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FOLLOW UP STUDY OF GROWTH AND DEVELOMENT IN NEONATES WITH RESPIRATORY DISTRESS

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بسم الله الرحمن الرحيم

﴿قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ﴾

صدق الله العظيم

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ABSTRACT

Objectives: The aim of this study is to investigate the possible impact of respiratory distress on infants' growth and neurodevelopment at 6 to 24 months after birth in both preterm and full-term infants.

Methods: Data from 52 infants who were born in September 2003 through August 2004 and cared for at the neonatal intensive care unit of a private hospital were collected. They were divided into two groups, group I with 32 full-term infants and group II with 20 preterm infants. Respiratory distress was assessed according to Silverman Retraction Score. The studied groups were followed up at the ages of 6, 12, 18 and 24 months to assess: 1) Anthropometric measurements including; weight, length and head circumference and 2) neurodevelopmental assessment by using Bayley scales of infant development-second edition for Mental Developmental Index (MDI) and Psychomotor Developmental Index (PDI). Variables considered for the multivariate analyses included sex, maturity, Silverman scores, requiring mechanical ventilation, mechanical ventilation duration, O_2 supply duration, use of surfactant and diagnosis.

Results: The majority of the infants had moderate degree of respiratory distress (96.9% of F.T. and 100% of P.T). The commonest cause of respiratory distress in our study was transient tachypnea of newborn (78.1% of F.T. and 55% of P.T). Only 19.2% of all patients (30% of P.T. and 12.5% of F.T) required mechanical ventilation. The mean of mechanical ventilation duration was 5.25 ± 3.30 days in F.T. and 15 ± 12.30 days in P.T. The mean of O_2 supply duration was 2.41 ± 1.36 days in F.T. and 6.25 ± 7.64 days in P.T. Regarding the weight, length and head circumference, they were significantly increased in F.T. and P.T. groups throughout the four visits. Also, the rate of change in weight, length and head circumference was highly significantly different in P.T. compared to F.T. patients referred to their chronological ages. 90.4% of all patients (90.6% of F.T. and 90% of P.T.) had MDI and PDI scores ≥100. Only 9.4% of F.T. and 10% of P.T. showed mild developmental delay at 24 months of age (with corrected age of P.T. patients) with MDI and PDI scores between 90-99 which are far from the significantly handicapped range (≤70) on the Bayley scales.

Conclusion: There were no adverse effects on growth and development of infants who exposed to postneonatal respiratory distress, neither for preterm or full-term patients. The performance of full-term patients suggested that their mental and motor Bayley scores were comparable to those of average, healthy F.T. infants of the same age. Also, preterm patients with corrected age performed in the average range compared to healthy full-term infants of the same age.

Key Words: growth . neurodevelopment . preterm (P.T.) . full-term (F.T.) . follow-up . outcome . respiratory distress . Bayley scale

LIST OF ABBREVIATIONS

• **ARDS:**	Acute Respiratory Distress Syndrome.
• **BP:**	Blood pressure.
• **BPD:**	Bronchopulmonary Dysplasia.
• **BSID-II:**	Bayley Scale of infant Development-2nd edition.
• **CLD:**	Chronic Lung Disease.
• **F.T.:**	Full-term.
• **GH:**	Growth Hormone.
• **HFV:**	High Frequency Ventilation.
• **hGH:**	Human Growth Hormone.
• **HMD:**	Hyaline Membrane Disease.
• **HRQOL:**	Health Related Quality Of Life.
• **ICU:**	Intensive Care Unit.
• **IDM:**	Infant of Diabetic Mother.
• **IQ:**	Intelligence Quotient.
• **IVF:**	In Vitro Fertilization.
• **IVH:**	Intraventricular Hemorrhage.
• **MAS:**	Meconium Aspiration Syndrome.
• **NEC:**	Necrotizing Enterocolitis.
• **NICU:**	Neonatal Intensive Care Unit.
• **P.T.:**	Preterm

• **PDA:**	Patent Ductus Arteriosus.
• **PPHN:**	Persistent Pulmonary Hypertension of Newborn.
• **PROM:**	Premature Rupture of Membrane.
• **QOL:**	Quality Of Life.
• **RDS:**	Respiratory Distress Syndrome.
• **ROP:**	Retinopathy of Prematurity.
• **SGA:**	Small for Gestational Age.
• **TTN:**	Transient Tachypnea of Newborn.
• **UTI:**	Urinary Tract Infection.

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INTRODUCTION

INTRODUCTION

The growth rate is an important indicator of the child's health state. Premature newborns require an especially exact and reliable assessment of their growth which should include, above all, their maturity ***(Kwinta et al., 2002).***

The outcome of premature newborns varies widely from centre to centre and from country to country. Gestational age is an important factor for predicting outcomes as birth weight ***(Bucher et al., 2003).***

Extremely low birth weight infants develop a growth deficit during the first few weeks of life that not only persists but also worsen during hospitalization. Potential causes of this growth deficit include the medical nutritional management that is part of the usual care of extremely low birth weight infants. Because these infants are discharged with this growth deficit, catch up growth will have to occur at home ***(Steward and Pridha, 2002).***

The preterm infants without intrauterine growth retardation catch up the term infants after three months. The preterm small for gestational age remain smaller than the preterm appropriate for gestational age or term infants in all measures throughout their first two years of life ***(Piekkala et al., 1998).***

In a long term prospective study, 46 unselected infants born before 35 completed weeks of gestational age were followed up, and compared to 26 full-term infants at 9 and 18 months of chronological age. Their height and weight were still lower than that of full term, but the difference disappeared when age was corrected for gestational age at birth ***(Forslund and Bjerre, 1985).***

Gortner et al. 2003 found that no significant differences regarding neurodevelopmental outcome at 22 months were observed between small for gestational age and appropriate for gestational age infants. Small for gestational age infants didn't show catch up of growth.

The newborns born between 29-32 weeks of gestation have faster growth rate than newborn born between 24-28 weeks of gestation. The assessment of development of extremely premature newborns should be based on growth charts prepared separately for a given gestational age ***(Kwinta et al., 2002).***

Ninety percent of very low birth weight infants attained sitting at a corrected age of 9 months and walking at a corrected age of 16 months. Transient hypotonia did not modify the pattern of sitting and walking and it could be considered a variation of normality within the development of very premature infants ***(Pallas Alonso et al., 2002).***

Infants with bronchopulmonary dysplasia who required $O_2 \geq 28$ days are similar in growth, general health and neurologic outcome to the neonatal comparison group (who required $O_2 < 28$ days) when reached 18 months of age. But infants with bronchopulmonary dysplasia who required $O_2 \geq 36$ days are similar to the previous two groups at 18 months of age in growth, general health and neurologic outcome but differ in having a higher number of days of rehospitalizations for respiratory causes, more hernia repair, and more developmental delays ***(Gregoire et al., 1998).***

AIM OF THE STUDY

AIM OF THE STUDY

The aim of this study is to evaluate the impact of respiratory distress in the neonatal period on infants' growth and development during the first two years of life in both preterm and full-term infants.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Chapter (1): Brain Development

The brain and central nervous system develop steadily through fetal life, infancy and childhood. There are no dramatic changes that occur with or because of birth itself although sensory experience following birth is obviously different. At birth the cerebellum is more maturely developed than the cerebrum. Neuronal development and dendritic connections are more evident and myelination is already occurring from the oligodendroglia. Cerebral myelination and dendritic connections are predominantly postnatal events. Brainstem and higher reflexes develop in late fetal life in an orderly fashion and can be used to estimate gestation. Interruption at any stage will cause damage. The seriousness of ensuing problems will depend on the maturity of the brain at the time the damage occurs. Some recognition patterns seem innate in the newborn. Immediately after birth many newborns will follow a simple stylized face through 180° though if the features are scrambled this will not occur. Other experiments show rapid learning ability; for example by the fifth day of life the breast-fed infant will be able to detect his own mother by his sense of smell. ***(McIntosh, 1984).***

The concept of developmental neurology depends upon an understanding of brain development and the factors which affect it. Brain development can be divided into three stages ***(Alberts et al, 1989):***

1. Formation of The Neural Crest And Closure Of The Neural Tube;
2. Primitive Vesicle Formation;
3. Differentiation of The Primitive Vesicles, Especially The Telencephalic Vesicle, Into The Cerebral Cortex.

Closure of Neural Tube and Formation of Neural Crest

The neural tube becomes visible 22 days after conception and closure takes 4 days starting from the middle. The rostral and caudal ends of the neural tube will therefore be the last to close, i.e. the anterior and posterior neuropore. The cells at the margin of the neural plate and ectoderm form two longitudinal columns of cells, the neural crest cells. It is not known what controls neural tube closure though dopamine and noradrenaline are thought to be important: methyltransferase arrests catecholamine synthesis and causes the chick to develop spina bifida. In humans interference with closure in spina bifida is most often due to a combination of genetic factors with environmental factors such as folate deficiency. Other substances such as radiation, vitamin A excess, cytostatic drugs (especially antifolate drugs) and drugs such as sodium valproate may interfere with neural tube closure. In humans rubella, herpes simplex and toxoplasmosis infection in the mother will also occasionally interfere with neural tube closure and the effect of a heavy alcoholic binge at the time of closure is suspect. Agenesis of the sacrum with neural dysplasia may form part of the caudal regression syndrome seen in the infant of the diabetic mother ***(Brown et al, 1991).***

Development of The Cerebral Vesicles

The rostral end of the neural tube divides into three primitive vesicles: the prosencephalon, mesencephalon and rhombencephalon. In humans these are thought to be visible at around 28 days. The prosencephalon is subdivided into telencehalon and diencephalons. The telencephalon gives rise to the cerebral cortex and both the diencephalon and the telencephalon give rise to the thalamus. The diencephalon also gives rise to the third ventricle, hypothalamus, parts of the basal ganglia and the eye. The mesencephalon gives rise to the midbrain and the rhombencephalon to cerebellum, pons and medulla ***(Brown et al, 1991).***

Development of the telencephalon

Cell division and migration

The vesicle is generally thin walled but with a thick layer of cells, the germinal plate, adjacent to the ependyma. There is a clear intermediate zone and an outer marginal zone. Cells divide in the subependymal germinal plate, then migrate outwards along guidewires provided by the processes of the Bergman glial fibers to form the "cortical plate" of the marginal zone, i.e. the future cerebral cortex. The more recently the cell migrated, the more external its position in the cortical plate and hence the so-called "inside out rule". Cells do not undergo mitosis once they have left the germinal zone. Cell division in the subependymal zone remains active to about 28 weeks' gestation. Between 28 and 34 weeks the subependymal zone (germinal plate) undergoes rapid dissolution, but even at term a thin layer of subependymal cells can still be seen. The cells in the subependymal layer, although primitive, are already differentiated in that they are destined for certain areas of cortex. Several generations of young neuroblasts may migrate along the same glial fiber and so columns of cells form in the future cerebral cortex and this gives rise to grouping of cells in the cortex into cortical units or modules. Cells destined to be neurons tend to migrate before those which will give rise to glia ***(Alberts et al, 1989).***

Cell differentiation

There are six different types of neuron in the cerebral cortex and 60 different types of cell in the central nervous system. Blood vessels must penetrate the plate and the organization of the blood supply by mesenchyme invasion is not understood. In anencephaly one of the most obvious abnormalities on histological examination is a total disruption of vascular architecture with large areas of vascular malformation. A similar kind of vascular abnormality is seen in association with occipital encephalocele. Differentiation of neurons involves their correct orientation i.e. with axons pointing downwards. In cortical dysplasias many neurons may be upside down. The axon develops from neurites which grow out from the cell body and move by ameboid movement. It is not known how the neurite is guided into its eventual effector site but there are chemicals which attract and some which repel the growing axon and many chemical substances such as lamellin and fibronectin are now known to be implicated. The classic six cortical layers of the neocortex form in the order 5, 6, 3, 4, 2 and 1, granular cells of the fourth and second layer being particularly slow to mature. Glial multiplication occurs between 28 weeks and term as the so-called second DNA spurt. Damage to the developing glia such as the oligodendroglia may result in a postnatal failure of myelination and this can now readily be seen on MRI Imaging. Up to the 28th week the cerebral cortex has been smooth and the insular open with the opercular lip and single central sulcus. As cell numbers increase and the surface area of the cortical brain matter increases compared to the underlying future white matter, infolding is necessary to accommodate the greater surface area and this is seen in the formation of the gyri ***(Evrard, 1992).***

Biochemical maturation

Once cell differentiation occurs certain specific substances may be produced, such as fetal glial-specific protein which appears as glial cells mature at 24 weeks. As neuronal membrane formation increases there is an increase in ganglioside formation. There is little ganglioside in the cerebral cortex during the phase of cell division but when processes start to form, with the need to form large amounts of membrane, there is a rapid increase in ganglioside concentration. The most rapid rise is from the time of birth until the first 2 postnatal months and it has leveled off by 4 months after birth. Synaptosomal membranes are particularly rich in ganglioside. The type of ganglioside changes; GT1 forms up to 40% of ganglioside in early fetal life and then GDla at the time of the ganglioside spurt. GMl tends to be high but fairly constant during the whole period. GTl falls away after 26 weeks leaving GMl and GDla as the principal gangliosides at term. Ganglioside in the cortex differs from that in myelin by having 90% of its fatty acid content provided by stearic acid. After the first 4 weeks of postnatal life the astrocyte and the hepatocyte can synthesize certain essential fatty acids necessary for membrane formation from linoleic and linolenic acid in the diet. Before this time it is necessary to provide arachidonic and decosohexenoic acid in the diet. The fatty acid content of some of the structural brain lipids can therefore depend upon the type of milk that the infant is fed. This has led to speculation as to whether decosohexenoic acid which is present in breast milk but not in synthetic formulae should be added to infant formulae. Enzymes differentiate in different patterns throughout the brain, e.g. succinic acid dehydrogenase appears in the visual cortex long before it does in the motor cortex. There appears to be a critical time for the development of many enzymes and thyroid hormone is also needed over a comparatively narrow band of time (critical period). There is a large influx of amino acids into the fetal brain during maturation to keep pace with the high rate of protein synthesis and this influx falls when the rapid phase of brain development is over. Amino acid imbalance can block protein synthesis within cells and inhibit mitosis ***(Evrard et al, 1992).***

Cell process formation

Dendritic growth starts at 28 weeks gestation and is maximal from 28 to 35 weeks. The formation of dendritic spines, i.e. connections between neurons, is vital to the development of modules which make up the learning units of the brain. Severe loss of spines is seen in chromosome disorders such as trisomy 18 and in the infant suffering from infantile spasms. More spines are formed than is necessary and at first they are thin but then thicken as synaptic contact is made. If no contact is made the thin ones are lost by 6 months after birth. Even in a short period of artificial ventilation of the premature infant, there may be abnormal dendritic spine formation ***(Evrard et al, 1992).***

Myelination

Myelin is produced in the central nervous system by the oligodendroglial cells and in the peripheral nervous system by the Schwann cells. The cells form a membrane and wind round the axon in the well-known Swiss roll fashion. The first sheath is known as premyelin and it is only later that the lipids are laid down to produce the protein lipid sandwich of mature myelin. The purpose of myelin is to allow rapid conduction down the axon and to insulate it from ionic changes in the extracellular environment which would cause spontaneous depolarization. Conduction is faster the better myelinated the axon and this shown as the markedly increasing nerve conduction velocity in the premature infant between 28 and 46 weeks, when it increases at the rate of about 1 m/s per week. The brain weighs around 350 g at birth and over the next 4 years will grow by a further 1000g. This is largely due to myelination and the formation of dendrites, Nissl and association pathways. Myelination of brain occurs rapidly in the first 6 months after birth and the there is a slower phase over the next 4 years and a very slow phase up to 16 years of age. There are definite myelogenetic cyceles. The leg area of the cortex myelinates before the arm area, yet upper limb function is accurate and well developed by the time the child takes his first clumsy steps. Myelination of short association pathways such as the frontohypothalamic tract occurs gradually over the whole of childhood ***(Evrard et al., 1992).***

