick children were at risk in terms of intellectual, social and personal development as a consequence of the disease. They had also found that such children scored less in mental performances tests and involved in games less frequently than healthy children. David (1971) found that severe malnutrition led to intellectual impairment and

both nutrition and intellectual development were also associated with various social factors.

Om prakash (1982) conducted a stury on socioeconomic status and intelligence in rural children and revealed that socio economic status, occupational status as well as the, educational level of the family had a direct influence on child's intelligence. Through his study he observed that the children belonged to poor social class, illiterate family members and poor housing facilities differed widely in the I.Q. scores compared to the children of the same age group with sound socio economic as well as occupational status.

Singh (1976) also reported similar results through his study, "Social disadvantage, intelligence and scholastic achievements". He reported that socially advantaged children were significantly superior in scholastic achievements to socially disadvantaged group. The social factors like education of parents, income, occupation etc. had a direct influence in intellectual capacity and school achievements.

Studies mentioned above throw light on the fact that though other factors influence intelligence, brain development is relatively influenced by the food intake of a person. Since brain development has a direct influence on intelligence, nutrition will definitely have a major

influence in the development of intelligence. There is enough research evidence to prove that the brain impairment starts at a very early age, as early as in prentatal period but whether these damages could be repaired, is a question leading to much controversial answers even today.

Gopinath and Karmakar (1981) reported that in undernutrition the development of the Cerebral cortex was less and the brain development was retarded and the delay in brain development resulted in deficit or delay in functional and perceptual development. They also pointed out that if rehabilitated arlier, this could be recovered.

Similarly Puri et al. (1984) conducted studies on effect of supplementation on mental abilities and found that supplementary diet improved the mental abilities of the subjects. The results of the study conducted by Clichester (1969) on infants and preschool children revealed that in protein calorie malnutrition there was retardation of growth, significant retardation in mental development, speech motor development and social relations. In severe malnutrition it was indicated that there was an extremely marked and possibly irreversible reduction in brain size. But he found that a high calorie high protein concentrate could decrease the retardation and supplementation could improve the intellectual capacity(Clichester 1969).

Further, Chavez (1974) reported that the children subjected to supplementation grew faster and scored higher marks than those who were not treated. He also pointed out that maternal nutrition and social environment also affected the physical and mental growth of children.

The same results were obtained by Chowla et al. (1983). They found that after six month's supplementary feeding programme the experimental group improved significantly in their mental performances. It was possible that a higher nutritive value of the supplement together with a stimulating environment at balwadi produced a significant improvement in intellectual abilities.

Devadas (1979) conducted a study on evaluation of a food supplement to school children between age group 5 to 8 years who were malnourished and their mental abilities were tested, and again after improving the diets the mental tests were repeated and found that after supplementation the nutritional status as well as their intelligence improved.

Hicks et al. (1983) conducted studies on undernourished children and reported that a supplementation of nutrients would improve the intellectual level of children provided the subjects were not highly malnourished. As per this study the subjects improved in the performance of mental tests after supplementation.

Arellano et al. (1977) conducted a study in Guatemala children of low socio economic status and in this study children who suffered from protein energy malnutrition were given supplementary feeding. The authors concluded that by supplementation the nutritional status of the children were improved and also obtained good results in psychological tests. They observed that in girls there was a consistent relation between height and results of test. In boys there was a similar relation at 3, 4 and 5 years but practically none at 6 and 7. However, some other studies revealed that the brain damage occured due to malnutrition is irreversible. The study done by Kadam (1983) viewed that the brain development occured during prenatal and postnatal period. Hence undernutrition or malnutrition during prenatal period or early period after birth would definitely cause irreversible brain damage. Similarly Rao and Barnes et al.(1970 pointed but that the physical damage occured due to early malnutrition could be remedied later with supplementation of good diet but the damage caused to brain during preschool years was mostly irreversible and permanent. Dobbing (1972) also conducted studies on relation of undernutrition to brain development and concluded that nutritional restrictions even if followed by subsequent restoration, failed to compensate the loss that had occured in intellectual development. He also found that permanent changes occured in brain because of nutritional restrictions during vulnerable period of brain growth

MATERIALS AND METHODS

MATERIALS AND METHODS

A study was conducted to evaluate the influence of nutritional status on intelligence of school children belonging to NES block Trivandrum Rural. The study was designed to evaluate the intelligence of children with reference to the socio economic background, dietary pattern of the family as well as children, behavioural problems and nutritional status of the children.

A. Area of the Study:

The area selected for the study was NES block Trivandrum Rural, which encompases the area located in the north eastern periphery of Trivandrum City. This block consists of four panchayats namely - Ulloor, Kadakampally, Vattiyoorkavu, and Chettivilakam. Of these Uloor and Kadakampally were selected for the study. These Panchayats were selected mainly because of the following reasons.

1. The schools were situated in remote rural areas comparising of underprivileged sections of the community with absolute rural characters.

2. In these Panchayats Government and private schools were available for selection and.

3. All age group children ie from Pre-school to high school children (3-15) were available.

B. Plan of action:

In order to achieve the objectives of the present study following actions were taken.

1. Collection of details regarding schools in the four Panchayats of NES block, through verification of records available in the Offices of the Directorate of Public Instructions and NES block.

2. Selection of two schools situated in the two Panchayats.

3. Random selection of children of different age group from the two schools.

4. Assessment of socio economic and food consumption pattern of the families of the selected children.

5. Assessment of dietary habits of the families in general and children in specific.

6. Assessment of the health and nutritional status of the selected children through anthropometric clinical and biochemical studies.

7. Determining the dietary intake of randomly selecte sub-samples selected randomly by weighment method.

8. Testing the intelligence of selected children by standard intelligence tests.

9. Correlating the nutritional status of the children with intelligence score.

C. Selection of samples:

1. Selection of schools:

There were a total of 16 schools under the NES block Trivandrum. But most of them were either upper primary or lower primary and only a few were high schools.

In some areas though Government high school was available private high school was not available. So for the present study Kadokampally and Ulloor panchauats were selected as these two panchayats were the areas where both schools are available.

2. Selection of children:

Children were selected randomly from the two schools of the two panchayats are presented in table I.

Table I. Selection of children.

	Age group	No: of Samples		Total No: of Children
		Boys	Girls	
School I (Govt.)	3-5	15	15	30
	6-11	15	15	30
	12	15	15	30
	14-16	15	15	30
School II (Pvt.)	3-5	15	15	30
	6-11	15	15	30
	12	15	15	30
	14-16	15	15	30
		120	120	240

D. Conduct of the study:

1. Scoio economic and dietary survey:

A socio economic and dietary survey was conducted in the families of the 240 children selected for the study, using questionnaire method.

2. Food weighment survey:

Food weighment survey was conducted in the subsamples of the 10 families selected randomly from the 240 house holds.

3. Assessment of nutritional status:-

Nutritional status was assessed by conducting anthros nometric studies biochemical and clinical tests among tne 240 children selected for the study.

4. Intellegence test was conducted among the 240 children selected for the study.

5. An assessment of the children were collected from concerned class teachers.

Selection of method of study:

i) Verification of records to collect details regarding the Panchayats and location of schools from the offices of Directorate of public instructions and NES block.

ii) Socio economic and dietary survey to collect information about the occupation, income and educational qualification of family members, family size monthly expenditure pattern, frequency of purchase and use of food items, usual meal pattern of the family as well as the child was conducted using a suitably structured and pretested questionnaire. The questionaire is presented in Appendix I the data was collected by interview method. Interview method was used because it consists of a face to face verbal interchange in which the investigator attempt to elicit information or expression of opinion or belief from another person (Lindzey 1954). Moreover, this is a systematic method by which a person enters more or less imaginatively into the innter life of a comparative stranger (Devadas and Kulandaival 1975).

iii) Weighment survey was conducted in 10 subsample families selected randomly from the 240 families to get accurate amount of actual food intake. The investigator visited the house early morning and weighed the food before eating and the plate waste was also taken. Thus the food intake of the child was obtained. This was an accurate method of observing the actual food intake of an individual (Devadas 1971) II.

iv) Nutritional status of the children were determined through anthropometric, clinical and biochemical studies

FIG 1. HEIGHT MEASUREMENT

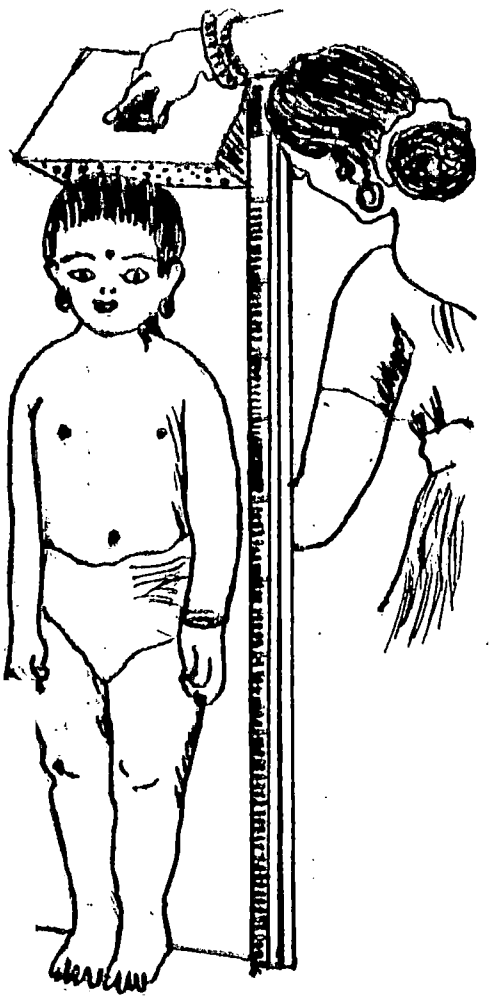
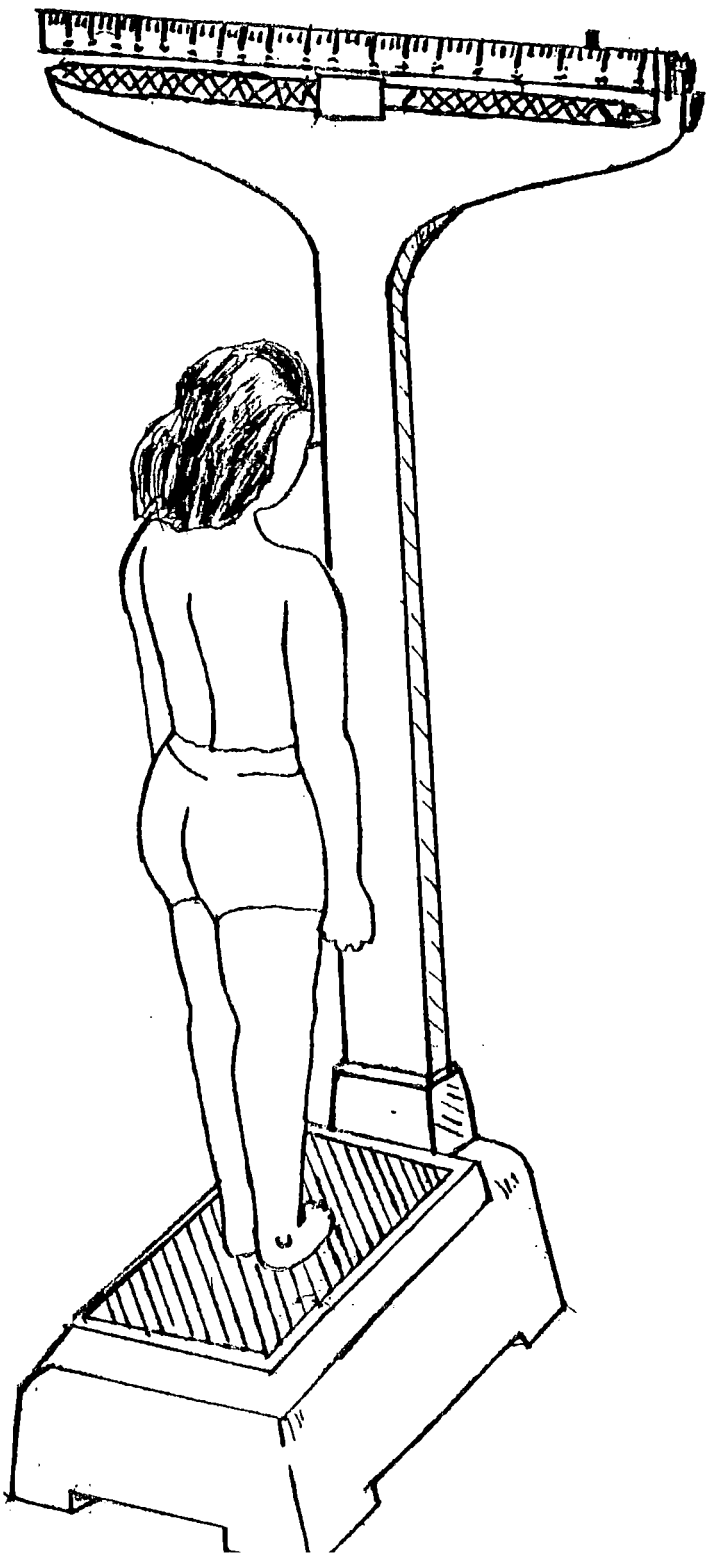


FIG 2. WEIGHT MEASUREMENT



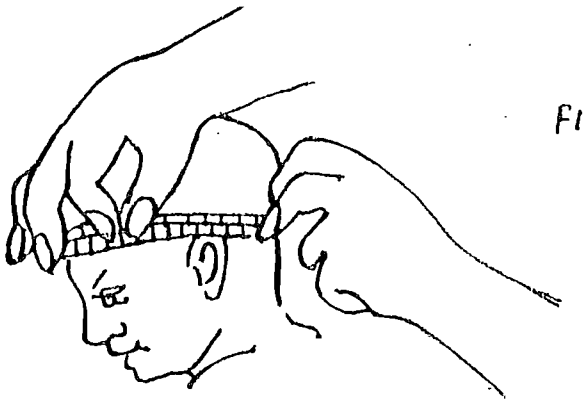


FIG. 5. MEASUREMENT OF HEAD CIRCUMFERENCE.

