A STUDY ON VARIOUS FACTORS AFFECTING GROWTH DURING THE FIRST TWO YEARS OF LIFE

Dr. Naheed Vaida

Senior Associate Professor, Institute of Home Science, University of Kashmir, Hazratbal, Srinagar

Abstract

Growth is a dominant biological activity during the first two decades or so of human life, including, of course nine months of prenatal life. Growth is an increase in the size of the body as a whole or the size attained by specific parts of the body. It is a fundamental characteristic of all living organisms. The integrated nature of growth and maturation is largely maintained by a constant interaction of genes, hormones, nutrients and other factors. These factors also influence physical performance. Healthy growth and development in early life have a profound effect on health across the life span. Research studies over the past decade demonstrated the link between early life events and adult chronic diseases and found that babies born at lower birth weights have an increased risk of developing heart disease, diabetes, and high blood pressure in later life. Infants with poor birth outcomes begin life with multiple risk factors that may prevent them from reaching their full health and development potential. For the present study 194 infants were studied for a period of two years. The results reveal that gender as such had no significant impact on the growth of children. Also, children exclusively breast fed had better weight and crown heal length(CHL) as compared to those who were on mixed feed. Literacy status of mother and socio economic status were found to play a significant role. Children belonging to families where both parents were working were healthy as compared to families where mothers were housewives.

Keywords: Growth, Gender, Feeding Pattern, Weaning, Income, Working Status, Mother's literacy status, Birth Order, Birth Spacing, Infants , Mothers

Introduction

Growth is a dominant biological activity during the first two decades or so of human life, including, of course nine months of prenatal life. While growing the individual also

matures. Growth is an increase in the size of the body as a whole or the size attained by specific parts of the body. It is a fundamental characteristic of all living organisms. Growth is a form of motion. Growth means the increase in the size of the various parts and organs of the body by multiplication of cells and intercellular components during the period commencing from fertilization to physical maturity. Changes in size are outcomes of three underlying cellular processes: (a) an increase in cell number or hyperplasia; (b) an increase in cell size or hypertrophy; (c) an increase in intercellular substances or accretion. Hyperplasia, hypertrophy and accretion all occur during growth, but the predominance of one or another process varies with age and the tissue involved. The increase in number is a function of cell division (mitosis), which involves the replication of DNA and the subsequent migration of the replicated chromosomes into functional and identical cells.

Stages Of Growth

The stages or phases of growth have been classified in different manners by different researchers.

Prenatal Period

The prenatal period comprises, on the average, about 10 lunar months (there are 28 days in a lunar month), 9 calendar months, or 40 weeks. A fertilized egg of a multi cellular animal is transformed into an embryo by cell division, growth and differentiation. This growth into the embryo is called prenatal growth. In the prenatal period (before birth) the embryo is formed with rudiments of all organs and systems. Prenatal growth has three distinct stages: the fertilized ovum (egg), or zygote (first 2 weeks); the embryo (from 2 to 8 weeks) and the foetus (from 2 to 10 lunar months). The human ovum at conception is about 0.1 mm in diameter. During the first part of this period (ovum), it is like a homogeneous mass. During the embryonic stage, though the rate of growth is slow, yet during this time the differentiation process in the mass to form various regions which later on give rise to different parts, like head, arm, leg and others starts. By the eighth week the embryo becomes child-like in appearance. During foetus stage the rate of growth in length as well as weight is considerably high.

Postnatal Period

Postnatal growth is commonly divided into the following age periods.

Infancy

Infancy comprises the first year of life. This is a period of rapid growth in most bodily systems and dimensions and rapid development of the neuromuscular system. After birth, the growth is oriented towards functional state of life. Growth is mainly by addition of more cells or increase in the protoplasm. It can be said that anabolic processes exceed catabolic

processes and there is increase in size, shape and weight. This characterizes the infant stage. Immediately after birth the rate of growth increases. In case weight the peak velocity is reached at two months after birth. The cells become larger in size. The cervical and lumber curvatures of the spinal column appear as the baby begins to straighten the head and tries to sit up and to stand. During infancy growth is very rapid. More than 50 percent of birth length and 200 percent of birth weight take place during the first year of life.

Childhood

Childhood ordinarily spans from the end of infancy (the first birthday) to the start of adolescence. The infant attains childhood before reaching adolescence. It is often divided into early childhood and middle childhood. The early childhood is the period of eruption of milk teeth. The middle childhood (7 to 10 years) is the period of eruption of permanent teeth, though not all erupt. The late childhood starts from the prepubertal period and continues up to the time of puberty. Childhood is period of relatively steady progress in growth and maturation and rapid progress in neuromuscular or motor development.

Adolescence

After childhood comes adolescence. The adolescence period extends from the time of puberty up to around 20 years. In this period of life, the hormonal influences play a leading role in order to attain sexual maturity. During this period there is a marked acceleration of growth which is known as adolescence growth spurt. The adolescence spurt is a constant phenomenon and occurs in all children, though it varies in intensity and duration from one child to another. In boys it takes place, on the average from age 12 to 15. In girls the spurt begins about two years earlier than in boys. Differentiation in primary and secondary sexual characteristics marks the adolescence period. There are changes in the reproductive organs, in body size and shape, in the relative proportions of muscle, fat and bone and in a variety of physiological functions. At adolescence sex differences in physical increase greatly, chiefly due to the differential action of hormones, gonadal and other. Men become considerably larger, acquire broader shoulders, a deeper larynx; women enlarge their pelvic diameter and deposit fat in various strategic places, including the breast.

Hormonal Basis of Adolescence

Adolescence is intimately linked to the secretion of sex hormones in boys and girls. The male sex hormone is testosterone secreted by the gonad, testes. The female sex hormone is oestrogen secreted by ovary. The gonads, ovary and testes are stimulated by pituitary hormones, called Follicle stimulating hormone (FSH) and Luteinizing hormone (LH). Together, these are called gonadotrophins. The pituitary hormones, FSH and LH, in turn are

controlled by hormones of specialized region of brain, called hypothalamus. Hypothalamus secrets gonadotrophin releasing hormone (GnRH). Under appropriate internal and external signals, GnRH is released from hypothalamus that has effect on pituitary causing release of gonadotrophins. Gonadotrophins act on gonads and effect release of testosterone and oestrogen in males and females respectively.

