THE RELATIONSHIP OF SELECTED ENVIRONMENTAL FACTORS TO WEIGHT AND HEIGHT OF INDIAN PRESCHOOL CHILDREN

by

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CHAPTER I

INTRODUCTION

The physical growth of the child goes through an important phase during the first six years of life. During these years the foundation for further optimal growth is laid. One of the ways in which the physical growth of the child can be measured is through weight and height measurements. It should be recognized that weight and height are not the only indices of physical growth; nevertheless, these measurements give an indication of the direction in which a child's growth is progressing. These measurements also form a basis for the further examination of the physical status of the child.

Growth in weight and height is affected by both environmental and genetic factors. An individual's inherited genetic pattern responds in a given way to a given environment and needs a proper healthy environment to attain the maximum potential development.

Some environmental factors which may have direct or indirect influence on growth in weight and height are diet, state of health, geographic location, season, temperature, sunshine, rest and exercise, socioeconomic status, and the emotional atmosphere of the home. Weight is more readily affected by environmental conditions such as diet and the state of health, although the effect of a prolonged adverse or optimal environment is evident in both weight and height. This fact has been supported by studies conducted on effects of environmental factors on weight and height.

There has been a wide variety of research done on the effects of certain physical factors on weight and height of children in the United States. The findings indicate that certain factors such as nutrition, socioeconomic status, and geographic location may have more pronounced effect on weight and height than others. Among other factors, culture and nationality differences play an important role in influencing the rate and the nature of physical growth. This fact implies that the findings of one country may not be applicable to another.

In India very little research has been done in the area of child development. Often the sources of information about children are based on studies done in other countries or on generalizations from the individual's own experiences. Basu has pointed out the need for research about children:

> Although it has been many times said that research is the cornerstone of an efficient programme of services for children, little time, effort and resources have been devoted for this purpose, generally. As a result today adequate information regarding the prevalent trends, practices and methods and the needs, problems, assets and attitudes, in relation to the child is not available.[1]

Recently there has been widespread interest in nutritional studies in relation to improvement of the diets of expectant mothers, infants and school children, and the effect of nutrition on the health and the growth of these groups. Nevertheless, in India in the area of physical growth, much research needs to be done.

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[1]S. Basu, "Child Welfare Services in India Today and Plans for Future," The Preschool Child, University Symposia Series: No 10. (Baroda: The Maharaja Sayajirao University of Baroda, 1960), p. 21.

The present study was designed to study the relationship of selected environmental factors to the weight and height of Indian preschool children. The environmental factors chosen for this investigation were diet pattern, sleep, and parental income.

In India the practice of using certain foods in the diet varies according to the religious beliefs of the people. Most people belonging to the Hindu religion do not include eggs, meat, and fish in their diet; other Hindus eat eggs but not the meat and fish. Preschool children belonging to these two Hindu groups and to a third group, composed of people of varied religious background which allowed eggs, meat, and fish in the diet, were studied to investigate the effect of different diet patterns on weight and height.

Various authors in the United States have emphasized the importance of sleep for the growth of children. Olson states, "Sleep is important for conservation of energy needed for the growth and repair of tissues."[2] Since information concerning the importance or the relation of sleep to the growth of preschool children in India is lacking, it was decided that a study of the relationship of the amount of sleep taken by Indian preschool children to their weight and height should be studied.

Studies conducted in the United States indicate that family income has an effect on weight and height of children. The low per capita income in India may have an effect on the diet of the people, which could, in turn, influence the weight and height of children.

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[2]W. Olson, Child Development, (Boston: D. C. Heath and Company, 1949), p. 65.

This factor has been pointed out in the Indian Reference Annual of 1960, "The general raising of dietary standards is largely an economic problem and is linked up with the development of Indian economy."[3]

It was hoped that the present study, conducted on a sample of Indian preschool children, will contribute to the understanding of certain aspects of physical growth of preschool children and the extent to which these are related to the environmental factors selected for the study. It is hoped that this information can be used to the advantage of children. It may raise some questions which will open the way for more interest and research in this area.

Statement of the Problem

The purpose of this study was to investigate: (1) possible significant differences between weight and height of the three groups of children using the varying diet patterns; (2) the relationships between the amount of sleep and the weight and height of the subjects; and (3) the relationship between the parental income and the weight and height of the subjects.

DEFINITIONS OF TERMS USED

Certain words used in this study may require the following definitions.

Preschool children refers to children from 2.5 to 5.9 years of age.

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[3]The Research and Reference Division Ministry of Information and Broadcasting, India: A Reference Annual, 1960, (Delhi: The Publication Division, Ministry of Information and Broadcasting, Government of India, 1960), p. 142.

Height age refers to normal height achieved by children at the sequence of chronological ages.

Height quotient is the height ratio obtained by dividing height age by chronological age of a specific child.

Weight age refers to normal weight achieved by children at the sequence of chronological ages.

Weight quotient is the weight ratio obtained by dividing weight age by the chronological age of a specific child.

Hours of sleep includes the average number of hours per day a child slept during the experimental week.

Parental income refers to the monthly income earned by one or both of the parents of the child.

Diet pattern refers to the frequency with which certain foods were eaten by the child during the experimental period.

CHAPTER II

REVIEW OF LITERATURE

Literature in the field of the physical growth of children points to the fact that a great deal of research has been done in this area since the last century. As Thompson reports, "Shortly before 1760 there were scientific studies of the weight and physical proportions of the newborn, but it was not until 1779 that the first seriatim study of physical growth was published."[4] As more studies were conducted, the revelation of various facts regarding physical growth of children helped to bring about changes in the viewpoints and the techniques of researchers. Bayley points out the current trend of research in physical growth:

> Studies in physical growth are concerned, in the first place, with determining the averages, and normal deviations from average, of various measurements of size and body proportions in children at specified ages. Second, they are concerned with learning the relative influence of the various factors... ....which operate in determining the course of growth. And third, they are concerned with the evaluation and prediction of the trends of growth in individual children.[5]

Literature on weight and height of preschool children. Weight and height measurements have been considered as criteria for determining the physical growth of children. Forest has pointed out that it

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[4]H. Thompson, "Physical Growth," Manual of Child Psychology, L. Carmichael, editor (New York: John Wiley and Sons, Inc., 1954), p. 294.

[5]N. Bayley, "Child Development-V, Physical Growth," Encyclopedia of Educational Research, W. Monroe, editor, (New York: The Macmillan Company, 1950), p. 153.

has been generally agreed that weight and height were always accepted as the important measures of growth and nutritional status of the child. As scientific interest in the development of the "whole child" increased, careful studies on weight and height of children were conducted.[6]

Some of the well-known longitudinal and cross sectional studies, such as the Harvard Growth Studies,[7] The University of Iowa Studies by Baldwin,[8] and the Brush Foundation Study of Child Growth and Development,[9] have helped to establish norms and growth rates.

Woodbury[10] did an extensive study on the statures and weights of children under six years. Taking a random sample of children throughout the United States, he obtained 17,200 records of heights and weights. His findings showed that: (1) boys under six years were on the average one-third to one-half an inch taller and weighed about one pound more than girls of the same ages, and (2) the average growth

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[6]I. Forest, Child Development (New York: McGraw-Hill Book Company, 1954), p. 89.

[7]W. Dearborn, J. Rothney, and F. Shuttleworth, "Data on Growth of Public School Children," Monographs of the Society for Research in Child Development, Vol. 3, (Washington: National Research Council, 1938), 136 pp.

[8]B. Baldwin, "The Physical Growth of Children from Birth to Maturity," University of Iowa Studies in Child Welfare, Vol. 1 (Iowa City: University of Iowa, 1921), 411 pp.

[9]K. Simmons, "The Brush Foundation Study of Child Growth and Development: II, Physical Growth and Development," Monographs of the Society for Research in Child Development, Vol. 9, (Washington: National Research Council, 1944), 87 pp.

[10]R. Woodbury, "Statures and Weights of Children Under Six Years of Age," Community Child-Welfare Series No. 3, Children's Bureau Publication No. 87, (Washington: Government Printing Office, 1921), pp. 9-114.

rate for both sexes decreased in comparison to the yearly growth rate during the first two years of life. This extensive sampling has shed some light on sex differences and on physical growth patterns.