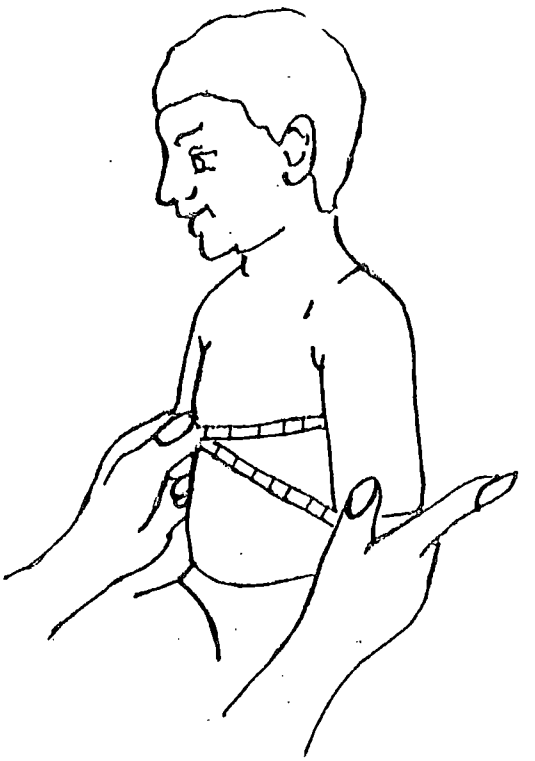


FIG. 3. MEASUREMENT OF CHEST CIRCUMFERENCE

FIG. 4. MEASUREMENT OF MID-UPPER ARM CIRCUMFERENCE

FIG.6.CLINICAL OBSERVATION

FIG.7.COLLECTION OF BLOOD

(i) Anthropometric study was chosen since this is considered to be one of the most practical field techniques for the quantitative assessment of the nutritional status of children (Trowbridge 1979).

More over, combination of clinical examination and anthropometric studies were reported to be valuable assets in the assessment of nutritional status (Choudhary et al.1985).

The anthropometric measurements used in the study were taken according to the techniques outlined by Jelliffee (1966). Details of the method is given in Appendix-III and Fig 1 to 5.

ii). The presence or absence of clinical deficiency symptoms which is an index of nutritional status, was assessed by a qualified physician. The proforma used for this purpose is the schedule suggested by National Institute of Nutrition for clinical survey. The schedule is presented in Appendix-IV and fig. 6.

iii). Estimation of haemoglobin was done under biochemical studies. The method employed was cyannethemoglobin method (ICMR 1984). The details of the method are presented in Appendix-V. fig. 7.

iv). Information on hea

children were collected from the parents by recall method with the use of a well structured, pretested questionnaire. In most of the houses both parents were respondents and in som houses where father was unavailable, mother answered the questionnaire.

The details of questionnaire is given in Appendix-VI.

v. General performance of the children in schools were collected from the concerned class teachers using a well structured questionnaire. Since intelligence is defined to be a combination of different components such as reasoning capacity, attention span, memory power, imagination and creativity, intelligence cannot be fully measured by a single performance lost. Hence different components were assessed. Since the respondents were school going children, teachers were considered the best media to collect informations and teachers assessment was also included for the study.

The questionnaire is presented in Appendix-VII.

Through these questions the school performance, interest and involventment in extra curricular activities behaviour at school and details regarding social development were collected. For collecting these details teachers were interviewed during lunch intervals.

Intelligence score of the children were assessed by using - Mathew test of mental abilities (Mathew 1973). fig. 8.

This test was used because there is no need to change the test for each age group. Since this single test is applicable to a wide range (Syamala 1985).

FIG.8.MEASUREMENT OF INTELLIGENCE

The details are given in the appendix.VIII

vi. Statistical methods adopted.

Students 't' test is applied to compare the anthropometric observation of children with the standard measurements on these.

The students intelligence score were measured in terms of the time taken by the student to do a single problem. Since there were 12 problems to do by each student ,the time taken by each student to do a problem was weighted by the relative information supplied by that variable in the sample where the information is taken in terms of the reciprocal of the variance.

In the same way nutritional status of each student were computed in terms of anthropometric observations.

The relationship of intelligence score (y) with nutritional status (x) is defined in terms of linear regression

$y = a + bx$, where 'b' determines the rate of change in intelligence score for unit change in nutritional status. The value of coefficient of determination explains the degree of variation in 'y' explained by 'x'.

RESULTS

RESULTS

A study to assess the influence of nutritional status on intelligence of children was conducted among selected school children from NES block Trivandrum, Rural. The result of the study are presented under following heads.

1. Family background of the selected school children.
2. Personal history of the selected school children.
3. Nutritional status and intelligence level of the selected school children.

1. FAMILY BACKGROUND OF THE SELECTED SCHOOL CHILDREN

Family background of the children was assessed by eliciting informations regarding the socio-economic and personal characteristics of the family, details related to their house and its surroundings and food consumption pattern of the members of 240 families.

1. a. Socio-economic and personal characteristics of the families.

Under the socioeconomic and personal characteristics, details regarding religion and caste, family type and size, educational status and occupational status were collected.

1.a.1. Religion and caste of the families surveyed.

Details regarding the religion and caste of the families surveyed are presented in table 1.a.1.

Table 1.a.1. Religion and caste of the families surveyed.

Community	Religion							
	Hindu		Christian		Muslim		Total	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per cent
Forward	34	14.17	23	9.58	10	4.17	67	27.92
Backward (OBC)	74	30.83	51	21.25	--	--	125	52.08
Scheduled Caste (SC)	48	20.00	--	--	--	--	48	20.00
Total	156	65.00	74	30.80	10	4.17	240	100.00

As revealed from table 1.a.1. majority of sample surveyed belonged to Hindu religion (65 percent) followed by Christians (30.80 percent) and Muslims (4.17 percent). This was further classified as forward, backward and schedule Castes. From the table it was clear that majority of sample surveyed belonged to backward communities (52.08 percent) followed by forward caste (27.92 percent) and scheduled caste (20 percent).

.a.2. Types of the families surveyed.

Details of the family type as nuclear, extended or oint are presented in table 1.a.2.

Table 1.a.2. Types of families surveyed.

Type of family	No:	Percent
Nuclear	168	70
Extended (with one or two relatives)	72	30
Joint	--	--
Total	240	100

As depicted in table 1.a.2 70 percent of the families surveyed was of nuclear type and remaining 30 percent was extended type with one or two relatives.

1.a.3. Size of the families surveyed.

Details regarding the size of family is presented in table 1.a.3.

Table 1.a.3. Details of family size.

No. of members	No. of families	Percent
0 - 3	44	18.33
3 - 5	132	55.00
5 - 7	53	22.08
Above 7	11	4.60
Total	240	100

As depicted in table 1.a.3. majority of the families (55 percent) belonged to a medium size, with members ranging from 3 to 5. Small families were comparitively less since this type formed only 18.33 percent of the total families surveyed.

1.a.4. Classification based on number of children.

Classification of the families based on the number of children along with sibling order is presented in table 1.a.4.

Table 1.a.4. Classification based on number of children

No. of children	No. of families	Sibling order of the children				
		Ist child	2nd child	3rd child	4th child	5th child
One child	44 (18.33)	44 (18.33				
Two children	50 (20.83)	22 (9.17)	28 (11.67)			
Three children	80 (33.33)	13 (5.47)	18 (7.5)	49 (20.41)		
Four children	49	-			49 (20.41)	
Five children	17 (7.08)	-			4 (1.67)	13 (5.47)
Total	240 (100)	79 (32.91)	46 (19.17)	49 (20.41)	53 (22.08)	13 (5.47)

* Percentage is given in parenthesis.

As revealed in table 1.a.4. 33.33 percent of the families had three children. Families having two children and four children were almost equal as 20.8 and 20.4 percent respectively. As revealed in the table majority of the children were found to be first (32.91 percent) in the sibling order.

1.a.5. Educational status of the adult members of the families surveyed.

Details regarding the educational status of the adult members of the families surveyed is presented in table 1.a.5. and fig. 9

Table 1.a.5. Educational status of the adult members of the families surveyed.

Educational level	Male Members		Female		Total	
	No.	percent	No.	Percent	No.	percent
Illiterate	3	1.06	6	2.27	9	1.61
Lower primary level	72	25.53	129	46.73	201	36.02
Upper primary level	152	53.90	123	44.56	275	49.28
High school level	51	18.09	18	6.52	69	12.36
College level	4	1.48	-	-	4	0.72
Total	282	50.53	276	49.47	558	100

Fig. 9a Educational status of male members

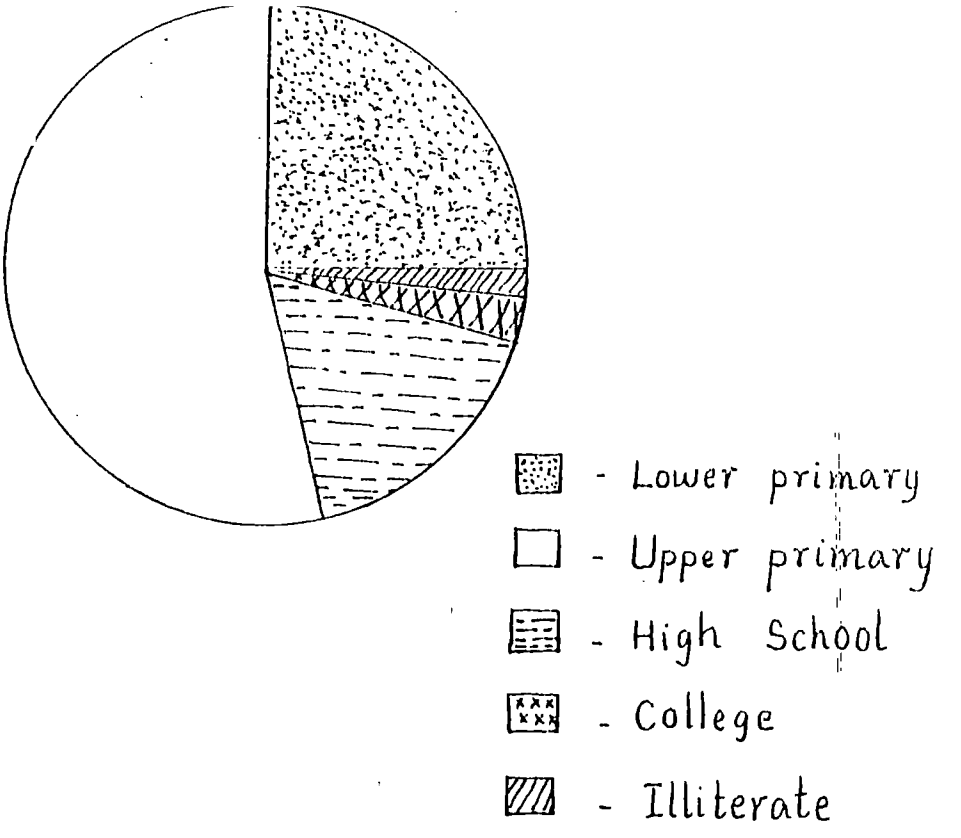
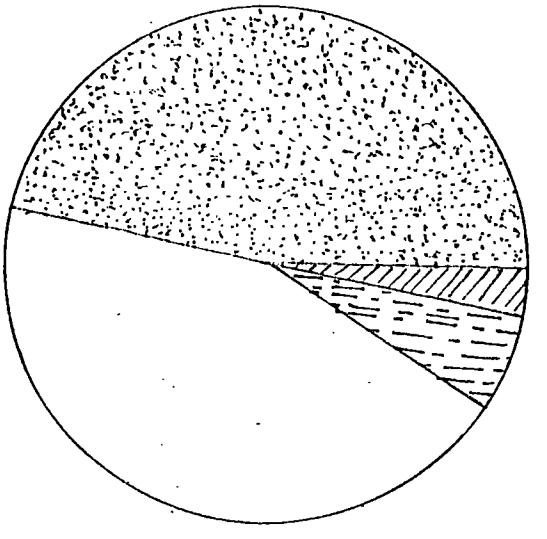


Fig 9b Educational status of female members



From the table 1.a.5. it could be found that majority of the adult members had studied upto upper primary level (49.28 percent). Only male members (0.7 percent) had studied to college level. However, it could be noted that a higher percentage had (36.02 percent) education upto lower primary level.

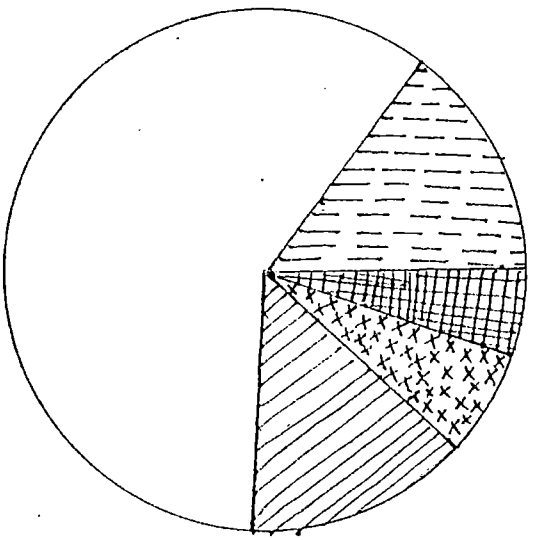
1.a.6. Occupational status of the families surveyed.

Details regarding the occupational status of the family members are presented in table 1.a.6 and fig. 10.

Table 1.a.6 occupational status of the family members.