Physiological Changes

Changes in physiological function occur during adolescent spurt. They are much more marked in boys than girls and serve to confer on the male his greater strength and physical endurance. Before adolescence boys are on average a little stronger than girls. After adolescence boys are much stronger, chiefly by virtue of having larger muscles. Boys have larger hearts and lungs relative to their size, a greater capacity for carrying oxygen in the blood, and a greater power for neutralizing the chemical products of muscular exercise. In short, the male becomes at adolescence more adapted for the tasks of hunting, fighting and manipulating all sorts of heavy objects, as is necessary in some forms of food gathering. There occurs in the boys an increase in the number of red blood cells at puberty and consequently in the amount of hemoglobin in the blood. No sex difference exists before adolescence. The systolic blood pressure rises throughout childhood, but this process accelerates in boys at adolescence; the heart rate falls. The alveolar carbon dioxide tension increases in boys and not in girls, giving rise to a sex difference in the partial pressure of carbon dioxide in arterial blood. Coincidentally, the alkali reserve rises in boys. Thus, the blood of an adult man can absorb during muscular exercise, without change of pH, greater quantities of lactic acid and other substances produced by the muscles than that of a woman – a necessity in view of greater relative development of muscular bulk in the male. As a direct result of these anatomical and physiological changes the athletic ability of boys increases greatly at adolescence.

Factors Affecting Growth And Development

The integrated nature of growth and maturation is largely maintained by a constant interaction of genes, hormones, nutrients and other factors. These factors also influence physical performance. Some are hereditary in origin. Others, such as season, dietary restriction, severe psychological stress, originate in the environment and simply affect the rate of growth at the time they are acting. Others again, such as socio-economic class, reflect a complicated mixture of hereditary and environmental influences and probably act throughout the whole period of growth.

Genetic control

The height, weight or body-build of a child or an adult always represents the resultant of both the genetical and environmental forces, together with their interaction. It is a long way from the possession of certain genes to the acquisition of a height of 2m. gene depends for its expression firstly on the internal environment created by all the other genes, and secondly on the external environment. The control of body size is certainly a complicated affair involving many genes, yet a disturbance in a single gene or group of genes may produce a widespread and drastic effect, as in the condition of achondroplasia, which is inherited as a simple dominant. On the other hand, the effects may be quite restricted and specific. The genetic control of dental maturation and eruption appears to be separate from that of skeletal maturation, and there is even evidence that the genes controlling the growth of different segments of the limbs are independent of each other. It is now believed that dental development and the sequence of ossification are primarily genetically controlled; the timing of ossification is partly influenced by genetic factors and partly by environmental ones. Maturation as a whole is even more affected by environment, but genetic influences are still detectable. It seems that the genetic materials operate throughout entire period of growth. Heredity influenced the rate of growth of early maturers or late maturers. Parent – offspring correlation in regard to height from birth to maturity for each are and sex has been reported. Chromosomal abnormalities suggest genetical control on growth. Genetic factors probably play the leading part in the difference between male and female patterns of growth.

Environmental

There is a well-marked seasonal effect on velocity of growth visible in most human growth data. Growth in height is on average fastest in spring and growth in weight fastest in autumn. This is true at all ages, including adolescence. The mechanism of the seasonal effect is not known; probably variations in hormone secretion are involved. Climate seems to have a very minor effect on overall rate of growth in man. It has been suggested that each major race of mankind varies in stature according to the climates in which they live. Seasonal variation in growth has also been observed in many studies. Longitudinal studies have shown that only about 30% of the children have cycles of increase and decrease in growth velocity which are strictly seasonal. The remaining children show accelerations and decelerations of growth which can not be clearly related with seasons.

Endocrine regulation

Endocrine glands are commonly referred to as ductless glands, or glands of internal secretion. They secrete chemical substances, hormones directly into the bloodstream. Human

growth is affected by biochemical products such as hormones. Hormones are regarded as growth promoting substance. Probably all the endocrine glands influence growth. Most of the hormones are secreted by the endocrine glands and play a significant role in regulating the pattern of growth and development as per instructions of the genes. The most important hormone controlling growth from birth up to adolescence is growth hormone or somatotrophin. This is infact a polypeptide secreted by the pituitary. It helps growth of bones and thereby increases the height of persons. Growth hormone controls the rate at which growth takes place upto the time of steroid - induced adolescent spurt. Its administration causes the amino acids to be incorporated into tissues to form new protein. It also causes an over all growth rate of most of tissues including brain. Thyroid hormone plays a vital role throughout the whole of growth. The activity of the thyroid, judged by the basal metabolic rate, decreases gradually from birth to adolescence. In hypothyroidism growth is delayed, skeletal maturity, dental maturity and growth of the brain are all affected. During adolescence a new phase of growth occurs under the control of steroid hormones secreted by the adrenals and gonads. The gonads of both sexes secrete estrogens in small quantities from the time of birth onwards. At puberty the estrogen level rise, sharply in girls and to a much more limited extent in boys; the sex differences is possibly due to an inhibitory hormone secreted by the seminiferous tubules of the testicle. Testosterone, produced by the testicle, is important in stimulating growth and it is responsible for the greater growth of muscle. Gonadotrophins are responsible for the growth of the ovaries and testis, and later on the secretion of the amounts of estrogens and testosterone responsible for the growth and development of secondary sex characters.