Literature on the diet of children. The literature revealed that a great deal of research has been done on dietary intake of children of all ages. Some researchers conducted studies on the adequacy of the diet of children consumed at home and at school, and on their food habits at various age levels. Others have compared the physical growth of different racial groups and nationalities in relation to their nutrient intake. One of the objects of some of these studies was to improve the diet by the addition of supplementary foods and thus provide for the healthy growth of the child.

Winters[11] compared the adequacy of the diet of a sample of Mexican, Negro, and American children of preschool age by studying the weekly records of each child's intake. He found that there was no difference in the average protein intake of the three nationalities, but in every case the younger children received a larger amount of protein per body unit than the older ones. The mineral and caloric content in the American diet was found to be higher than in either the Mexican or the Negro diet. The difference in calcium content of the diets of these three groups was explained on the basis of difference in milk consumption. American children drank more milk than the other two groups. An interesting factor revealed by this study was that a large

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[11] J. Winters, "Comparative Studies of American Children of Nursery School Age," American Journal of Public Health, 21: 1003-1012, September, 1931.

number of children were maintaining normal weight on diets which contained less than the given standards of one or more nutrients. Winters, using the Merrill-Palmer figures as a basis for comparison studied the normal height for age in the three groups and found that 17 per cent of the American, 27 per cent of the Negro, and 86 per cent of the Mexican children were below this range. The researcher concluded that factors other than diet were important in determining height and that mineral deficiencies were responsible for the above differences to some extent.

A study by Epright, et al.,[12] showed the effect of adequate diet on weight and height. The subjects were divided according to the adequacy of nutrient content in their diets. The diet of the first group contained all the nutrients in adequate amounts in accordance with standards established for dietary allowances. The diet of the second group had one nutrient which was less than 67 per cent of the recommended dietary allowances. Results of the study showed that the children in the first group were, on the average, heavier and taller than those of the second group. The boys and girls of the first group were found to be at the 140 and 130 developmental level of Wetzel grid; the children in the second group at the same level were older in age, thus showing the relationship between diet and growth patterns.

In some studies the effect of adequate nutrient intake in

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[12]Epright, et. al., "Relationship of Estimated Nutrient Intake of Iowa School Children to Physical and Biochemical Measurements," Journal of Nutrition, 54: 557-570, December, 1954.

children's diet was not evident in weight and height measurements. Frazier[13] studied a large group of children between the ages of six to sixteen years for six months of the school year 1934-35 to find the effect of school lunches on their physical growth. Growth records were used to study the deviation from average weight for height and age at the beginning, and at the end of the study. The total mean gain of children eating adequate school lunches was 2.86 pounds. The total mean gain of the control group not receiving adequate noon lunches was 2.57 pounds. The difference of 0.29 pounds was not significant. Forty-nine per cent and 42 per cent of the children in the experimental group and control group, respectively, made expected gains in weight and height according to Baldwin-Wood standards.

Two research teams, Fletcher and Schuck and Moyer and Macy,[14] also found that improved diet had no significant effect on the weight and height of school children. Factors other than nutrition may have affected the physical growth of children in these studies. It was also possible that the general health of the children was affected by the

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[13]E. Frazier, "The Effect of Adequate School Lunches Upon the Physical Growth of Mississippi School Children," Journal of Home Economics 30: 258-261, April, 1938.

[14]M. Fletcher and C. Schuck, "Dietary Practices and Nutritional Status of Two Groups of Virginia School Children," Journal of Home Economics, 42: 732-734, November, 1950; E. Moyer and I. Macy, "Nutritional Reconditioning of Children," American Journal of Public Health, 39: 205-213, February, 1949.

improved diet without its effect being shown in increments of weight and height.

The effect of an inadequate diet on the physical growth of children was evident in the studies conducted during the depression and the war. Laporte[15] did a study on the effects of war-imposed dietary limitations on the growth of Paris children. He found that the average weight and height of boys and girls were less in 1944 than they were in 1938.

The above findings were supported by a study reported by Dreizen, et al.[16] who studied two groups of white children in Alabama, ranging in age from two years and eleven months to fifteen years and eleven months, for a period of ten years. By comparing one group for which there was clinical evidence of nutritive failure with the children of another group without the nutritive failure, Dreizen, et al. found that in the group with nutritive failure the lag in weight and height was evident by the third year. After that the weight lag increased continuously in both boys and girls with nutritive failure. The mean height difference throughout the age range was 2.42 inches for boys and 1.77 inches for girls. The mean weight difference at each age interval was 12.74 pounds for boys and 11.34 pounds for girls.

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[15] M. Laporte, "Effects of War-Imposed Dietary Limitations on the Growth of Paris School Children," American Journal of Diseases of Children, 71: 244-247, March, 1946.

[16] S. Dreizen, et al., "The Effect of Nutritive Failure on the Growth Patterns of White Children in Alabama," Child Development, 24: 189-202, September, 1953.

Studies which have dealt specifically with the addition of supplementary foods to already adequate or inadequate diets have shown a marked effect of the supplements on the weight and height of children. In one study, the growth of boys ranging in age from seven to eleven years was observed by Corry Mann[17] from 1921 to 1925. One group received a basic diet; another group received, in addition to basic diet, a pint of fresh cow's milk. The first group gained an average of 3.85 pounds and 1.84 inches per boy per year. The second group gained an average of 6.98 pounds and 2.63 inches per boy during the twelve months. The gain in weight and height was maintained by both of the groups throughout the period of study, and the difference in weight and height of the groups was found to be significant.

A favorable effect of supplementary foods was found also by Roberts, Blair, and Greider[18] in a study of boarding school children, most of the subjects being girls ranging in age from two to fourteen years. Since the nutritive content of their diets was below the recommended dietary allowances, they were provided milk and other dairy products, eggs, whole grain cereals, and pineapple juice as supplements. Comparisons were made on the rate of gain, before, during, and after the supplementation for one year. The researchers found that the percentage of children under average weight for height decreased and there

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[17] H. Corry Mann, Diets for Boys During the School Age, Medical Research Council (London: His Majesty's Stationary Office, 1926), 81 pp.

[18] J. Roberts, R. Blair and M. Greider, "Results of Providing a Liberally Adequate Diet to Children in an Institution: II, Growth in Height and Weight," Journal of Pediatrics, 27: 410-417, November, 1945.

was a definite shift of the group towards a more favorable weight-height status.

The importance of supplementing milk to a diet was indicated in a study by Roberts, et al.[19] in which the growth of three groups of institutionalized children was followed for one year. One group remained on the institutional diet as the control, a second group received a pint of evaporated milk daily, and a third group received an equal amount of irradiated milk. The growth of both groups receiving the supplement exceeded that of the control group. The researchers concluded that these differences in growth were probably due to the dietary supplements.

Experiment on rats by Rose and McCollum[20] pointed to the part played by protein in physical growth. In one study, three suitable diets for young children differing from each other in the proportion of cereal and vegetable content promoted good growth in four generations of rats. Later, eggs, equivalent to an egg a day in a child's diet, were added to one diet. The egg diet resulted in a greater weight gain of young rats of one month of age, (which corresponded to a child's age of two and one-half years). These weight gains exceeded the weight gains of the rats on the other diets.

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[19] L. Roberts, et al., "Effect of Milk Supplement on the Physical Status of Institutional Children," American Journal of Diseases of Children, 56: 287-300, August, 1938.

[20] M. Rose and E. McCollum, "Studies in Nutrition: II, The Effect of Adding Egg to a Diet Already Adequate," Journal of Biological Chemistry, 78: 549-555, July, 1928.

The results of a study done on children by Rose and Borgeson[21] did not show such a marked effect of the addition of an egg to a low-priced but adequate diet, as found in Rose and McCollum's study on rats.[22] Children of one and one-half to five years of age were used in this study. The children were divided into two groups and an egg a day was added to the diet of one group. The results showed the effect of improvement of the diet on children in both groups but no significant difference was found between the egg group and the non-egg group. Rose and Borgeson concluded:

> In short, so far as growth in height and weight is concerned, the influence of a diet well supplied with milk and vegetables was so favorable to good growth that children living under like conditions and regularly fed such a diet were not stimulated by the egg to further gain in either height or weight.[23]

Wang, Hawks, and Kaucher,[24] in a study of undernourished children of four to twelve years of age, found that, although the caloric content of two diets was the same, children on a high protein diet gained more weight than those on a low protein diet.