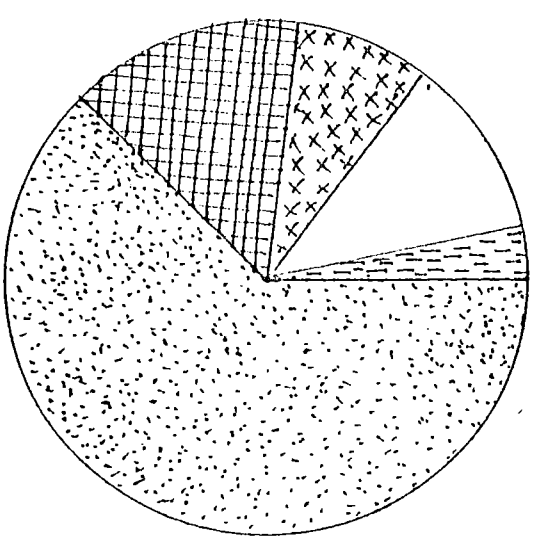
Groups	Male		Members female		Total	
	No:	percent	No:	percent	No:	percent
Government job	41	14.53	9	3.26	50	8.96
Labourers	169	59.92	32	11.59	201	36.02
Tea shop	40	14.18	-	-	40	7.17
Tailors	18	6.38	22	7.98	40	7.17
Vendors	14	4.96	40	14.50	54	9.67
House work	-	-	173	62.68	173	31.34
Total	282	100	276	100	558	100

Fig 10 a Occupational status of male members



- Government job
- Labourers
- Tea shop
- Tailors
- Vendors
- Housework

Fig 10 b Occupational status of female members



As revealed from table 1.a.6 majority of male members (59.92) were agricultural labourers where as majority of female members were engaged only in house work (62.68 percent). Only 8.96 percent members had permanent job like government job. Skilled workers were also found to be comparatively very few (7.17 percent)

1.a.7. Income wise distribution of the families surveyed.

Distribution of the families surveyed based on income is presented in table 1.a.7.

Table 1.a.7. Income wise distribution of families surveyed.

Income range	No.	percent
200 - 400	22	9.16
400 - 600	151	62.91
600 - 800	59	24.58
800 -1000	8	100
Total	240	100

As revealed in table 1.a.7. it was found that majority of the families surveyed belonged to lower middle income group (62.91 percent).

1.b Details related to houses and surroundings:

Details related to house and surroundings included information on possession of house, general structure of house

like number of rooms and other facilities in the house and facilities available to children at home and accessibility to school from their homes.

1.b.1. Possession of house and other facilities available:

Details regarding possession of house and other facilities like possession of garden and electrification of houses are presented in table 1.b.1.

Table 1.b.1. Details regarding possession and other facilities available at house.

Particulars	No.	percent
1. Possession of house own	203	84.58
Rented	37	15.42
	240	100.00
2. Electrification of house	240	100
3. House with ornamental/ Kitchen garden	188	78.93
House with any garden	52	21.67
Total	240	100

As depicted in table 1.b.1. 84.58 percent of the families had own house. All houses were found to be electrified and 78.93 percent houses had garden.

1.b.2. Number of rooms in the house

Details regarding the number of rooms available in the house is given in table 1.b.2.

Table 1.b.2. Number of rooms in the house

No. of rooms	No. of families	percent
0-2	8	3.33
0-4	162	67.50
5-6	70	29.17
Total	240	100.00

As revealed in table 1.b.2. 67.5 percent of the families had houses with 3 to 4 rooms and 29.17 percent had 5 to 6 rooms.

1.b.3. Details of other facilities available to the children.

Details of facilities available to children include possession of separate room, play materials, books and also presence of additional educational media like television and radio and additional facilities such as vehicles at home. These are presented in table 1.b.3.

Table 1.b.3. Details of other facilities available at home

Facilities available	Yes No:	Yes percent	No No:	No percent
Children possessing separate room	35	14.58	205	85.42
Children possessing play material	80	33.33	160	66.67
Children having text books for learning	200	83.33	40	16.67
Children having books for acquiring additional knowledge	130	54.17	110	45.83
Educational media				
1. Television	8	3.33	232	96.67
2. Radio	218	90.83	22	9.17
Vehicles possessed by the family				
Cycle	90	37.52	150	62.50
Scooter	-	-	240	100
Car	-	-	240	100
Children having own vehicle (cycle)	26	10.84	214	89.16

As revealed in table 1.b.3. children possessing own room and play materials were very few. (14.58 and 33 percent respectively) 16.67 percent children did not even have text

books for regular classroom learning. Among other educational media only 3.3 percent of the families had television where as 90.83 percent of families had radio which is comparitively cheaper media of education. 37.5 percent of the families had own vehicle of which 10.83 percent of the families had provided the facilities to the children.

1.b.4. Mode of conveyance to school.

Details of mode of conveyance enjoyed by the children to school are presented in table 1.b.4.

Table 1.b.4. Mode of conveyance to school.

Mode of conveyance	No.	percent
By walk	180	75.00
By Bus	25	10.42
Escorted by mother/ sister/elders	35	14.58
By own vehicle	-	-
Total	240	100.00

As revealed in table 1.b.4. 75 percent of the children went to school by walking.

1.b.5. Time taken and distance covered to reach the school.

Time taken and distance covered by the children to reach the school is presented in table 1.b.5.

Table 1.b.5. Time taken and distance covered to reach the school.

Time taken to reach the school			Distance covered to reach the school		
Time range	No:	percent	Distance range	No:	percent
With 15 minutes	136	56.67	within ½ kilometer	128	53.33
15 to 30 minutes	87	36.25	within ½ to 1 kilometer	90	37.50
Above 30 minutes	17	7.08	More than 1 kilometer	22	9.17
Total	240	100.00		240	100.00

As revealed in table 1.b.5. 56.67 percent of the children reached the school within 15 minutes. 36.25 percent within 15 to 30 minutes and 7.08 percent took more than 30 minutes. 53.33 percent of the children had their homes within ½ kilometer, 37.5 percent within ½ to 1 kilometer while 9.17 percent came from a distance of more than one kilometer. The children staying for away possessed cycles.

15 percent of the children were reported to go home for lunch while 36.67 percent had their lunch from school and the rest (48.33 percent) brought lunch to the school.

1.c. Food consumption pattern of the families surveyed:

Details regarding the food consumption pattern are presented under monthly expenditure pattern of the families. Detailed expenditure pattern with reference to food items, frequency of purchase and use of food items daily dietary pattern of the families as well as the children were included.

1. c.1. Monthly expenditure pattern of the families surveyed.

Monthly expenditure pattern of the families on different items like food, shelter, clothing, transportation health, education, entertainment and savings are presented in the table. 1.c.1.

Table 1.c.1. Monthly expenditure pattern in percentage

Range of expenditure in percentage of income	Food		Clothing		Shelter		Transportation		Health		Education		Entertainment		Savings	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent
0-10			225	96.75	212	83.33	216	90	220	91.67	168	70	235	97.92	36	15
10-20			15	6.25	28	11.67	19	7.92	20	8.33	72	30	5	2.08		
20-30							5	2.08								
30-40																
40-50																
50-60																
60-70	19	7.91														
70-80	176	73.33														
80-90	45	18.76														
90-100															204	85
Nil																

Table 1.c.1. revealed that 73.33 percent of the families spent 70 to 80 percent of their income for food while 18.75 percent of the families spent 80 to 90 percent of the income while 7.91 percent spent only 60 to 70 percent of their income. Among 240 families surveyed only 15 percent of the families had savings. Comparatively only a small percentage of income was used for clothing, shelter, health, education, transportation and entertainment.

1.c.2. Expenditure pattern with reference to different food items:-

Expenditure pattern of the families surveyed with reference to food items is presented in table 1.c.2.

Table 1.c.2. Expenditure pattern with reference to different food items:

Percentage of income spend for items	Cereals		Pulses		Roots tubers		Vegetables		Fish		Milk		Meat		Egg		Fat		Suger	Nuts & oil seeds		Fruits	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent		No:	per-cent
0-5			92	38.33			182	75.83	104	43.33	128	53.33	27	11.25	132	55	240	100		60	25		
5-10			60	25	78	32.51	46	19.17	88	36.67	22	9.17	17	7.08	92	38.33							
10-15					94	39.17	12	5 .00	28	11.67					16	6.67							
15-20					68	28.33			20														
20-25																							
25-30																							
30-35																							
35-40																							
40-45																							
45-50	22	9.17																					
50-55	49	20.41																					
55-60	117	48.75																					
60-65	52	21.67																					
65-70																							
70-75																							
75-80																							
Nil			88	36.67							90	37.5	196	81.67								180.75	

Table 1.c.2 revealed that 45 to 65 percent of income was spent on cereals. About 5 to 20 percent was spent on roots and tubers and for fish. Lesser amounts were spent on foods like pulses, egg and milk. 36.67 percent of the families were found not to use pulses while 37.5 percent and 81.67 percent never used milk and meat / egg respectively.

1.c.3. Frequency of use of different food items.

Frequency of use of different food items in a month is presented in table 1.c.3.

Table 1.c.3. Frequency of use of different food items.

	Daily		More than thrice in a week		Twice in a week		Once in a week		1-2-times in a month		Occassi-onaly		Never		Total	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent
Cereals	240	100														
Pulses							64	26.67	56	23.33	26	10.33	94	39.17		
Roots and tubers	32	13.33	86	35.83	70	29.17			52	21.64						
Green leafy vegetable			42	17.50	26	10.81	104	43.33			68	28.33				
Other vegetables			240	100												
Fruits											60	25	180	75		
Milk and Milk products	92	38.33					38	15.83			20	8.33	90	37.50		
Nuts and oil seeds			30	12.5	38	15.84	54	22.52			120	50				
Fish	104	43.33	44	18.33												
Egg			54	22.50							44	18.33	142	59.17		
Sugger	170	70.83														
Jaggery	70	29.17														
Palm oil	240	100														

As revealed in table 1.c.3. cereals, oil, sugar or jaggery were the food items used daily by the families surveyed. Fish was also one of common foods items included frequently in their diets. All families tried to use at least any one of the vegetables on alternate days. Foods such as pulses, fruits, milk and milk products, green leafy vegetables and egg were not found as regular items in the dietary pattern.

1.c.4. Dietary pattern of the family:

The dietary pattern of the families with special reference to various food combination was assessed for three consecutive days and results are presented in table 1.c.4.

Table 1.c.4. Dietary pattern of the family

Food combination	Breakfast		Lunch		Tea		Dinner	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent
Fresh preparations cereals alone					24	10		
Cereals + vegetable	23	9.38	46	19.17			42	17.5
Cereals + pulse	25	10.41	17	7.08			110	45.83
Cereals + tuber + fish			24	10				
Cereals + fish	11	4.58	116	48.33			26	10.83
Cereals + vegetable + Fish ~~fish~~ * tuber + fish	52	21.67	19	7.92	95	39.58		
Leftoverfoods Tuber + chillies	45	18.75	18	7.5	103	42.91		
Cereals + Chillies	84	35			18	7.50	62	25.83

As depicted in table 1.c.4. cereal-fish, cereal-vegetable and cereal-pulse combinations were found to be the most common acceptable food combinations in the main meals. For breakfast as well as for evening tea, left over foods like cereal chillie and tuber chilli combinations were consumed by many of the families (53.75 percent and 50.4 percent respectively). Cereal-fish combination was the popular

item in lunch. (52.5 percent) while cereal-pulse combination in supper (39.16 percent). Tuber-chillie and tuber-fish combinations were used as snack item during evening tea.

1.c.5. Dietary pattern of children.

The dietary pattern of the children is presented in table 1.c.5.

Table 1.c.5. Dietary pattern of the children

Food combination	Breakfast		Lunch		Tea		Dinner	
	No:	per-cent	No:	per-cent	No:	per-cent	No:	per-cent
Fresh preparations								
Cereals alone	24	10	-	-	18	75	-	-
Cereal + sugar/ jaggery	46	19.17	-	-	13	5.41	-	-
Cereal + vegetable	38	15.83	51	21.25	-	-	46	19.17
Cereal + pulse	-	-	88	36.67	-	-	134	55.83
Cereal + tuber + fish	-	-	23	9.58	-	-	-	-
Cereal + fish	26	10.83	42	17.5	-	-	18	7.5
Cereal + vegetable + fish			18	7.5	-	-	-	-
Tuber + fish	34	14.17	-	-	103	43	-	-
Left over food								
Cereal + chillies	72	30	18	7.5	19	7.92	38	15.83
Tuber + chillies					87	36.25	-	-

As revealed in table 1.c.5. daily dietary pattern of the children was almost the same as the adult diet. About 36 percent of the children had their lunch from school. 96.25 percent children consumed left over foods like cereal-chillie or tuber chillie combination at different times like breakfast (30 percent) lunch (7 percent) tea (43 percent) dinner (15 percent). Cereal-vegetable combination was used only by 21.25 percent for lunch and 19.17 percent for supper.

1.c.6. Diet given to the children at different age level.

Diet given to the children at different age level and during illness is presented in table 1.c.6.

Table 1.c.6. Diets given to the children at different age level and during illness.

Age group	Breakfast	Midmorning	Lunch	Tea	Dinner
3-6 years	Adult food	-	Adult food	Adult food	Adult food
6-9 years	"	-	"	"	"
9-12 years	"	-	"	"	"
12-15 years	"	-	"	"	"
During illness	Porridge/bread				

As revealed in table 1.c.6. the diets of children were same as that of adults except during illness when simple foods such as porridge or bread were given. An analysis of the diet given to the children indicated that no special food was given to them during growing stage.

1.c.7. Influence of family size on the use of important food items. The influence of number of family members on the frequent use of different food items are presented in table 1.c.7.

Table 1.c.7. Influence of family size on use of important food items.