Nutritional

Growth is closely related with nutrition. A sufficiency of food is essential for normal growth. An adequate supply of calories is naturally essential for the normal growth of humans and the need varies with the phase of development. Nine different amino acids have been claimed to be essential for growth and absence of any one will result in disordered or stunted growth. Other factors are also essential for growth. For example, zinc plays a part in protein synthesis and is a constituent of certain enzymes; a deficiency of zinc causes stunting, interference with sexual development and falling out of hair. Iodine is needed for the manufacture of the thyroid hormones. Bone will not grow properly without an adequate supply of calcium, phosphorus and other inorganic constituents such as magnesium and manganese. Iron is required for the production of haemoglobin. Vitamins play an important part in growth. Vitamin A is thought to be control the activities of osteoblasts. In vitamin C

deficiency the intercellular substance of bone is inadequately formed. Vitamin D deficiency is the cause of rickets. Malnutrition during childhood delays growth, and malnutrition in the years proceeding adolescence delays the appearance of the adolescent spurt. Growth studies have demonstrated that malnutrition may cause serious impairment of growth. The term malnutrition generally refers to the effects of an inadequate intake of calories or other major dietary components such as proteins. Malnutrition may also result from diseases which decrease the appetite or interfere with digestion and assimilation. A majority of malnourished children fail to achieve their full genetic potential of body growth (both linear and ponderal) and are thus stunted or wasted or both.

Cultural

The physical growth of human beings is definitely affected by cultural factors. Culture differs from ethnic group to ethnic group. The body growth differences correlate with varied cultural groups. The physical growth of the body follows some adaptations in different geographical areas of distribution of the groups.

Socioeconomic

Socioeconomic influence on human growth is also a well known factor. Children from different socioeconomic levels differ in average body size at all ages that have been investigated. The upper groups being always more advanced along the course to maturity. The cause of this socio - economic differential are probably multiple. Nutrition is almost certainly one, and with it all the habits of regular meals, sleep, exercise and general organization that distinguish, from the point of view, a good home from a bad one. Growth differences are more closely related to the home conditions than to the strictly economic status of the families and home conditions reflect the intelligence and personality of the parents. Size of family exerts an indirect influence on the rate of growth. In a large family with limited income the children do not get proper nutrition. As a result the growth is affected. The number of children in the family exerts an effect on the children's rate of growth. Children in large families have been shown to be usually smaller and lighter than children in small families. Possibly this is because in large families children tend to get less individual care and attention.

Healthy growth and development requires family-centered, community-based, culturallycompetent, coordinated care and support throughout the life course during preconception and prenatal periods, infancy, childhood, adolescence, and adulthood.

Components include:

• Addressing factors that affect biologic, psychological, social and emotional growth and development.

• Conducting prevention, screening, assessment, and intervention to promote healthy growth and development across the life span.

• Promoting healthy social, emotional, behavioral, cognitive, linguistic, sensory, and motor development.

Healthy growth and development in early life have a profound effect on health across the life span. Research studies over the past decade demonstrated the link between early life events and adult chronic diseases and found that babies born at lower birth weights have an increased risk of developing heart disease, diabetes, and high blood pressure in later life. Infants with poor birth outcomes begin life with multiple risk factors that may prevent them from reaching their full health and development potential. In an average week in Wisconsin (based on data for 2008), 1,385 babies are born. Of these, 153 babies are born preterm (before 37 weeks of gestation), 97 babies are born low birthweight (less than 2,500 grams or approximately 5.5 pounds), and 10 babies will die before reaching their first birthday (Wisconsin Interactive Statistics on Health).

Significant racial and ethnic disparities in birth outcomes exist in Wisconsin. A greater proportion of infants born to Black/African American women than those born to White women are low birthweight or preterm. Health conditions related to prematurity and low birthweight are the leading cause of infant mortality for Blacks/African Americans. In 2006-2008, infants bornto Black/African American women were 2.8 times more likely to die in the first year of life than infants born to White women (Wisconsin Interactive Statistics on Health).

Objectives

- To study the relation between gender and growth.
- To study different feeding and weaning practices and its impact on growth.
- To know the impact of literacy and income on the growth.
- To study the relation between working status, birth order and birth spacing and its influence on growth.

Material And Methods

The present study has been carried out over a period of 2 years on longitudinal basis with the aim to obtain empirical information about Kashmir urban children on growth in the first two years of life and compare it with that of other Indian children. One basic need that

was fulfilled by conducting the present study was to obtain much needed growth norms and patterns of Kashmiri urban children.

Sampling

A multistage purposive random sampling technique was used to select the urban children born to normal mothers without any evident medical problem likely to influence growth. The children have been selected form five wards of Srinagar (urban) city which was arbitrarily divided into four zones. The initial sample of 300-350 children was selected and followed up for 2 years, however moderate compliance to follow ups and data collection as per Performa (Schedule) designed especially for the purpose left with only 194 children for complete analysis and interpretation.

Method Used

For assessment of growth:

Anthropometric measurements of weight and Crown Heal Length were taken.

Tools Used (Testing Kit) *For Growth*

- Electronic Weighing Machine
- Infantometer (specially designed for purpose)

Testing procedures

- **Length** was measured with the help of an infantometer with the child lying supine. The head touching the head board, and the knees were held extended. The second board touching the feet (the whole foot and not just the toes). The length was read from the measurements marked on the infantometer.
- **Weight** was recorded with the help of an electronic weighing machine. During the first year when the child was unable to stand the mother was asked to pick up the child in her lap and then weight of both mother and child was recorded. After that only mother's weight was recorded and her weight was subtracted from the weight (mother and child) recorded earlier. This way the child's weight was obtained. During 2^{nd} year the child was asked to stand on the weighing machine and his weight was recorded.

Follow up

At the time of registration children were arranged in such a way that they made three separate cohorts for each month. Each cohort would accordingly get a turn for follow up after a gap of 3 months as per their turn. On an average twenty children were observed every week.

As described earlier, certain number of children could not be followed because either they had changed their address or were out of station for more than six months. Some children or their parents were uncooperative for assessment of growth. Four children died during 2 years period. The final sample left was only 194, who have been regularly followed without many problems.

Analysis

- Simple frequency analysis was done to group children within various weights and Crown Heal Length (CHL) ranges and to determine average with standard deviation for weight and Crown Heal Length at specific months (quarterly intervals) during two year period.
- Percentile of weights and Crown Heal lengths at specific months were computed and compared to NCHS and ICMR standards.
- Impact of various socio- medical factors like weaning, feeding pattern, mother's literacy, working status, income, birth order and birth spacing on growth pattern was determined and differences if any tested by applying test of significance (t-test).