While discussing the role of animal and vegetable protein in diet, Maynard stated that studies on farm animals have shown that poor growth previously ascribed to the poor protein quality of plant sources, was due, at least in part, to the absence of the "animal protein" factor.

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[21] M. Rose and G. Borgeson, Child Nutrition on a Low-Priced Diet, Child Development Monographs, No. 17, (New York: Teacher's College, Columbia University, 1935), 109 pp.

[22] Rose and McCollum, loc. cit.

[23] Rose and Borgeson, op. cit., p. 46.

[24] C. Wang, J. Hawks, and M. Kaucher, "Metabolism of Undernourished Children: VII, Effect of High and Low Protein Diets on the Nitrogen and Caloric Balance of Undernourished Children," American Journal of Diseases of Children, 36: 1161-1172, December, 1928.

He further pointed out the need for controlled studies with human subjects to find out the specific deficiencies of a vegetable diet and the way in which they can be corrected in terms of available food.[25]

Scrimshaw and Guzman[26] emphasized the need for more studies concerning the effect of animal and vegetable protein diets on physical growth so that animal or vegetable protein diets could be recommended to underdeveloped areas. They compared the effects of supplementary animal and vegetable protein on health and physical growth of children consuming a diet low in animal protein. For the purpose of the study, children from the schools in both rural and urban areas were selected. A group of children from an urban area was given lunch containing milk and other sources of animal protein; the children studied as a control group received no supplement. Children from one rural area received lunch containing animal protein and another group was given soya milk in addition to lunch. Children from a second rural area received Vitamin B_{12} in addition to the vegetable protein lunch; the children in the control group did not receive any supplements. The results showed that for the children in the urban group no effect of the lunch on the rate of gain in weight and height could be detected during the three year period. The rural children receiving animal protein diets did not

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[25] L. Maynard, "Some World Nutrition Problems," Journal of American Dietetics Association, 28: 111, February, 1952.

[26] N. Scrimshaw and M. Guzman, "The Effect of Dietary Supplementation and the Administration of Vitamin B12 and Aureomycin on the Growth of School Children," Current Research on Vitamins in Trophology, (New York: The National Research Foundation, Inc., 1953), pp. 101-117.

show measurable improvement in the rate of gain in weight and height. In the second rural group, addition of Vitamin B_{12} appeared to produce a small effect on gain in height during the experimental period. On the basis of this and other studies conducted by Scrimshaw and Guzman, they concluded:

> If the positive effect of these agents is confirmed by further studies under similar conditions, serious consideration must be given to providing the minimum quantity of animal protein necessary for satisfactory growth in underdeveloped areas or possibly the enrichment of vegetable diets by Vitamin B_{12} in some other manner.[27]

Literature on the effect of economic conditions on growth.

Research pertaining to the influence of economic conditions on weight and height of children points out the effects of low family income and poor economic conditions imposed by economic depression and war on the physical growth of young children.

A study conducted in India pointed out the adverse effect of living conditions on the health and growth of children. Taneja and Ghai[28] studied seventy children of one to twelve years of age from families with low income. The researchers found that forty-one children had poor caloric intake and that forty did not get milk or other animal protein in their diet. The children were retarded in growth as found by radiological examination and had a higher incidence of anemia.

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[27] Ibid., p. 115.

[28] P. Taneja and O. Ghai, "Influence of Environmental Factors on Growth," The Indian Journal of Child Health, 4: 249-260, June, 1959.

The effects of economic conditions on Puerto Rican children were studied by Mitchell.[29] He studied children from both urban and rural areas. There was a correlation coefficient .51 between the height of children and the monthly rent paid by their respective families. Children from the houses where higher rent was paid showed a tendency to be taller. The urban children, who lived with fewer persons per room in the house and who were in an advanced grade for their age, showed a tendency to be taller. The rural children with privileged socioeconomic status did not show as consistent a tendency to be larger in weight and height as did the urban children.

In a comparison of Hebrew children from charity institutions with those from private schools, Boas[30] found that children from private schools were considerably taller and heavier than institutionalized children. Herskovits[31] also found in a study of Negro children, that orphanage children were smaller in height and weighed less than those from public schools.

Children of the same race living in different countries also exhibit a difference in their growth patterns. Gruelich[32] found this to

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[29] H. Mitchell, "A Study of Factors Associated with the Growth of Puerto Rican Children," Human Biology, 4: 469-508, June, 1932.

[30] F. Boas, "The Growth of Children as Influenced by Environmental and Hereditary Conditions," School and Society, 17: 305-308, March, 1923.

[31] H. Herskovits, "The Influence of Environment on a Racial Growth Curve," School and Society, 22: 86-88, July, 1925.

[32] W. Gruelich, "Growth of Children of the Same Race Under Different Environmental Conditions," Science, 127: 515-516, March, 1958.

be true in a study of American-born Japanese children as compared with those living in Japan. The American-born Japanese children were found to be significantly taller, heavier, and more advanced in skeletal development than the comparable children in Japan.

Palmer[33] did extensive research on the effect of economic depression on the growth of children from different economic classes. In one study conducted in 1933-34, the researcher found that children whose families received aid from the city welfare society weighed less and made lower gains in weight during the year of study than the children in the population as a whole.

In another part of this same investigation, 5,000 working class urban families were studied during 1929-33. The families were classified into three groups: (1) families that remained in a comfortable economic condition during the entire period, (2) families that remained poor, and (3) families that were economically comfortable in 1929 but who became poor by 1933. Results show that children from families that had become poor, failed by 2 per cent to gain the weight of children in the group as a whole. It was concluded that the weight of these children had been affected by economic depression.[34]

A comparative study of the school children from economically underprivileged and privileged areas, supported the assumption that economic

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[33] C. Palmer, "Further Studies on Growth and Economic Depression," Public Health Reports, 49: 1453-1469, December, 1934.

[34] C. Palmer, "Height and Weight of Children of Depression Poor," Public Health Reports, 50: 1106-1113, August, 1935.

condition of the family could be a contributing factor to growth in weight and height. Hundley,[35] et. al., selected schools from economically favored and underprivileged areas. Height and weight records were collected for the years 1925-27, 1932-34, and 1947-49. Children in both groups for the years 1947-49 were taller by 0.91 to 1.59 inches and heavier by 2.59 to 3.53 pounds than were children in the years 1925-27. The economically favored children were consistently taller and heavier than the other group. The effect of depression was most evident on the economically favored group, as decreases in weight and height gains were noted during those years.

The effect of family income on weight and height of children was indicated in a study by Wise and Meredith.[36] The weight and height of a group of Alabama preschool girls whose families had an average income of fifty-six dollars per month were compared with two groups of Iowa children from families with higher incomes. The researchers found that, at three years of age, the difference between the mean height of the two groups was statistically significant. At the mean age of five years, the differences between both the mean weights and the mean heights of both groups were found to be significant.

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[35] J. Hundley, et. al., "Height and Weight of First-Grade Children as a Potential Index of Nutritional Status," American Journal of Public Health, 45: 1454-1461, November, 1955.

[36] F. Wise and H. Meredith, "The Physical Growth of Alabama White Girls Attending W P A Preschools," Child Development, 13: 165-174, September, 1942.

Literature on sleep of preschool children. The importance of sleep has been emphasized for many years. In 1925, Fleming, reporting her study on sleep, commented on the lack of research in this area:

> It was discovered that no systematic study was made of the hours of sleep of preschool children. . . . Pediatricians and child care specialists frequently give schedules of sleep for young children, but a study of these reveals gross disagreements and little evidence upon which to base accurate conclusions.[37]

Fleming[38] studied the hours that a preschool child slept during the twenty-four hour period. It was found that hours spent in sleep decreased gradually between the ages of eighteen months and seventy-two months. Length of sleep during the day time also showed a decrease analogous to the length of sleep at night. In a later study by Foster, Goodenough, and Anderson,[39] a trend of decrease in the proportion of sleeping hours during day time was found in preschool children with increasing chronological age; but the total amount of sleep remained constant from two to seven years.