Psychogenesis

This limbic system develops early and the small infant is capable of nonverbal communication involving limbic and temporal lobe structures long before he has the ability to utilize language communication. The cerebral cortex is made up of neurons which form modules. Each module is connected with its mirror image the opposite side and these form in effect "brain chips" on the neuron acts as a memory and switch system and is basically a computer. Each module consists of some 2500 neurons and the cerebral cortex can be regarded as being made up of innumerable small computing or learning units. Modern computer technology suggests that the most effective way of improving power is to allow two computers to talk to each other and this is in essence what happens between the two cerebral hemispheres. Each neuron has what is known as a cartridge on its apical dendrite which allows control of what the cell learns. In addition the left side of the brain, particularly over the superior aspect of the temporal lobe, is completely different anatomically from the right. There are 17 times more cells on the left and there appears to be preprogramming for the learning of language with a different anatomical substrate. This is the part of the brain which is the most different between man and the higher apes. The development of modules, the connection of these modules one with another by association fibers and the preprogramming of these units for the learning of specific tasks is basic to the development of the brain as an organ of learning. If a module is damaged on one side of the brain it can be taken over by the opposite side. Normally one side is inhibited, i.e. there is reciprocal cerebral inhibition or "dominance" so that there is no interference between one side of the brain and the other. The left side of the brain develops more slowly than the right in boys. The parts of the brain on the left subserving language (the so-called tertiary zones) are amongst the last to mature under genetic control. This slower development in boys partly explains the higher incidence of developmental abnormality affecting speech, language, reading and writing which are five times more common in boys than girls ***(Brown et al., 1991).***

Cognitive development:

Piaget proposed that children's thinking does not develop entirely smoothly: instead, there are certain points at which it "takes off" and moves into completely new areas and capabilities. He saw these transitions as taking place at about 18 months, 7 years and 11 or 12 years. This has been taken to mean that before these ages children are not capable (no matter how bright) of understanding things in certain ways, and has been used as the basis for scheduling the school curriculum ***(Atherton, 2005).***

The Following table shows the stages of cognitive development according to Piaget theory:

Table (A): Stages of Cognitive Development:

Stage	Characterized by
Sensorimotor (Birth- 2 yrs)	▪ Differentiates self from objects. ▪ Recognizes self as agent of action and begins to act intentionally: e.g. pulls a string to set mobile in motion or shakes a rattle to make a noise. ▪ Achieves object permanence: realizes that things continue to exist even when no longer present to the sense (pace Bishop Berkeley)
Pre-operational (2-7 years)	▪ Learn to use language and to represent objects by images and words. ▪ Thinking is still egocentric: has difficulty taking the viewpoint of others. ▪ Classifies objects by a single feature: e.g. groups together all the red blocks regardless of shape or all the square blocks regardless of color.
Concrete operational (7-11 years)	▪ Can think logically about objects and events. ▪ Achieves conservation of number (age 6), mass (age 7), and weight (age 9). ▪ Classifies objects according to several features and can order them in series along a single dimension such as size.
Formal operational (11 years and up)	▪ Can think logically about abstract propositions and test hypothesis systematically. ▪ Becomes concerned with the hypothetical, the future, and ideological problems.

(Atherton, 2005)

Psychosocial Development:

All of the stages in Erikson's epigenetic theory are implicitly present at birth (at least in latent form), but unfold according to both an innate scheme and one's up-bringing in a family that expresses the values of a culture. Each stage builds on the preceding stages, and paves the way for subsequent stages. Each stage is characterized by a psychosocial crisis, which is based on physiological development, but also on demands put on the individual by parents and/or society. Ideally, the crisis in each stage should be resolved by the ego in that stage, in order for development to proceed correctly. The outcome of one stage is not permanent, but can be altered by later experiences. Everyone has a mixture of the traits attained at each stage, but personality development is considered successful if the individual has more of the "good" traits than the "bad" traits ***(Davis and Clifton, 1995).***

The following table shows stages of pschosocial development according to Erikson's theory:

Table (B): Psychosocial Development Stages

Personality Stage	**Psychosexual Mode**	**Psychosocial Modality**	**"Virtue"**
Trust vs. Mistrust	Incorporative1 Incorporative2	Getting Taking	Hope
Autonomy vs. Shame, Doubt	Retentive eliminative	Holding on Letting go	Willpower
Initiative vs. Guilt	Intrusive	Making	Purpose
Industry vs. inferiority			Competence
Identity vs. Role			Fidelity
Confusion			
Intimacy vs. Isolation			Love
Generativity vs. Stagnation			Care
Integrity vs. Despair			Wisdom

Davis and Clifton, 1995)

Psychosexual Development:

The concept of **psychosexual development,** as envisioned by Sigmund Freud at the end of the nineteenth and the beginning of the twentieth century, is a central element in the theory of psychology. It consists of five separate phases: oral, anal, phallic, latency, and genital. In the development of his theories, Freud's main concern was with sexual desire, defined in terms of formative drives, instincts and appetites that result in the formation of an adult personality ***(Myre, 1974).***

The following is a model of Freud of pschosexual development:

Table (C): Freud's model of psychosexual development

Stage	Age Range	Erogenous zone (s)	Consequences of Fixation
Oral	0-18 months	Mouth	Orally aggressive: involves chewing gum or ends of pens. Orally Passive: Involves smoking/eating/kissing/fellatio/cunnilingus
Anal	18-36 months	Bowel and bladder elimination	Anal-retentive: Obsession with organization or excessive neatness. Anal-expulsive: Reckless, careless, defiant, disorganized, Coprophiliac.
Phallic	3-6 years	Genitals	Oedipus complex (in boys only according to Freud) Electra complex (in girls according to Jung not Freud)
Latency	6 years-puberty	Dormant sexual feelings	(People do not tend to fixate at this stage, but if they do, they tend to be extremely sexually unfulfilled).
Genital	Puberty and beyond	Sexual interests mature	Frigidity, impotence, unsatisfactory relationships.

(Myre, 1974)

Assessment of development:

Neurodevelopmental process, such as the acquisition of basic gross and fine motor skills, depend to a great extent on maturation of neural structures, but they may be profoundly modified by the environment and by experience ***(Vaughan and Litt, 1992).***

Development depends on the maturation and myelination of the nervous system as well as on practice. The direction of development is "cephalo-caudal", a progression which depends on the myelination of the nervous system. It is clear that as the nervous system undergoes differentiation, the patterns of behavior also differentiate ***(Abbassy et al., 1972).***

The human brain undergoes continuous structural remodeling in response to signals originating from inside and outside of the body. At a molecular level these changes can be very subtle and involve minor modifications of synaptic proteins. At a cellular level, dendritic spines or nerve cell abrosizations are reshaped. Finally, entire nerve cells are newly generated or removed, even in the mature brain ***(Gage, 2000).***

In developing nervous system these changes are particularly drastic and hence are more easily observed and investigated ***(Barde, 1990).***

Developmental and Psychological Testing:

British scientist Sir "Francis Galton" is among the first to investigate individual differences in mental ability. "Galton" is perhaps best known as the founder of **"eugenics",** a science devoted to the principle that the hereditary characteristics of human being can be "perfected" through selective breeding of gifted individuals. Discussed in his book ***(Detterman, 2002).***

The study of infant and child development, or developmental psychology, dates back to the naturalistic observations of "Johann Heinrich Pestalozzi" in the 18th century. By the late 1800s and early 1900s, a contingency of psychologists around the world ("Alfred Binet" in France; "Wilhelm Preyer" in Germany, "Stanley Hall", "James Mark Baldwin", and "John B Watson" in the United States) acknowledged that development took place from conception and continued throughout life, with increasing complexity. Some of the earliest work in developmental psychology grew from the study of 'Wilhelm Preyer" in his landmark publication. *"Die Seele des Kindes"* (The mind of the child) in 1882. He proposed an objective, methodological study of children through systematic observation and an ecological approach. "Preyer" addressed the development of children's perceptions, motivation, and "intellect" (i.e., language and social cognition) ***(Maurine, 1999).***

Psychological tests are not always required to assess psychiatric symptoms, but they are also valuable in determining a child's developmental level, intellectual functioning, and academic difficulties. A measure of adaptive functioning (including the child's competence in communication, daily living skills, socialization, and motor skills) is a prerequisite when a diagnosis of mental retardation is being considered ***(Kaplan and Sadock, 2000).***

The "Gesell infant Scale", the "Cattell Infant Intelligence Scale", "Bayley Scales of infant Development", and the "Denver Developmental Screening Test" include developmental assessments of infants as young as 2 months of age. The "Gesell Infant Scale" measures development in four areas: motor, adaptive functioning, language, and social. The "Cattell Infant Intelligence Scale" is developed as a downward extension of the "Stanford-Binet Intelligence Scale" ***(Kaplan and Sadock, 2000).***

Infant assessments are valuable in detecting developmental deviation and mental retardation and in raising suspicions of a developmental disorder. Whereas infant assessments rely heavily on sensorimotor functions, intelligence testing in older children and adolescents includes later-developing functions, including verbal, social, and abstract cognitive abilities ***(Kaplan and Sadock, 2000).***

Tests of cognitive functions and development:

There are countless development tests for children from birth to about seven years of age, as well as tests for assessing development in disabled school-age children. The tests measure various skills, including the following as mentioned by ***Plake, (2003).***

- Gross motor skills.
- Fine motor skills.
- Communication.
- Memory.
- Number concepts.
- Letter recognition.
- Social competence.

Examples of these tests include:

1. *Clinical Newborn Behavioral Assessment Scale (CLNBAS):*

Ages and stages questionnaires are used to identify infants and young children who may need further evaluation. These questionnaires are completed by the parent and are administered at the following ages:

- Two-month intervals between the ages of four and 24 months.

- Three-month intervals between the ages of 24 and 36 months.
- Six-month intervals between the ages of 36 and 60 months ***(Plake, 2003).***

2. *Gesell Infant Scale:*

The origins of infant assessments are often traced to the work of Arnold Gesell, a physician and psychologist at the Yale Clinic of Child Development. Gesell had been influenced by Charles Darwin's work in his interest in the growth and development of children. In the early 1920s Gesell compiled a schedule of tasks for infants ages 4, 6, 9, 12 and 18 months of age and 2, 3, 4, and 5 years of age. By identifying predictable stages of development for the brain, visual and motor systems ***(Maurine, 1999).*** When used with very young infants, the test focus on sensorimotor and social responses to a variety of objects and interactions, and when used with older infants and preschoolers, emphasis is placed on language acquisition ***(Kaplan and Sadock, 2000).***

3. *Denver Developmental Screening Test:*

The "Denver Developmental Screening Test" (DDST) is used to screen the development of infants and young children (birth through age 6). It has been revised several times, the most recent revision is the Denver II, 1992. One of the strengths of the

DDST (and the Denver II) is the one-page record form that highlights the infant's successes and failures, providing a summary of the child's skills at a quick look. The Denver II is a screening test, not a diagnostic test. The Denver II is usually followed by a more comprehensive tests of infant functioning, such as the "Bayley Scales of Infant Development" (BSID-II) ***(Mauriue, 1999).***

4. *Bayley Scales of Infant Development*

American developmental psychologist known for her "Scales of Mental and Motor Development." Nancy Bayley" was a pioneer in the field of human development.

She devoted her life to documenting and measuring intellectual and motor development in infants, children, and adults. Her studies of the rates of physical and mental maturation have greatly influenced the understanding of developmental processes. Her "Bayley Scales of Mental and Motor Development" are used throughout the world as standardized measurements of infant development. In 1966, she became the first woman to win the Distinguished Scientific Contribution Award of the American Psychological Association (APA) ***(Lipsitt & Dorothy 1990).***

She studied the development of emotions in children and the maintenance of intellectual abilities throughout adulthood. Bayley also studied the impact of maternal behaviors on children. She argued forcefully that poor development in children was the result of poverty and other social factors, rather than psychological factors ***(Margaret, 2001).***

Bayley, (1958) outlines the skills and behaviors that we can observe during the first years. In the early months of life, we can only observe variations in sensory-motor coordination and simple adaptive responses. These adaptive responses develop into rudimentary forms of interpersonal communication in the form of gestures, vocalizations, and basic emotional responses. Then we have language gradually developing. At first, language is tied to the immediate and real; later, it becomes more symbolic. The child begins to abstract and generalize his experience ***(Lawrence, 1996).***

She incorporated many items from "Gesell's" assessment and also from other's work such as ***"Kuhlman's" (1922)*** Handbook of Mental Tests and ***"Preyer's" (1882)*** "Die Seele des Kendes" (The mind of the child), she also developed new items in 1933 ***(Aylward, 1997).***

Descriptive Information of (BSID II):

The "Bayley Scales of Infant Development" (BSID-II), is an individually "administered test that assesses the current developmental functioning of infants and children from the ages of 1 month to 42 months.

The main purpose of the test is to diagnose developmental delay and plan intervention strategies. BSID-II consists of three scales: mental, motor and behavior rating scale. The mental and motor scales assess the child's current level of cognitive, language, personal-social, and fine and gross motor development. The behavior rating scale assesses the child's behavior during the testing situation. Time of administration under 15 months: 25 to 35 minutes, over 15 months: up to 60 minutes, Mental Scale yields a normalized standard score called the Mental Development index, evaluating a variety of abilities: sensory/perceptual acuities, discriminations, and response; acquisition of object constancy; memory, learning, and problem solving; vocalization, beginning of verbal communication; basis of abstract thinking; habituation; mental mapping; complex language; and mathematical concept formation. **Motor Scale** assesses these skills: degree of body control, large muscle coordination, liner manipulatory skills of the hands and fingers, dynamic movement, dynamic praxis, postural imitation, and stereognosis. **Behavior Rating Scale** provides information that should be used to supplement information gained from the Mental and Motor scales, like attention/arousal, orientation/engagement, emotional regulation, and motor quality. The Bayley scales are used to determine whether a child is developing normally and help in early diagnosis and intervention in cases of developmental delay. Additionally, they can be used to qualify a child for special services and/or demonstrate the effectiveness of those services ***(Maureen, 1999).***

The Bayley Infant Neurodevelopmental Screener (BINS):

The Bayley Infant Neurodevelopmental Screener examines the neuropsychological development of infants from 3 to 24 months of age. It includes items that have been extracted from existing tests and requires approximately 10 minutes to administer, initial comparisons with other measures of infant development suggest that the BINS has high sensitivity, meaning that it recognizes infants who have developmental delay's ***(Aylward, 1997).***

5. *Wechsler Intelligence Scale for Children" (WISC-IV):*

The most widely used test of intelligence for school-age children and adolescents is the fourth edition of the "Wechsler Intelligence Scale for Children" (WISC-IV). It can be given to children from 6 to 16 years old, yields a verbal IQ, a performance IQ, and a combined full-scale IQ. The verbal subtests consist of vocabulary, information, arithmetic, similarities, comprehension, and digit span (supplemental) categories. The performance subtests include block design picture completion, picture arrangement, object assembly, coding and symbol search (supplemental). The scores of the supplemental subtests are not included in the computation of IQ. An average full-scale IQ is 100: 70 to 80 represents borderline Intellectual function: 80 to 90 is in the low average range; 90 to 109 is average; 110 to 119 is high average: and above 120 is in the superior or very superior range. The multiple breakdowns of the performance and verbal subscales allow a great flexibility in identifying specific areas of deficit and scatter in intellectual abilities. Because a large part of intelligence testing measures abilities used in academic settings, the breakdown of the WISC-IV can also be helpful in pointing out skills in which a child is weak and may benefit from counteractive education ***(Kaplan and Saccuzzo, 2005).***

The 'Stanford-Binet intelligence Scale" covers an age range from 2 to 24 years. The "McCarthy Scales of Children's Abilities" and the "Kaufban Assessment Battery for Children's" are two other intelligence tests that are available for preschool and school-age children. They do not cover the adolescent age group ***(Kaplan and Sadock, 2000).***

6. *Stanford-Binet intelligence scales:*

In 1905 French psychologist Allied Binet and colleague Theodore Simon devised one of the first tests of general intelligence. The test sought to identify French children likely to have difficulty in school so that they could receive special education. American psychologist, Lewis Terman, revised the test. Terman's first adaptation, published in 1916, is called the Stanford-Binet Intelligence Scale. The name of test derived from Terman's attachment to Stanford University ***(Detterman, 2002).***

Description of Stanford-Binet intelligence scales-4th Ed:

The "Stanford-Binet Intelligence Scale" covers an age range from 2 to 24 years. It relies on pictures, drawings, and objects for very young children and on verbal performance for older children and adolescents.