Results And Discussion

TABLE - 1
GROWTH (WT AND CHL) IN RELATION TO GENDER PATTERN

Age in Months	Weight			CHL			P - Values	
	Male Mean ± SD (Kgs.)	Female Mean ±SD (Kgs.)	Overall Mean ±SD (Kgs.)	Male Mean ±SD (Kgs.)	Female Mean ±SD (Kgs.)	Overall Mean ±SD (Kgs.)	CHL	Weight
Birth	3.05 ±.48	2.89 ±.49	2.97 ±.49	50.24±2.80	48.09±3.18	49.17±3.17	<.0001(S)	<.024 (S)
3rd	5..11 ± .86	4.81 ±.78	4.96 ±.83	58.76±3.37	56.35±4.33	57.53±4.06	<.0001(S)	<.015 (S)
6th	6.66 ± 1.06	6.29 ± 1.01	6.48 ± 1.05	64.00±3.71	61.29±4.57	62.64±4.37	<.0001(S)	<.016 (S)
9th	7.88 ±1.25	7.49 ±1.14	7.69 ±1.21	68.53±3.70	65.80±4.11	67.18±4.13	<.0001(S)	<.024 (S)
12th	8.39 ± 1.38	8.55 ±1.22	8.72 ±1.31	73.08±4.04	70.35±4.29	71.71±4.38	<.0001(S)	>.077 (IS)
15th	9.63 ±1.44	9.34 ±1.29	9.49 ±1.37	76.54±4.24	74.20±.11	75.36±4.32	<.0001(S)	>.151 (IS)
18th	10.41± 1.59	10.01 ± 1.45	10.21 ±1.53	79.62±4.30	77.39±4.06	78.54±4.32	<.0001(S)	>.072 (IS)
24th	11.55 ±1.65	11.04 ± 1.49	11.29 ± 1.59	84.06±4.28	81.38±3.71	82.7 0±4.21	<.0001(S)	<.026 (S)

Table 1 reveals that children at birth had an average weight of 2.97 ± 0.49 kgs. males averaging 3.05 ± 0.48 kgs and females 2.89 ± 0.49 kgs. The CHL at birth among males was 50.24 ± 2.80 cms which is higher than females whose average length is 48.09 ±3.18 cms. The mean CHL for both sexes being 49.17 ± 3.17 cms. Assessment of weight and CHL at 3rd month revealed weight as 5.11 ± 0.86 kgs for males and 4.81 ± 0.78 kgs for females and the mean weight for both groups was 4.96 + 0.83 kgs. Similarly CHL for males was 58.76 + 3.37 cms and in females 56.35 ± 4.33 cms and the overall CHL for both sexes was 57.53 ± 4.06

cms. At 6th month the same pattern for weight and CHL is followed by males who had higher weight and length (6.66 ± 1.06 kgs and 64.00 ± 3.71 cms) than the females (6.29 ± 1.01 kgs and 61.29 ± 4.57 cms). The average weight and CHL for both sexes was 6.48 ± 1.05 kgs and 62.64 ± 4.37 cms respectively.

Values at 9th month again reveal a similar picture with mean weight being 7.88 ± 1.25 kgs for males and 7.49 ± 1.14 kgs for females. The overall mean weight being 7.69 ± 1.21 kgs. As regards to CHL the males are longer (68.53 + 3.70 cms) than females (65.80 ± 4.11 cms). Overall mean CHL being 67.18 ± 4.13 cms.

The measurements at 12th month showed 8.89 ± 1.38 kgs among males and 8.55 + 1.22 kgs among females as the weight and 73.08 ± 4.04 cms among males and 70.35 ± 4.29 cms among females as the lengths respectively, the overall average (both sexes) was 8.72 ± 1.31 kgs in respect of weight and 71.71 ± 4.38 cms in respect of CHL. At the 15th month average values for both sexes in respect of weight and CHL are 9.49 ± 1.37 kgs and 75.36 ± 4.32 cms respectively. The males having weight (9.63 ± 1.44) marginally more than females (9.34 ± 1.29 kgs). With regard to CHL the males were 76.54 ± 4.24 cms and females 74.20 ± 4.11 cms long.

At 18th month on an average males weighed 10.41 ± 1.59 kgs and females weighed 10.01 ± 1.45 kgs. The overall mean weight being 10.21 ± 1.53 kgs for both sexes. The CHL among the males was 79.62 ± 4.30 cms as compared to females who were 77.39 ± 4.06 cms long. The overall mean CHL being 78.54 ± 4.32 cms.

At the end of 2 years the anthropometric values present a similar picture, we find that males have 11.55 + 1.65 kgs weight and 84.06 + 4.28 cms CHL and females 11.04 ± 1.49 kgs weight and 81.38 + 3.71 cms CHL. The overall averages for both sexes being 11.29 ± 1.59 kgs in respect of weight and 82.71 ± 4.21 cms in respect of CHL.

Difference between the weights of males and females is significant right upto 9th month ($p < .001$) of age but from 12th - 18th month although males have higher values but statistically they are not significant ($P > .05$). However the difference is significant at the end of 24th month.

With regard to CHL the difference is significant throughout 2 year period ($P<.01$). The males being longer than females.

Table-2
Growth (Chl& Wt.) Of Children Un Relation To Feeding Pattern

	E.B.F		M.F		A.M		P.value
	Mean	S.D ±	Mean	S.D ±	Mean	S.D±	
Wt. at 12th month	8.99	1.24	8.07	1.38	9.00		<.05(S)
Wt. at 24th month	11.33	1.56	11.25	1.63	12.50		>.71(IS)
CHL at 12th month	72.56	4.06	71.08	4.70	76.10		<.02(S)
CHL at 24th month	82.76	3.96	82.60	4.52	85.70		>.75 (IS)

Table 2 reveals that exclusively breast fed children had an average length of 72.56 ± 4.06 cms. and 82.76 ± 3.96 cms. at 12th and 24th month respectively. In comparison, children on mixed feeding had an average length of 71.08 + 4.70 cms. and 82.60 ± 4.52 cms. at 12th and 24th months respectively. The lone child who was on artificial milk only had an average length of 76.10 cms. at the end of 1st year and 85.70 cms. at the end of 2nd year. The weight of babies at 12th and 24th month age were 8.99 + 1.24 Kgs. and 11.33 ±1.56 Kgs. for breast fed children, 8.07 ± 1.38 Kgs. and 11.25 ± 1.63 Kgs. for mixed fed children and 9.00 Kgs. and 12.50 Kgs. for the children on artificial milk respectively. The difference in mean weight and CHL was statistically significant in first year of life.