Reynolds and Mallay[40] conducted a careful study of children who lived in the nursery school with their parents for six weeks. The teachers recorded the exact time a child went to sleep and when he woke up. The age range of children was from seventeen to sixty-two months.

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[37] B. Fleming. "A Study of Sleep of the Young Children," Journal of the American Association of University Women, 19:25, October, 1925.

[38] Ibid., pp. 25-27.

[39] J. Foster, F. Goodenough, and J. Anderson, "The Sleep of Young Children," Pedagogical Seminary and Journal of Genetic Psychology, 35: 201-218, June, 1928.

[40] M. Reynolds and H. Mallay, "The Sleep of Young Children," Pedagogical Seminary and Journal of Genetic Psychology, 45: 322-351, December, 1933.

The researchers found that the younger children slept for a longer period of time than the older ones. There was a high negative correlation coefficient (-.83) between chronological age and sleep, which indicated that the amount of sleep tended to decrease as the child grew older. A correlation of .055 was found between the total amount of sleep and the particular height-weight index used as a measurement of the physical growth of child. In discussing their findings, the researchers commented that another measure of physical growth might have shown a significant relationship between sleep and the growth of children.

The above findings were supported by Shinn[41] in a study conducted on two groups of nursery school children in New York and Hawaii. The object of the study was to investigate the relation of length of sleep to certain environmental factors and the weight of the children. The results showed that the correlation coefficient between weight and total sleep was .002, which suggested that there was no significant relationship.

This discussion of the review of literature has included the research relating to the effects of diet and economic conditions of the family on weight and height of children. A number of studies on the amount of sleep of the preschool children and its relation to the weight and height were also reviewed.

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[41]A. Shinn, "A Study of Sleep Habits of Two Groups of Preschool Children, One in Hawaii and One on the Mainland," Child Development, 3: 159-166, June, 1932.

CHAPTER III

PROCEDURES

The weights and heights of sixty-four Indian preschool children attending the Faculty of Home Science Nursery School and Kindergarten were studied in relation to their diet pattern, hours of sleep and parental income.

Children were weighed and their heights were measured once during the period of the study. Information concerning the birth dates and the religion of the children was obtained from admission forms which were filed by the parents when the child was admitted to the school. Parents and teachers were asked to keep a seven-day record of each child's diet and sleep pattern. The investigator visited the parents to get the information about their monthly income and the family size.

Weights and heights were changed into quotients to obtain a ratio of the measurements. The cases were divided into three groups according to the professed inclusion of foods containing animal protein in their diet, as follows:

Group I. Milk
Group II. Milk and eggs.
Group III. Milk, eggs, meat, and fish.

The relationships of the diet of these three groups, the hours of sleep, and the parental income to weight and height were investigated by statistical analysis.

THE SITUATION

In 1949, the nursery school 'Chetan Balwadi' was established as a part of the Faculty of Home Science, Maharaja Sayajirao University of Baroda to provide laboratory experience for students studying pre-school children.

The nursery school provided opportunities for the daily supervision of the physical well being of the child. Apart from a daily and yearly medical examination, weights and heights of the children were recorded every month by the nursery school teachers.

In the academic year of 1959-60, Smart[42] used the weight and height records collected during ten years to obtain weight and height norms for the nursery school children. In his study only these measurements were used which were made within fifteen days before or after the birth date. The averages of the variables, weight and height, for each age, and sex, were computed. Since the averages for all the variables, except the average weight of the boys, fell very close to straight lines, these were used in setting up the norms.

> Straight lines were fitted to the four averages for each of the four variables by the method of least squares. The formulas for these lines are as follows, with Y being Height or Weight and X being age.

Boys' Height	$Y = 29.13 + 2.23X$
Boys' Weight	$Y = 20.83 + 2.44X$
Girls' Height	$Y = 27.16 + 2.66X$
Girls' Weight	$Y = 15.33 + 3.61X$

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[42] R. Smart, "Tentative Norms for Height and Weight," (Unpublished Study, Chetan Balwadi, Faculty of Home Science, Maharaja Sayajirao University of Baroda, Baroda, 1960), 8 pp.

> In setting up the norms for height and weight, inches by quarter-inch and pounds by quarter-pound were substituted in the equations.[43]

The norms were to be considered as approximate and temporary because of the small number of cases.

THE SAMPLE

There were sixty children in the nursery school section and twenty-five in the kindergarten section of 'Chetan Balwadi'. All children were initially included in this study. After the data were collected, the number of cases decreased due to the following reasons:

1. Failure of parents to return the diet and sleep records.
2. Return of incomplete and inaccurate forms.
3. Discontinuation from the school.
4. Illness.

There were sixty-four records with complete information. Some records which had partially complete data were used only for the calculations of the factors recorded; e.g., if a record had incomplete sleep data but was complete as far as other information was concerned, it was studied only for the factors for which the complete information was available.

The mean age of the subjects was 4.8 years and the ages ranged from 2.5 to 5.9 years. The sample of preschool children eventually used in this study was composed of thirty-four boys and thirty girls.

After the mean parental income was computed, it was evident that most cases in the sample belonged to a high income group. The

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[43] *Ibid.*, p. 2.

mean parental income of this group of children was 878.5 rupees per month. Singh reported that, as calculated by the 1951 census, the per capita income in India for 357 million people was 252 rupees.[44] There was the possibility that the per capita income could have increased during the intervening ten years; however, the mean income of the parents of the children in the sample was obviously above the per capita income in India. There was a wide range of distribution in the parental income of the children since the lowest and the highest monthly incomes of the parents were seventy-five rupees and five thousand rupees respectively. The mean number of members per family was 6.5.

The children studied in this investigation belonged to three different religions. Eighty-nine per cent were Hindu, five per cent were Muslim, and five per cent were Zoroastrian. Although the children included in the study belonged to the three different religions and came from widely varying economic levels, the majority of the cases represented one religion and a fairly homogeneous income group.

THE PROCEDURE

The nursery school conducted monthly meetings for parents as part of the parent education program. At the first meeting, the parents were given an explanation of the purpose and the procedures of this study. Following this meeting, printed forms consisting of seven pages, one for each day, were sent to the parents with instructions. The

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[44] B. Singh, Economic Planning in India: 1951-1956, (Bombay: Hind Kitabs Ltd., 1953), p. 36.

parents were asked to keep a daily record of the child's diet and sleep for seven consecutive days. A sample of the form used is given in the appendix.

The children ate lunch at the nursery school five days a week. An attempt was made on the part of the school to provide a balanced diet to the children. The diet had to be kept vegetarian, however, with milk as the only source of animal protein because those parents who, because of the religious belief, did not allow meat and eggs in their family diet, objected to these foods being served to their children. Since it was difficult to plan separate diets for the groups, milk and milk products were used to substitute for the limitations mentioned above.

During lunch time one teacher sat with six to seven children at each table. Forms were given to the teachers to record the lunch diets of the children. The cases to be observed by the teachers were distributed so that each teacher had no more than three children to observe each week. This was done to facilitate complete diet recording on the part of the teacher.

Teachers also observed the same children at the nap hour, which was scheduled half an hour before lunch for the older group and one hour after lunch for the younger group. The mean hours of sleep taken per child per day were 10.2, as computed from the records kept by parents and teachers. Both parents and teachers were instructed to record the exact time that the child actually slept. Nevertheless, the possibility of error should be taken into consideration, since it was difficult to determine the exact moment when a child fell asleep.

The parents of the children were visited at home to collect the forms, to get information about the parental income, and to discover whether eggs, meat, or fish were allowed in the diet.

During the home visit the reason for recording their monthly income was explained to the parents. Most of the parents readily provided the information. Others had to be assured that the figures would be kept anonymous and used only for research purposes. The figures for parental income represented the income from regular work by one or both parents and the added income from property, farm, and additional business, if any.

The number of members living in the child's family was recorded with the other information about the child. This information helped to describe the sample.

Weights and heights of children were recorded once during the period that the diet data and sleep data were being recorded by parents and teachers. Children's socks and shoes were removed, and all the measurements were taken in the morning soon after the children arrived at school. Weight was recorded in quarter pounds from a balance scale. The height was read from a scale attached to the balance scale and was recorded in quarter inches.