(Percentage given in parenthesis)

Food items	0-3 members N=44						3-5 members N=132						5-7 members N=53						above 7 members 11					
	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never
Pulses				16 (36.36)	17 (38.63)	11 (25)					34 (25.75)	29 (21.96)	17 (12.87)	52 (39.39)				12 (22.6)	10 (18.86)	7 (13.20)	24 (45.28)				2 (18.18)		4 (36.36)	5 (45.45)
Green leafy		11 (25)		14 (31.8)		19 (43.18)			22 (16.67)	26 (19.67)		65 (49.24)	19 (14.39)			7 (13.20)		21 (39.62)		26 (49.05)				2 (18.18)	4 (36.3)	5 (45.4)		
Fruits					18 (40.90)	26 (59.09)						42 (31.81)	90 (68.18)							53 (100)							11 (100)	
Milk and milk products	22 (50)			8 (18.18)		4 (9.09)	10 (22.72)	51 (38.63)			22 (16.67)		16 (12.12)	43 (32.57)	16 (30.18)			8 (15.09)			29 (54.7)	3 (27.27)					8 (72.72)	
Nuts and oil seeds		6 (13.63)		7 (15.90)	12 (27.27)	19 (43.18)		18 (13.63)			19 (14.39)	32 (24.24)	63 (47.72)		6 (11.32)			6 (11.32)	12 (22.6)	29 (54.71)						9 (81.81)	
Eggs		13 (29.54)			8 (18.18)	23 (52.27)		30 (22.72)				25 (18.93)	77 (58.33)		11 (20.75)					11 (20.75)	30 (56.60)						11 (100)	
Sugar	44 (100)				112 (34.84)				10 (18.86)						4 (36.36)													
Jaggerry					20 (15.15)				43 (81.12)						7 (63.63)													

Table 1.c.8. Influence of income on frequency of use of food items.
(Percentage given in parenthesis)

Food items	Rs.200 - 400 N=22						Rs.400 - 600 N=151						Rs.600 - 800 N=59						Rs.800 - 1000 N=08					
	Daily	More than thrice in a week	Twice in a week	One in a week	1-2 times in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 time in a month	Occassionally	Never	Daily	More than thrice in a week	Twice in a week	Once in a week	1-2 times in a month	Occassionally	Never
Pulses						14 (63.63)	8 (36.37)				20 (13.24)	33 (21.85)	12 (7.94)	86 (56.95)				36 (61)	23 (39)							8 (100)		
Green leafy Vegetables			2 (9.09)	12 (54.54)	8 (36.37)					16 (10.59)	4 (2.64)	71 (47.01)		60 (39.71)			22 (37.3)	18 (30.5)	19 (32.2)					4 (50)	2 (25)	2 (25)		
Fruits						22 (100)							12 (7.94)	139 (92.05)					44 (74.6)	15 (25.42)							4 (50)	4 (50)
Milk and Milk products				8 (36.3)	14 (63.63)	39 (25.12)					24 (15.89)		12 (7.94)	76 (50.33)	48 (81.35)			11 (18.6)			5 (62.5)			3 (37.5)			
Nuts and oil seeds				2 (9.09)	4 (18.18)	16 (72.72)			9 (5.96)		21 (13.90)	36 (23.84)	85 (56.29)			13 (22)		9 (15.3)	18 (30.5)	19 (32.2)			8 (100)					
Eggs		3			8 (36.37)	11 (50)			23 (15.21)				14 (9.27)	114 (75.4)		26 (44)			18 (30.5)	15 (25.5)			2 (25)				4 (50)	2 (25)
Sugar	4 (11.8)					109 (72.18)							49 (83)							8 (100)								
Jeggerry	18 (81.18)					42 (27.8)							10 (17)															

As revealed in table 1.c.7. size of the family was an important factor which affected the use of different food items. From the table it could be noted that as the number of members in a family increased the use of food decreased to a certain degree. In the families having less than 3 members and 3 to 5 members, almost all foods were used atleast morethan thrice, twice or at least once in a week where as in families where 5 to 7 or above 7 members were present the frequency of use of food items decreased to occassionally or once in a month or never.

1.c.8. Influence of income on frequency of use of food item:

The influence of income of a family on the frequency of use of different food items is presented in table 1.c.8.

As revealed in table 1.c.8 the income of a family positively affected the use of different food items. As the income increased the frequency of use of various foods were increased. In the income group of Rs.200 to 400, they used almost all foods occassionally or once in a week except sugar and jaggery.

2. PERSONAL HISTORY OF THE SELECTED CHILDREN

Personal history of the children selected for the study was assessed by eliciting details on morbidity status behavioural problems at home, assessment of children by mother

and class teacher, their intellectual performance, social behaviour pattern at school and involvement in activities at school. Of these, informations related to health and behavioural problems at home was collected from parents while all other details such as assessment in classroom, intellectual and social development and participation in different activities in school were collected from teachers.

2.a.1. Information regarding morbidity status of the selected children.

Morbidity status of the children are presented in table 2.a.1. and Fig.11.

Table 2.a.1. Morbidity status of the children:-

Disease occured	Yes		No	
	No.	Percent	No.	Percent
Mumps	182	75.83	58	24.17
Measles	136	56.67	104	43.33
Chickenpox	106	44.17	134	55.83
Dysentry	80	33.33	160	66.67
Jaundice	78	32.50	162	67.50
Diarrhoea	70	29.17	170	70.83

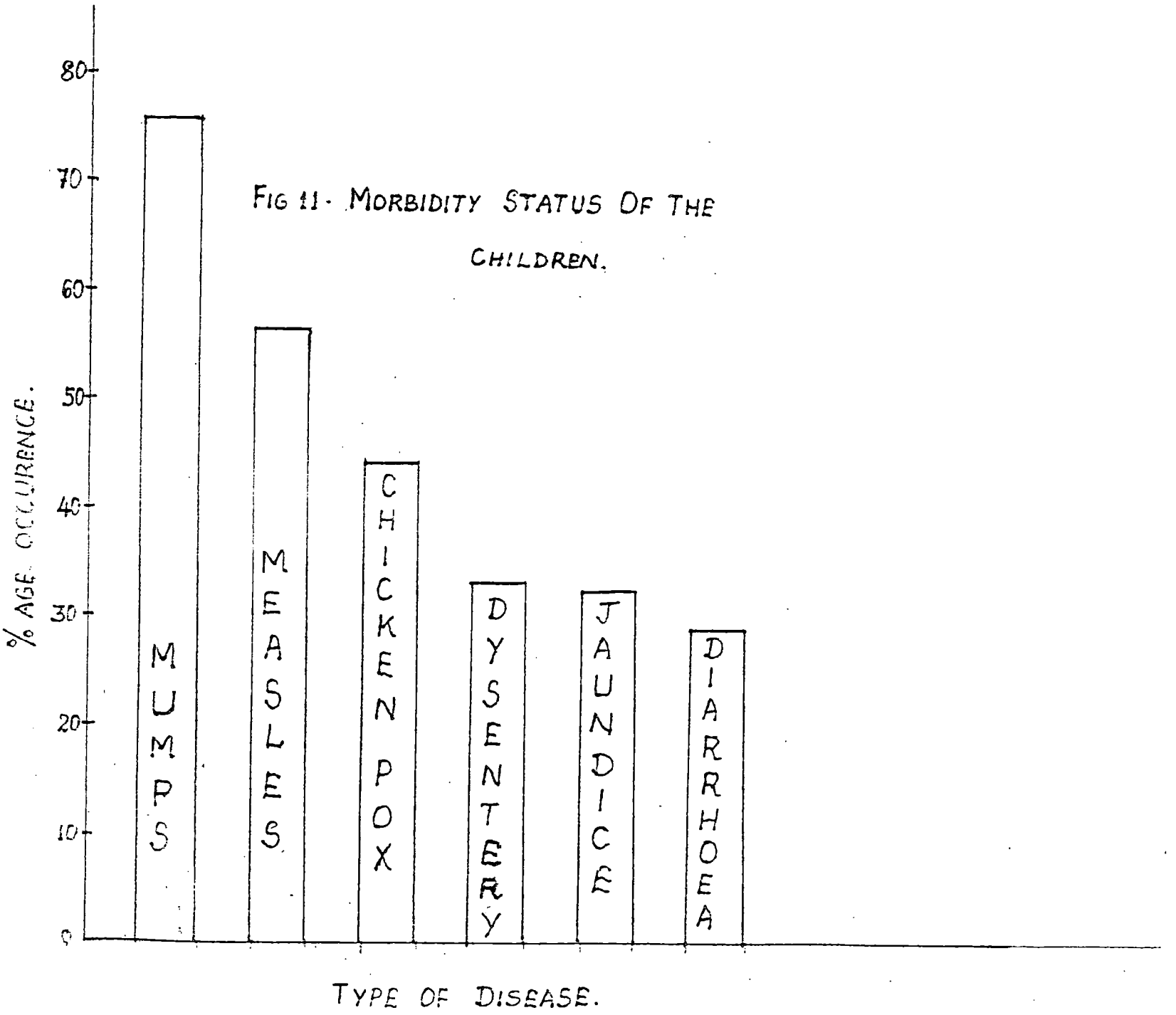


FIG 11. MORBIDITY STATUS OF THE CHILDREN.

As revealed in table 2.a.1. many of the children were found to be affected by different types of infectious diseases which were generally caused due to lack of timely vaccination, poor environmental hygiene and sanitation.

2.b.1. Details of behavioural problems of children at home.

Informations on different behavioural problems of children are presented in table 2.b.1.

Table 2.b.1. Behavioural problems of the children.

Sl. No.	Behavioural problems	Yes		No.	
		No.	percent	No.	Percent
1.	Nailbiting	94	39.17	146	60.33
2.	Bed wetting	82	34.17	158	65.83
3.	Thumb sucking	30	12.5	210	87.5
4.	Day dreaming	28	11.67	212	88.33
5.	Sibling rivalry			240	100
6.	Depression			240	100
7.	Rebellous towards elders	96	40	144	60
8.	Speech difficult	-		240	100
9.	Lethargic	30	12.5	210	87.5
10.	Irregularity in studies	104	43.33	136	56.67
11.	Playfulness and lack of renounce	60	25	180	75
12.	Quarrelsome	75	32.25	165	68.75
13.	Saying lies			240	100
14.	Kleptomania			240	100

As revealed in table 2.b.1. nailbiting (39.17 percent) bed wetting (34.17 percent) irregularity in studies (43.33 percent) rebellousness towards elders (40 percent) and quarrelsome nature (31.25 percent) were found to be the common behavioural problems prevalent among the children. Thumbsucking (12.5 percent) day dreaming (11.67 percent) lethargy (12.5 percent) and playfulness (25 percent) were also other behavioural problems identified.

2.c.1. Child as assessed by the teacher.

Informations regarding the behaviour of the children in the classroom intellectual performance, social behaviour pattern and participation in different activities were collected from the teacher.

2.c.1. Information regarding behaviour in classroom.

Details of behaviour in classroom in presented in able 2.c.1.

Table 2.c.1. Behaviour of children in classroom.

Behaviour pattern	Preschool		Lower primary		Upper primary		Highschool		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Fighting with friends	24 (4)	36 (60)	28 (46.67)	32 (53.33)	26 (43.33)	34 (56.67)	8 (13.33)	52 (86.67)	86 (35.83)	154 (64.17)
Rebellous towards teacher	60	60 (100)		60 (100)		60 (100)		60 (100)		240 (100)
Constant fear	16 26.67)	44 (73.33)	21 (35)	39 (15)	9 (15)	51 (85)	11 (18.33)	49 (81.67)	57 (23.75)	183 (76.25)
Jealousy towards classmates	8 (13.33)	52 (86.67)	14 (23.33)	46 (76.67)	22 (36.67)	38 (63.33)		60 (100)	44 (18.33)	196 (81.67)
Revengeful towards classmates	60	60 (100)		60 (100)		60 (100)		60 (100)		60 (100)
Friendly towards classmates	60 (100)		24 (40)	36 (6)	32 (53.33)	28 (46.67)	48 (80)	12 (20)	164 (68.33)	76 (31.67)

Percentage given in parenthesis

As revealed in table 2.c.1 certain behaviour pattern such as jealousy towards classmates increases from preschool age upto upper primary level but in high school it was not seen whereas friendly towards class mates, constant fear and fighting with friends were of fluctuating nature.

2.c.2. Intellectual perfomance in classroom.

Informations based on various components of intelligence are described in the table 2.c.2.

Table 2.c.2. Intellectual performance of the children.

Components of intelligence	Pre school			Lower primary			Upper primary			High school			Total		
	Below average	Average	Above average	Below average	Average	Above average	Below average	Average	Above average	Below average	Average	Above average	Below average	Average	Above average
Reasoning capacity	29 (48.33)	31 (51.67)		25 (41.67)	35 (58.33)		27 (45)	33 (55)		18 (30)	40 (70)		99 (41.25)	141 (58.75)	
Attention span	21 (35)	39 (65)		27 (45)	24 (4)	9 (15)	31 (51.67)	22 (36.67)	7 (11.67)	22 (36.67)	24 (40)	14 (23.33)	101 (42.08)	109 (45.42)	30 (50)
Memory power	18 (30)	42 (7)		29 (48.33)	23 (38.34)	8 (13.33)	28 (46.67)	23 (38.34)	9 (15)	23 (38.34)	25 (41.67)	12 (20)	98 (40.83)	113 (47.08)	29 (12.08)
Imagination and creativity	6	60 (100)			60 (100)			60 (100)			60 (100)			240 (100)	
Performance at school		60 (100)		29 (48.33)	25 (41.67)	6 (10)	33 (55)	22 (36.67)	5 (8.33)	23 (38.34)	25 (41.67)	12 (20)	85 (35.41)	132 (55)	23 (19.59)

Percentage is given in parenthesis.

As revealed in table 2.c.2. majority of the children showed average intellectual capacity in classroom (55 percent) while some were below average (35.41 percent) and a few were above average (9.59 percent). Though there were children who showed above average ability in reasoning capacity and attention span, in general they came to average level only.

2.c.3. Influence of type of family on intellectual development of children. Details of influence of family type on the development of different components of intelligence is presented in table 2.c.3.

Table 2.c.3. Influence of type of family on intellectual development of children.

Components of intelligence	Nuclear N = 168			Extended N = 72		
	Below average No.	Average No.	Above average No.	Below average No.	Average No.	Above average No.
Reasoning capacity	67 (39.9)	101 (60.1)	-	32 (44.44)	40 (55.56)	-
Attention span	57 (39.9)	87 (51.8)	24 (14.3)	44 (61.11)	22 (30.6)	6 (8.33)
Memory power	60 (35.8)	86 (51.2)	22 (13)	38 (52.8)	27 (37.5)	7 (9.7)
Imagination and creativity	- -	168 (100)	-	-	72 (100)	-
Performance at school	53 (31.54)	96 (57.12)	19 (11.3)	32 (44.44)	36 (50)	4 (5.6)

Percentage is given in parenthesis.

As revealed in table 2.c.3 it was found that in nuclear type families the percentage of children below average was comparitively less than that of extended families.

2.c.4. Influence of family size on intellectual development.