Table-3
Growth (Chl & Wt.) Of Children In Relation To Weaning Pattern

	Normal		Delayed		P.value
	Mean	S.D ±	Mean	S.D ±	
Wt. at 12th month	9.06	1.12	7.11	0.89	<.00 (S)
Wt. at 24th month	11.74	1.27	9.14	1.12	<.00 (S)
CHL at 12th month	72.55	3.98	67.72	4.00	<.00 (S)
CHL at 24th month	83.75	3.53	77.65	3.54	<.00 (S)

Table 3 reveals that the mean weight and CHL (at the end of 1st. year) among children with delayed weaning was lower i.e., 7.11 + 0.89 Kgs. and 67.72 ± 4.00 cms. respectively. A similar picture was found at the end of 2nd year where in the values were 9.14 ± 1.12 Kgs. In case of weight and 77.65 ± 3.54 cms. in case of CHL. In contrast the weight and CHL of children with normal weaning at the end of 1st. and 2nd. year was higher i.e., 9.06 ± 1.12 Kgs. weight at the end of 1st. year and 11.74 ± 1.27 Kgs. weight at the end of 2nd. year. In respect of CHL the values were 72.55 ± 3.98 cms. and 83.75 ± 3.53 cms. for 1st. and 2nd year respectively. The difference for both weight and CHL at the end of 1st. and 2nd. year was significant statistically.

Table - 4
Growth (Chl & Wt.) Of Children In Relation To Income Pattern

	Low upto 20,000		Lower Middle 20001-40,000		Upper Middle 40,001-62,000		High 62,001-86,000		Above 86,000		P. value
	Mean	SD±	Mean	SD±	Mean	SD±	Mean	SD±	Mean	SD±	
Wt. at 12th month	8.56	1.29	8.74	1.26	8.75	1.31	9.05	1.37	9.75	1.06	>.08
Wt. at 24th month	11.05	2.75	11.06	1.67	11.51	1.45	11.52	1.58	11.56	1.34	<.01
CHL at l2 month	71.26	4.50	71.45	4.27	72.28	3.51	72.90	5.26	74.00	0.00	>.07
CHL at 24 month	82.15	3.98	82.95	33.78	83.06	4.48	83.75	5.27	85.05	2.6	<.01

With respect to income the mean values for weight and CHL at the end of 1 st year were as follows. Children belonging to low income group had CHL of 71.26 + 4.50 cms. and weight of 8.56 ± 1.29 Kgs., children of lower middle group had length of 71.45 + 4.27 cms. and weighed 8.74 + 1.26 Kgs. and the children whose parents had income above Rs.86,000 per annum had average length of 74.00cms. and weighed 9.75 ± 1.06 Kgs. The difference in the mean weights and CHLs were insignificant statistically. However, at the end of 2nd year, the difference in the mean weights and CHLs was significant. The weight for children belonging to low income group was 11.05 ± 2.75 kgs, 11.06 ± 1.67 kgs for lower middle group and 11.56 ± 1.34 kgs for children belonging to above 86,000 income group. For CHL the values were 82.95 ± 3.78 cms, for lower income group, 83. 06 ± 4.48 cms for lower middle group, 85.05 ± 2.61 cms for upper middle income group and 82.15 ± 43.98 cms, for above 86,000 income group.

Table-5
Growth (Chl & Wt.) Of Children In Relation To Working Status Of Mother

	Working		House Wife		P.value
	Mean	S.D ±	Mean	S.D ±	
Wt. at 12th month	9.05	1.10	8.64	1.35	>.08 (IS)
Wt. at 24th month	11.98	1.22	11.11	1.63	<.002 (S.)
CHL at 12th month	72.97	4.14	71.38	4.39	<.041 (S)
CHL at 24th month	84.33	3.55	82.26	4.28	<.005 (S)

The children whose mothers were working showed more weight and CHL (at the end of 1st. and 2nd. year) than children whose mother's were housewives. The values for CHL at the end of 1st. year were 72.97 ± 4.14 cms. and 71.38 ± 4.39 cms. for children whose mothers were working and housewives respectively. In respect of weight the values were 9.05 ±1.10 Kgs. and 8.64 + 1.35 Kgs. (at the end of 1st. year) for children of working and housewives respectively. The values for the 2nd. year present a similar picture. In case of working

mother's children the weight was 11.98 ± 1.22 Kgs. and 11.11 ± 1.63 Kgs for children whose mothers were housewives. The difference between the CHL was statistically significant both at 12th. and 24th. month. While as for weight at the end of 1st year, the difference was insignificant.

Table-6
Growth (Chl. & Wt.) Of Children In Relation To Mother's Literacy Status

	Literate		Illiterate		P.value
	Mean	S.D ±	Mean	S.D ±	
Wt. at 12th month	9.<07	1.16	8.16	1.35	<.001 (S)
Wt. at 24th month	11.80	1.35	10.44	1.60	<.001 (S)
CHL at 12th month	72.91	4.24	69.80	3.91	<.001(S)
CHL at 24th month	84.06	3.70	80.39	4.04	<.001 (S)

The growth at 12th and 24th month was found to be better amongst children with literate mothers, the mean weight at 12th. month was 9.07 ± 1.16 Kgs. and it was 11.80 ± 1.35 Kgs. at 24th. months whereas CHL at 12th. month was 72.91 ± 4.24 cms. and 84.06 ± 3.70 cms. at 24th. months as compared to children of illiterate mothers whose mean weight and CHL was 8.16 ± 1.35 Kgs. and 69.8 ± 3.91 cms. at the end of 1st year and 10.44 ± 1.60 Kgs. and 80.39 ± 4.04 cms. at the end of 2nd. year.