This intelligence scale, the earliest version of an intelligence test of its kind, leads to a mental age score as well as an intelligence quotient ***(Kaplan and Sadock, 2000).*** It is used as a tool in determining the presence of a learning disability or a developmental delay, and in tracking intellectual development.

This test has been fairly recently revised to provide multiple I.Q scores instead of a single I.Q score. In addition to being able to measure the verbal and nonverbal areas of a child's development.

The Binet test also provides a quantitative score, measuring the child's mathematical reasoning and a memory score, measuring the child's short term memory. (While the Wechsler scales also have subtests which measure these areas, they do not provide I.Q scores isolating these abilities).

The test cannot be used to diagnose mental retardation in children aged three or less. Intelligence testing requires a clinically trained examiner. The Stanford-Binet Intelligence Scale should be administered and interpreted by a trained professional, preferably a psychologist ***(Shore et al., 1992).***

*** Other Tests:**

- Peabody developmental gross motor scale for infants.
- Bury infant check to help identify children with special needs.
- Infant monitoring system for children aged four months to 36 months.
- Early copping inventory of 48 items on sensory-motor organization, reactive behavior, and self-initiated behavior that are used to assess everyday copping strategies in children between the ages of four and 36 months ***(Plake, 2003).***

Chapter (2): Growth and Development

Normal growth is a sign of good health and ill children often grow slowly, so growth must be assessed in any child presenting with, or monitored for, important health problems, whether in specialist or primary care practice. The value of growth monitoring in developing countries has recently been questioned ***(Pampanich and Garner, 1999).***

Growth hormone deficiency can occur as an isolated condition, as part of multiple pituitary hormone deficiency, or as a consequence of other disease, usually detected by specialist follow up. Multiple pituitary hormone deficiency usually presents within the first 2 years of life with hypoglycemia, micropenis, obesity, or obvious failure to thrive, which necessitate investigation ***(Herber and Milner, 1984).***

Some girls with Turner's syndrome can be detected antenatally or in the neonatal period, but the remainder, perhaps 60% are identified because of short stature, amennorhoea, or infertility ***(Jellinek and Hall, 1994).***

Normal short children would also be identified by growth monitoring and could be "reassured" about their short stature, or offered treatment and growth hormone treatment is of doubtful value for such children ***(Voss, 1995).***

Effective growth monitoring needs precise measurement, accurate plotting on appropriate charts, correct interpretation, and a plan of investigation for screen positive cases. Some endocrinologists prefer longitudinal charts, but the 1990 nine centile charts are recommended for general use ***(Savage et al., 1999).***

Measuring height is subject to error as a result of poor technique, variations between instruments and observers, diurnal variation, and plotting mistakes. Stretching the child while measuring will not eliminate diurnal variation, but might increase interobserver error ***(Voss and Bailey, 1997).***

Sensitivity of height measurement as a screening test could be improved by including children above the 0.4th centile who are short for parental height. A single height measurement will identify only those very short (or tall) children whose growth is so deviant that their height is outside the cut off point chosen. Growth monitoring might be more useful it multiple height measures, rather than just two, were to be obtained by primary health care staff, making it easier to identify errors of measuring and plotting and to recognize the truly normal pattern ***(Cole, 1994).***

Weight and height are traditionally assessed together and can be interpreted using a body mass index (BMI) chart. The role of BMI charts in community practice needs further study and "screening" for obesity would not currently fulfill accepted criteria. Recording height and weight together would have greater clinical and public health value than height alone ***(Prentice, 1998).***

The growth of a normal child is likely to follow a particular centile. Deviation from centile lines is only evident when growth is extremely slow or continues at a diminished rate over a long period of time. In this instance, plotting successive height velocities on a suitable velocity chart. ***Tanner & Whitehouse (1976)*** give valuable information. Successive velocities do not correlate and must oscillate about the 50th centile if the child is to keep up with his or her peers. The child whose velocity over successive years is consistently on or below the 25th centile becomes progressively shorter compared with peers, whilst a child growing with a 75th centile velocity over successive years will become progressively taller. The longer the period of follow-up, the more a reduced growth velocity is likely to represent pathology. This would also, circumvent the misinterpretation of oscillations in height velocity which commonly occur in normal children and may actually be seasonal or may occur cyclically over intervals of about 2 years ***(Butler et al., 1990).***

Many disorders of growth present during infancy, when growth rate is particularly rapid. The rapid but decelerating growth of the first 2 years of life is a continuation of fetal growth and is predominantly nutrition dependent. Over-or undernutrition during this period may have lifelong effects on growth. Both weight and length should be considered in assessing the growth of a child in infancy. Centile charts exist for both parameters. Birthweight is predominantly controlled by the maternal uterine factors, so that a child who carries genes for large size cannot grow to his or her full potential until the postnatal period, when the restraint of the uterus is removed. At that time, there is a period of rapid catch-up growth. By 12-18 months of age, the catch-up period is complete and, subsequently, the child proceeds along his/her centile. During this period, a child with a low birthweight centile rises through the centiles, whereas a child with a higher birthweight centile may fall through the centiles. If a child with a low birthweight falls through the centiles, then further assessment is essential. Studies conducted in developing countries show poor growth alternating with rapid growth in infants postweaning and this correlates with the availability of food ***(Costello 1989).***

Karlberg et al (1987) showed that the earlier the onset of the childhood component of growth, the smoother the transition on the growth curve. Onset of the childhood component after the age of 12 months was extremely unlikely.

Preterm infants whose birthweight is appropriate for their gestational age grow normally given adequate postnatal treatment.

Their weight and length should be plotted in relation to their postconception age. Small for dates babies do not, on average, reach the height and weight of normal children, even though they may have some initial catch-up growth. Their problems are often compounded by feeding difficulties in the first year of life which further compromise growth ***(Bucher, 2002).***

Factors Affecting Growth:

Hormonal Factors:

The insulin-like growth factor (IGF-I) is an important postnatal growth factor and its concentration increases at term and postnatally. Serum IGF-II levels remain detectable and are constant during the lifespan of human being, although the postnatal role of this peptide is unclear. In the fetus, however IGF-II is the more important growth factor ***(Baker et al, 1993).*** At puberty, maturity is related to six hormones ***(Karlberg et al., 1987).***

After the onset of the childhood period, growth proceeded at a normal rate. In children with growth hormone deficiency who have a growth hormone gene deletion, the growth pattern is compatible with a continuation of the infancy component. This is because the childhood phase is predominantly dependent on the normal secretion of hGH by the anterior pituitary and in the absence of GH secretion, there is a failure of the childhood phase to take over ***(Wit & Van Unen 1992).***

Genetic Factors:

The target height of a child is calculated by measuring the parents' heights and plotting them on the centile charts after the appropriate correction of the six of the child and then calculating the mid-parental target height (MPH) as follows:

MPH if male = [father's height + (mother's height + 14)]/2

MPH if female = [(Father's height - 14) + mother's height]/2

The 2nd and 98th centiles for the family are defined by the MPH + 10 cm ***(Voss et al., 1991).***

Nutrition:

This is particularly important in determining early growth and influencing maturation. Early overfeeding leads to tall stature and growth advance, with consequent early pubertal maturation and the early achievement of final height. Obesity during the first 2 years of life leads to tall stature, whereas obesity or overfeeding later in childhood does not alter final stature. Malnutrition, especially at a period of rapid growth, such as in utero or in the first year of life, also has lifelong consequences. It affects later height and weight and also neurodevelopmental outcome ***(Barker 1992).***

Ethnic Differences in Growth:

Ethnic differences are observed in the rate and pattern of growth and these can result in significant differences in final height. These may be determined genetically, but may also be due to nutritional differences. The African child matures earlier than the average Caucasian child, not only in terms of physical development but also in terms of motor development. In view of the variation between different population groups, growth standards should ideally be constructed for each population group. It is of note that the shapes of growth curves are constant between different populations and that growth rate is remarkably constant between different populations. The topic has been extensively covered by ***Eveleth & Tanner (1990).***

Seasonal Variation in Growth:

Many children demonstrate a marked seasonal effect on growth velocity. They differ not only in the time of year at which they grow fastest, but also in the magnitude of the difference between one season and another ***(Ranke et al., 1988).***

Disease:

Although minor and relatively short illnesses cause no measurable growth retardation, major chronic illnesses may lead to significant growth retardation, which may then be accompanied by a catchup period when the disease is cured. Whether the genetic potential for height is then achieved depends upon the length of the illness and how long treatment was deferred ***(Lifshitz and Moses, 1985).***

Psychological Disturbance:

Blizzard and Bulatovic (1992) showed that the sadistic influence of a matron in a German orphanage was profoundly restrictive on children's growth, in spite of an adequate calorie intake. When the influence was removed, the children grew well, demonstrating the reversible nature of psychosocial deprivation.

Socioeconomic Factors:

Children in the upper socioeconomic groups are generally taller than those in the lower socioeconomic groups. In contrast, there is little difference in weight, although obesity is actually more common in older children from lower socioeconomic groups. The causes of the socioeconomic height difference are multiple. Differences in nutrition are important, as are home conditions. Those children from well-organized homes where the habits of regular meals, sleep and exercise have been followed are, on average, taller ***(Hill and Hogg, 1989).***

Secular Trend:

During the last 100 years there has been a striking tendency for children to become progressively taller at all ages. The recent introduction of growth charts based upon data collected in 1990 shows an increase of up to 1.7 cm in the heights of British boys and girls since 1966. The trend towards taller height in children also reflects a more rapid maturation. This is shown by the trend towards earlier menarche of 3-4 months per decade since 1850 in average Western European girls. The causes of this secular trend are probably multiple and include improved nutrition, although possible other factors remain unknown ***(Freeman et al., 1995).***

Factors Affecting Development:

Physiological studies have shown that chronic hypoxemia may occur in preterm infants who require supplemental oxygen for extended periods and that this hypoxemia may contribute to poor growth and development ***(Askie et al., 2003).***

Piekkala et al. (1987), concluded that the developmental scores of infants suffering from respiratory distress syndrome were significantly poorer than full-term infants at age of two years for gross motor, audiovisual and psychosocial categories, whereas for fine motor development, the difference disappeared by the age of two years. The growth of those infants with respiratory distress syndrome was satisfactory even if their heights remained below that of their full term peers.

Neurocognitive sequelae occurred in 73% (54 of 74) of ADRS survivors at hospital discharge, 46% (30 of 66) at 1 year, and 47% (29 of 62) at 2 years ***(Hopkins et al., 2004).***

Acute Respiratory Distress Syndrome is characterized by lung injury and hypoxemia, has a high mortality rate, and is associated with significant morbidity including cognitive and emotional sequelae and decreased quality of life ***(Hopkins et al., 2004).***

Patients who survived the acute respiratory distress syndrome had lost 18 percent of their base-line body weight by the time they were discharged from the intensive care unit and stated that muscle weakness and fatigue were the reasons for their functional limitation. Lung volume and spirometric measurements were normal by 6 months, but carbon monoxide diffusion capacity remained low throughout the 12-month follow-up. No patients required supplemental oxygen at 12 months, but 6 percent of patients had arterial oxygen saturation values below 88 percent during exercise ***(Herridge et al., 2003).***

Long-term ARDS survivors exhibit impaired health status and the presence of cognitive deficits is associated with disability and considerable impairments in health related quality of life. More detailed psychiatric research is required to establish the etiology of these cognitive impairments ***(Rothenhausler et al., 2001).***

Diet provides the energy needed for internal organs and affects metabolic pathways. The brain regulates food intake through complex processes. Moreover, the specific content of the food affects certain biochemical and hormonal functions in the body and brain, thus linking diet to behavior and cognition ***(Anderson, 1996).***

Shiveley et al. (2000), added that carbohydrates significantly affects moods of behavior through triggering insulin release, protein intake affect brain functioning and mental health as many neurotransmitters are made from amino acids.

It used to be thought that intelligence was determined entirely by the genes inherited from one's parents. It is now clear that there are both genetic and environmental contributions to intelligence and to personality. The contribution of each is complex as both the individual and the environment are continuously changing over time and the interaction between them which molds psychological growth is fluid and dynamic. The contribution of genetic inheritance is important and twin studies have suggested that up to 80% of the variance in intelligence in a population can be attributed to genetic transmission. Environmental factors may act in two ways: firstly by affecting the brain biologically-brain damage; secondly by altering the child's opportunity to learn by limiting or expanding his experience-psychosocial factors ***(Rutter et al., 1970).***

Psychosocial Factors:

In general, people rather than physical elements are the most important factors in the environment of the young child. The parents are responsible for giving the child the opportunities to enable learning. Most crucially, if the infant does not develop a sense of trust in people from that first relationship with a parent then he is likely to have lifelong difficulties with relationships. There are various factors which affect the parents' capacity to cope well with the task of child rearing. Children from depriving environments tend to show developmental delay, particularly of language. Children best learn the meaning of words when the word and the object are closely and frequently associated. The child deprived of simple play with adults does not have the opportunity to hear simple language related to his immediate environment. He may be surrounded by more complex visual and auditory stimuli from the television or older siblings but he will be unable to interpret and learn from these stimuli because of their complexity or because of interference from background noises. Children can only learn about actions and reactions if the responses are consistent. This applies particularly to behavior development ***(Rutter et al., 1970).***

Children continue to practice skills if they are rewarded or the behavior is reinforced. A young baby hits an object during an involuntary action. If it makes a noise or looks attractive he is likely to try again and thus the process of exploring the environment starts. If when the baby waves his arms around and makes a noise there is no feedback or response from his environment or he gets shouted at, he is likely to stop exploring and keep quiet. It has been suggested that in this way severe deprivation in the first year of life can affect the child's ability to learn for the rest of his life ***(Hall, 1991).***

Biological Factors:

A child's development may be affected by abnormalities of brain function, of special senses or of effector organs such as the muscles. Brain damage or dysfunction may affect all areas of function or only specific areas of function. Diffuse insults may produce specific dysfunction because of the vulnerability of a particular area of the brain at the time of insult (e.g. periventricular leukomalacia in preterm, basal ganglia damage at term) and the skills being learned at any time. The Effects of an insult, e.g. cranial irradiation, may not be immediately apparent but only materialize when new learning is attempted. In many children with so-called developmental disorders (e.g. dyslexia, language disorder) there is no evidence of brain damage but often a strong family history. Presumably there is a genetic factor affecting the maturation of certain brain functions ***(Shalet et al., 1992).***

Defects of special senses most commonly affect vision and hearing and can result in a severe restriction of the information a children receives. Sensory defects interfere with the integration of information from various sources which is essential to normal development. Thus, the child with severe visual impairment may show delay in all areas of development. The normal stimulus which comes from seeing an object is absent and the child needs much more encouragement to explore his environment. Identifying and consequently labeling objects through touch, sound and smell is very much harder and therefore language acquisition is delayed. The congenitally profoundly deaf child will have severe language problems. Attaching labels in the form of signs and symbols to concrete objects is relatively easy but attaching labels to more abstract concepts (e.g. distance, size) and learning how to use the subtleties of language structure (e.g. tenses and word order) is much more difficult. There is evidence that milder degrees of sensory handicap can interfere with later development. The child who has been unable to learn about distance because of uncorrected myopia may remain clumsy and have difficulty throwing and catching even after the refractive error has been corrected. The child with intermittent hearing loss due to secretory otitis media may present later with reading and spelling difficulties as a result of interference with integrating sounds with symbols when younger ***(Sonksen and Macrae, 1987).***

Disorders of movement may be due to abnormality of the brain (cerebral palsy), spinal cord (paraplegia), nerves (spinal muscular atrophy) or muscles (dystrophy). These disorders have a direct effect on movement and also limit the child's experience. The child who cannot move independently does not experience space and distance and cannot reach things to manipulate them. It is important for parents and therapists to recognize this and to provide the child with compensatory experience ***(Sheridan, 1975).***