The influence of family size on different components of intelligence are presented in table 2.c.4

Table 2.c.4. Influence of family size on intellectual development.

Components of intelligence	0-3 members N=44			3-5 members N=132			5-7 members N=53			Above 7 members N=11		
	Below average No.	Average No.	Above average No.	Below average No.	Average No.	Above average No.	Below average No.	Average No.	Above average No.	Below average No.	Average No.	Above average No.
Reasoning capacity	16 (36.37)	28 (63.63)	-	54 (41.00)	78 (59.00)	-	24 (45.32)	29 (54.71)	-	5 (45.51)	6 (54.51)	-
Attention span	11 (25.00)	27 (61.37)	6 (13.63)	58 (43.93)	60 (45.55)	14 (10.91)	26 (49.05)	19 (35.84)	8 (15.09)	6 (54.52)	3 (27.32)	2 (18.19)
Memory power	9 (20.45)	27 (61.37)	8 (18.18)	55 (41.67)	63 (47.73)	14 (10.92)	27 (50.9)	19 (35.84)	7 (13.21)	7 (63.63)	4 (36.44)	
Imagination and creativity		44 (100)			132 (100.00)			53			11	
Performance in class	8 (18.18)	30 (68.19)	6 (13.63)	52 (39.4)	69 (52.34)	11 (8.32)	22 (41.56)	25 (47.17)	6 (11.32)	3 (27.32)	8 (72.72)	

Percentage is given in parenthesis.

As revealed in table 2.c.4. as the number of members increased a decrease in the intellectual development of children was observed. The children from small families were found to be better than the children belonging to the medium and large families.

2.c.5. Social behaviour pattern of the children.

Social behaviour pattern of the children at school is presented in table 2.c.5.

Table 2.c.5. Social behaviour pattern of the children.

Social behaviour	Preschool		Lower primary		Upeer primary		High school		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
a. Talkative	12 (20)	48 (80)	18 (30)	42 (70)	24 (40)	36 (60)	18 (30)	42 70)	72 (30)	168 (70)
b. Calm and quiet	48 (80)	12 (20)	42 (70)	12 (30)	36 (60)	24 (40)	42 (70)	18 30)	168 (70)	72 (30)
c. C - - :	48 (80)	12 (20)	40 .56.67)	20 (33.33)	37 (61.67)	23 (38.34)	49 (81.67)	11 (18.33)	174 (72.5)	66 (27.5)
d. Poularity in school	8 (13.33)	52 (86.67)	12 (20)	48 (80)	8 (13.33)	52 (86.67)	14 (23.33)	46 (76.67)	42 (17.5)	198 (82.5)
e. Acceptable behaviour	44 (73.33)	16 (26.67)	46 (76.67)	14 (23.33)	44 (73.33)	16 (26.67)	49 (81.67)	11 (18.33)	183 (76.25)	57 (23.75)
f. Sharing nature of own belongings with 36 others	36 (60)	24 (40)	34 (56.67)	26 (43.33)	44 (73.33)	16 (26.67)	48 (80)	12 (20)	162 (67.5)	78 (32.5)
g. Friendly nature	60 (100)	-	60 (100)	-	60 (100)	-	60 (100)	-	240 (100)	-
h. Type of play preferred										
a. grouplay	60	-	60	-	60	-	60	-	240	-
b. solitarplay	(100)		(100)		(100)		(100)		(100)	

Percentage is given in parenthesis.

However, only very few were popular in school (17.5 percent). All children were friendly towards classmates.

.c.6. Participation in extracurricular activities by the children.

Details regarding participation in extra curricular activities by the children are presented in table 2.c.6.

Table 2.c.6. Participation in extracurricular activities in the school.

Activities	Participation		Non participation	
	No.	percent	No.	Percent
Artistic talents	32	13.33	208	86.67
Envolvement in extra curricular activities	78	32.50	102	67.50

As revealed in table 2.c.6 only 32.5 percent children participated in extracurricular activities and very few (13.33 percent) children had special artistic talents.

3. Nutritional status of the selected children.

Nutritional status of the children selected for the study were assessed by anthropometry, biochemical observation,

linical observation and through dietary intake.

.a.1. Anthropometric observation.

The anthropometric observation included height, weight chest and head circumference of the children. The results are presented in table 3.a.1.

Height for the age profile of the children. Height for the age profile is presented in table 3.a.1.

Table 3.a.1. Height for age profile.

Age in months	Sex	No. of children	observed mean height	Standard height	t value
48-54	M	16	94.23	92.24	3.32**
	F	12	93.09	92.23	1.96
54-60	M	8	97.44	99.21	2.46*
	F	9	98.52	99.20	0.75
60-66	M	6	106.21	106.42	0.24
	F	9	105.44	106.41	1.29
72-84	M	10	114.77	116.75	2.32*
	F	9	113.43	116.52	5.24**
84-96	M	11	122.12	122.00	0.11
	F	12	121.58	121.58	0.13
96-108	M	9	127.55	127.27	0.64
	F	9	127.07	127.00	0.17
108-120	M	10	133.28	132.56	1.17
	F	12	133.21	133.00	0.527
120-132	M	11	138.17	137.53	1.022
	F	8	139.40	138.75	0.845
132-144	M	9	144.00	142.54	1.64*
	F	10	146.43	144.53	2.91*
144-156	M	12	152.25	151.54	1.192
	F	14	151.02	150.00	0.144
156-168	M	18	158.42	157.72	4.32**
	F	16	154.33	153.52	2.99*

* Significant at 5 percent level
** Significant at 1 percent level

As depicted in table 3.a.1. almost all children had heights near to their standard (NIN 1975).

3.a.2. Weight for age profile:

The weight for age is presented in table 3.a.2.

Table 3.a.2. Weight for age profile.

Age in months	Sex	No. of children	Observed mean	Standard value	t value
49-54	M	16	14.44	15.5	0.87
	F	12	18.41	15.00	6.87**
55-60	M	8	15.41	6.4	3.21
	F	9	15.00	5.2	1.35
60-66	M	6	16.82	.7.28	1.99
	F	9	15.00	.6.75	4.59**
72-84	M	10	20.00	21.75	3.71
	F	9	19.27	20.75	3.66**
86-96	M	11	22.90	24.25	1.36
	F	12	22.80	23.37	1.17
96-108	M	9	24.20	26.62	5.69**
	F	9	25.80	26.12	0.58
108-120	M	10	27.25	28.87	3.17**
	F	12	28.07	29.00	0.60
120-132	M	11	29.46	31.25	2.57
	F	8	31.96	32.12	0.22
132-144	M	9	33.30	34.00	1.80
	F	10	35.43	36.25	1.97
144-156	M	12	36.04	37.62	2.79*
	F	14	38.71	41.00	2.01
156-168	M	18	40.78	42.37	3.06*
	F	16	41.50	44.12	3.87**

* Significant at 5 percent level
** Significant at 1 percent level

As revealed in table 3.a.2. there was not much significant difference in weights from the standard. A few children, from preschool, lower primary and high school had a significant difference in weight.

3.a.3. Classification of children based on weight (g) height^2 (cm^2) is presented in table 3.a.3.

Table 3.a.3. weight/height^2 profile.

		0.00135	0.00135-0.0015	>0.0015
Preschool	M	6	8	16
	F	5	11	14
Lower primary	M	5	9	16
	F	6	6	18
Upper primary	M	-	6	24
	F	-	9	21
High school	M	-	3	27
	F	-	5	25
Total		22 (9.17)	57 (23.75)	161 (67.08)

As revealed in table 3.a.3. only 9.17 percent children had current severe malnutrition while 23.75 percent

had current moderate malnutrition and majority were (67.08 percent) normal.

3.a.4. Classification based on head circumference of children.

Classification based on the head circumference of children is given in table 3.a.r.

Table 3.a.4. Head circumference profile of children.

Children	Sex	Mean head circum-ference	Less than Meanhead circum-ference	greater than Meanhead circum-ference
Preschool	M	51.0	8	22
	F	50.7	9	21
Lower primary	M	52.5	6	24
	F	52.1	7	23
Upper primary	M	53.1	5	25
	F	52.9	6	24
High school	M	53.5	5	25
	F	53.0	4	26
Total			50	190

As revealed in table 3.a.4. it was found that children having head circumference less than the mean value had poor nutritional status (20.83 percent) and remaining 79.17 percent had good nutritional status.

3.b.1. Haemoglobin level of the selected children.

Haemoglobin level of the children are presented in table 3.b.1.

Table 3.6.1. Haemoglobin level of the children.

Haemoglobin level	Preschool N=60		Lower primary N=60		Upper primary N=60		High school N=60		Total	
	Boys N=30	Girls N=30	Boys N=30	Girls N=30	Boys N=30	Girls N=30	Boys N=30	Girls N=30	Boys N=120	Girls N=120
9.5-10	11 (36.67	18 (60)	-	-	-	-	-	-	11 (9.17)	18 (15)
10-10.5	19 (63.33)	12 (40)	-	-	-	-	-		19 (15.83)	12 (10)
10.5-11	-	-	6 (20)	8 (22.67)	-	-	-	14 (46.67)	6 (5)	22 (18.33)
11-11.5	-	-	24 (80)	22 (73.33)	6 (20)	7 (23.33)	-	7 (23.33)	30 (25)	36 (30)
11.5-12	-	-	-	-	14 (46.67)	15 (50)	-	-	14 (11.67)	15 (12.5)
12-12.5	-	-	-	-	10 (33.33)	8 (26.67)	-	9 (30)	10 (8.33)	17 (14.17)
12.5-13	-	-	-	-	-	-	-	-		
13-13.5	-	-	-	-	-	-	-	19 (63.33)	-	19 (15.83)
13.5-14	-	-	-	-	-	-	-	11 (36.67)	-	11 (9.17)
Total	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)	120 (100)

Percentage is given in parenthesis.

As revealed in table 3.6.1. it was seen that low haemoglobin level was common among preschool children (80 percent girls and 36.67 percent boys) followed by high school girls (46.67 percent) and lower primary school level children (20 percent boys and 26.67 percent girls). Upper primary school level children were found to be the last in this order.

3.6.2. Birth order of selected children.

Details regarding the birth order of the children, selected for the study is presented in table 3.6.2.

Table 3.6.2. Birth order of the selected children.

birth order	Preschool		Lower primary		Upper primary		High school		Total		Total children
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	boys	Girls	
Ist child	7	5	8	6	14	14	15	10	44 (18.33)	35 (14.58)	79
2nd child	-	-	6	7	10	9	6	8	22 (9.16)	24 (10)	46
3rd child	7	3	9	9	6	7	4	4	26 (10.8)	23 (9.5)	49
4th child	16	22	7	8	-	-	-	-	23 (9.5)	30 (12.5)	53
5th child							5	8	5 (2.08)	8 (3.3)	13

As revealed in table 3.b.2. majority of selected children were eldest child (18.33 percent boys and 14.58 percent girls) followed by fourth order child (9.5 percent boys and 12.5 percent girls) in third order child (10.8 percent boys and 9.5 percent girls) child in second order (9.16 percent boys and 10 percent girls and lastly in fifth order child (2.08 percent boys and 3.3 percent girls.

3.b.3. Haemoglobin level and birth order of preschool children.

Details of haemoglobin level and birth order of preschool children is presented in table 3.b.3.

Table 3.b.3. Haemoglobin level and birth order of preschool children

* Normal Hb. level = 11 N = 60

Haemoglobin levels (g/dl)	Ist child		2nd child		3rd child		4th child		5th child	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
9.5 - 10							11 (18.35)	18 (30)		
10-10.5	7 (11.67)	5 (8.33)			7 (11.67)	3 (5)	5 (8.33)	4 (6.67)		

As revealed in the table 3.b.3. children belonging to had a low level of haemoglobin.

3.6.4. Haemoglobin level and birth order of lower primary children.

Informations on haemoglobin level and birth order of the selected lower primary children is presented in table 3.6.4.

Table 3.6.4. Haemoglobin level and birth order of lower primary children.

* Normal Hb level 11.5 N = 60

Haemoglobin levels (g/dl)	Ist child		2nd child		3rd child		4th child		5th child	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	N=60									
10.5-11							6 (10)	8 (13.33)		
11-11.5	8 (13.33)	6 (10)	6 (10)	7 (11.67)	9 (15)	7 (11.67)	1 (1.67			

Percentage is given in parenthesis.

As revealed in table 3.6.4 compared to normal value all the children had a lower level of haemoglobin.

3.6.5. Haemoglobin level and birth order of upper primary children.

Informations on haemoglobin level and birth order of the selected upper primary children is presented in table 3.6.5

Table 3.6.5. Haemoglobin level and birth order of upper primary children.

* Normal Hb value - 11.5 N=60

Haemoglobin level(g/dl)	Ist child Boys	Ist child Girls	2nd child Boys	2nd child Girls	3rd child Boys	3rd child Girls	4th child Boys	4th child Girls	5th child Boys	5th child Girls
				N=60						
11-11.5					6 (10)	7 (11.67)				
11.5-12	4 (6.67)	6 (10)	10 (16.67)	9 (15)						
12-12.5	10 (16.67)	8 (13.33)								

Percentage is given in parenthesis

As revealed in table 3.6.5. compared to normal value (11.5) only percent children had low haemoglobin level.

3.6.6. Haemoglobin level and birth order of high school childre

Details of haemoglobin level and birth order of high school children is presented in table 3.6.6.

* standard value (Gopaldas. T. and Seshadri. S. 1987)

Table 3.b.6. Haemoglobin level and birth order of high school children.

* Normal Nb value for Boys-13 N=30 For Girls-11.5 N=30

Haemoglobin level (g/dl)	Ist child		2nd child		3rd child		4th child		5th child	
	Boys	Girls	Boys	Girls N=60	Boys	Girls	Boys	Girls	Boys	Girls
10.5-11	-	-	-	2 (3.33)	-	4 (6.67)	-	-	-	8 (13.33)
11-11.5		1 (1.67)		6 (10)						
11.5-12										
12-12.5		9 (15)								
12.5-13										
13-13.5	4 (6.67)		6 (10)		4 (6.67)				5 (8.33)	
13.5-14	11 (18.33)									

Percentage is given in parenthesis

As revealed in table 3.b.6 for girls only 15 percent had higher haemoglobin values. Where as for boys all had a normal or above normal haemoglobin level.