Table-7
Growth (Chl & Wt.) Of Children In Relation To Birth Order Of The Of Child

	1st. Born		2nd. Born		3rd. Born		4th & above		P value
	Mean	S.D ±	Mean	S.D±	Mean	S.D±	Mean	S.D±	
Wt. at 12th month	8.85	1.23	9.02	1.28	8.47	1.27	8.06	1.44	<.013(S)
Wt. at 24th month	11.57	1.41	11.64	1.51	10.86	1.64	10.40	1.72	<001(S)
CHL at 12th month	72.80	4.18	71.84	3.84	70.73	5.08	70.35	4.08	<039(S)
CHL at 24th month	83.70	4.20	82.85	3.95	81.93	4.62	80.93	3.34	<028 (S)

In case of birth order, the weight and CHL at the end of 1 st. and 2nd. year of life, is far better amongst 1st. and 2nd. born, as compared to children with higher birth orders. The values for CHL (at 12th month) were 70.35 ± 4.08 cms. for 4th and above born. Similarly for 24th month the values were 83.70 ± 4.20 cms. for 1st. born, 82.85 ± 3.95 cms. for 2nd. and 80.93 ± 3.34 cms. for children whose birth order was 4th or above. With regard to weight the values for 1st. year were 8.85 ± 1.23 Kgs. for 1st. born, 9.02 ± 1.28 Kgs. for 2nd and 8.06 + 1.44 Kgs. for 4th. born or above. At the end of 2nd year the weight for 1st. bom was 11.57 +

1.41 Kgs, 11.64 ± 1.51 Kgs. for 2nd. born and 10.40 ± 1.72 Kgs. for 4th. or above born. The difference in mean weight and CHL was found to be significant statistically also.

Table-8
Growth (Chl & Wt.) Of Children In Relation To Birth Spacing

	<3 years				> 3 years				
Age	**Wt.**		**CHL**		**Wt**		**CHL**		**P value**
	Mean	**S.D ±**	**Mean**	**S.D±**	**Mean**	**S.D±**	**Mean**	**S.D±**	
12th month	8.85	1.02	71. 32	3.72	9.72	1.12	72.97	3.88	<.001 (S)
24th month	10.85	1.58	79.18	4.01	12.21	1.62	81.35	4.27	<.001 (S)

It was observed that spacing had an impact on growth pattern. At the end of 1st. year the children whose mother had practized spacing of more than 3 years weighed 9.72 ± 1.12 Kgs. as compared to those children whose mother's had not practized spacing, weighing only 8.85 ± 1.02 Kgs. With regard to crown heal length a similar pattern was observed. Children of mothers practizing spacing were 72.97 ± 3.88 cms. as compared to children where mothers had not practized spacing were 71.32 ± 3.72 cms. long.

The difference in weights and CHL was more marked at the end of 2nd. year, wherein it was observed that children whose mothers had practised spacing had an average weight and CHL of 12.21 ± 1.62 Kgs. and 81.35 ± 4.27 cms. respectively. On the other hand the children whose mothers had not practized spacing had an average weight and CHL of 10.85 ± 1.58 Kgs. and 79.18 ± 4.01 cms. respectively.

Discussion

While assessing the growth of children in relation to various socio-medical factors, it was found that the mean weight and CHL of male and female children showed a significant difference in the growth during 1st 9 months of life with males having better mean weight and height compared to their counterparts. However, this difference was minimal at 12 months of age and from 15 months of age there was no significant difference in the weight in the present study except at 24th month were difference was again significant. Similar findings have been reported by Joseph and John (1970) in a hospital based study showing significantly higher growth among male children than female children. Even Phadke and Limaye (1973) have substantiated such findings from urban areas.

It was found that 52.6% (102) children remained exclusively breast fed and another 46.9% (91) continued with mixed feeding. There was a clear cut difference in the Wt and CHL at 12th month of age. The weight was definitely better amongst children exclusively breast fed compared to mixed fed children in the 1st year and in the 2nd year there was no

difference probably due to beneficial effects of breast milk which get nullified during 2nd year due to improper weaning and infections. These findings are consistent with the findings of Ahn *et al* (1980) Rafiqul (1984), Victora (1986). Prentice (1994) who in their study concluded that breast feeding needs to be encouraged in 1st 2 years of life. It was interesting to note that the majority of children (83%) had been weaned normally (between 6-9 months of age) and only 17% had delayed weaning (beyond 12 months) Weight and CHL at 12th and 24th months was significantly better amongst children weaned appropriately compared to children with delayed weaning. Sidhu *et al* (1981) and Kumari *et al* (1981) have shown that there is a definite impact of feeding and weaning on growth parameters especially the weight and height of the children.

Study from WHO and UNICEF (1991) have observed that weight gain was usually in infants who did not receive any food supplements until after 6 months. Swaminathan (1964) and others have shown that children have better weight if weaned properly, otherwise they fall back in the growth especially with weight and subsequently the CHL is also affected if not weaned at appropriate age.

Conveney (1985) and Grummer and Lawrence (1993) have not been able to confirm these findings in relation to exclusive breast feeding / artificial feeding and have reported a negative association between prolonged breast feeding and growth. Sinha *et al* (1991) concluded in his study that unsatisfactory growth in children may be related to quality and quantity of supplementary foods.

The growth in relation to literacy status of mothers has shown a significant difference in the weight and CHL at 12th and 24th months of age. These findings are in agreement with Formen *et al* (1995). The difference in the weight and CHL of children of literate and illiterate mothers was clearly shown by Christen *et al* (1988) in his study. Literacy not only improves choice of qualitative but also the quantitative feeding and weaning practices.

The child's growth in relationship to low income group when assessed for weight and CHL at the end of 1st and 2nd year showed lower mean values for weight and CHL in comparison to children belonging to high income group. However, the differences were more conspicuous at the end of 2nd year as compared to the end of 1 st year. This can be attributed to availability of food (especially the weaning food which after all is a purchasable commodity) and lack of appropriate and adequate knowledge. Improper weaning, inadequate supplementary feeding coupled with infections affects growth more during 2nd year of life

than in the 1st year of life. Achar and Yankaver (1962) and Harishchandra *et al* (1971) have also reported similar findings in relation to the weight of children.