When faced with a child showing delay or an abnormal pattern of development it is important to consider which factor is contributing. There may well be more than one and biological and social factors may well interact. When there is a biological abnormality, psychosocial factors become even more important determinants of the child's future, but it is precisely in this situation that parental resources are stretched. The child with a disability may have particular characteristics which are likely to make it harder for the parents to react to him, e.g. he may not smile or he may go rigid when picked up and thereby not elicit the normal mothering response. This can result in a vicious circle with the child becoming more disabled than originally expected. The severe visual impairment child may withdraw into self-stimulation, the rarely handled child with cerebral palsy becomes more rigid. The more competent, less stressed parents may well have resources to consciously modify their reaction and provide for the child's special needs. The less competent or more stressed parents are less likely to be able to do this ***(Hall et al., 1990).***

The First Year:

During the first year of life, physical growth, maturation, acquisition of competence, and psychologic reorganization occur in discontinuous bursts. These changes qualitatively change a child's behavior and social relationships. Children acquire new competences in the gross motor, fine motor, cognitive, and emotional domains. The concept of developmental lines highlights how more complex skills build on simpler ones; but it is also important to realize how development in each domain affects functioning in all of the others. Physical growth parameters, and normal ranges for attainable weight, length and head circumference can be estimated. Table (D) presents an overview of key milestones by domain ***(Behrman et al., 2004).***

Table (D): Developmental Milestones in the First 2 Yr of Life

Milestone	**Average Age of Attainment (mo)**	**Developmental implications**
Gross Motor		
Head steady in sitting	2.0	Allows more visual interaction
Pull to sit, no headlag	3.0	Muscle tone
Hands together in midline	3.0	Self-discovery
Asymmetric tonic neck reflex gone	4.0	Child can inspect hands in midline
Sits without support	6.0	Increasing exploration
Rolls back to stomach	6.5	Truncal flexion, risk of falls
Walks alone	12.0	Exploration, control of proximity to parents
Runs	16.0	Supervision more difficult
Fine Motor		
Grasps rattle	3.5	Object use
Reaches for objects	4.0	Visuomotor coordination
Palmar grasp gone	4.0	Voluntary release
Transfers object hand to hand	5.5	Comparison of objects
Thumb-finger grasp	8.0	Able to explore small objects
Turns pages of book	12.0	Increasing autonomy during book time
Scribbles	13.0	Visumotor coordination
Builds tower of two cubes	15.0	Uses objects in combination
Builds tower of six cubes	22.0	Requires visual, gross, and fine motor coordination
Communication and Language		
Smiles in response to face, voice	1.5	
Monosyllabic babble	6.0	Child more active social participant
Inhibits to "no"	7.0	Experimentation with sound, tactile sense
Follows one-step command with gesture	7.0	Response to tone (nonverbal) Nonverbal communication
Follows one-step command without gesture (e.g. "Give it to me")	10.0	Verbal receptive language
Speaks first real word	12.0	Beginning of labeling
Speaks 4-6 words	15.0	Acquisition of object and personal names
Speaks 10-15 words	18.0	Acquisition of object and personal names
Speaks two-word sentences (e.g., "Mommy shoe")	19.0	Beginning grammaticization, corresponds with 50+ word vocabulary
Cognitive		
Stares momentarily at spot where object disappeared (e.g., yarn ball dropped)	2.0	Lack of object permanence (out of sight, out of mind) Self-discovery, cause and effect
Stares at own hand	4.0	Active comparison of objects
Bangs two cubes	8.0	Object permanence
Uncovers toy (after seeing it hidden)	8.0	Beginning symbolic thought
Egocentric pretend play (e.g., pretends to drink from cup)	12.0	Able to link actions to solve problems
Uses stick to reach toy	17.0	Symbolic thought
Pretend play with doll (gives doll bottle)	17.0	

(Behrman et al., 2004)

AGE 6-12 MONTHS:

Months 6-12 bring increased mobility and exploration of the inanimate world, advances in cognitive understanding and communicative competence, and new tensions around the themes of attachment and separation. Infants develop will and intentions, characteristics that most parents welcome but still find challenging to manage ***(Behrman et al., 2004).***

Physical Development: Growth slows more. The ability to sit unsupported (about 7 mo) and to pivot while sitting (around 9-10 mo) provides increasing opportunities to manipulate several objects at a time and to experiment with novel combinations of objects. There explorations are aided by the emergence of a pincer grasp (around 9 mo). Many infants begin crawling and pulling to stand around 8 mo and walk before their first birthday either independently or in a walker. Motor achievements correlate with increasing myelinization and cerebellar growth. These ambulatory achievements expand infants' exploratory range and create new physical dangers as well as opportunities for learning. Tooth eruption occurs, usually starting with the mandibular central incisors. Tooth development also reflects, in part, skeletal maturation and bone age ***(Hill and Hogg, 1989).***

Cognitive Development: At first, everything goes into the mouth; in time, novel objects are picked up, inspected, passed from hand to hand, banged, dropped, and then mouthed. Each action represents a nonverbal idea about what things are for (in piagetian terms, a schema). The complexity of an infant's play, how many different schemata are brought to bear, is a useful index of cognitive development at this age. The pleasure, persistence, and energy with which infants tackle these challenges suggest the existence of an intrinsic drive or mastery motivation. Mastery behavior occurs when infants feel secure; those with less secure attachments show limited experimentation and less competence. A major milestone is the achievement (about 9 mo) of object constancy, the understanding that objects continue to exist even when not seen. At 4-7 mo, infants look down for a yarn ball that has been dropped but quickly give up if it is not seen. With object constancy, infants persist in searching, finding objects hidden under a cloth or behind the examiner's back ***(Behrman et al., 2004).***

Emotional Development: The advent of object constancy corresponds with qualitative changes in social and communicative development. Infants look back and forth between an approaching stranger and a parent, as if to contrast known from unknown, and may cling or cry anxiously. Separations often become more difficult. Infants who have been sleeping through the night for months begin to awaken regularly and cry, as though remembering that parents are in the next room ***(Brayden and Poole, 1995).***

At the same time, a new demand for autonomy emerges. Infants no longer consent to be fed but turn away as the spoon approaches or insist on holding it themselves. Self-feeding with finger foods allows infants to exercise newly acquired fine motor skills (the pincer grasp); it may be the only way to get a child to eat. Tantrums make their first appearance as the drives for autonomy and mastery come in conflict with parental controls and with the infants' still-limited abilities ***(Ainsworth et al., 1978).***

Communication: Infants at 7 mo are adept at nonverbal communication, expressing a range of emotions and responding to vocal tone and facial expressions. Around 9 mo, infants become aware that emotions can be shared between people; they show parents toys gleefully, as if to say, "When you see this thing, you'll be happy, too!". Between 8 and 10 mo, babbling takes on a new complexity, with many syllables ("ba-da-ma") and inflections that mimic the native language. At the same time, infants lose the ability to distinguish between vocal sounds that are undifferentiated in their native language. The first true word- i.e., a sound used consistently to refer to a specific object or person-appears in concert with an infant's discovery of object constancy. At this age, picture books provide an ideal context for verbal language acquisition. With a familiar book as a shared focus of attention, a parent and child engage in repeated cycles of pointing and labeling, with elaboration and feedback by the parent ***(Bates and Dick, 2002).***

Implications for parents and pediatricians: With the developmental reorganization around 9 mo, previously resolved issues of feeding and sleeping re-emerge. Pediatricians can prepare parents at the 6-mo visit so that problems can be understood as the results of developmental progress and not regression. Parental ambivalence about separation can express itself in a delay in introducing finger foods or drinking from a cup (usually before the 1st birthday) or an intrusive, overly neat approach to meal times. Poor weight gain at this age often reflects a struggle between an infant and parent over control of the infant's eating. Discussions about an infant's drive for autonomy and need for limited choices may avert such problems. Infants' wariness of strangers often makes the 9-mo examination difficult, particularly if the infant is temperamentally prone to react negatively to unfamiliar situations. Time spent talking with the mother and playing with the child will be rewarded by more cooperation. By using picture books as part of the routine health supervision visit, pediatricians can effectively promote reading aloud while addressing a variety of behavioral issues, including object exploration, autonomy, attention, language, and the continued importance of physical closeness and shared enjoyment ***(Behrman et al., 2004).***

The Second Year:

At approximately 18 mo of age, the emergence of symbolic thought causes a reorganization of behavior with implications across many developmental domains ***(Stern, 1985).***

AGE 12-18 MONTHS

Physical Development: The growth rate slows further in the 2nd yr of life, and appetite declines. "Baby fat" is burned up by increased mobility; exaggerated lumbar lordosis makes the abdomen protrude. Brain growth continues, with myelinization throughout the 2nd yr. Most children begin to walk independently near their first birthday; some do not walk until 15 mo. Highly active, fearless infants tend to walk earlier; less active, more timid infants and those who are preoccupied with exploring objects in details walk later. Early walking is not associated with advanced development in other domains ***(Zuckerman et al., 1999).***

At first, infants toddle with a wide-based gait, knees bent, and arms flexed at the elbow; the entire torso rotates with each stride; the toes may point in or out, and the feet strike the floor flat. Subsequent refinements lead to greater steadiness and energy efficiency. After several months of practice, the center of gravity shifts back and the torso stays more stable, while knees extend and arms swing at the sides for balance. The toes are held in better alignment, and the child is able to stop, pivot, and stoop without toppling over *(Zuckerman et al., 1999).*

Cognitive Development: As toddlers master reaching, grasping and releasing, and grater mobility gives them access to more and more objects, exploration increases. Toddlers combine objects in novel ways to create interesting effects, such as stacking blocks or putting things into a videocassette recorder slot. Playthings are also more likely to be used for their intended purposes (combs for hair, cups for drinking). Imitation of parents and older children is an important mode of learning. Make believe play centers on the child's own body (pretending to drink from an empty cup) *(Behrman et al., 2004).*

Emotional Development: Infants developmentally approaching the milestone of their first steps may be irritable. Once they start walking, their predominant mood changes markedly. Toddlers are described as "intoxicated" with their new ability and with the power to control the distance between themselves and their parents. Exploring toddlers orbit around their parents, like comets around the sun, moving away, then returning for a reassuring touch before moving away again. In unfamiliar surroundings, with temperamentally timid children, such orbits might be small or nonexistent; in familiar ones, a bold child might orbit out of sight *(Brayden and Poole, 1995).*

A child's ability to use the parent as a secure base for exploration depends on the attachment relationship. Attachment is typically assessed using the so-called "strange situation" procedure, in which the parents temporarily leave the child in an unfamiliar playroom. When their parents leave, most children stop playing, cry, and try to follow. The child's security of attachment is coded based on his or her response upon the parents' return. Securely attached children instantly go to their parents to be picked up, are comforted, and then are able to return to play. Children with ambivalent attachments go to their parents but then may resist being comforted and may hit at their parents in anger. Children categorized as avoidant may not protest when the parents leave and may turn away upon the parents' return. Insecure response patterns may represent strategies infants develop to cope with punitive or unresponsive parenting styles and may predict later cognitive and emotional problems. Controversy continues about how infant temperament and prior experience of separations might affect the interpretation of strange situation results ***(Ainsworth et al., 1978).***

Linguistic Development. Receptive language precedes expressive. By the time infants speak their first words, around 12 mo, they already respond appropriately to several simple statements such as "no", "bye-bye", and "give me". By 15 mo, the average child points to major body parts and uses four to six words spontaneously and correctly, including proper nouns. Toddlers also enjoy polysyllabic jargoning, but do not seem upset that no one understands. Most communication of wants and ideas continues to be nonverbal ***(Koplan, 1995).***

Implications for Parents and Pediatricians: Parents who cannot recall any other milestone tend to remember when their child began to walk, perhaps because of the symbolic significance of walking as an act of independence. A child's ability to wander out of sight also obviously increases the risks of injury and need for supervision. When walking is precluded by physical disability, parents and care providers should facilitate exploration and help the child attain greater control over separation and proximity through wheelchairs or other assistance. Patterns of response similar to those rated in the strange situation procedure may be observable in the pediatric clinic. Many toddlers are comfortable exploring the examination room but cling to the parents under the stress of the examination. Infants who become more, not less, distressed in their parents' arms or who avoid their parents at times of stress may be insecurely attached. Young children who, when distressed, turn to strangers for comfort rather than to parents are particularly worrisome ***(Behrman et al., 2004).***

AGE 18-24 MONTHS

Physical Development: Motor development is incremental at this age, with improvements in balance and agility and the emergence of running and stair climbing. Height and weight increase at a steady rate, although head growth slows slightly ***(Zuckerman et al., 1999).***

Cognitive Development: At approximately 18 mo, several cognitive changes come together to mark the conclusion of the sensorimotor period. Object permanence is firmly established; toddlers anticipate where an object will end up, even though the object was not visible while it was being moved. Cause and effect are better understood, and toddlers demonstrate flexibility in problem solving, for example using a stick to obtain a toy out of reach or figuring out how to wind a mechanical toy. Symbolic transformations in play are no longer tied to the toddler's own body, so that a doll can be "fed" from an empty plate. Like the reorganization at 9 mo, the cognitive changes at 18 mo correlate with important changes in the emotional and linguistic domains ***(Behrman et al., 2004).***

Emotional Development: In many children, the relative independence of the preceding period gives way to increased clinginess around 18 mo. This stage, described as rapprochement, may be a reaction to growing awareness of the possibility of separation. Many parents report that they now cannot go anywhere without having a small child attached to them. Separations at bed-time are often difficult, with frequent false starts and tantrums. Many children use a special blanket or stuffed toy as a transitional object: something that functions as a symbol of the absent parent (in psychoanalytic terms, the object). The transitional object remains important until the transition to symbolic thought has been completed and the symbolic presence of the parent has been fully internalized. Individual differences in temperament, both in the child and the parents, play a critical role in determining the balance of conflict versus cooperation in the parent-child relationship ***(Crittenden, 1995).***

Self-conscious awareness and internalized standards of evaluation first appear at this age. Toddlers looking in a mirror will, for the first time, reach for their own face rather than the mirror image if they notice a red dot on their nose or some other unusual appearance. They begin to recognize when toys are broken and may hand them to parents to fix. When tempted to touch a forbidden object, they may tell themselves "no, no", evidence of internalization of standards of behavior. That they often go on to touch the object anyway demonstrates the relative weakness of internalized inhibitions at this stage ***(Ainsworth et al., 1978).***

Linguistic Development: Perhaps the most dramatic developments in this period are linguistic. Labeling of objects coincides with the advent of symbolic thought. Children may point at things with their index finger rather than their whole hand as though calling attention to objects not for the purpose of having them but of finding out their names. When this protolinguistic naming is accompanied by the phrase "Whazzat?" the child's intentions are clear. After the realization that words can stand for things, a child's vocabulary balloons from 10-15 words at 18 mo to 100 or more at 2 yr. After acquiring a vocabulary of about 50 words, toddlers begin to combine them to make simple sentences, the beginning of grammar. At this stage, toddlers understand two-step commands, such as "Give me the ball and then get your shoes". The emergence of verbal language marks the end of the sensorimotor period. As toddlers learn to use symbols to express ideas and solve problems, the need for cognition based on direct sensation and motor manipulation wanes ***(Bates and Dick, 2002).***

Implications for Parents and Pediatricians: With children's increasing mobility, physical limits on their explorations become less effective; words become increasingly important for behavior control as well as cognition. Children with delayed language acquisition often have greater behavior problems. Language development is facilitated when parents and caregivers use clear, simple sentences, ask questions, and respond to children's incomplete sentences and gesture communication with the appropriate words. Regular periods of looking at picture books together continue to provide an ideal context for language development. Pediatricians can help parents understand the resurgence of problems with separation and the appearance of a treasured blanket or teddy bear as a developmental phenomenon. Management of difficult behavior and assessment of children with delayed speech are considered. Helping parents to understand and adapt to their children's different temperamental styles can constitute an important, and very appreciated, intervention ***(Behrman et al., 2004).***

Chapter (3): Neonatal Respiratory Distress

Respiratory disorders are the most frequent cause of admission for special care in both term and preterm infants. Signs and symptoms include cyanosis, grunting, nasal flaring, retractions, tachypnea, decreased breath sounds with rales and/or rhonchi, pallor, and apnea. A wide variety of pathologic lesions may be responsible for respiratory disturbances including hyaline membrane disease, respiratory distress syndrome, aspiration syndrome, pneumonia, sepsis, congenital heart disease, heart failure, pulmonary hypertension, choanal atresia, hypoglycemia, hypoplasia of the mandible with posterior displacement of the tongue, macroglossia, malformation of the epiglottis, malformation or injury of the larynx, cysts or neoplasms of the larynx or chest, pneumothorax, lobar emphysema, pulmonary agenesis or hypoplasia, conegnital pulmonary lymphangiectasis, tracheoesophageal fistula, avulsion of the phrenic nerve, hernia or eventration of the diaphragm, intracranial lesion, neuromuscular disorders, and metabolic disturbances ***(Stoll and Kliegman,2000).***