The norms set by Smart[45] were used to read the weight ages and the height ages of the children. Separate norms had been set for boys and girls. The differences that may exist between weight and height of

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[45]Smart, loc. cit.

children belonging to different countries were recognized by using the tentative norms established for children of the same nationality. Martin and Stendler supported this assumption while discussing the nature of physical growth of the child:

> Differences in size, rate of growth, and physique have been established among groups of differing culture, nationality, and religion. So called racial characteristics may actually be due to differences in pattern of living, including the dietary, that are cultural in origin and related to circumstances of geography and climate.[46]

The point of their discussion can be emphasized by an illustration of differences in weight and height of American and Indian children of the same age. At the age of three years, the mean height and weight of Indian girls was 35.1 inches and 26.2 pounds respectively, according to norms set by Smart.[47] For the same age group of American girls, the average height and weight was 37.5 inches and 32.4 pounds as reported by Bayley in 1956.[48]

Height ages and weight ages of children were changed into quotients to get a ratio of the measurements and thus eliminate the age differences in the group. The quotients were obtained by the following method:

$$\frac{HA}{CA} \times 100$$

HA = Height Age
CA = Chronological Age

The same method was used for computing weight quotient by substituting weight age for height age.

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[46] W. Martin and C. Stendler, Child Behaviour and Development (New York: Harcourt, Brace and Company, 1959), p. 470.

[47] Smart, loc. cit.

[48] N. Bayley, "Growth Curves of Height and Weight by Age for Boys and Girls: Scales According to Physical Maturity," Journal of Pediatrics, 48: 187-194, February, 1956.

The chronological ages of children were computed from the birth dates which were taken from the admission forms. The date of birth was subtracted from the date the measurement was taken, which gave exact age in years, months, and days. The ages were recorded to the nearest month.

CHAPTER IV

ANALYSIS OF DATA

The data collected during the one week period were statistically analyzed to determine the relationship of diet, hours of sleep, and parental income to weight quotients and height quotients of sixty-four children attending the nursery school of the Faculty of Home Science, Baroda, India. Diet information recorded during the one week period by parents and nursery school teachers was used to describe the food pattern of the Indian preschool children.

The total number of sixty-four children were divided into three groups according to the professed inclusion of foods containing animal protein in their diet as follows:

Group I. Milk
Group II. Milk and eggs.
Group III. Milk, eggs, meat, and fish.

The data were subjected to an analysis of variance in order to investigate the association between diet pattern and weight quotients and height quotients of the above three groups.

The coefficient of correlation was used to investigate the relationship between the average amount of sleep per day and the weight and height quotients. The same method was used to determine the relationship between monthly parental income and the weight and height quotients of the subjects in the sample.

The results of the data analysis shall be described in the following order: (1) a description of the diet patterns of the three groups of

children; (2) the analysis of variance for diet pattern and the weight and height quotients; (3) the correlation coefficient for the relationship between hours of sleep and the weight and height quotients; and (4) the correlation coefficient for the relationship between parental income and the weight and height quotients.

I. DIET PATTERN OF THE THREE GROUPS OF INDIAN NURSERY SCHOOL CHILDREN

Parents and nursery school teachers were instructed to record the quantity of foods eaten during seven consecutive days and to specify the names of the foods. These records were used to describe the pattern of diet followed by each of the three groups.

The frequencies of the diet were calculated separately for each of the three groups. By this method it was possible to detect the differences in frequency of the various foods eaten by children belonging to different groups.

The diet consumed by children was divided into twelve food groups. This classification was done on the basis of a report by the Indian National Advisory Committee, quoted by Patwardhan and Ranganathan.[49] Some changes were made in the original eleven group classifications by adapting the vegetable and fruit groups to the present study. In the present classification, citrus fruits were classified as a separate group

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[49] V. Patwardhan and S. Ranganathan, The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets, Health Bulletin No. 23, (Nasik Road: The Manager, Government of India Press, 1956), p. 16.

since the ascorbic acid content makes the composition of citrus fruits different from other fruits. Remaining fruits and vegetables, other than green and yellow vegetables, were combined into one group. Foods which could not be included in any of the other eleven groups, such as jam, relish, chutney, pickles, tea, and coffee, were classified as the miscellaneous group.

The classification of foods used in the present study included the following twelve food groups:

1. Cereals of all kinds.
2. Pulses, nuts, seeds, and dried beans.
3. Green and yellow vegetables.
4. Root vegetables.
5. Citrus fruits.
6. Other fruits and vegetables.
7. Milk and milk products, except butter and ghee.
8. Eggs.
9. Meat and fish.
10. Sugar, jaggery, and honey.
11. Vegetable oil, ghee, and butter.
12. Miscellaneous.

The frequency of foods eaten during the week was determined by counting the number of times a child ate one particular food. The quantity of food was not taken into consideration since the amount of food recorded was not consistent and accurate due to the absence of standard measuring devices in the homes. Two types of foods belonging

to the same group were counted as a frequency of two; for example, rice and wheat bread included in the same meal were counted as two servings from the cereal group. The food products which had more than one ingredient belonging to other food groups were classified in each of their respective groups. A table of the frequencies of foods eaten during the experimental week is found in the appendix.

The mean frequencies computed for each food group represented the average number of times a food was eaten during the experimental week by each child. These frequencies are presented in Table I.

TABLE I

THE MEAN FREQUENCIES OF FOODS CONSUMED DURING THE ONE WEEK PERIOD

FOOD GROUPS	1	2	3	4	5	6	7	8	9	10	11	12
Group I	25.4	12.7	7.0	2.8	5.0	8.0	24.0	-	-	11.5	7.0	10.0
Group II	25.8	14.0	7.1	4.2	5.0	11.2	27.0	.1	-	12.8	7.7	6.4
Group III	28.6	11.7	9.8	4.7	4.7	12.0	24.4	3.0	3.2	16.8	5.6	9.0

The figures in Table I show that milk and cereal were the foods most frequently consumed by the children. This tendency was found to be consistent in all of the three groups. Next in frequency of use were pulses and nuts and the sugar group. Vegetables and fruits occupied the fourth place in the diet of the children in the three groups.

It was not possible to judge the adequacy of diet due to inaccurate recording of the quantity of foods; nevertheless, the diet patterns revealed that certain foods constituted the major part of the diets. The use of citrus fruits in the diet was infrequent. In the nursery school fresh lemon juice in the form of a drink was served to all the children daily and tomatoes were often included in salads. However, an examination of diets recorded at home revealed that very few children had citrus fruit or green vegetables included in their daily diet at home. One of the reasons for this lack of citrus fruits in the recorded diets could have been that most citrus fruits were more expensive than other fruits. The lack of knowledge of nutrition could also have contributed to this trend.

The comparison of Groups I, II, and III revealed some interesting facts about the diet of the different groups. Although the parents of children in Group II had given the information that they allowed eggs in their diet, the computation of frequencies showed that eggs were eaten only once during the experimental week by one child. In Group III, meat, fish, and eggs were consumed less frequently than any other food groups. Examination of the table of frequencies given in the appendix indicates that some children in Group III ate meat and eggs once each day but that others had eggs or meat included in their diet infrequently throughout the week.

II. THE RELATIONSHIP OF CERTAIN FOOD GROUPS TO THE WEIGHT AND HEIGHT QUOTIENTS

Another purpose of this study was to determine whether the weight and height means of the three diet groups differed significantly from each other. For this purpose an analysis of variance was used.

Relation to weight. The mean weight quotients for the three diet groups are presented in Table II.

The data were subjected to an analysis of variance to test the null hypothesis that there was no significant difference between the mean weight quotients of the three diet groups. The findings of the analysis of variance are presented in Table III.

TABLE II

THE MEAN WEIGHT QUOTIENTS OF THE THREE DIET GROUPS

Diet Group	Number of Children	Mean Weight Quotient
I	30	86.7
II	19	111.5
III	15	113.1

Analysis of data (Table III) revealed that children on the diet with milk as the source of animal protein (Group I) had significantly

smaller weight quotients than the children receiving animal protein in the form of milk and eggs (Group II), or milk, eggs, and meat (Group III).