Even the birth order of the child has shown significant effect on the weight and CHL at the end of 1st and 2nd year of life. The first and second born child being advantageous of having better weight and CHL as compared to babies with higher birth order (4th and above). The differences stands to the reason that children with 1st and 2nd birth order not only are looked after better but also do not face the sharing problems on account of food intake. Morley.D *et al* (1968) has also found association between low weights and birth order greater than seven without any corresponding relationship at lower birth orders in Nigerian children. Similar findings have been reported by Wray and Aguirre (1969) wherein it is reported that prevalence of PEM increases with birth ranks much as it does with family size. The child rank in the family would effect his nutritional status. A higher birth order number implies a large number of children already present in the family.

Even children born to mothers who had practiced spacing (> 3 years) had weight and CHL significantly better than their counterparts at the end of 1st and 2nd year of life. Thus confirming the fact that given the longer time interval between the births, the children could be looked after and cared better during his 1st and 2nd year of life and also would allow the mother to rebuild her reserves for a better future pregnancy outcome who otherwise would go in "maternal depletion syndrome" and thus results in better child outcome once again. Vijay Kumar, (1992) has also substantiated such findings by reporting that the increase in birth weight to which birth spacing contributes brings in a higher quality of child life. Thus ensures maternal and child survival and decreases morbidity.

In the present study, majority of mothers (78.90%) were housewives and only 21.1% were working. The growth of the children belonging to housewives showed significantly lower weight and CHL at 12th month and 24th months of age in comparison to children belonging to working mothers. Similar findings have been reported by Christen *et al* (1989), who has attributed the difference in the growth of child to increase in income of families among working mothers. Though the other studies have not found any positive effect on growth. In fact, they have observed a negative effect on child's nutritional status through non-financial mechanisms that effect food consumption and health (Rabiee 1980).

Evidence from a number of other studies (Grewal *et al* 1973) in India (Rawsin and Valverde in 1976) in Costa Rica, (Chutikul and Srilaksana 1986) in rural Thailand associated the women who worked outside the home with lower nutritional status for their children. This

is often so because the mother's job seriously affected the amount of time she is able to devote to child care and young children are often left under the supervision of older siblings. The Life Course Health Development Model (Lu and Halfon, 2003) is useful in understanding disparities in birth outcomes and the influences on healthy growth and development across the life span. The model illustrates that birth outcomes are influenced by the health of the mother throughout her life, not just during the nine months of pregnancy. Many women enter pregnancy with risk factors for poor birth outcomes such as obesity, stress, smoking, or sexually transmitted infections. It is important to optimize women's health prior to pregnancy by providing screening, education, and interventions to reduce those risk factors. Interventions include providing preventive measures (multivitamins with folic acid, immunizations), managing health conditions (diabetes, infections), and supporting healthy behaviors (smoking cessation, physical activity). Additionally, variations in exposures to risk and protective factors across the life span contribute to racial and ethnic disparities. Chronic experiences with risk factors such as racism and poverty have a negative impact on health. Social support and access to high-quality health care are known protective factors that support health. Early childhood is also a critical development period with lifelong impacts on health. Recent research has clearly shown that brain development of children before the age of five has a profound influence on their social, emotional, language, memory, physical, and cognitive development. Positive environments and relationships in the life of a child serve as protective factors to support development and provide a strong foundation for all future learning, behavior, and health. It is well established that adverse conditions such as family turmoil, enduring poverty, violent neighborhoods, and substandard daycare conditions put children at higher risk for mental health and developmental problems that can persist into school-age years and adulthood.

Summary And Conclusion

The average weight of new born (around birth) was 2.97 ± 49 kgs and the average CHL was 49.17 ± 3.17 cms. The assessment of weight and CHL at quarterly intervals during first and second year revealed that the overall weight and CHL of children at 6 months was 6.48 ± 1.05 kgs and 62.64 ± 4.37 cms respectively. At 12th month it was 8.72 ±1.31 kgs and 71.71 ±4.38 cms respectively thus confirming the fact that weight of children had doubled by 6 months and tripled by 12 months of age. However, with respect to CHL there was only 46% (45.84%) increase up to 12 months from the base value (birth value).

The second year of life in the present study shows that mean weight and CHL at 18 months was 10.21 ± 1.53 kgs and 78.54 ± 4.32 cms respectively. At 24th months the values

were 11.29 ± 1.59 kgs and 82.70 ± 4.21 cms for weight and CHL respectively. These values were almost comparable to national averages reported by NIN and were better than ICMR. Thus a 4 fold increase (quadruple effect) of weight change was seen by 24 months of age though CHL showed only 68.19% increase from the base value (birth value) in comparison to usual 75% increase reported in various standards.

The rate of growth for weight parameter was very fast i.e., 87.83% in first three months. Thereafter, there is a steady slowing down of growth in the next six months ranging between 18.67% to 13.39% which in the second year of life shows further slowing at a consistent rate. Similar pattern of growth rate increase is seen for crown heal length.

The growth of children in relation to various socio-medical factors showed that the mean weight and CHL among male and female children had a significant difference during first nine months of life with males having better mean weight and CHL compared to their counter parts. However, this difference was minimal at 12 months of age and from 15 months of age there was no significant difference in the weight and CHL. Even the percentile values showed similar pattern which was more evident in respect of CHL than weight in children.

In respect of feeding and weaning it was seen that there is clear cut difference in the weight and CHL at 12th and 24th months of age. The weight was definitely better amongst children who were exclusively breast fed compared to children who were on mixed feeding in the first year. It was interesting to note that the majority of children (83%) had been weaned normally. Weight and CHL at 12th and 24th months was significantly better amongst children weaned appropriately (6 to 9 months) compared to children with delayed weaning.

The growth in relation to literacy status of mothers has shown a significant difference in the weight and CHL at 12th and 24th months of age. The mean weight and CHL being better in case of children born to literate mothers than with those of children born to illiterate mothers.