It is occasionally difficult to distinguish cardiovascular from respiratory causes or sepsis on the basis of clinical signs alone. Any sign of postnatal respiratory distress is an indication for immediate examination and diagnostic evaluation including a blood gas determination and roentgenogram of the chest. Timely and appropriate therapy is essential to prevent ongoing injury and improve outcome. As a result of important advances in understanding the pathophysiology of respiratory disease, neonatal and infant deaths from early respiratory disease have declined markedly. The challenge is to continue to improve survival, but also to reduce short and long - term complications related to early lung disease ***(Stoll and Kliegman, 2000).***

Transient Tachypnea of the Newborn

Transient tachypnea of the newborn (TTN) is also known as wet lung or type II RDS. It is a benign disease of near-term, term or large preterm infants who have respiratory distress shortly after delivery that usually resolves within 3-5 days ***(Gomella et al, 2004).***

Transient tachypnea of the newborn (TTN) is also known as delayed clearance of fetal lung fluid. In 1966, Avery and coworkers reported on eight near term infants with early onset of respiratory distress whose chest radiographs showed hyperaeration of the lungs, prominent pulmonary vascular markings, and mild cardiomegaly. The respiratory symptoms were transient and relatively mild, and most infants improved within 2 to 5 days. The investigators named the disorder transient tachypnea of the newborn and speculated that it was the result of delayed clearance of fetal lung liquid ***(Taeusch and Avery, 2000).***

Most authors agree with Avery and coworkers that TTN represents a transient pulmonary edema resulting from delayed clearance of fetal lung liquid. Clearance of the fetal lung liquid actually begins before birth (during the last few days of gestation and during labor). During the first step of this process, secretion of lung liquid is inhibited by increased concentrations of catecholamines and other hormones. Then reabsorption occurs: passively, secondary to differences in oncotic pressure between the air spaces, the interstitium, and blood vessels, and actively, secondary to active transport of sodium out of the air space. Infants born prematurely or those born without labor do not have the opportunity for early lung liquid clearance, and they begin their extrauterine life with excess water in the lungs. After birth, water in the air spaces moves rapidly to the extra-alveolar interstitium, where it pools in perivascular cuffs of tissue and in the interlobar fissures. It is then cleared gradually from the lung by the lymphatics or by absorption directly into the small blood vessels. Infants with TTN, however, are often hypoproteinemic, and decreased plasma oncotic pressure may delay the direct absorption of water into the blood vessels. In addition, these infants can have elevated pulmonary vascular pressures and ventricular dysfunction, which increase central venous pressure and impair thoracic duct function and the removal of interstitial water by the lymphatics. This is especially true in infants who receive a large transfusion of blood from the placenta as a result of delayed cord clamping or milking of the cord ***(Taeusch and Avery, 2000).***

The symptoms of TTN may result from compression of the compliant airways by water that has accumulated in the perivascular cuffs of the extra-alveolar interstitium. This compression results in airway obstruction and hyperaeration of the lungs secondary to gas trapping. Hypoxia results from the continued perfusion of poorly ventilated lung units; hypercarbia results from mechanical interference with alveolar ventilation and from central nervous system depression. Lung function measurements in infants with TTN are compatible with airway obstruction and gas trapping. The functional residual capacity measured by gas dilution is normal or reduced, whereas measurements of thoracic gas volume by plethysmography are increased, suggesting that some of the gas in the lungs is not in communication with the airways ***(Taeusch and Avery, 2000).***

It was initially thought that TTN was limited to term or larger preterm infants, but it is now clear that small infants also may present with pulmonary edema from retained fetal lung liquid. This may complicate their surfactant deficiency and account for some of their need for supplemental oxygen and ventilation. There is often a history of heavy maternal sedation, maternal diabetes, or delivery by elective cesarean section. Affected infants may be mildly depressed at birth, and this may mask many of their early symptoms. They are often tachypneic with respiratory rates ranging from 60 to 120 breaths/min and may have hyperinflation with grunting, chest wall retractions, and nasal flaring ***(Taeusch and Avery, 2000).***

Arterial blood gas tensions often reveal a respiratory acidosis, which resolves within 8 to 24 hours, and mild to moderate hypoxemia. These infants seldom require more than 40% oxygen to maintain an adequate PaO2 and usually are in room air by 24 hours of age. They have no evidence to indicate right-to-left shunting of blood at the ductus arteriosus or foramen ovale. Chest radiographs reveal hyperaeration, which is often accompanied by mild cardiomegaly. Water contained in the perivascular cuffs produces prominent vascular markings in a sunburst pattern emanating from the hilum. The interlobar fissures are widened, and pleural effusions may be present. Occasionally, coarse, fluffy densities may be present, indicating alveolar edema. The radiographic abnormalities resolve over the first 2 to 3 days after birth ***(Taeusch and Avery, 2000).***

As its name implies, TTN is a benign, self-limited disease. The infant's need for supplemental oxygen is usually highest at the onset of the disease then progressively decreases. Infants with uncomplicated disease usually recover rapidly without any residual pulmonary disability. Although the symptoms of TTN relate to pulmonary edema, one controlled trial that assessed therapy with diuretics found no evidence for their efficacy, however many infants respond to nasal CPAP ***(Taeusch and Avery, 2000).***

Respiratory Distress Syndrome

Definition

Respiratory distress syndrome (RDS), previously referred to as hyaline membrane disease (HMD), occurs after the onset of breathing in infants with insufficiency of the pulmonary surfactant system. The incidence of RDS is inversely related to gestational age. In babies born at 28-32 weeks, RDS occurs in up to 50% of live births ***(Lemons et al., 2001).***

RDS is a clinical diagnosis warranted in a preterm newborn with respiratory difficulty, including tachypnea (>60 breaths/min), chest retractions,and cyanosis in room air that persists or progresses over the first 48-96 hours of life, and a characteristic chest x-ray appearance (uniform reticulogranular pattern and peripheral air brochograms). The clinical course of the disease varies with the size of the infant, severity of the disease, use of surfactant replacement therapy, presence of infection, degree of shunting of blood through the patent ductus arteriosus(PDA), and whether or not assisted ventilation was initiated ***(Gomella et al, 2004).***

Other factors influencing the severity of RDS:

- RDS is associated with prematurity or stressed high risk infants.
- Gender RDS is usually more severe in male infants with higher mortality.
- Multiple gestations.
- Diabetes mellitus: poor control increases the risk.
- Perinatal factors: delivery by caesarian section prior to onset of labor, asphyxia, acidosis and hypothermia increase the risk.
- Rh incompatibility.
- Genetic factors: preterm infants born to women with previous preterm infants affected by RDS are at an increased risk of RDS, suggests an important genetic or other familial tendency in its origin ***(Liley and Stark, 1998).***

Pathophysiological aspects and lung mechanics:

The primary disturbance is impaired or delayed surfactant synthesis followed by a series of events that may progressively increase the severity of the disease for several days. The infant must generate tremendous intra-thoracic pressure gradients to maintain patent alveoli. Because of a soft pliable chest cage, the newborn infant cannot continue to generate these increased intra-thoracic pressure gradients leading to progressive atelectasis and decreased pulmonary compliance with a resultant hypoxemia and metabolic acidosis. In addition, depending on the degree of prematurity, the alveoli may not yet be well developed and the pulmonary circulation may not be close enough to the respiratory bronchioles, alveolar ducts and alveoli to provide sufficient gas exchange exacerbating the hypoxemia and metabolic acidosis ***(Burchfield and Neu, 1993).***

Overall, the atelectasis causes ventilation/perfusion imbalance and may lead to hypoventilation and hypercarbia. This factor combined with damage to capillary endothelial cells by hypoxia and acidosis, causes fluid leakage into the alveoli. The fluid is rich in protein, and fibrin clot formation occurs with the death of epithelial cells, forming the characteristic hyaline membrane ***(Aloan and Hill, 1997).***

The disease severity of neonatal RDS is correlated with plasma clotting and fibrinolytic and kinin-kallikrein activity. Activation of clotting fibrinolysis and kinin-kallikrein is accompanied with a transient decrease of the neutrophil count and a steady decrease of the platelet count in the severe RDS group. It was suggested that this activation process likely contributes to respiratory insufficiency in neonatal RDS ***(Brus et al., 1997a).***

RDS typically thought to be exclusively a problem of relative surfactant deficiency, is now suspected to be characterized by an even greater air space fluid burden from the inability to absorb fetal lung fluid. In vivo experiments have demonstrated that the lung epithelium secretes chloride (Cl^-) and fluid throughout gestation and develops the ability to actively reabsorb sodium (Na^+) only during late gestation. Active ion transport plays a critical role in the liquid movement across the fetal and perinatal lung epithelium. The mature lung switches from active Cl^- (fluid) secretion to active Na+ (fluid) absorption in response to circulating catecholamines. Changes in oxygen tension augment the Na^+ transporting capacity of the epithelium and increase gene expression for the epithelial Na+ channel (ENaC). The inability of the immature fetal lung to perform this switch mechanism, results at least in large part from an immaturity in the expression of ENaC which can be upregulated by glucoconticoids ***(O'Brodovich, 1996).***

The inability of the fetal lung epithelium to switch from fluid secretion to Na^+ transport dependent absorption seems to be an important factor adversely contributing to the RDS of he newborn premature infant ***(Pitkanen and O'Brodovicl*t*, 1998).***

Pathology:

The gross findings at autopsy include diffuse lung atelectasis, congestion and edema. On histological examinations the peripheral air spaces are collapsed, but more proximal respiratory bronchioles, lined with necrotic epithelium and hyaline membranes, have an over distended appearance. There is obvious pulmonary edema, with congested capillaries, and the lymphatic and interstitial spaces are distended with fluid. The epithelial damage appears within 30 minutes of the onset of breathing. The hyaline membranes composed of plasma exudation products and associated with damaged capillaries, appear within 3 hours of birth ***(Welty et al., 2005).***

A schematic representation of the complex series of acute and chronic events lead to neonatal RDS and the accompanying lung injury secondary to therapeutic intervention in these infants ***(Jobe, 1997).***

There is indirect evidence that neutrophils play a role in lung injury in infants with RDS. Circulating neutrophils counts are lower in infants with RDS than in infants without RDS and the neutrophil count is inversely correlated with the severity of RDS ***(Bras et al., 1997b).*** Circulating neutrophils from infants with RDS have more activation markers on their surface than are seen in neutrophils from infants without RDS (Yuppoizen et al, 2002), and neutrophil oxidation products are much higher in tracheal aspirates from infants with RDS than in those from infants without RDS ***(Buss et al., 2003).***

Clinical manifestations:

The typical infant with RDS presents with signs of respiratory distress either immediately at birth or within few hours after birth, as they may not be recognized for several hours until the rapid shallow respiration has increased to 60 or more breaths per minute. Breath sounds are diminished and may reveal dry, crackling sounds of air movement, (rales). Clinical signs include nasal flaring: intercostals, substernal, or suprasternal retractions: use of accessory muscles of breathing: tachypnea, prominent (often audible) grunting: tachycardia; and central cyanosis. The condition progresses to death in severely affected infants, but in milder cases, the symptoms and signs may reach a peak within 3 days, after which gradual improvement sets in ***(Aloan and Hill 1997; Stoll and Kliegman, 2000).***

Radiological findings:

Occasionally, the initial roentgenogram is normal, only to develop the typical pattern at 6-12 hours. Typical chest roentgenogram in RDS initially shows a diffuse, fine reticulogranular or ground glass appearance. Characteristic air bronchograms may be seen in the periphery of lung fields (due to the air in the major bronchi, which is clearly demarcated against the white opacified lung). With increasing severity, the granular area increases and becomes confluent so that the lungs show a homogenous ground glass appearance and the heart borders are obscured. The chest roentgenogram may show a complete white out, demonstrating fluid filled and atelectatic alveoli. The lung volume is also characteristically reduced ***(Long and Corbet, 1998; Thilo and Rosenberg, 1999).***

Table (E): Grading of the severity of RDS using radiological criteria

Grade I	Fine reticulogranular mottling, good lung expansion.
Grade II	Mottling with air bronchogram.
Grade III	Diffuse mottling, heart border just discernible, prominent air bronchogram.
Grade IV	Bilateral confluent opacification of lungs (white out)

(Halliday, 1998)

Prevention:

Because RDS is a problem of insufficient lung maturity, the best way to prevent it would be to prevent premature birth; for this purpose. The effective strategies are thought to be early discovery and treatment of bacterial infections, and the liberal use of tocolytics ***(Joint Working Party, 1992).*** At present however, the two major approaches to the problem are (1) prediction of the risk for RDS by antenatal testing of amniotic fluid samples and (2) antenatal treatment of women in preterm labor with glucocorticoid hormones to accelerate fetal lung maturation ***(Welty et al., 2005).***

Treatment:

1. Supportive therapy:

Improvements in supportive perinatal care are one of the major factors for improved outcomes in babies with RDS. Over the years, an improved understanding of neonatal physiology has contributed towards understanding the role of maintenance of oxygenation, perfusion, glucose homeostasis, thermoregulation, nutrition and specific organ supports. The role of minimal handling and analgesia has also been understood better in recent years ***(Stevens and Gibbins, 2002).*** The importance of developmentally supportive care to improve the neuropsychologic outcomes of the babies is being realized now ***(Kleberg et al., 2002).***

2. Assisted ventilation:

In preterm infants with RDS the application of CPAP is associated with reduced respiratory failure (requiring intubation and positive pressure ventilation) ***(Ho et al., 2002a).*** In the recent years there is a resurgence of interest in the use of early CPAP as the primary mode of treatment of RDS ***(Subramaniam et al., 2000).*** This has been stirred by the reports of lowest rates of chronic lung disease (CLD) from centers which use early CPAP the most ***(Ho et al., 2002b).***

Currently, there is a whole lot of research going on into improvements of design and mode of administration of CPAP ***(De Klerk and De Clerk, 2001).***

Nasal intermittent positive pressure ventilation (NIPPV) is another non invasive modality of ventilation which has recently come up. NIPPV augments CPAP by superimposing ventilator inflations on nasal CPAP. It has been shown to be more effective in preventing failure of extubation ***(Davis et al., 2002).***

Although assisted ventilation decreased RDS related mortality, earlier ventilators were associated with complications such as air leaks, bronchopulmonary dysplasia (BPD) secondary to barotrauma and volutrauma, airway damage and intraventricular hemorrhage (IVH). Advances in microprocessor technology, transducers and real time monitoring have enabled patient-triggered ventilators and synchronization of mechanical ventilation with patient effort, Physiologic studies have demonstrated short-term benefits of patient triggered ventilation over conventional ventilation ***(Cleary et al., 1995).*** During synchronized mechanical ventilation, peak airway pressure and spontaneous inspiration coincide. Thus with synchronized ventilation adequate gas exchange can be achieved at lower peak airway pressures reducing barotrauma, air leaks and CLD. However, these benefits have not yet been demonstrated in clinical trails ***(Donn and Sinha, 1998).***

High frequency oscillatory ventilation (HFOV) is another promising concept which has been tried over the last decade. Though very promising in terms of reducing barotrauma, the advantages have not been demonstrated in clinical trials ***(Keszler and Durand, 2001).***

Although positive pressure ventilation stays the backbone of neonatal ventilation, volume controlled ventilation is making a gradual comeback ***(Sinha and Donn, 2001).***

Current ventilators are able to control and deliver small tidal volumes suitable for neonates which were not possible earlier. The newest technology is able to combine the virtues of both pressure and volume controlled ventilation and deliver a "guaranteed volume" within set pressure limits ***(Herrera et al., 2002).***

3. Lung maturation therapies:

(a) Antenatal Steriods:

Antenatal steriods not only decrease the incidence and severity of RDS, but also overall neonatal mortality, intraventricular hemorrhage (IVH) and necrotizing enterocolitis (NEC). Long-term follow-up of children exposed to one course of antenatal steriods have not shown any adverse effects ***(Doyle et al., 2000).***