TABLE III

ANALYSIS OF VARIANCE OF THE MEAN WEIGHT QUOTIENTS OF THE THREE DIET GROUPS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between Groups	2	10440.85	5220.42	7.57 **
Within Groups	61	42027.15	688.96	
Total	63	52468.00		

** Significant at 1 per cent level.

The t test of significance showed that there was no significant difference between the weight quotients of children in Group II as compared to those in Group III. The value of t (.084, 32 d.f.) was not significant even at the 5 per cent level.

The results would suggest that accepted inclusion of eggs, meat, and fish in the diets of Indian preschool children was associated with significantly increased weight quotients.

Relation to height. The mean height quotients for the three groups are presented in Table IV.

TABLE IV

THE MEAN HEIGHT QUOTIENTS OF THE THREE DIET GROUPS

Diet Group	Number of Children	Mean Height Quotient
I	30	97.6
II	18	107.8
III	15	107.5

The null hypothesis was employed that there was no significant difference between the mean height quotients of the three diet groups. The findings of an analysis of variance are presented in Table V.

TABLE V

ANALYSIS OF VARIANCE OF THE MEAN HEIGHT QUOTIENTS OF THE THREE DIET GROUPS

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Square	F Ratio
Between Groups	2	1534.25	767.12	1.75
Within Groups	60	34185.17	569.75	
Total	62	35719.42		

This F ratio with 2, 60 degrees of freedom was not found significant at the 5 per cent level; therefore, the null hypothesis was not rejected.

The analysis of data (Table V) revealed that there was no significant difference between the mean height quotients of the children in the three groups.

The results would suggest that accepted inclusion of eggs, meat, and fish in the diets of Indian preschool children was not associated with increased height quotients of children.

III. RELATIONSHIP OF HOURS OF SLEEP AND INCOME TO THE WEIGHT AND HEIGHT QUOTIENTS

One of the purposes of this study was to determine whether there is a linear relationship between the weight and height quotients and both the hours of sleep and the parental income of the sample of preschool Indian children. Thus four correlation coefficients were computed to investigate the relationship between: (1) the hours of sleep and the weight quotients, (2) the hours of sleep and the height quotients, (3) the parental income and the weight quotients, and (4) the parental income and the height quotients.

The relationship between sleep and weight quotients. The sample mean for the hours of sleep was 10.2 hours. The range was from 9.3 to 11.9 hours.

The computed r for hours of sleep and weight quotients was found to be .17. This value of r was not significant at the 5 per cent level. This indicated that no significant relationship existed between the number of hours of sleep and the physical growth of these preschool children as measured by the weight quotient.

The relationship between sleep and height quotients. The coefficient of linear correlation between hours of sleep and the height quotients was .084. The value of r was not found significant at the 5 per cent level.

The relationship between parental income and weight quotients. The mean parental income of the group was 878.5 rupees. The range was from 75 to 5,000 rupees.

The coefficient of correlation was computed to determine the relationship between the amount of parental income and the weight quotients.

The value of r for the linear relationship between income and weight quotients was .21. In order to be significant at the 5 per cent level r would have to be at least .25. The fact that .21 differs little from .25 suggests that there might be a correlation here even though this study did not reveal conclusive evidence for its existence. It is possible that, although income did not have a direct effect on weight, the amount of income may have affected the quality of diet, which, in turn, had a more direct effect on weight.

The relationship between parental income and the height quotients. The correlation of coefficient between parental income and the height quotients was .035. This value of r was not significant at the 5 per cent level. The finding suggests that there was no significant relationship between the parental income and the height of Indian pre-school children represented in this investigation.

CHAPTER V

SUMMARY, FINDINGS, AND CONCLUSIONS

Changes in the growth of children have been most commonly studied by measurements of weight and height. A great deal of research has been done on this aspect of physical growth. Nevertheless, there are many questions which are still unanswered. Much is known about the rate of growth and the prediction of adult height, but the extent to which the various environmental and genetic factors affect the growth pattern of weight and height have not been fully explored.

In India, scientific knowledge about the growth of children is noticeably lacking. The traditional practices and religious beliefs have played an integral part in the child's physical environment, but these are not based on scientific research. The extent to which different dietary and routine practices affect the physical growth, or specifically the weight and height, of young children is not known.

In general, the Indian diet is found to be inadequate for optimum growth, but how much of it is due to poverty, religious restrictions or plain ignorance is a matter of controversy.

SUMMARY

The weights and heights of sixty-four preschool children attending the Faculty of Home Science Nursery School and Kindergarten, Baroda, India, were studied in relation to the children's diet pattern, hours of sleep and parental income.

The objects of the study were: (1) to investigate the possible significant differences between weight and height of the three groups of children using the varying diet patterns; (2) to determine the relationship between the amount of sleep and the weight and height of the subjects; and (3) to determine the relationship between the parental income and the weight and height of the subjects.

Children attending the Faculty of Home Science Nursery School and Kindergarten were selected for the purpose of the study. There were sixty-four children who had complete records which could be used for the study. They ranged in age from 2.5 to 5.9 years and included thirty-four boys and thirty girls. The mean age of the subjects was 4.7 years.

The mean parental income of the subjects was 878.5 rupees per month and the mean family size was 6.5 persons per family. These figures suggested that the children belonged to a fairly high income group. The subjects in the study belonged to three different religions: 89 per cent were Hindu, 5 per cent were Muslim, and 5 per cent were Zoroastrian. The groups were relatively homogeneous in relation to income and religion.

The parents at home and the teachers at the nursery school were instructed to keep a week's record of the foods eaten by the children and to note the time of their sleeping and waking hours. By means of

home visits the investigator secured information about the parents' monthly income, the number of members in the family, and whether they allowed eggs, meat, and fish in the diet.

Children's weight and height measurements were taken during the week the data were being recorded. The birth dates were found in the admission forms filed by the parents at the beginning of the year.

In the nursery school weight and height records had been collected during the preceding ten years. In the year 1959-60, Smart[50] used these records to establish tentative norms for Indian preschool children. The norms were presented in the form of weight age and height age tables, which were separate for boys and girls.

These norms were used to convert the observed measurements of weight and height into quotients to get a ratio of measurements and thus eliminate the age differences of the subjects.

The children were divided into three groups according to the professed inclusion of foods containing animal protein in their diet as follows:

Group I.	Milk.
Group II.	Milk and eggs.
Group III.	Milk, eggs, meat, and fish.

The frequency of the various foods eaten during the week was calculated for each of the three groups and catagorized according to a

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[50] R. Smart, "Tentative Norms for Height and Weight," (Unpublished Study, Chetan Balwadi, Faculty of Home Science, Maharaja Sayajirao University of Baroda, Baroda, 1960), pp. 8.

twelve group classification, adapted from a report by the Indian National Advisory Committee. The purpose was to investigate the difference between the frequency of the use of all foods by the three groups.

Data were subjected to an analysis of variance to investigate the difference between the mean weight and height quotients of the three groups. By linear correlation weight and height of the children were studied in relation to both the number of hours of sleep and the parental income.

FINDINGS

The mean frequencies computed for the foods eaten during the week showed that milk and cereals were consumed most frequently by the children in all of the three groups. A comparison of the groups revealed that eggs, meat, and fish were eaten less frequently by Groups II and III than it was assumed when the study was originated. It should be pointed out in this connection that children were assigned to groups originally on the basis of information provided by parents.

When the three groups were compared for differences in mean weight quotients and mean height quotients, it was found that no significant difference existed between the mean height quotients. The type of diet consumed by the subjects had a significant effect on weight since the mean weight quotients of Group I differed significantly from the means of Group II and Group III.

In regard to a possible linear relationship between weight and height quotients and the two environmental factors, sleep and parental income, it was found that: (1) there was no significant linear correlation between sleep and weight quotients; (2) there was no significant linear correlation between sleep and height quotients; (3) there was no significant linear correlation between parental income and weight quotients; and (4) there was no significant linear correlation between parental income and height quotients.