The child’s growth in relationship to family income showed that weight and CHL at the end of first year had lower mean values for children belonging to low income group in comparison to children belonging to high income group. Similar pattern was also observed at the end of 24 months age. The differences at the end of second year were more conspicuous rather than at the end of first year.

Even the birth order of the child has shown significant effect on the weight and CHL at the end of first and second year of life. The first and second born child being advantageous of having better weight and CHL as compared to babies with higher birth order. In respect of

birth spacing, weight and CHL of children who's mother had practiced spacing > 3 years was significantly better that the children who's mothers gave birth to another baby within 3 years.

The growth of the children belonging to housewives showed significantly lower weight and CHL at 12th month and 24th months of age in comparison to children belonging to working mothers.

References:

Achar, S.T., and Yankaver, A. (1962). "Studies on birth weight for South Indian infants". *The Indian Journal of Child Health*, Vol. 11-No.4.

Ahn, C.H; Madean W.C.L. (1980). "Growth of the exclusively breast fed infants in first six months". *American Journal of Clinical Nutrition*, Vol.33: 183-192.

Christian P., Gujral. S., Rita D., Abbi, Gujrals and Gopaldas T. (1989). "Relationship between maternal and infant nutritional status". *Journal of Tropical Pediatrics*, Vol. 35: 71-76.

Christian P., Rita D., Abbi, Gujrals and Gopaldas T. (1988). "The role of maternal literacy and Nutrition knowledge in determining children's Nutritional Status". *Food Nutrition Bulletin*, Vol.10. No.4:25-40.

Chutikul and Srilaksana. (1986). "Malnourished children - an economic approach to the causes and consequences in rural Thailand USAED." *Research and Development Abstract*, Vol.2:46.

Coveney, John (1985). "Is Breast Milk the best food for all Infants"; *Human Nutrition: Applied Nutrition*. Vol. 39A: 179-188.

Forman, M.R., Hundt, G.L., Berendes, H.W., Saad, K.A.,Zangwill, L., Chang, D., Bell maker, I., Saad, L A and Graubard, B. I. (1995)." Undernutrition among Bedouin Arab children: a follow-up of the Bedouin Infant Feeding study". *American Journal of Clinical Nutrition*, Vol.61, No.3:pp 495-500

Grewal T., Gopaldas T.and Grade VJ (1973). "Etiology of Mal nutrition in Rural Indian Pre-school children in M.P". *Journal of Tropical Pediatrics & Environmental Child Health*. Vol.19: 265-270.

Grummer, S., Laurene, M.(1993). "Does prolonged breast feeding impair child growth? A critical review". *Pediatrics*, Vol.91, No. 4: p.766-771.

Harish Chandra,(1971). "Birth wt of infants of different economic groups in Hyderabad". *Indian Journal of Pediatrics,* vol. 59, No.6:p.99-103.

John, C. and Joseph, P.H. (1970). "A study of the birth wt of Infants Born in a Hospital in Bombay city". *Demographic Training Research Centre,* Bombay.

Kumari S; Barti. P, Goel N. (1981). "Weight Pattern of breast fed infant -A Cross Sectional Study". *Indian Journal of Pediatrics,* Vol.18 : 333-336.

Lu MC, Halfon N. Racial and ethnic disparities in birth outcomes: a life-course perspective.Matern Child Health J. 2003;7:13-30.

Morley D.C., Bickwell J. and Woodland M. (1968). "Factors influencing the growth & Nutritional status of infants & young children in Muigan village". *Transactions of Royal Society of Tropical Medicine and Hygiene*, Vol. 62:164-165.

Phadke, M.V. and Limaye, C. (1973). "Infant Growth in Urban and Rural Maharashtra". *Indian Pediatrics,* Vol.10, No.6:387-390.

Prentice, Ann (1994) "Extended Breast Feeding and Growth in Rural China". *Nutrition Reviews,* Vol.52, No.4:144-146.

Rabiee, F. Geissler (1980). "Maternal work and child nutrition in Iran". 14th International Contress, Seoul, Korea, 226-227. In Yasoda Devi and Geervani (Eds). *Determinants of Nutritional Status of Pre-School Children*. Discovery Publishing House, New Delhi, p.21.,

H.C. (1984) "Determinants of Dietary Intake and Dietary Adequacy for Pre- school Children in Bangladesh". Food and Nutrition Bulletin, VoL6:17-33.

Rafiqual, H.C.(1984) "Determinants of Dietary Intake and Dietary Adequacy for Pre-school Children in Bangladesh". *Food and Nutrition Bulletin*, Vol.6:17-33

Rawson, Jan. G. and Valverde, V. (1976). "The etiology of malnutrition among preschool children in rural Costarica." *Journal of Tropical Pediatrics and Environmental Child Health,* Vol.22:12-17.

Sidhu, LS, Grewal R., Bhatnagar, DP. (1981). "A study of physical growth in breast fed and bottle fed male infants". *Indian Pediatrics,* Vol.48: 75-79.

Sinha, A and Kumar, A.R.(1991). "Infant Growth in relation to feeding practices in low income families". *Indian Pediatrics*. Vol. 28, No.l:57-64

Swaminathan, M.C; Jyothi, K.K; Raghbir, S.H. Shantham Madhavan and Gopalan (1964). "A semi-longitudinal study of growth of Indian children and the related factors". *Indian Pediatrics,* Vol.1: 255-263.

Victora C.G., Vaughan J.P, Krikwood, P.R; Martinez, J.C and Barcelos, L.B (1986). "Risk

factors for malnutrition in Brazilian Children : the role of social & environmental variables". *Bulletin of WHO*, Vol. 64:299-309.

Vijay Kumar, K.(1992). "Birth spacing and its bearing on birth weight". *Indian Journal of Community Medicine*, Vol.XVII:No.l:.15-19.

Wisconsin Department of Health Services, Division of Public Health, Bureau of Health Information and Policy. Wisconsin Interactive Statistics on Health (WISH) data query system, Retrieved March 9, 2010 from http://dhs.wisconsin.gov/wish/

Wray and Aguirre (1969). In Devi and Geervani (Eds.) *Determinants of Nutritional Status of Pre-School Children*. Discovery Publishing House, New Delhi, p.28.