* Gopaldas.T. and Sheshadris. (1987)

3.c.1. Clinical status of the children.

Clinical status of the children assessed by a trained physician is presented in the table 3.c.1.

Table 3.c.1. Clinical status of the children.

	Pre school		Lower primary		Upper primary		High school		Total	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Protein calorie Malnutrition	6 (20)	7 (23.33)							6 (20)	7 (23.33)
Anaemia	12 (40)	18 (60)	8 (26.67)	9 (30)	4 (6.67)	7 (23.33)	-	16 (53.33)	24 (21.6)	50 (41.6)
Teeth caries	16 (53.33)	12 (4)	14 (45.67)	18 (60)	14 (45.67)	9 (30)	4 (6.67)	5 (8.33)	66 (55)	44 (36.67)
Mottled enamel	11 (36.67)	8 (26.67)	18 (60)	12 (40)	9 (30)	11 (18.33)	-	-	38 (31.67)	31 (25.83)

Percentage is given in parenthesis.

As revealed in table 3.c.1 it was found that the 23.33 percent Girls and 20 percent boys among preschool children had protein calorie malnutrition while these symptoms were not. Present in the other age groups. Anaemia was more common among girls. (41.6 percent) compared to boys (21.6 percent) Anaemia was common among girls at preschool and high school periods 60 and 53.33 percent respectively). In this respect girls at upper primary and lower primary school levels were found to be better (23.33 and 30 percent respectively). Anaemia among boys was highest in preschool years (45.67 percent) gradually decreasing as age increased and in highschool no one was found to be anaemic. However, dental caries was found to be more common among boys (55 percent) than in girls (36.67 percent). Among boys preschool children (53.33 percent) were mostly affected by this followed by lower primary (45.67) and upperprimary (45.67). This was less common among highschool children (6.67 percent). Among girls highest percentage- was found among lower primary age (60 percent) followed by preschool (40 percent) upper primary (30 percent) and lastly highschool (8.33 percent) Mottled enamel was high among boys (31.33 percent) compared to girls (25.83). In this respect boys in lower primary school (60 percent) were found to be affected more followed by preschool children (36.67 percent) and then upper primary (30 percent). Among girls also high percentage of mottled enamal was seen in lower primary age(40.00 percent) followed

by preschool children (26.67 percent) and lastly upper primary children (18.33 percent). This was not found in highschool children.

3.c.2. Anaemia and birth order of children.

Details of occurance of anaemia and birth order is presented in table 3.c.2 and fig. 12.

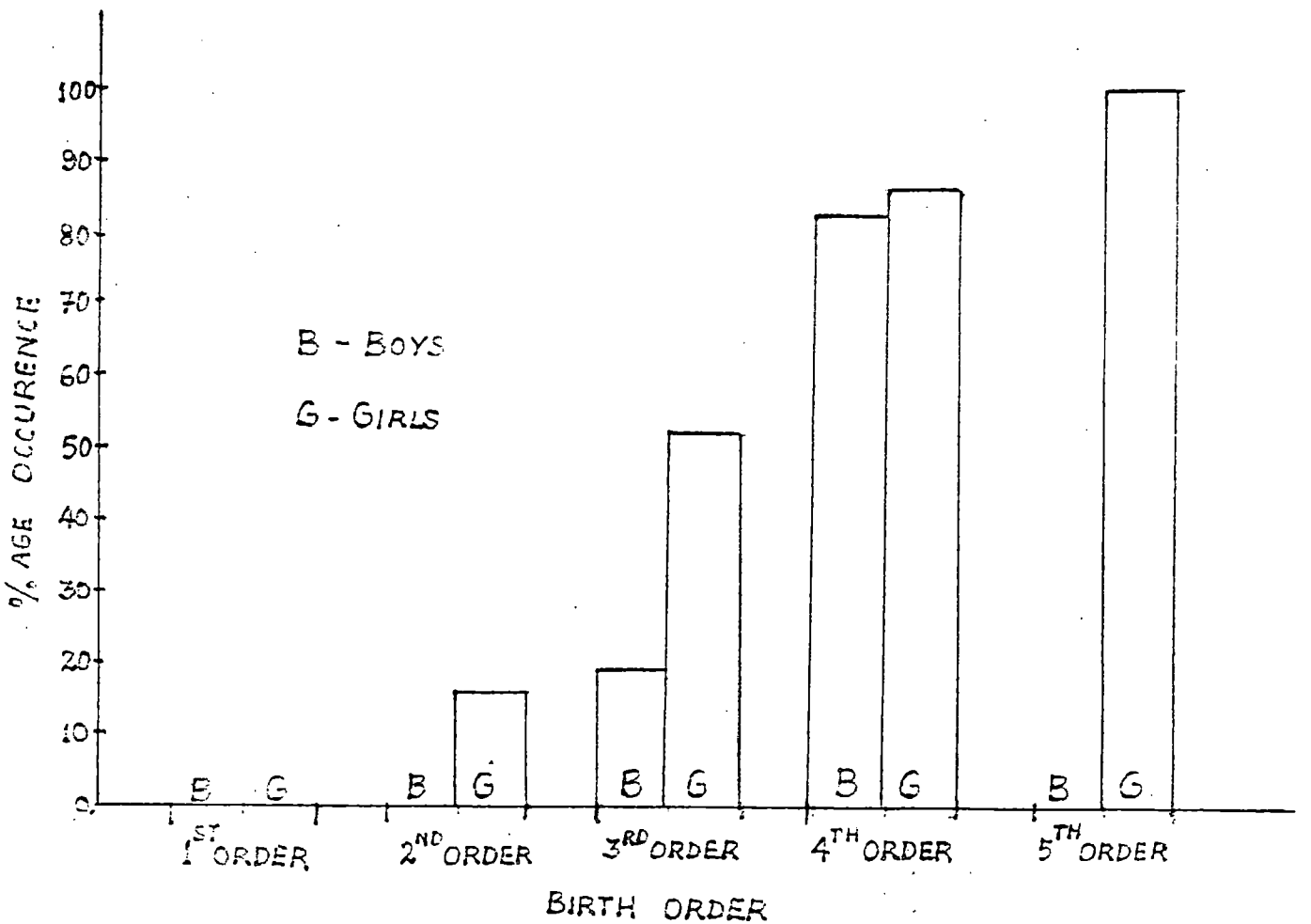
Table 3.c.2. Anaemia and birth order of children.

	Birth order									
	Ist child		2nd child		3rd child		4th child		5thchild		Total	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Pre-school N=60							12	18			12	18
Lower-primary N=60					1	1	7	8			8	9
Upper primary N=60					4	7					4	7
High-school N=60			4		4				8		-	16
Total			4 (16.6)	5 (19.2)	12 (52.17)		19 (82.6)	26 (86.6)	8 (100)		24	50

Percentage is given in parenthesis.

As revealed in table 3.c.2. it was found that as the birth order of he child increased the haemoglobin level decreased.

FIG 12. ANAEMIA AND BIRTH ORDER OF CHILDREN



Dietary deficiency prevalent among children.

The dietary deficiency prevalent among the children was assessed by eliciting information on average food consumption and average nutrient intake of children through food weighment method.

3.D.1. Average food consumption pattern of the children.

Average food consumption pattern of the children of different age group is presented in table 3.D.1..

Table 3.D.1. Average food consumption of the children

Food-groups	R.D.A.	3-6 year N=2			6-9 years N=2			9-12 years N=2			Boys 12-15 Years N=2			Girls 12-15 years N=2		
		Amo-unt con-sum-ed	Per-cent-age of RDA met	R.D.A	Amo-unt con-sum-ed	per-cent-age of RDA met	R.D.A	Amo-unt con-sum-ed	Perce-ntage of RDA met	R.D.A	Amo-unt con-sum-ed	Perc-entage of RDA met	R.D.A	Amo-unt con-sum-ed	Percen-tage of R.D.A. met	
Cereals	200	188	94	250	242	96.8	320	308	96.25	430	400	93.02	350	320	91.4	
Pulses	50	11	5.5	60	16	26.67	60	19	31.67	50	14	28	50	12	24	
Green leafy vegetables	75	-	-	75	-	-	100	16	16	100	20	20	150	30	20	
other vegetables	30	15	50	30	15	50	70	15	21.4	75	14	18.67	75	10	13.33	
Roots and tubers	15	46	306.6	15	50	333.33	25	90	360	75	215	386.67	75	200	266.67	
Fruits	50	10	20	50	5	10	50	-	-	30	-	-	30	-	-	
Fish, meat and egg	30	38	126.67	30	42	140	30	48	160	30	49	163.3	30	49	163.3	
Milk	200	30	15	200	15	75	200	-	-	150	-	-	150	-	-	
Fat and oil	25	12	48	30	22	73.3	35	32	91.41	40	36	90	40	20	50	
Sugar	40	25	62.5	50	35	70	50	25	50	30	15	50	30	10	33.33	

Table 3.D.1. revealed that 91 to 96 per
recommended allowance was met in the case of c
age groups. Foods like roots and tubers and f
consumed more than the actual recommended allo
protective foods like milk, fruits and green l
were consumed in negligible amounts only veget
fats and acts also were included in insuffici

3.D.2. Average nutrient intake of the
Average intake of different nutrients by the c
presented in table 3.D.2.

Table 3.D.2. Average Nutrient in take of children from 3-15 years.

Nutrients	Pre school No-2			Lower primary No-2			Upper primary No-2			High school No-2			Highschool girls No-2		
	Average nutrient in take	R.D.A.	Percentage of R.D.A met	Average nutrient in take	R.D.A	Percentage of RDA met	Average nutrient in take	R.D.A	percentage of R.D.A met	Average nutrient in take	RDA	Percentage of RDA met	Average nutrient in take	R.D.A.	Percentage of R.D.A met
Caloric (kd)	1036	1500	69.06	1364	1800	75.77	1552	2100	73.4	1985	2500	79.4	1850	2200	84.5
Protein (g)	21	22	95.4	29	33	87.87	36	41	87.8	43	55	78.18	39	50	78
Calcium (mg)	310	500	62	290	500	58	320	600	33.33	305	700	50.83	290	600 700	48.33
Iron (mg)	9.2	20	60.52	10.5	20	70	10.5	15 20	70	17	25	68	21	33	60
Bcarotene(Mg)	251	1200	20.9	336	1600	21	508	2400	21.17	670	3000	22.33	665	3000	22.16
Thianiine (Mg)	0.48	0.8	60	0.53	0.9		58.8	0.7	1	70	0.9	1.3	69.23	0.7	1.1
Ribeflav in(Mg)	0.37	0.8	58.75	0.6	1	60	0.8	1.2	66.67	1	1.4	71.2	0.7	1.2	58.33
Niacin (mg)	7.2	10	72	8.2	12	68.33	9	14	64.28	11	17	64.7	9	14	64.28
Vitamin-C (mg)	22.4	30 50	74.67	24	30.50	80	22	30 50	73.33	24	30.50	68.57	22	30 50	73.3

As revealed from table 3.D.2 about 70-84 percent of calorie needs and 78 to 95 percent of protein were met. With regards to iron only 60-70 percent of recommended allowance and 58-70 percent of the daily allowance of thiamiine and riboflavin was met 64-72 percent of the recommended allowance of miacin was also met in all children and 64.78 percent of daily allowance of vitamin C was also met. However the most neglected nutrient namely β carotene was present in negligible amounts (20.9 to 22.33).

Intelligence of the children.

The result of the intellectual development and nutritional and non nutritional factors is presented below.

Weighted mean of nutritional status from anthropometric indises = 2.9225

Weighted mean of intelligence of the children from the test conducted = 0.7893.

Coefficient of determination = 32.2%

32.2% of variation in intelligence is determined by the linear regression relationship of variance by

$Y = 1.6510 - 0.2949\,x$ where Y = Intelligence

x = Nutritional status.

DISCUSSION

DISCUSSION

A study conducted on the influence of nutritional status on intelligence, among selected children of different age groups was mainly to assess the family background and personal characteristics of children which have an effect on their intellectual development.

An extensive socio-economic survey was undertaken among 240 families, majority of whom belonged to backward communities or scheduled caste. The sample was drawn from Ulloor and Kadakampally panchayats covering 46 wards within the radius of 43.12 square kilometers.

The nuclear type families were more common among the families surveyed who seemed unwilling to live in large groups under one roof. There is an argument that nuclear type families are generally better than joint type for the healthy development of a child (Saxena 1986) and in the present study 70 percent of the families was nuclear type. (Table 2.c.3). Earlier studies had also indicated that there was a significant difference in intellectual development of children from nuclear and extended families (Saxena 1986).

Family size is an important factor which greatly influences the development of children in all respects (Devadas et al. 1980). Occurance of school dropouts and poor scholastic achievements were reported from families of large

size (Rao et al. 1983). In the present study majority of families belonged to medium size with members ranging from 3 to 5 (Table 2.c.4). It was also found that as the number of members increased a decrease in the intellectual development of children occured. Family size was also found to influence the frequency of use of different food items (Table 1.c.7).

Majority of the families (81.67 percent) studied were having three or more than three children. In the present study majority of the children (32.9%) being the eldest were considered to have a favourable environment needed for their physical and mental development, even though the opportunities were not well utilised due to various other factors.

The educational level of the parents is a major factor which influences the growth and development of children. (Bhatia 1972). In the present study the parents of the children studied were found to be moderately educated. The majority of males had studied up to upper primary level (53.9 percent) where as among females majority studied only up to lower primary level (46.73 percent). The ratio of school dropouts is reported to be higher among females than their male counter parts in earlier studies (world bank 1984).

A basic feature of our rural economy is that agriculture is the major source of living and employment. From the results it was found that majority of the heads of the families were labourers (59.92 percent) depending on

land and most of the mothers were engaged in routine house hold work (62.68 percent). Earlier studies indicated that the occupational status of parents also influenced the nutrition and development of family members (Klein et al. 1972).