Moreover concerns have risen regarding the effect of repeated courses of steriods on growth and long-term neurodevelopmental outcome ***(Esptin et al., 2000).***

(b)Surfactant replacement therapy:

The introduction of surfactant therapy for RDS markedly reduced the mortality rate of premature infants and is now established as a safe and effective standard of care ***(Weiss. 2004).***

The stiff atelectatic lung of the premature infant with RDS does not inflate easily. With each expiration, the surfactant-deficient alveoli collapse, and the subsequent opening pressure is very high. Without surfactant, the alveoli resists inflation because of high surface tension at the air-fluid interface. Adding surfactant lowers the surface tension, allows the alveolus to remain inflated, and permits gas exchange ***(Jobe, 2004).***

The ventilatory techniques used during and after surfactant administration can profoundly affect the function of surfactant and the risk of lung injury ***(Kallapur and Ikegami, 2000).***

Complications

(A) Chronic complications:

(1) Bronchopulmonary dysplasia:

It is defined as an oxygen requirement in a premature infant at 36 weeks' post conception age. Long-term consequences consist of pulmonary dysfunction in adolescents and young adults and potentially impaired growth and cognitive function ***(Giacoia et al., 1997).***

Mechanisms of lung injury:

Strategies to recruit Clinical lung volume are surfactant, positive end expiratory pressure (PEEP) and HFV. However, if not judiciously used, aggressive recruitment can lead to excessive tidal volumes that can lead to damage of the pulmonary epithelium. The injured epithelium allows protein, fluid, and blood to leak into the airways, air sacs, and interstitial space. The resultant oedema interferes with lung mechanics, surfactant function and gas exchange leading to further lung damage ***(Clark et al., 2001).*** Oxygen can lead to damage in tissues secondary to the production of free radicals. Preterm infants are known to have insufficient antioxidant systems and are thus extremely susceptible to oxygen-induced injury ***(Davis et al., 2003).***

Another mechanism working synergistically with the above factors is inflammation. The pulmonary vasculature contains a large store of marginated neutrophils. Neutrophils are responsible for the storage and release of multiple inflammatory mediators. The inflammatory response can also be triggered by mechanical ventilation and resultant injury to the alveolar-capillary barrier and increase the risk of BPD ***(Van Marter et al., 2002).***

The classic or original pathology was that of interstitial fibrosis and smooth muscle hypertrophy. Some very immature infants can be born with minimal lung disease still progresses to a form of CLD. The mechanism of lung damage appears to be a decrease or interruption of alveolarization or alveogenesis, sometimes referred to as the "new BPD" ***(Jobe, 1999).*** Lung collagen probably plays a role in the development if the alveolus early (22 to 30 weeks) in fetal lung formation by playing a role in alveolar septation. One recent study investigated the effect of ventilation on the collagen architecture of the premature lung. The authors demonstrated that excessive positive pressure ventilation can compress and damage the collagen network resulting in an arrest of lung development ***(Thibeatift et al., 2003).***

2. **Retinopathy of prematurity (ROP):**

Occurs in > 80% of neonates weighing less than 1 kg and is increased by prolonged administration of oxygen. Found in both eyes with abnormal retinal vascularization. Clears up spontaneously in many cases but in about 4% of cases, condition progresses to blindness within first year ***(Brennan et al., 2003).***

3. **Neurologic impairment:**

Occurs in approximately 10-70% of infants and is related to the infant's gestational age, the extent and type of intracranial pathology, the presence of hypoxia, and the presence of infections. Hearing and visual handicaps further may compromise the development of these infants ***(Pramanik, 2001).***

B)Acute complications:

1. **Air leak:**

Risk factors for air leak in premature infants include respiratory distress syndrome, mechanical ventilation, sepsis and pneumonia. Types include pneumothorax, pneumomediastinum, Pneumopericardium, pulmonary interstitial emphysema ***(Ogino, 2004).***

2. **Intracranial hemorrhage:**

It is observed in 20-40% of premature infants with greater frequency in infants with RDS who require mechanical ventilation. Cranial ultrasound is performed within the first week and thereafter as indicated in premature infants younger than 32 weeks gestation. Prophylactic indomethacin therapy and antenatal steroids have decreased the incidence of intracranial hemorrhage in these patients with RDS. Hypocarbia and chorioamnionitis are associated with an increase in periventricular leukomalacia ***(Pramanik, 2001).***

3. PDA:

The frequency that a premature neonate will develop a hemodynamically significant left to right shunt through a patent ductus arteriosus is inversely proportional to advancing gestational age and weight ***(Wechsler and Wernovsky, 2004).***

4. Apnea of prematurity:

Episodes of apnea prolonged for 20 seconds or more or those accompanied by bradycardia or color change (desaturation) are considered significant. On neurodevelopmental follow-up evaluation, infants with significant apnea of prematurity do not perform as well as do similar premature infants without recurrent apneas ***(Cheung et al., 1999).*** Apnea of prematurity usually resolves by 38 weeks of post conception age but sometimes resolution is delayed until weeks. In many infants there is a good correlation between the attainment of full nipple feeds and the cessation of' apnea episodes ***(Darnall et al., 1997).***

5. Pulmonary hemorrhage:

It usually occurs between days 2 and 4 of life in infants who are receiving mechanical ventilation. It has been associated with a wide variety of predisposing factors, including prematurity, asphyxia, overwhelming sepsis, intrauterine growth retardation, massive aspiration, severe hypothermia, congenital heart disease, and coagulopathies ***(Hansen and Corbet, 2005).***

Infants of Diabetic Mothers

Introduction

Before the introduction of insulin, it was uncommon to have to deal with pregnancy in women with diabetes mellitus. However, many women with diabetes have delivered babies since insulin was introduced. In 1959, ***Dr. James Farquhar*** wrote the following delightful description:

These infants are remarkable not only because like foetal versions of Shadrach, Meshach and Abednego, they emerge at least alive from within the fiery metabolic furnace of diabetes mellitus, but because they resemble one another so closely that they might well be related. They are plump, sleek, liberally coated with vernix caseosa, full-faced and plethoric. The umbilical cord and the placenta share in the gigantism. During their first 24 or more extrauterine hours they lie on their backs, bloated and flushed, their legs flexed and abducted, their lightly closed hands on each side of the head, the abdomen prominent and their respiration sighing. They convey a distinct impression of having had such a surfeit of both food and fluid pressed upon them by an insistent hostess that they desire only peace so that they may recover from their excesses. And on the second day their resentment of the slightest noise improves the analogy, while their trembling anxiety seems to speak of intrauterine indiscretions of which we know nothing.

Pathophysiology

Although the subject of diabetes mellitus is not a simple one and some newer facts confuse and complicate the issue, some oversimplification seems justified. For all practical purposes, the main problem related to elevated levels of blood glucose in the diabetic mother. There is normally a gradient of blood glucose from mother to fetus of about 75%. Because most diabetic mothers have hyperglycemic levels, relative hyperglycemia exists in the fetus. This condition results in stimulation of the fetal pancreas and accounts for the marked hypertrophy of the beta cells of the islets of Langerhans observed in infants of diabetic mothers (IDMs) who die. The increased output of insulin combined with the availability of glucose substrate results in accelerated growth rates (with macrosomia) and deposition of fat. This situation is most marked in infants born to mothers who are insulin dependent, and for obstetric reasons (e.g. higher stillbirth rate, cephalopelvic disproportion), delivery at 36 or 37 weeks gestation was frequently accomplished in these mothers. With tighter control of diabetes, delivery closer to term is now more usual. Some mothers demonstrate an abnormality of glucose tolerance only during pregnancy and are said to have gestational diabetes. The same problems as those seen in insulin-dependent diabetes are likely to be seen in gestational diabetes, but to a lesser extent. By careful dietary regulation, the tendency to macrosomia can be decreased, with delivery occurring at or close to term. Diabetes mellitus in the mother is usually subdivided according to the classification of White ***(Cowett et al., 1982):***

Group A	Abnormal glucose tolerance test results only (chemical diabetes)
Group B	Onset after age 20, duration less than 10 years
Group C	Onset ages 10 to 19, duration 10 to 19 years
Group D	Onset before age 10, or duration 20 years or more; vascular disease in legs; retinal changes or fundoscopic change
Group E	Same as D, with pelvic arteriosclerosis
Group F	Kidney involvement
Group R	Active retinitis proliferans.

In some cases of diabetes, intrauterine growth retardation (IUGR) may occur, which has usually been associated with the more severe grades of diabetes and is presumably secondary to vascular problems. However, in some cases, it may occur very early in pregnancy. Another interesting clinical association is that diabetic women whose glucose levels are poorly controlled around the time of conception may have a higher incidence of infants with congenital abnormalities. These malformations seem to be related to increased amounts of glycosalated hemoglobins (particularly HbA) and may be decreased by tight glucose control in the periconceptional period. It has been reported that macrosomia correlates with the amount of animal insulin found in cord serum and that increased amounts of animal insulin are transferred when large amounts of insulin antibody are found in the mother. Transfer of insulin takes place as an insulin-antibody complex. This does not seem to be a problem with recombinant human insulin ***(Morriss et al., 1984).***

Diagnosis and Clinical Course

The classic IDM, as described by ***Dr. Farquhar***, resembles other babies who are IDM so closely that there is usually no doubt about the diagnosis. Because of their increased intrauterine growth, they are frequently very large for gestational age. For the uninitiated, such increase in size can lead to the false assumption that a baby born prematurely is at term. Convincing evidence now exists to corroborate the long-held opinion that IDMs may behave in a less mature way at a given gestational age, at least as far as pulmonary function is concerned (resulting in a higher frequency of respiratory distress syndrome).

This condition seems to be the result of fetal hypersecretion of insulin, blocking the enzyme-inductive capability of cortisol in the lung ***(Landon, 1993).***

The neonatal problems likely to be encountered in IDMs are as follows:

1. Hypoglycemia secondary to hyperinsulinemia.
2. Respiratory distress syndrome.
3. Hypocalcemia.
4. Hyperbilirubinemia.
5. Hypertrophic cardiomyopathy.
6. Congenital abnormalities.
7. Renal vein thrombosis.

Hypertrophic cardiomyopathy is important because using digoxin may be deleterious with this problem. It appears to be a benign disorder that resolves spontaneously, but propranolol may be needed. The incidence and type of congenital abnormalities has varied in different series of IDMs. In Boston, congenital heart disease is prominent; in Copenhagen, neural tube or osseous defects predominate; and in Edinburgh, there was no statistically significant difference in the incidence of defects compared with the non-diabetic population. Another unusual abnormality is the small left colon syndrome. There does seem to have been some decrease in the number of abnormalities as a result of good control of maternal diabetes. Renal vein thrombosis has been reported to be a problem that occurs with markedly increased frequency in IDMs when compared with other infants. With present management, it is rarely encountered ***(Piper and Langer, 1993).***

Management

Infants born to insulin-dependent mothers and those of gestational diabetics who look like IDMs should be cared for in a special care nursery. It seems wise to replace the constant infusion of glucose via the placenta with an extrauterine infusion of glucose to prevent the rapid development of hypoglycemia, although the evidence showing that low levels of glucose in IDMs cause long-term sequelae is far from conclusive. This infusion is usually given by the intravenous route, but in the very obese baby, finding a vein may be difficult. Under such circumstances, we frequently elect to use an umbilical artery catheter until feeding is established. Because of the frequency of respiratory difficulty and the tendency of IDMs to vomit on the first day, oral feeding are usually deferred for 12 to 24 hours. Measurement of blood glucose using a test strip seems particularly valuable for detecting hypoglycemia and may be performed on a drop of blood obtained from a warmed heel stick. Hourly determination for the first 4 to 6 hours, followed by determinations at 4 hour intervals are usually performed. If an infusion has not been started, some people prefer to use glucagons to treat hypoglycemia. It seems easier to anticipate hypoglycemia and begin a glucose infusion before it occurs. If low blood glucose level occurs despite 10% dextrose infusion, it may be necessary to given a 15% solution or to resort (in refractory cases) to corticosteroids. Subsequent intellectual impairment has been described in some IDMs but does not seem to be the result of hypoglycemia. After oral feeding is begun, the glucose solution by infusion should be gradually decreased or changed to 5% to prevent reactive hypoglycemia. This change usually occurs at 24 hours and is discontinued at 48 hours of age ***(Morriss, 1984).***

Treatment of the respiratory distress syndrome in IDMs differs little from that in other babies. Hypocalcemia may be corrected if necessary with calcium gluconate, and hyperbilirubinemia may be controlled with phototherapy in most instances. Conservative management is usually employed in the rare case of renal vein thrombosis ***(Morriss, 1984).***

Some babies appear to lose a lot of weight, but if on calculation this loss does not exceed 10% of birth weight, it can probably be accepted as being within normal limits. In other words, the absolute weight loss (e.g. 400 g) may be unremarkable when the baby's birth weight is also very high (e.g. ≥ 4.5 kg. Which is not an unusual birth weight for an IDM) ***(Morriss, 1984).***

Summary

The typical IDM may be seen less frequently now and in the future, thanks to tighter control of the glucose level in the mother. However, it is still common to see infants of insulin-dependent diabetic mothers who are large for gestational age as a result of macrosomia (Presumably secondary to increased endogenous insulin production). Neonatal management is primarily concerned with (1) prevention and treatment of hypoglycemia, and (2) treatment of the respiratory distress syndrome. These babies require special care nursing, as may infants born to mothers with gestational diabetes ***(Morriss, 1984).***

Congenital pneumonia

It is diffuse alveolar or interstitial disease that is usually asymmetric and localized. Intrauterine pneumonia may be confused with RDS because it is seen more frequently in premature infants, and the manifestations may be quite similar ***(Gomella et al, 2004).***

Pathophysiology

Prolonged labor (longer than 24 hours), prolonged rupture of membranes (longer than 24 hours), maternal fever, foul-smelling amniotic fluid, and other evidence of amnionitis have all been associated with intrauterine pneumonia. However, these findings are not prerequisite. The infecting organism can frequently be recovered from the maternal genital tract as well as the baby. Infection is either (1) bloodborne via the placenta or (2) ascending, in which the amniotic fluid becomes infected. Labor, via contractions, seems to predispose to ascending infection. Although many microorganisms have been implicated, the most commonly associated organism at the present time is group B β-hemolytic streptococcus. Hyaline membranes with embedded organisms have been observed pathologically in the lungs of babies who die ***(Sherman et al., 1980).***

Diagnosis

Difficulty may be encountered in the delivery room, with infants demonstrating poor Apgar scores and a need for resuscitation, or it may be delayed for several hours. Rapid respirations, grunting and retractions may be noted. Apnea and shock (poor peripheral perfusion) are more likely to be seen in the first 24 hours in intrauterine pneumonia than in RDS. Hypothermia also may be noted. In a term infant who first develops grunting and retractions after the first 12 hours, there are few other diagnoses to be considered. White blood count and differential may reveal neutropenia or an abnormally high band to total neutrophil ratio. The level of C-reactive protein may not be increased early with group B streptococcal infection but rises later. Chest x-ray is frequently diagnostic, although this disorder may be confused with RDS in some premature infants ***(Philip, 1985).***

Management

In cases in which infection may be suspected (e.g., prolonged rupture of membranes or maternal fever), it may be valuable to perform a smear of the gastric aspirate. Many pus cells (polymorphonuclear leukocytes) in the depressed (low-Apgar) premature infant suggest infection. In group B streptococcal infection, many cocci are usually seen in the gastric aspirate smear. The gastric aspirate can also be evaluated with the foam stability (shake) test. If the result is positive, pneumonia is more likely and RDS very unlikely). A negative result may not distinguish between RDS and pneumonia. Evaluation of tracheal aspirate may be helpful. These findings, with or without an abnormal white blood count and differential, should initiate a sepsis evaluation, which includes blood, urine, and cerebrospinal fluid cultures. Treatment with broad-spectrum antibiotics is usually begun until the results of cultures and sensitivities are known. Treatment should consist of a penicillin and an aminoglycoside (we currently start therapy with ampicillin and gentamicin). Duration of therapy is usually 1 week, if C-reactive protein levels rapidly return to normal ***(Philip, 1985).***