CONCLUSIONS

On the basis of the sample, the procedures, and the statistical analysis used in this study, the following conclusions were reached:

I. Diet Pattern of the Three Groups of Indian Nursery School Children.

a. The diet of children in the three groups did not differ markedly in the frequency with which foods were included in the meals, although there was a slight tendency for the diet pattern in Group III to have a higher frequency of use of all the twelve food groups than the other two groups.

b. A wide range was found between the frequency of use of the twelve food groups, i. e., certain foods were eaten much more frequently than the others. Milk and cereal were the two foods included in the meals most frequently, and the records revealed that milk was frequently consumed in between the regular meals. Pulses and nuts; sugar and other sweet products; fruits; green, yellow, and other vegetables; fried

foods, and various other foods which were used as relishes were eaten once or twice in a day. The two foods much less frequently used than the others were root vegetables and citrus fruits, which were consumed on the average of four times a week.

c. The records suggested that foods from all of the twelve food groups were offered in the nursery school lunches, but that fewer of the foods from the twelve food groups were included in the meals in the homes. Vegetables and fruits, citrus as well as others, in cooked or raw form were included in every lunch served to the children at the nursery school. The meals eaten at home frequently included cereals, milk, pulses, nuts, and fried foods.

d. The use of eggs, meat, and fish was found to be less frequent than some other foods such as cereal, milk, pulses, and sugar. In Group II, eggs were included only once in one child's diet during the experimental week. The children in Group III, whose parents allowed eggs, meat, and fish in their diet, used those foods only three times during the week. This finding points to the pattern of Indian diet in which cereal is used as the main food in the meals. Also the expense involved in including eggs, meat, and fish in the diet could have been a discouraging factor.

II. The Relation of Certain Food Groups to the Weight and Height Quotients.

a. The diet was found to be associated with the weights of the

three groups of subjects. The average weights of the children in the first group differed significantly from the average weights of the second and third groups. The mean weight quotient of the first group was found to be lower than the mean weight quotients of the other two groups. This suggested that the inclusion of eggs, meat, and fish in the diet could be associated with increased weight of the children.

b. There was no significant difference between the average heights of the three groups. There was a slight tendency for the observed mean height quotient of Group I to be lower than the mean height quotients of Groups II and III. This finding suggested that there was a possibility of the diet being associated with the greater height of the children consuming eggs, meat, and fish.

III. The Relationship of Hours of Sleep to Weight and Height.

The average hours of sleep per day and the weight and height of the subjects were not significantly related.

IV. The Relationship Between Parental Income and Weight and Height.

a. The relationship between parental income and weight was not found significant; however, the mean parental income and the average weight of the children in the first group were found to be less than those for the other two groups. This finding suggests that income could be a factor affecting the quality of diet, which in turn, could directly affect the weight.

b. The parental income and the height of the subjects were not significantly related.

In general it is concluded that diet was one factor which was found to be associated with the weight of this sample of Indian preschool children. Hours of sleep and parental income were not found to be significantly related to weight of the subjects. Height was not significantly related to any of the environmental factors which were studied.

The findings of this study revealed the importance of diet for the optimum growth of children in weight. At the same time it indicated the need for more extensive research on the food habits and the quality of diet of children in India and their effects on weight and height. The present study was limited by the small size of the sample and by its type, by the short length of time used in data collection, and by the lack of accurate methods of recording diet information. Further research covering a longer period of time is needed to study the effect of routine habits and the financial status of the family on weight and height of Indian preschool children.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Forest, Ilse. Child Development. New York: McGraw-Hill Book Company, Inc., 1954.

Martin, William, and Celia Stendler. Child Behaviour and Development. New York: Harcourt, Brace and Company, 1959.

Olson, Willard C. Child Development. Boston: D. C. Heath and Company, 1959.

Singh, Buljit. Economic Planning in India: 1951-1956. Bombay: Hind Kitabs Ltd., 1953.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

Baldwin, Bird T. "The Physical Growth of Children From Birth to Maturity," University of Iowa Studies in Child Welfare, Vol. I. Iowa City: University of Iowa, 1921.

Basu, Sita. "Child Welfare Services in India Today and Plans for Future," The Preschool Child, p. 22-26. University Symposia Series: No. 10. Baroda: The Maharaja Sayajirao University of Baroda, 1960.

Corry, Mann, H. C. Diets for Boys During the School Age. Medical Research Council. London: His Majesty's Stationary Office, 1926.

Dearborn, Walter F., John W. M. Rothney, and Frank K. Shuttleworth. "Data on Growth of Public School Children," Monographs of the Society for Research in Child Development, Serial No. 14, Vol. III. Washington: National Research Council, 1938.

Patwardhan, V. N., and S. Ranganathan. The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets. Health Bulletin No. 23. Nasik Road: The Manager, Government of India Press, 1956.

Research and Reference Division, Ministry of Information and Broadcasting. India: A Reference Annual, 1960. Delhi: The Publication Division, Ministry of Information and Broadcasting, Government of India, 1960.

Rose, Mary Swartz and Gertrude M. Borgeson. Child Nutrition on a Low-Priced Diet. Child Development Monographs, No. 17. New York City: Teachers College, Columbia University, 1935.

Scrimshaw, Nevin S., and Miguel A. Guzman. "The Effect of Dietary Supplementation and the Administration of Vitamin B_{12} and Aureomycin on the Growth of School Children," Current Research on Vitamins in Trophology. New York: The National Vitamin Foundation, Inc., 1953.

Simmons, Katherine. "The Brush Foundation Study of Child Growth and Development: II. Physical Growth and Development," Monographs of The Society for Research in Child Development, Serial No. 37, Vol. IX. Washington: National Research Council, 1944.

Woodbury, Robert Morse. "Statures and Weights of Children Under Six Years of Age," Community Child-Welfare Series No. 3. Children's Bureau Publication No. 87. Washington: Government Printing Office, 1921.

C. PERIODICALS

Bayley, Nancy. "Growth Curves of Height and Weight by Age for Boys and Girls, Scales According to Physical Maturity," Journal of Pediatrics, 48: 187-194, February, 1956.

Boas, Franz. "The Growth of Children as Influenced by Environmental and Hereditary Conditions," School and Society, 17: 305-308, March, 1923.

Dreizen, Samual, et. al. "The Effect of Nutritive Failure on the Growth Patterns of White Children in Alabama," Child Development, 24: 189-202, September, 1953.

Epright, Ercel S., et. al. "Relationship of Estimated Nutrient Intake of Iowa School Children to Physical and Biochemical Measurements," Journal of Nutrition, 54: 557-570, December, 1954.

Fleming, Bernice M. "A Study of the Sleep of Young Children," Journal of American Association of University Women, 19: 25-27, October, 1925.

Fletcher, Mary Virginia and Cecilia Schuck, "Dietary Practices and Nutritional Status of Two Groups of Virginia School Children," Journal of Home Economics, 42: 732-734, November, 1950.

Foster, Josephine C., Florence L. Goodenough, and John E. Anderson. "The Sleep of Young Children," Pedagogical Seminary, 35: 201-218, June, 1928.

Frazier, Ernestine. "The Effect of Adequate School Lunches Upon the Physical Growth of Mississippi School Children," Journal of Home Economics, 30: 258-261, April 1938.

Greulich, William Walter. "Growth of Children of Same Race Under Different Environmental Conditions," Science, 127: 515-516, March, 1958.

Herskovits, Melville J. "The Influence of Environment on a Racial Growth Curve," School and Society, 22: 86-88, July, 1925.

Hundley, James M., et. al. "Height and Weight of First-Grade Children as a Potential Index of Nutritional Status," American Journal of Public Health, 45: 1454-1461, November, 1955.

Laporte, M. "Effect of War-Imposed Dietary Limitations on Growth of Paris School Children," American Journal of Diseases of Children, 71: 244-247, March, 1946.

Leonard, Maynard A. "Some World Nutrition Problems," Journal of American Dietetics Association, 28: 109-112, February, 1952.

Mitchell, Harold H. "A Study of Factors Associated with the Growth and Nutrition of Puerto Rican Children," Human Biology, 4: 469-508, December, 1932.

Moyer, Elsie Z., and Icie G. Macy. "Nutritional Reconditioning of Children," American Journal of Public Health, 39: 205-213, February, 1949.