Income of the family definitely affects the nutritional status and development of the child (Devadas 1980) and hence the income level of sample was studied. The average percapita income among the families surveyed was Rs.610. The results of the present study indicated that majority of families belonged to lower middle income group. Lower percapita income is an index of poverty. The planning commission, Government of India placed the figure of 48 percent below poverty line in the year 1979 - 1980. In the present study 9.16 percent of families fell below poverty line.

However the salient findings of the study indicated that income was a major factor which decided the frequency of use of various food items in their diets (Table 1.c.8). This is in agreement with the earlier studies.

With regards to the housing condition and facilities, most of them lived in their own houses (84.58 percent) and majority of the families (78.93 percent) had ornamental/ Kitchen garden. Almost all had (96.67) minimum facility of 3 or 4 rooms.

Regarding the facilities available for children at home only a few children (14.58 percent) possessed own rooms and 33.3 percent had play materials and 54.17 percent possessed books for acquiring additional knowledge. There were children (16.67 percent) who did not have text books for learning. The result of possession of other educational media like television and radio indicated that only very few families (3.33 percent) possessed television while majority (90.83 percent) families possessed radio.

Home environment is one of the factors responsible for poor intellectual development of children. According to Upadhyay and Agarwal, (1984) Chitra et al. (1988) poor housing facilities and poor learning environment lead to poor intellectual development also. In the present study also it was found that the housing condition was a major factor contributing to learning environment.

The distance covered to reach the school and time taken to reach the destination are certain other factors which may indirectly influence the learning capacity of the children. According to Read (1973) hungry and tired children were in attentive and irritable in classroom. The results of the present study revealed that 90 percent of the children were not affected much by this since they were residing within a radius of 1 kilometer from school.

Results of the present study on expenditure pattern revealed that all the families spent major part (60-90 percent) of their income on food. Seventy percent of the families were able to spent below 10 percent of their income for the education of children. Ninety percent of the families spent less than 10 percent for health, clothing and entertainment. The inability of the families to provide much better facilities for children might have influenced the intellectual development of children.

From the results of the monthly expenditure pattern of food it was found that all families spent much on calorie rich foods namely cereals, roots and tubers, and the children were also mainly subsisting on adult diets. Roots and tubers and fish were the most favourite foods of the families surveyed. This finding is in tone with the earlier studies conducted by Lina and Reddy (1984). Foods such as pulses and milk were given little importance probably because of lack of purchasing power and ignorance about the nutritional value of these foods. Regarding the frequency of use of food items, cereals, fish, roots and tubers were daily used by all the families where as use of vegetables and leafy vegetables were only once or twice in a week and as pulses were used only occasionally by many of the families.

From the results of the dietary pattern it was found that there was no difference in the dietary pattern of adults

and that of children. Children were not given any special food in any of their growing stage and dietary pattern of children from age 3 to 15 was almost same since the diets were composed of only foods consumed by adult members of the family. Earlier studies by Bhat and Dahiya (1985) have indicated that majority of Indian children receive only ordinary home diets, and these diets were deficient in Vitamin A, C and iron. Findings of Devadas et al. (1971) had indicated that food consumed by an individual had direct influence on his intellectual development.

The mean number of episodes of illness was calculated from the longitudinal data collected on every child and results of morbidity status indicated that majority of children had suffered from almost all infectious diseases. It is true that malnutrition increases susceptibility to infection, while infections adversly affect nutritional status and probably this inturn affects the intellectual development. It was also reported that chronic sickness or any kind of injury affect the intellectual and social development of children (Eiser 1986). Children hospitalized for diseases had inferior mental scores (Mc Gregor 1980). From these we can conclude that in the present study also the infection had played a role in intellectual development though not directly, since the occurance of such illness might have affected the regularity in studies. Moreover

frequent attack by infection would lead to poor nutritional status and this inturn would affect the intellectual development.

An assessment of behavioural problems of the children indicated that some children were reported to be in the habit of nail biting, thumb sucking and bed wetting. Earlier studies by Kale (1983) had indicated that these behavioral problems may be due to emotional sociological and environmental stress. Singhal et al. (1988)revealed that thumb sucking was prevalent among even 12 year old children also and their behavioral problems could be resulted from either over protection or neglect, or out of loneliness, However these behavioral problems were found commonly among upper class families and these problems affect the intellectual development of a person. In the present study though the causes of these behavioural problems were not probed in to, it can be assumed that these might have influenced the intelligence of the children.

Similarly results of the assessment by class teacher indicated that some children had the habit of fighting with friends, and were in constent fear, and jealous of their classmates. Among these jealousy towards classmates was reported to be common behavioural problem prevalent from preschool level to upper primary. However, in high school

level this behaviour was found to disappear. All the other behaviour patterns were of fluctuating nature when a comparison was made among different age groups. The results of intellectual performance in class room was assessed by monitoring the different components of intelligence. From the results it was found that though the children were above average in attention span or memory, their performance in classroom were only of average level.

With regard to social behaviour in class, almost all the children had acceptable behaviour. Co-operative nature of children decreased as they advanced from preschool to upper primary level but in highschool this nature was reported to have increased. Similarly sharing nature was seen only in few children during preschool and lower primary school period.

Regarding the participation in extracurricular activities only 32.5 percent participated in such activities while 13.33 percent had artistic talents.

Nutritional status of the children selected for the study was directly measured through anthropometric studies. The results of anthropometric observation indicated that, height for age profile was more or less similar to standards except in few children in lower primary school level. Weight for age profile indicated that few children from preschool,

lower primary and highschool level had a significant difference in weight from their standards. The numerical differences in weight and height of the experimental children and standard value were too small to be of any statistical significance. Jelliffee (1966) rightly found out that a shift in weight for age is a better guide in assessing the nutritional status than absolute weight measurements. The average weights of children of different age groups were slightly less than the standard values for their age. Mean weights of male children in the age group of 96 to 120 months and females in the age group of 49 to 54 months, 60 to 84 months and 156 to 168 months were significantly less than the standard height for their age.

Recent reports had suggested that modification of a weight-height ratio viz. weight/height^2 may be a more accurate measurement for the examination of malnourished children (Rao, 70 and NiN 1974). In the present study, the ratio of weight/height^2 indicated that only 9.17 percent of the children had severe malnutrition, 23.75 percent had current moderate and 67.08 percent children were normal. Classification based on head circumference showed that only 20.83 percent of children had poor nutritional status while remaining 79.17 percent had optimum nutritional status.

With regard to haemoglobin level of the children the results indicated that majority of the children had low haemoglobin level especially in preschool age lower primary level and in high school girls. It was more common among girls than their male counterparts. Earlier studies by Popkin and Lin-ybnez (1982) revealed that low haemoglobin level decreased the scholastic achievements of the children.

Regarding the haemoglobin level and birth order of the children it was found that in preschool children and lower primary level children irrespective of their orderal positior all the children had low haemoglobin level. Among upper primary school level children 21.67 percent had low haemoglobin value and among high school level children only females, irrespective of birth order had low haemoglobin level.

Results of the clinical assessment of the children by physician also indicated that the children had anaemia ((30.83 percent), dental carries (45.83 percent) and mottled enamel (28.75 percent). Detailed history pertaining to nutritional disordes among children of different age groups indicated that the youngest children were mostly affected by protein-calorie malnutrition and as they grew old the incidence of this nutritional disorder reduced. Among older children this disorder was absent. However, anaemia was

found to be very common. From earlier studies by Sumatri and Pollit (1984), Webb and Oski (1973) had reported that anaemic children achieved less in the performance test as well as in school curriculum. So in the present study also it could be concluded that the children having anaemia performed to less in the class rooms and this might be the reasons for the average or below average performance in classrooms though they attended classes regularly.

Results of the food consumption of children indicated that children consumed cereals, roots and tubers and fish. Earlier studies by ICMR (1984), Sankhla and Goyal (1985) and Varma and Bajaj (1985) reported that diets of children from low socio-economic groups were mainly cereal based and in take of nutritious foods like milk and fruits were low. Devadas et al. (1979) had stated that consumption of fruits was low every among preschool children of highly educated mothers. Similarly Sadasivam (1980) had reported that the average quantity of milk consumption is not even half of the recommended allowance. In the present study also similar results had been obtained. The caloric consumption of preschool children was about 69 percent of the recommended allowances, but 95 percent of protein was met. Only 60 percent of recommended allowances were met in the case of iron and thiamine while vitamin A consumption was relatively

poor since only 20 percent of the recommended allowance was met from their diets for all the age groupe Vitamin A deficiency was prevelent among the children of high school level also (100 percent). A more or less correctly distributed diet with a total calorie of 79-84 percentage of recommended allowance was consumed. B carotene deficiency was another noticable feture in the diets of all children of all age groups.

So altogether the results revealed that though the diets were sufficient in calorie and protein it was much deficient in other nutrients especially vitamins and iron. This might have influenced their intellectual capacity.

From the results of correlation between anthropometric indices and intelligence scores, it was found that 32.2 percent of variation in intelligence was due to influence of nutrition. Besides nutrition all the above said factors like socio-economic status, educational compons etc. might have also influenced the intellectual development of the children.

SUMMARY

of the families and children and also the food taken by children at different age levels and during illness.

The survey further revealed that the majority of families were of nuclear type with 2 to 4 children and few were below the poverty line. Educational level of the majority of mothers was only up to lower primary. Cereals, roots and tubers were the staple food items and fish was also used frequently while the diets were supplemented occassionally with vegetables and pulses.

Diets of the children were also of similar pattern as no special attention was given in this regard. The daily diet, as a whole, on an average was found to be deficient in iron and vitamin A. About 69-84 percent of the calorie requirement and 78-95.4 percent of protein requirement were met in their diets.

The health record of the children pointed out the fact that the occurance of almost all infectious diseases were very common. Lack of hygeine, negligence or lack of timely vaccination might be the reason for the occurance of the above conditions. Behavioural problems like nail biting, bed wetting, thumb sucking etc. were also quite common among these children.

With regards to the nutritional status of children, the data collected by anthropometric studies clearly indicated

SUMMARY

In developing countries undernutrition among children is a common health problem which affects their physical and mental development. Poor mental performance is reported to be related to poor nutritional status and sociocultural factors.

A study on the influence of nutritional status on intelligence was conducted among selected school children (240) from NES block (Vattiyoorkavu) Trivandrum Rural.

Survey on socio-economic and dietary pattern of the families, assessment of nutritional status of selected children using food weighment, anthropometric, clinical and biochemical techniques and collection of information regarding their health and behavioural problems along with administration of an intelligence test to assess their intelligence.

Assessment of the children by the corresponding class teacher gave information regarding their behaviour pattern at school, and also their intellectual and social development. The data thus collected were analysed statistically.

Survey on socio-economic, food consumption and dietary pattern of the families imparted information on family size, type of family, education, income expenditure pattern, frequency of purchase and use of food items, dietary pattern

that height for age was nearly equal to prescribed standards while weight for age was slightly less. Clinical and biochemical studies revealed that all the preschool children were anaemic and among high school level group, 85 percent of the female children were anaemic.

Assessment of the children by class teacher threw light on the behavioural pattern of the children in the classroom. Assessment of social and intellectual development of children revealed that family size and type of family too influenced the intellectual development. Allmost all children were showing average performance at school.

The results of the intelligence tests revealed that none of the children were able to complete the twelve problems within the allotted time. The intelligence was measured by computing the total time taken and number of problems done.

The statistical analysis of the data regarding nutritional status and intelligence revealed that the children were normal in height and weight for age but they performed poor in intelligence test. The children had low haemoglobin level and diets were deficient in iron and vitamin A. Also they had suffered from almost all infectious diseases and this might be the reasons for their poor intellectual performance.

The above study revealed that nutritional as well as non nutritional factors influenced the intellectual development of the children.

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APPENDICES

Appendix - I

A schedule to elicit information on socioeconomic, food consumption and dietary pattern of the selected children

1. Serial Number of the house :

2. Name of the child :

3. Address :

4. Name of the school :

5. Religion Caste : Hindu, Christian, Muslim, others.

6. Size and composition of family:-

Sl. No.	Relationship with the child	Age	Sex	Education	Income	Total family income

Total income of the family from permenant job -

Land -

House rent/others -

7. Dietary habit of the family - Vegetarian/Nonvegetarian

8. Dietary habit of the child - Vegetarian/Nonvegetarian

9. House and surroundings

1. Place

2. own/rented house -

.....cont'd

3. Is the house well ventilated - Yes/No

4. Is the house has ornamental garden - Yes/No

5. Is the house has kitchen garden - Yes/No

6. Number of rooms in the house -

10. Facilities available to the child at home

	Yes	No
Does the child has own room		
Does the child have play materials		
Does the child has text books for learning		
Does the child have other books for acquiringknowledge		

11. Other education medias available at home

1. Television
2. Radio

12. Vehicles possessed by the family

Cycle

Schooter

Car

13. Does the child has own vehicle

If yes which

14. How does the child go to school - by walk/by bus/by own vehicle/escorted by mother/sister/elders

15. How much time does the child take to reach the school.

....cont'd

Frequency of use of different food materials

Foods groups	Frequency of use of food stuffs				
	Daily	Weekly thrice	weekly twice	once in a week	occas-ionally	Not at all
1. Cereals						
2. Pulses						
3. Roots and tubers						
4. Other vegetables						
5. Green leafy vegetables						
6. Fruit						
7. Milk and milk products						
8. Meat						
9. Fish						
10. Egg						
11. Fat and oil						
12. Sugar and jaggery						
13. Readymade processed foods like jam squash, pickles etc.						
14. Bakery items						

....contd

Menu pattern of the children by three day recall method.

Menu	Preparations			Ingredients		
	Ist day	IInd day	IIIrd day	Ist day	IInd day	IIIrd day
Break fast						
Lunch						
Tea						
Dinner						
Others						

Menu pattern of the children of different age level and during illness.