Summary

This disorder most frequently follows ascending infection of the maternal genital tract. Particularly with group B streptococcal infection, the clinical manifestations may resemble those of RDS. Apnea, shock, and hypothermia may occur. Chest x-ray study frequently provides the diagnosis, and broad-spectrum antibiotic therapy is used ***(Philip, 1985).***

Neonatal pneumonia

Pneumonia that occurs after the first few days of life can no longer be considered congenital, or intrauterine. Many organisms have been associated with neonatal pneumonia, the most common being Escherichia coli, enterococci, staphylococci. However, particularly when assisted ventilation is used, the premature infant may succumb to organisms such as Klebsiella and Pseudomonas sp. ***(Papegeorgiou et al. 1973).***

Another form of pneumonia is that caused by Chlamydia trachomatis, which may produce a chest x-ray picture of hyperinflation with diffuse interstitial or patchy infiltrates. It is usually seen later in (or beyond) the neonatal period. It is unclear whether the pneumonia is caused by direct infection or is a hypersensitivity reaction to the organism. The fact that eosinophilia is often prominent may support the latter concept ***(Hammerschlag, 1978).***

Pneumonia caused by Staphylococcus aureus is not commonly seen at birth but may occur toward the end of the first month. The baby often appears much worse clinically than the chest x-ray study would suggest, but later the chest x-ray study may show pneumatoceles. Other organisms (Klebsiella pneumoniae and E. coli) have also been associated with pneumatocele formation in the newborn. Antibiotic treatment is directed toward eradicating the specific organism. Erythromycin seems to be useful in the treatment of chlamydial pneumonia ***(Jacob et al., 1980).***

Chapter (4): Outcome of Respiratory Distress on Growth and Development

Acute respiratory distress syndrome (ARDS) has a high mortality and is associated with significant morbidity. Prior outcome studies have focused predominant on short-term outcomes (6-12 months). Longitudinal neurocognitive, emotional, and quality of life in ARDS survivors were assessed at hospital discharge, and 1 and 2 years after hospital discharge using neuropsychologic tests and emotional and quality-of-life questionnaires. Neurocognitive sequelae occurred in 73% (54 of 74) of ARDS survivors at hospital discharge, 46% (30 of 66) at 1 year, and 47% (29 of 62) at 2 years. ARDS survivors report moderate to severe depression (16% and 23%) and anxiety (24% and 23%) at 1 and 2 years, respectively. The ARDS survivors had decreased quality of life, with the physical domains improving at 1 year, with no additional change at 2 years. Role emotional, pain, and general health did not change from hospital discharge to 2 years. Mental health improved during the first year and declined at 2 years. ARDS results in significant neurocognitive and emotional morbidity and decreased quality of life that persist at least 2 years after hospital discharge. ARDS can cause significant long-term, brain-related morbidity manifest by neurocognitive impairments and decreased quality of life ***(Hopkins et al., 2005).***

As more patients survive the acute respiratory distress syndrome, an understanding of the long-term outcomes of this condition is needed. The survivors of the acute respiratory distress syndrome have persistent functional disability one year after discharge from the intensive care unit. Most patients have extrapulmonary conditions, with muscle wasting and weakness being most prominent ***(Herridge et al., 2003).***

Extended survival is common among patients with ARF who require mechanical ventilation and who survive hospitalization. Among these patients, only a small fraction of the impairment in activity and QOL can be considered to be a sequela of the respiratory failure or its therapy. These findings are relevant to the care decision for such critically ill patients. Prolonged mechanical ventilation is associated with impaired health-related quality of life compared with that of a matched general population. Despite these handicaps, 99% of the patients evaluated were independent and living at home 3 yrs after ICU discharge. Future studies should focus on physical or psychosocial rehabilitation that could lead to improved management of patients after their ICU stay ***(Combes et al., 2003).***

Survivors of acute respiratory distress syndrome (ARDS) are at risk for long lasting cognitive decline due to hypoxemia, sepsis and/or psychological sequelae associated with aggressive supportive care in the intensive care unit. We conducted an exploratory study to assess cognitive performance in long-term survivors of ARDS and to investigate how cognitive functioning is related to employment status and health-related quality of life (HRQOL). Long-term ARDS survivors exhibit impaired health status and the presence of cognitive deficits is associated with disability and considerable impairments in HRQOL. More detailed psychiatric research is required to establish the etiology of these cognitive impairments ***(Rothenhausler et al., 2001).***

Postnatal risk factors that could potentially affect the cognitive development of preterm infants were investigated in the first phase of a longitudinal study. Risk status was stratified by the extent of the infants postnatal respiratory illness (i.e., chronicity), and by their length of hospitalization (i.e., severity). Three risk groups that differed significantly by birth weight, gestational age, and other neonatal characteristics were established by use of these combined criteria. The cognitive development of these infants was evaluated in their second year of life (12 or 18 months time post hospital discharge). Analysis of data from the Bayley, Uzgiris Hunt, and REEL scales indicated that the criteria of chronicity and severity of postnatal respiratory illness are effective predictors of cognitive and psychomotor risk of preterm infants. Regression analyses demonstrated that the variance accounted for by risk group on these outcomes was enhanced by two neonatal variables: birth asphyxia and sex of child. The study demonstrated that postnatal illness characteristics are highly associated with the cognitive development of preterm infants in the second year ***(Samuel et al., 1987).***

The performance of the infants with respiratory distress syndrome suggests that their developmental scores are comparable to those of average, healthy full-term infants of the same age. In contrast, the group of infants with bronchopulmonary dysplasia performed in the low-average to delayed range. Moreover, regression analyses show that type of respiratory illness explains more of the variance in cognitive outcomes than such neonatal factors as birth weight or gestational age. The study demonstrates that infants with bronchopulmonary dysnplasia are at high risk for developmental problems in their second year, and that the contribution of bronchopulmonary dysplasia to explanations of differential cognitive outcomes cannot be reduced to between – group differences in perinatal status ***(Meisels et al., 1986).***

In a prospective study, the cognitive, language, and motor development of 80 low birth weight infants was compared with that of 68 full-term infants, matched on social class, sex, parity, and maternal age. When the scores were not corrected for the degree of prematurity, the preterm infants, with the exception of the SGA (small-for-gestational age) singletons, had significantly lower cognitive (Bayley MDI), language (Reynell), and motor (Bayley PDI) scores at 2 years of age. When the scores were corrected for prematurity, only the motor development scores of the preterm AGA (appropriate-for-gestational age) group were lower than those of the full-term group. Using a system of demographic, perinatal, and reproductive variables, the cognitive, motor, and language development of these infants at 2 years could be predict with a high degree of accuracy, and infants with delayed development could be detected. Factors important in predicting developmental functioning and delay included socioeconomic status, parental educational level, maternal cigarette smoking, number of previous pregnancies, and in the preterm infants, apnea, birth asphyxia, and severity of respiratory distress. This model appears to be a promising one for the detection of infants at risk for developmental problems ***(Linda et al., 1982).***

In a long-term prospective study 46 unselected infants born before 35 completed weeks of gestational age were followed up, and compared to 26 full-term infants. At 9 and 18 months of chronological age their height and weight were still lower than that of full-terms, but the difference disappeared when age was corrected for gestational age at birth. The motor and neurological maturity and language development was delayed in the preterms still at 18 months, which could possibly also be explained by their lower biological age. Ten of the preterm infants showed, at one or several occasions during follow up, definite neurological abnormality. At 18 months of age two of them were handicapped, one with retrolental fibroplasias, nearly blind, and another with cerebral palsy (slight spastic diplegia). Five of them had late psychomotor development, while two were borderline and one normal. Pre-and perinatal risk groups were defined, but found that development at 18 months was not correlated to degree of risk. Neither was there any correlation between neurological examination at term and later handicap or psychomotor retardation. We found more illness, mostly due to common infections, during the first 18 months in the preterm group, as measured by the number of visits to a doctor and days spent in hospital ***(Forslund and Bjerrel, 1985).***

PATIENTS & METHODS

PATIENTS AND METHODS

The present follow up study was applied in a private hospital in Cairo with tertiary care Intensive Care Unit and performed during the period from September, 2003 till August, 2004. The total number of patients needed admission in this period was 360. Out of the total number, 137 patients were suffering from respiratory distress signs according to Silverman Retraction Score ***(Avery et al., 1973) Appendix(1).*** 98 patients were fulfilling the inclusion criteria of our study and 39 patients were excluded according to the exclusion criteria. Out of the 98 patients, 52 patients accepted to be included in this study.

Inclusion Criteria:

All neonates suffering from respiratory distress according to Silverman Retraction score, in their first week of life were candidate to this study (after signing a parental consent) which includes:

- Respiratory problems: as respiratory distress syndrome, transient tachypnea of newborn (TTN), meconium aspiration and persistent pulmonary hypertension of newborn (PPHN).
- Infections: as pneumonia.

- Miscellaneous: as infant of diabetic mother (IDM).

Exclusion Criteria:

All neonates suffering from any disease known to affect growth and development were excluded e.g.:

- Neonates with major congenital anomalies; major surgery or congenital infections.
- Neonates with complications of prematurity: Necrotizing enterocolitis, intracranial hemorrhage and pulmonary hemorrhage.
- Complicated full term: Hypoxic Ischaemic Encephalopathy and intracranial hemorrhage.

The study group was divided into two groups:

1. **Group I:** included 32 full term infants with gestational age 37-41 weeks and having respiratory distress with Silverman Retraction score ranged between 4 to 8.
2. **Group II:** included 20 preterm infants with gestational age 32-36 weeks and having respiratory distress with Silverman Retraction score ranged between 4 to 6.

Gestational age is assessed according to New Ballard Score, ***(Ballard et al., 1991) (Appendix 2).***

Methodology:

This study was divided into two phases:

Phase I: Collection of the raw data and creation of base line information. This had been achieved by:

A) Full and detailed history:

In order to build data base for the study, a data form designed by the Intensive Care Unit in Cairo University, was used and approved to include all the needed data of the study group *(Appendix 3)*. Stressing on:

1. **Personal history:** included all the patients' demographic data: name, sex, birth data, age at the time of enrollment, social status of the family according to ***Park and Park (1979), (Appendix 4).***
2. **Perinatal history:**
   - Prenatal history: health of the mother during pregnancy, diseases acquired during pregnancy, premature rupture of membranes, prenatal care, multiple pregnancies.
   - Natal history: duration of pregnancy, mode of delivery, fetal presentation.
   - Neonatal history: including the need for supplemental oxygen, using Ambu bag, the need of cardiac massage,

endotracheal intubation and if the newborn passed urine and meconium. Also, the use of medications in delivery room, color of the skin, history of apnea, grunting, seizures and Apgar scores.

3. **Physical examination** on admission to the Neonatal Intensive Care Unit including:
   - Vital signs: Temperature, O_2 Saturation, heart rate, respiratory rate, birth weight, birth length and head circumference.
   - Chest examination: for signs and symptoms of respiratory distress and Silverman retraction score.
   - Cardiac examination: poor peripheral perfusion, femoral pulsation, tachycardia and bradycardia.
   - Abdominal examination: presence of distension, liver enlargement and spleen enlargement.
   - Neurologic examination: lethargy, irritability, poor suckling, seizures, jitteriness, decreased spontaneous movement, increased muscle tone, Moro reflex, suckling reflex and grasping reflex, presence of meconium stained aspirate.

4. **The use of mechanical ventilation and O_2 supply:** including period of stay on mechanical ventilation, period of stay on O_2 supply and use of surfactant therapy.
5. **Admission diagnosis was registered.**

B) Orientation of the parents about the aim of the study associated with a written instruction to be considered before each visit ***(Appendix 5).*** A time schedule was designed for the four visits' appointments.

<u>Phase II:</u> Follow up of the patients' growth and development:

After discharge from the intensive care unit, we planned to apply the study at the ages of 6, 12, 18 and 24 months. In these four stations we performed:

A) **Anthropometric measurements including:**

- ***Weight:*** body weight was measured using regularly calibrated scale. The baby should be naked. If the baby is struggling, weigh his mother alone then with the baby on her arms and subtract the baby's weight.
- ***Length:*** A special board was used, calibrated in centimeters and millimeters. The board has a fixed head piece and a movable foot piece which was kept vertical to the longitudinal axis of the scale. In supine position, the infant's head was kept in contact with the fixed board

with the help of one person and gentle traction was applied to the ankles while doing gentle pressure on the knees by another person, on attempt to extend the legs, the moving foot piece was brought into contact with the infant's heels and kept vertical to the legs. A mean of three readings was apprximated to the nearest 0.5 centimeters *(Fig.A)*.

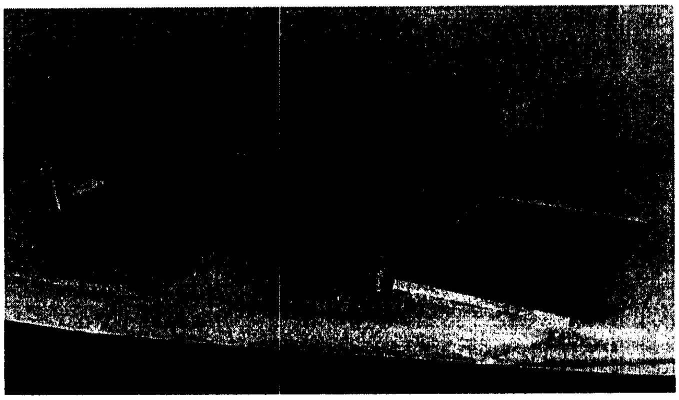

Fig. (A): Length Scale used in the study

- ***Head circumference:*** It was measured by passing a tape over the most prominent part of the occiput and just above the supraorbital ridges. A mean of three readings was approximated to the nearest millimeter.
- ***Weight for length.***

- After performing an accurate, precise and consistent measurements, accurate plotting of these measurements was done on the Egyptian growth charts which was designed by the Diabetic Endocrine and Metabolic Pediatric Unit in Cairo University and the National Research Centre in Cairo in December, 2003 ***(Appendix6).***
- The anthropometric measurements at birth were plotted on special charts. Based on maturity and intra-uterine growth ***(Lubchenco et al., 1966) (Appendix 7).***

B) Neurodevelopmental assessment; by using the Bayley scales of infant development-second edition (BSID-II) ***(Bayley, 1993) (Appendix 8)*****:** it was done every six months started from the age of six months up to the age of 24 months (Four visits).

- A detailed training was performed on Bayley scale by the candidate under supervision of a specialist professor in the National Research Center in Cairo.
- A typical set of Bayley was designed to be used as a tool for assessment of development.
- A well prepared room was prepared to perform the Bayley scale tests.

Bayley scales of infant development (BSID-II) is an individually administered examination that assesses the current developmental functioning of infants and children from 1 month to 42 months of age, it consists of three scales; mental scale, motor scale, and behavior rating scale (BRS) using test materials of BSID-II ***(Fig.B,C and Appendix 10).***

Mental scale: includes items that assess memory, habituation, problem solving, early number concepts, generalization, classification, vocalizations, language and social skills.

Motor scale: assesses control of the gross and fine muscle groups. This includes movements associated with rolling, crawling, creeping, sitting, and standing, walking, running and jumping. It also tests fine motor manipulations involved in comprehension, adaptive use of writing implements and imitation of hand movements.

Behavior rating scale: assesses qualitative aspects of the child's attention/arousal (under 6 months of age), orientation/ engagement towards the tasks, examiner and care giver, emotional regulation and quality of movement.

Fig. (B): Sample of the Bayley tools used in the study

Principles of BSID-II:

Assessment of mental and motor development for all patients was performed.

- **Motor and Mental Scales:**

Item sets:

1. To choose the appropriate item set (based on the child's chronological age for full-term infants and corrected age for preterm infants), round the child's calculated age to the nearest whole month. ***(Appendix 9).***

2. These item sets were constructed by examining the performance of the children from the standardization sample.

3. When testing a child of very low or very high ability, it may be necessary to test outside the item set appropriate for the child's age according to the basal and ceiling rules as shown in table (F).

Table (F): Basal and ceiling rules of BSID-II

	Mental scale	*Motor scale*
Basal rule	5 or more credited items	4 or more credited items
Ceiling rule	3 or more no credit items	2 or more no credit items

(Bayley, 1993)

- **Computing raw scores (Appendix 9):**

The child's raw scores of the mental and motor scales of BSID-II are computed by adding the total number of items for which the child receives credit on each scale to all items below the basal item.