Palmer, Carrol E. "Further Studies on Growth and the Economic Depression," Public Health Reports, 49: 1453-1469, December, 1934.

_____. "Height and Weight of Children of the Depression Poor," Public Health Reports, 50: 1106-1113, August, 1935.

Reynolds, Martha May and Helena Mallay. "The Sleep of Young Children," Pedagogical Seminary and Journal of Genetic Psychology, 43: 322-351, December, 1933.

Roberts, Lydia J., et. al. "Effect of a Milk Supplement on the Physical Status of Institutional Children," American Journal of Diseases of Children, 56: 287-300, August, 1939.

Roberts, Lydia J., Ruth Blair, and Marjorie Greider. "Results of Providing A Liberally Adequate Diet to Children in an Institution: Growth in Height and Weight," Journal of Pediatrics, 27: 410-217, November, 1945.

Rose, Mary Swartz and Ella L. McCollum. "Studies in Nutrition: II. The Effect of Adding Egg to a Diet Already Adequate," Journal of Biological Chemistry, 78: 549-555, July, 1928.

Shinn, Alida Wisscher. "A Study of Sleep Habits of Two Groups of Preschool Children, One in Hawaii and One on the Mainland," Child Development, 3: 159-166, June, 1932.

Taneja, P., and O. Ghai. "Influence of Environmental Factors on Growth," The Indian Journal of Child Health, 5: 249-260, June, 1956.

Wang, Che Che, Jean E. Hawks, and Mildred Kaucher. "Metabolism of Undernourished Children: VII. Effect of High and Low Protein Diets on the Nitrogen and Caloric Balance of Undernourished Children," American Journal of Diseases of Children, 36: 1161-1172, December, 1928.

Winters, Jet C. "Comparative Dietary Studies of American Children of Nursery School Age," American Journal of Public Health, 21: 1003-1012, September, 1931.

Wise, Fairye C. and Howard V. Meredith. "The Physical Growth of Alabama White Girls Attending W P A Preschools," Child Development, 13: 165-174, September, 1942.

D. ESSAYS AND ARTICLES IN COLLECTIONS

Thompson, Helen. "Physical Growth," Manual of Child Psychology, Leonard Carmichael, editor. New York: John Wiley and Sons, Inc., 1954, pp. 292-334.

E. ENCYCLOPEDIA ARTICLES

Bayley, Nancy. "Child Development: V. Physical Growth," Encyclopedia of Educational Research, Walter S. Monroe, editor. New York: The Macmillan Company, 1950. pp. 153-156.

F. UNPUBLISHED MATERIALS

Smart, Russell. "Tentative Norms for Height and Weight," Unpublished study, Chetan Balwadi, Faculty of Home Science, Maharaja Sayajirao University of Baroda, Baroda, 1960.

APPENDIX

A. Frequency Table

B. Form for Recording Diet and Sleep Data

APPENDIX A

THE FREQUENCY TABLE OF THE FOODS CONSUMED DURING THE ONE WEEK PERIOD

GROUP I

Food Groups	1	2	3	4	5	6	7	8	9	10	11	12
Subjects						Number of Servings per Week						
1	14	12	5	1	-	13	55	-	-	3	7	8
2	19	5	3	2	5	8	24	-	-	9	5	5
3	35	16	4	1	5	6	24	-	-	9	8	11
4	33	16	9	1	6	5	23	-	-	14	7	17
5	19	12	6	4	3	6	21	-	-	13	1	8
6	33	9	12	2	1	5	31	-	-	10	3	7
7	35	17	11	2	1	8	17	-	-	11	16	13
8	30	12	9	2	6	13	26	-	-	12	13	10
9	24	17	7	3	3	9	29	-	-	15	8	5
10	20	12	9	1	1	10	17	-	-	11	6	8
11	27	9	5	3	2	9	17	-	-	10	10	12
12	28	21	8	6	5	8	20	-	-	14	6	9
13	27	25	7	4	8	13	33	-	-	13	5	21
14	22	10	5	1	3	7	22	-	-	11	13	1
15	39	16	9	3	9	12	37	-	-	18	7	15
16	24	7	7	3	7	14	13	-	-	16	6	12
17	10	13	4	5	2	8	21	-	-	11	8	9
18	21	3	4	1	3	3	19	-	-	6	6	7
19	33	12	9	3	7	7	31	-	-	18	4	7
20	34	17	4	1	7	13	24	-	-	11	9	13
21	24	12	11	1	6	14	20	-	-	14	2	4
22	17	11	9	8	4	7	30	-	-	9	2	4
23	20	8	2	6	2	5	23	-	-	9	6	1
24	23	10	9	2	5	7	18	-	-	12	-	16
25	35	23	8	1	4	12	23	-	-	12	19	20
26	29	7	8	4	3	17	24	-	-	12	3	12
27	17	5	11	3	1	7	30	-	-	9	3	19
28	22	11	5	3	4	9	18	-	-	10	6	6
29	23	22	4	5	2	5	8	-	-	12	16	10
Total	737	370	204	82	115	260	698	-	-	333	205	290
Mean	25.4	12.7	7.0	2.8	4.0	8.0	24.0	-	-	11.5	7.0	10.0

APPENDIX A
(continued)

GROUP II

Food Groups	1	2	3	4	5	6	7	8	9	10	11	12
Subjects					Number of Servings per Week							
1	31	14	7	3	4	15	30	1	-	16	9	4
2	33	21	12	8	11	13	24	-	-	24	7	3
3	25	10	6	2	4	4	33	-	-	10	7	3
4	39	17	7	4	5	13	24	-	-	10	11	19
5	32	7	5	4	6	16	24	-	-	8	1	20
6	25	11	9	8	7	14	20	-	-	9	4	6
7	23	14	5	8	3	8	23	-	-	9	9	5
8	21	12	8	3	3	18	34	-	-	19	4	6
9	31	22	14	10	11	12	25	-	-	24	6	3
10	23	17	6	2	1	12	28	-	-	10	7	4
11	32	23	6	4	5	9	23	-	-	15	13	4
12	16	7	3	1	1	9	30	-	-	7	6	3
13	22	10	7	2	5	15	14	-	-	8	9	3
14	23	9	3	2	3	4	28	-	-	20	11	3
15	28	13	9	5	3	15	26	-	-	11	11	8
16	26	31	5	6	8	10	34	-	-	10	14	20
17	30	14	14	6	6	14	31	-	-	13	10	5
18	34	12	12	4	3	14	21	-	-	16	12	10
19	17	11	2	3	5	2	36	-	-	5	2	-
20	26	4	3	-	6	7	33	-	-	11	1	-
Total	537	279	143	85	100	224	541	1	-	255	154	129
Mean	25.8	14.0	7.1	4.2	5.0	11.2	27.0	.1	-	12.8	7.7	6.4

APPENDIX A
(continued)

GROUP III

Food Groups	1	2	3	4	5	6	7	8	9	10	11	12
Subjects	Number of Servings per Week											
1	28	4	6	2	4	13	42	-	1	31	8	16
2	36	22	17	5	9	10	25	4	5	17	5	11
3	26	16	4	5	2	25	18	3	1	10	7	12
4	35	7	15	7	5	16	39	1	6	29	9	5
5	33	13	6	1	4	7	17	1	8	12	5	6
6	20	15	9	7	10	11	37	7	6	14	3	8
7	22	10	5	2	4	13	23	5	1	17	6	7
8	29	15	7	3	2	11	17	1	1	8	7	5
9	24	8	13	4	4	16	25	4	4	12	6	4
10	39	8	14	8	5	10	25	1	2	29	6	11
11	17	13	8	6	9	8	34	7	6	13	2	7
12	31	14	11	2	1	12	18	-	-	13	3	14
13	18	13	6	8	3	5	23	-	-	9	3	7
14	42	6	16	6	4	12	13	9	4	22	9	14
Total	400	164	137	66	66	169	356	43	45	236	79	127
Mean	28.6	11.7	9.8	4.7	4.7	12.0	25.4	3.0	3.2	16.8	5.6	9.0

APPENDIX B

EXAMPLE OF THE FORM FOR RECORDING DIET AND SLEEP DATA

Date _____

Diet Data

Time	Name and Amount of Foodstuffs

Sleep Data

Time