Age	Breakfast	Lunch	Tea	Dinner	Others
3-6 years					
6-9 years					
9-12 years					
12-15 years					
During illness					

Appendix II

NATIONAL NUTRITION MONITORING BUREAU

(Indian Council of Medical Research)

FAMILY DIET SURVEY - ONE DAY WEIGHMENT

Family No. Name of the head of the family . . . . .Date

Village District State

Age and sex composition of those who have partaken the meal

Age	Adult	12-21	9-12	7-9	5-7	3-5	1-3	Below 1	Guests (Ages)
M									
F									

WEIGHT OF RAW FOODS IN GRAMS

FOOD STUFF	FOOD STUFF
CEREALS	PULSES
1. Bajra	8. Bengalgram
2. Jowar	9. Blackgram
3. Maize, dry	10. Green gram
4. Ragi	11. Khesari dal
5. Rice 3mly) 4mly) 3mly)	12. Lentil
6. Wheat flour	13. Redgram
7. Others	14. Soyabean
	15. Others

....contd

FOOD STUFF	FOOD STUFF
LEAFY VEGETABLES	
16. Drunstuk leaves	33. Banana, Ripe
17. Chekkurmanis	34. Lime & Orange
18. Amaranthus	35. Mango, Ripe
OTHER VEGETABLES	36. Melon, Water
19.	37. Papaya, Ripe
ROOTS & TUBERS	38. Tomato, Ripe
20. Carrot	39. Others
21. Onion, big	Plantain
22. Potato	FISH
23. Tapioca	40. Fish, Fresh
24. Others	41. Fish, Dry 500 kg
NUTS & OIL SEEDS	OTHER FRESH FOODS
25. Cashewnut	42. Meat
26. Coconut, dry	43. Chicken
27. Coconut fresh	44. Liver, Goat
28. Groundnut	45. Egg, Hen
29. Others	MILK & MILK PRODUCTS
30. CONDIMENTS & SPICES	46. Milk
FRUITS	47. Curds
31. Amla	48. Butter Milk
32. Apple	49. Skimmed milk, Liquid
	50. Cheese

....cont'd

FOOD STUFF		FOOD STUFF	
FATS & OILS		OTHER FOOD STUFFS	
51. Butter		55. Biscutt, Salt	
52. Ghee		56. Biscut, Sweet	50
53. Hydrogenated oil		57. Bread, White	
54. Cooking oil	50	58. Sugar	50
		59. Jaggery	
		60. Papad	
		61. Sago	
		62. Others.	

Dietary Information

Meal pattern	Type of preparation	Ingradients used	Raw amount (g/ml)	Total looked amo (g/ml)
Early morning				
Breakfast				
Mid morning				
Lunch				
Evening tea & Snacks.				

Appendix - III

Methods used for anthropometry:

The height of the children were measured using a stadiometer. The children were made to stand on a flat floor by the scale with feet parallel and with heels, buttocks, shoulders and back of the head touching the upright. The head was held comfortably erect with the lower border of the orbit in the same horizontal plane as the external auditory meatus. The arms were hanging at the sides in a natural manner. A wooden block was used as head piece which was gently lowered crushing the hair and making contact with the top of the head. The measurments were done to 0.5 cm accuracy.

Children were weighed wearing very light clothing. The weight was measured using a beam balance. Beam balance scales were used for measuring weight as they are less likely to be inaccurate if carefully looked after. The child was made to stand on the centre of the platform without touching anything else care was taken to use the balance firm nontilled surface and it was checked before use. The measurments are done to an accuracy of 0.1kg.

Head circumference was measured with a narrow flexible non stretch tape made of fiber glass. Head

....CON

circumference is related mainly to brain size and to a small extent to the thickness of scalp tissue and skull. It is a standard procedure in paediatric practices to detect pathological conditions. For taking measurements, the child's head was studied and the greatest circumference was measured by placing the tape firmly round the frantal bones fust superior to the supra orbital ridges, passing it round to the head at the same level on each side and laying it over maximum occipital prominence at the back. Measurements should be made to the nearest 0.1cm.

The flexible non stretch fibre glass tape was used to measure the chest at nipple line. The average of the inspired and expired chest measurement to the nearest 0.1cm was taken.

Mid arm circumference was measured to the nearest 0.1cm with a fibre glass tape by pacing gently but firmly round the limb to avoid compression of the soft tirsues. The left arm was measured while hanging, at its mid point.

Appendix IV

NATIONAL INSTITUTE OF NUTRITION

Nutritional Assessment Schedule Date:

State : District: Taluk: Village:

Serial No: Family No: Block:

Name of the subject : Sex : Male/Female

Name of the guardian/parent Occupation

Income (per annum)

Date of birth of the subject : Age.....Years.....Months..

ANTHROPOMETRY

Height (cm) Head circumference (cms)

Weight (kg) Chest circumference (cms)

Mid arm circumference (cms)

CLINICAL Examination

01*	Hair sparse	22	Pellagra
02*	Discoloured	23	Crazy pavement dermatosis
03*	Easily plucked	24	Pigmentation at Knuckles/Fingers/toes
04*	Moon face		
05	Parotid enlargement	25	Phrynoderma
06	Oedema	26	Koilonychia
07	Emaciation	27	Gums spongy bleeding
08	Marasmus	28	Craniotabes
09	Conjunctival xerosis	29	Epiphyseal enlargement
10	Bitot's spots	30	Beading of ribs

....cont'd

11	Corneal xerosis/ Keratomalacia	32	Frontal parie[illegible]
12	Corneal opacity	33	Teeth carries
13	Night Blindness	34	Teeth Mottled enamel.
14	Photophobia	5	Enlargment of spleen
15	Anaemic	5	Enlargment of liver
16	Nasolabial dysebacea		Soft :
17	Angular stomatitis		Firm :
18	Chelosis		Hard :
19	Red & raw tongue	37	Thyroid enlargment
20	Tonge papillae atrophic	38	Others
21	Papillae hyper trophic		

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* For children below 5 years only

Appendix V

Haemoglobin - cyanmethaemoglobin method

Principle

Hamoglobin is converted into cyanmethaemoglobin by the addition of potassium cyanide and ferri cyanide. The colour of cyanmethaemoglobin is read in a photoelectric calorimeter at 540 n.m. against a standard solution. Since cyanide has the maximum affinity for haemoglobin, this method estimates the total haemoglobin.

Reagent

Drabkin's solution: Dissolve 0.05g of potassium cyanide, 0.2g of potassium ferri cyanide and 1g of sodium bicarbonate in 1 litre distilled water.

Procedure

20ml of blood are measured accurately from a heamoglobin pipette and delivered on to a whatman No.1 filter paper disc. The filter paper is air dried labelled and can be stored upto one week. The portion of filter paper containing the blood is cut and dipped in 5ml Drabkins solution taken in a test tube. Wait for 30 minutes and mix the contents on a vortex misture and take the readings

....cont'd

Construction of standard curve

If the blood drawn from the subject contain haemoglobin 15g/dl. after estimation then prepare three reference standards as follows.

1. Reference standard A

4ml blood in 1000ml Drabkins reagent contain haemoglobin 15g/dl.

2. Reference standard B.

300ml of reference standard A + 200ml of Drabkins reagent contain haemoglobin concentration of 10g/dl.

3. Reference standard C.

200ml of reference standard A and 300ml Drabkins reagent contain a haemoglobin concentration of 7.5g/dl.

Thus we have three reference standards at three levels of haemoglobin concentrations. Use 5ml from each standard whenever haemoglobin estimations are done.

Appendix VI

Information on health and behaviour problems of childrer

Diseases	Yes	No
Measles		
Mumps		
Diarrhoea		
Dysentry		
Jaundice		
Chickenpox		

Behavioural problems of the children

Behavioural problems	Yes	No
1. Nail biting		
2. Bed wetting		
3. Thumb sucking		
4. Day dreaming		
5. Sibling rivalry		
6. Depression		
7. Rebellous towards el		
8. Speech difficulty		
9. Lethargic		
10. irregularity in studies		
11. Playfulness and lack of renounce		
12. Querrelsome		
13. Saying lies		
14. Kleptomania		

Appendix VII

Assessment by teacher

1. Name of the child -

2. Name of the school -

3. Date of birth -

4. Class -

5. Division -

6. Behaviour of the child in class

	Yes/No
Fighting with friends	
Rebellous towards teacher	
constant fear	
Jealousy towards classmates	
Revengeful towards classmates	
Friendly towards classmates.	

7. Intellectual development

	Below average	Average	Above average
a. Reasoning capacity			
b. Attention span			
c. Memory			
d. Imagination and creativity			
e. Performance at school			

....cont

8. Social development Yes/No

a. Talkative

b. Calm and quiet

c. Co-operative

d. Is the child popular in school -

e. Is the character and conduct of the child is good

f. Is the child willing to share his belongings with others

g. Is the child has friends

h. Type of play liked by the child

group play-
solitary play.

9. Participation in Extracurricular activities

Is the child has artistic talents Yes/No

Is the child participate in extra curricular activities Yes/No

Appendix VIII

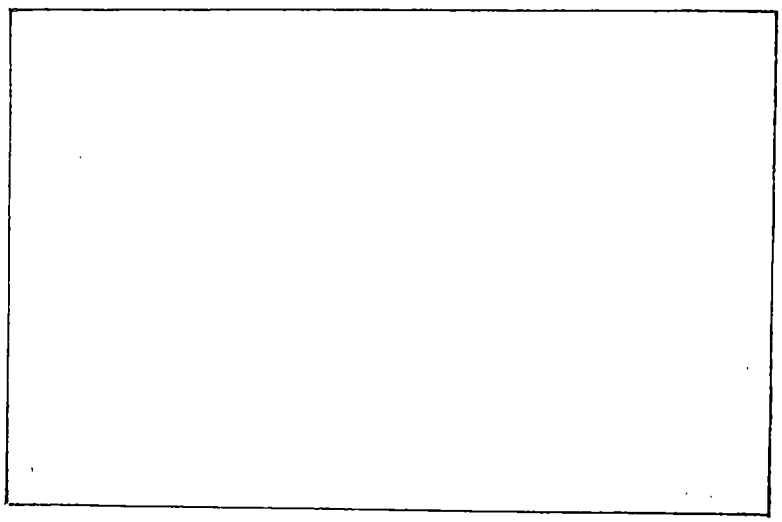
"Mathew test of Mental Abilities" is a test developed by Dr. Mathew, V.G. of Kerala University is meant for testing intelligence of children of all age groups. This consists of 12 problems which are cut-out in card-board and maximum time allotted for a problem is 3 minutes. The individual is allowed to solve the problems one by one while two consecutive failures occur. This is considered the limit of the individual

The method of computation is given below.

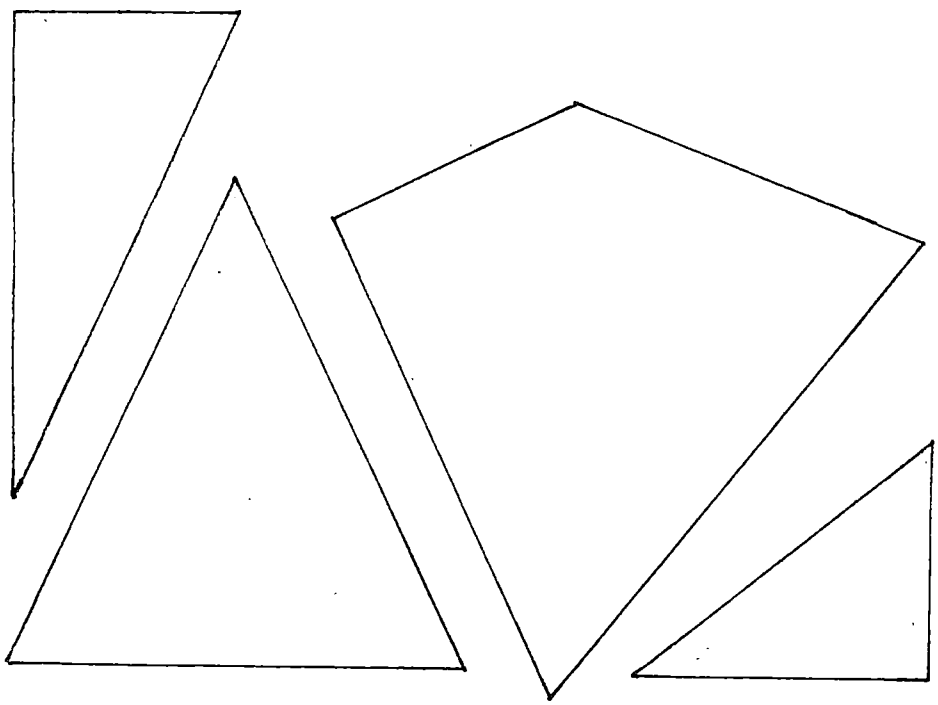
Serial No. of the children	Time taken in seconds for completing the problems												Total No. of problems done.
	1	2	3	4	5	6	7	8	9	10	11	12	
1													
2													
3													

....cont'd

Base



Segments



INFLUENCE OF NUTRITIONAL STATUS ON INTELLIGENCE OF CHILDREN IN NES BLOCK TRIVANDRUM

BY

SANDYA V. KAMATH

ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE DEGREE
MASTER OF SCIENCE
IN FOOD SCIENCE AND NUTRITION
FACULTY OF AGRICULTURE
KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF HOME SCIENCE
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ABSTRACT

A study was conducted to find the influence of nutritional status on the intelligence of children of various age groups (3 years to 15 years) from different schools that come under NES block, Trivandrum Rural.

A survey was conducted to assess socio-economic status and dietary pattern of the families. The nutritional status of the children was assessed by anthropometric, clinical and biochemical techniques. Information regarding health and behavioural problems at home were also collected.

An assessment of the children by the respective class teacher was also included to throw light on the child's intellectual, social and behavioural pattern at school.

An intelligence test (Mathew test of Mental Abilites) was administered to assess the intelligence of the selected children and the results were analysed statistically.

The results of the study indicated that no special attention was given in the diets of the children and the diet on an average was found deficient in iron and Vitamin A. Almost all infectious diseases and behavioural problems like nail biting, bed wetting, thumb sucking were very common among these children. An analysis of anthropometric data

revealed that height in proportion to age was nearly equal to standards prescribed while weight for age was slightly less. Clinical and biochemical studies revealed that all the preschool children and 85 percent of female children of high school level were anaemic.

The results of the above study has proved that the intelligence of children was influenced by nutritional as well as non-nutritional factors. Major non-nutritional factors identified were educational level of parents, family size and type and socio-economic status of the family.