- **Obtaining mental development index (MDI) and psychomotor development index (PDI):**

To convert raw scores for mental and motor scales to MDI and PDI scores, turn to the appropriate page of ***Appendix (9)*** in BSID-II example. Each page provides the index scores for the age span noted in the box at the top of the page.

Each raw score has an equivalent index score for each scale. The index scores for each scale range form 50 to 150 with a mean value of 100 and standard deviation of 15.

Fig. (C): One of the patients' sample during assessment

Statistical analysis:

Standard computer program SPSS for Windows, release 10.0 (SPSS Inc. USA) was used for data entry and analysis. All numeric variables were expressed as mean ± standard deviation (SD). Comparison of different variables in various groups was done using student t test and Mann Whitney test for normal and nonparametric variables respectively. Paired t or Wilcoxon signed ranks tests were used to compare variables. Chi-square (χ^2) test was used to compare frequency of qualitative variables among the different groups. Pearson's and Spearman's correlation test were used for correlating normal and nonparametric variables respectively. For all tests a probability (pf) less than 0.05 was considered significant. Graphic presentation of the results was also done ***(Daniel, 1995).***

Results

RESULTS

Growth and development were assessed in this study for 52 patients suffering from postneonatal respiratory distress. All the included patients were recruited from the Neonatal Intensive Care Unit of a private hospital in Cairo. The patients were divided into two groups, 32 were full-term infants (group I) with Silverman Retraction Score ranged between 4 to 8, and 20 preterm infants (group II) with Silverman Retraction Score ranged between 4 to 6.

All the enrolled patients were examined thoroughly. All patients' data during admission in NICU were collected and tabulated. Follow up of the patients' growth and development was performed in four chronological stations at 6, 12, 18 and 24 months of age. The followings were done in each visit:

1. Anthropometric measurements including weight, length and head circumference according to their chronological ages. Plotting of measurements on appropriate charts and interpretation was done.
2. Mental and motor developmental assessment using BSID-II according to the chronological age of group I patients and corrected age of group II patients.

The descriptive and statistical comparisons of the studied patients are shown in the following tables and figures.

Table (1): Maturity, sex and outcome of pregnancy in all patients (n=52)

	No. of cases	Percent
Maturity:		
Group I	32	61.5
Group II	20	38.5
Sex:		
Male	27	51.9
Female	25	48.1
Outcome of pregnancy:		
Single	48	92.3
Triplet	4	7.7

Table (1) shows the number of group I and group II, sex distribution and outcome of pregnancy in all patients. The number of group I and group II and the distribution of sex were almost comparable.

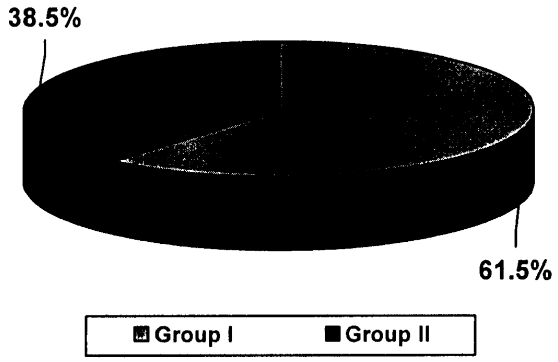

Fig. (1): Maturity in all patients

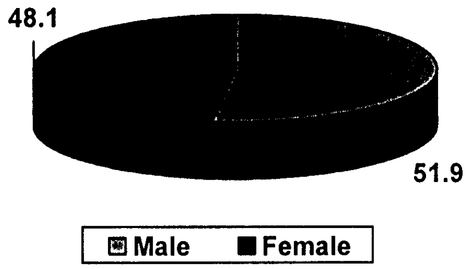

Fig. (2): Sex distribution in all patients

Table (2): Frequency of maternal information (n=52)

	Frequency	Percent
Social status:		
High	52	100
Consanguinity:		
Yes	11	21.2
No	41	78.8
Prenatal care:		
Yes	50	96.2
No	2	3.8
Fetal presentation:		
Vertex	49	94.2
Breech	3	5.8
PROM:		
Yes	7	13.5
No	45	86.5
Method of delivery:		
Vaginal	14	26.9
C-section	38	73.1
Use of forceps:		
Yes	0	0
No	52	100
IVF:		
Yes	4	7.7
No	48	92.3
Multiparity:		
Yes	24	46.2
No	28	53.8

Table (2) shows that all patients from high social class with low incidence of consanguinity and most of them had prenatal care. Few cases only with PROM and most of the deliveries were C-section.

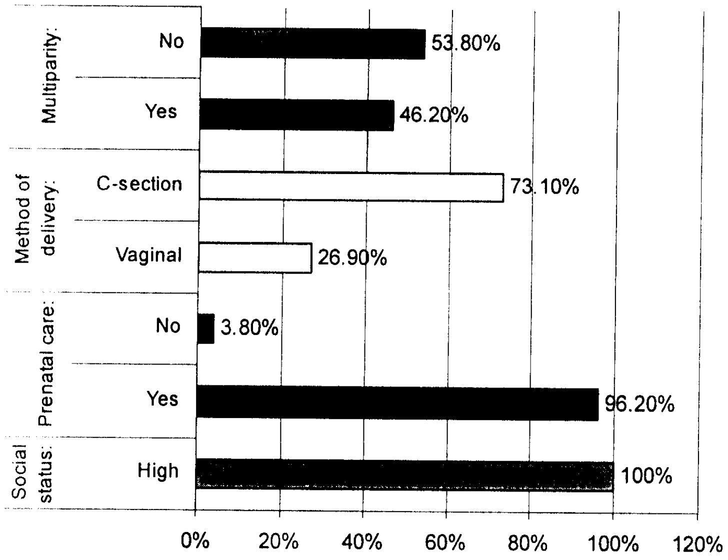

Fig. (3): Social status, prenatal care, method of delivery and multiparity

Table (3): Frequency of diagnosis in all patients (n=52)

	No. of cases	Percent
TTN	37	71.2
RDS	10	19.2
Pneumonia	1	1.9
IDM	4	7.7
Total	52	100

Table (3) shows different diagnoses in all patients where the majority of the cases were suffering from transient tachypnea of newborn followed by cases of respiratory distress syndrome.

Table (4): Association between sex and maturity

Maturity / Sex	Group I		Group II		χ^2	P
	No.	%	No.	%		
Male	15	46.86	12	60	0.849	0.357
Female	17	53.14	8	40		
Total	32	100	20	100		

Table (4) shows that there was insignificant relationship between sex and maturity in both groups.

Table (5): Relation between prenatal care and maturity

Maturity / Prenatal care	Group I No.	Group II No.	χ^2	P value
No	2	0	1.300	0.254
Yes	30	20		
Total	32	20		

Table (5) shows that there was insignificant relationship between the prenatal care and maturity in group I as well as in group II patients.

Table (6): Relation between method of delivery and maturity

Maturity / Delivery	Group I No.	Group II No.	χ^2	P value
V	12	2	4.731	0.030
C-section	20	18		
Total	32	20		

Table (6) shows that there was a significant relationship between the method of delivery and maturity in group I as well as in group II patients.

Table (7): Relation between IVF and maturity

Maturity IVF	Group I No.(%)	Group II No.(%)	χ^2	P value
No	32 (100)	16 (80)	6.933	0.008
Yes	0 (0)	4 (20)		
Total	32 (100)	20 (100)		

Table (7) shows that there was a significant relationship between IVF and maturity in group I as well as in group II patients.

Table (8): Relation between neonatal reflexes and maturity

Maturity Neonatal reflexes	Group I (n=32)	Group II (n=20)	χ^2	p value
Suckling reflex:				
Abnormal	31	11	13.895	0.001
Normal	1	9		
Moro reflex:				
Abnormal	1	10	16.214	0.001
Normal	31	10		
Grasping reflex				
Abnormal	1	11	18.658	0.001
Normal	31	9		

Table (8) shows that there was a significant relationship between the neonatal reflexes and maturity in group I as well as in group II patients regards Moro and Grasping reflexes.

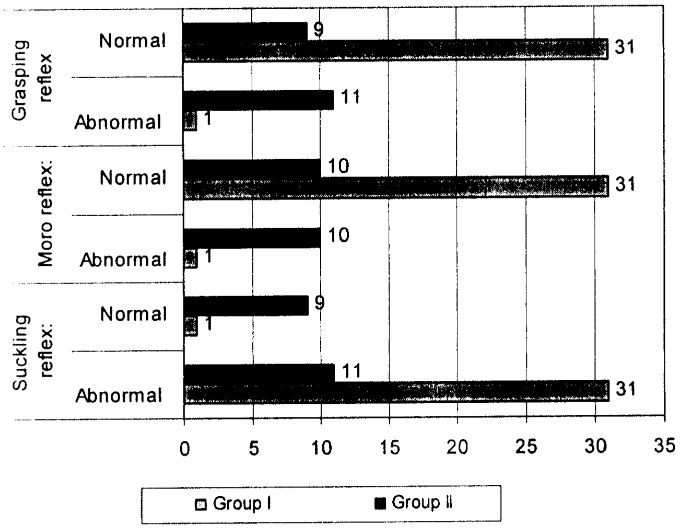

Fig. (4): Neonatal reflexes in both groups

Table (9): Relation between mechanical ventilation duration and Oxygen supply duration and Silverman retraction score in group I

Silverman	4	5	6	χ^2	P
	Mean ± SD	Mean ± SD	Mean ± SD		
Mechanical ventilation duration (days)	-	-	8.00 ± 1.41	12.34	0.006
Oxygen supply duration (days)	2.25 ± 1.45	2.33 ± 1.03	3.00 ± 1.58	1.50	0.474

Table (9) shows that the mean for mechanical ventilation duration and oxygen supply duration increased with higher scores of Silverman in group I. The relation between Silverman scores and mechanical ventilation duration was highly statistically significant.

Table (10): Relation between mechanical ventilation duration and Oxygen supply duration and Silverman retraction score in group II

Silverman	4	5	6	χ^2	P
	Mean ± SD	Mean ± SD	Mean ± SD		
Mechanical ventilation (days)	-	-	18.75 ± 12.95	12.34	0.006
Oxygen supply duration (days)	1.91 ± 1.14	11.25 ± 12.92	11.80 ± 5.81	10.75	0.005

Table (10) shows that the mean for mechanical ventilation duration and oxygen supply duration was increased with higher scores of Silverman in group II both were statistically significant.

Table (11): Comparison of the mechanical ventilation duration and Oxygen supply duration between both groups

	Group I	Group II	χ^2	P
	Mean ± SD	Mean ± SD		
Mechanical ventilation duration	5.25 ± 3.30	15.0 ± 12.3	1.34	0.246
O_2 supply duration	2.41 ± 1.36	6.25 ± 7.64	35.26	0.851

Table (11) shows that the mean of mechanical ventilation duration and O_2 supply duration in group I was insignificantly decreased if compared to the group II.

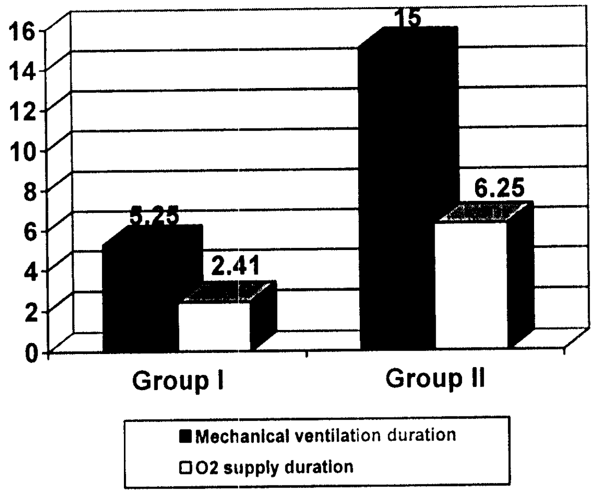

Fig. (5): Mean ±SD of mechanical ventilation duration and O_2 supply duration in both groups

Table (12): Relation between Silverman retraction score and maturity

Maturity / Silverman	Group I (n=32)		Group II (n=20)		χ^2	P
	No.	%	No.	%		
4	20	62.5	11	55	1.31	0.726
5	6	18.8	4	20		
6	5	15.6	5	25		
8	1	3.1	0	0		
Total	32	100	20	100		

Table (12) shows that the relation between Silverman retraction scores and maturity was statistically insignificant. The majority of cases 96.9% in group I and 100% in group II had a score between 4 and 6.

Table (13): Relation between Silverman retraction score and the mechanical ventilation in group I

Mechanical ventilation / Silverman	N (n=28)		Y (n=4)		χ^2	p
	No.	%	No.	%		
4	19	67.9	1	25	12.34	0.006
5	6	21.4	0	0		
6	3	10.7	2	50		
8	0	0	1	25		
Total	28	100	4	100		

Table (13) shows that the relationship between Silverman retraction scores and the use of mechanical ventilation was highly significant in group I.

Table (14): Relation between Silverman retraction score and mechanical ventilation in group II

Mechanical ventilation / Silverman	N (n=14)		Y (n=6)		χ^2	P
	No.	%	No.	%		
4	10	71.4	1	16.7	10.88	0.004
5	4	28.6	0	0		
6	0	0	5	83.3		
Total	14	100	6	100		

Table (14) shows that the relationship between Silverman retraction scores and the use of mechanical ventilation is highly significant in group II.

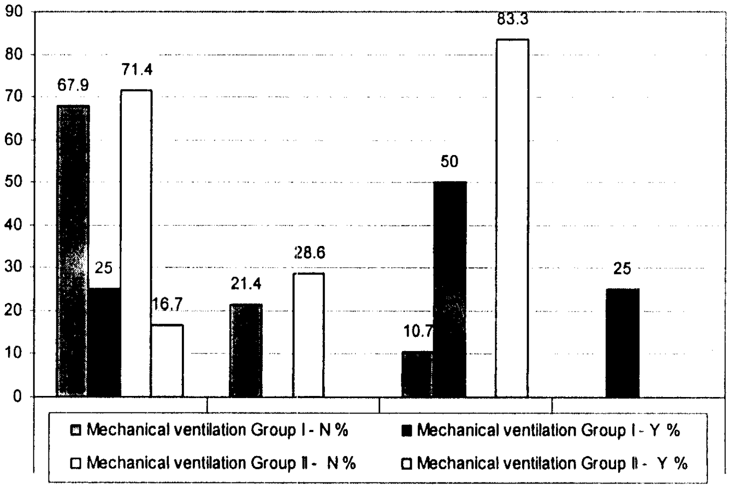

Fig. (6): Cases required mechanical ventilation in both groups according to Silverman retraction scores

Table (15): Relation between Silverman retraction score and the use of surfactant in group I

surfactant / Silverman	N (n=31)		Y (n=1)		χ^2	p
	No.	%	No.	%		
4	20	64.5	0	0	5.57	0.134
5	6	19.4	0	0		
6	4	12.9	1	100		
8	1	3.2	0	0		
Total	31	100	1	100		

Table (15) shows that there was no significant relation between using the surfactant and different Silverman retraction scores in group I.

Table (16): Association between Silverman retraction score and the use of surfactant in group II

Surfactant / Silverman	N (n=16)		Y (n=4)		χ^2	p
	No.	%	No.	%		
4	10	62.5	1	25	2.13	0.345
5	3	18.8	1	25		
6	3	18.8	2	50		
Total	16	100	4	100		

Table (16) shows that there was no significant association between using the surfactant and different Silverman retraction scores in group II.

Table (17): Association between the use of Surfactant and maturity

Maturity Surfactant	Group I	Group II	χ^2	p value
No	31	16	4.033	0.045
Yes	1	4		
Total	32	20		

Table (17) shows that the relationship between the use of surfactant and maturity was statistically significant in group I and being higher in group II patients.

Table (18): Association between diagnosis and maturity

Maturity Diagnosis	Group I No.	Group II No.	χ^2	p value
TTN	26	11	12.966	0.011
RDS	2	8		
Pneumonia	0	1		
IDM	4	0		
Total	32	20		

Table (18) shows that the relationship between the diagnoses and maturity was statistically significant in group I as well as in group II patients.

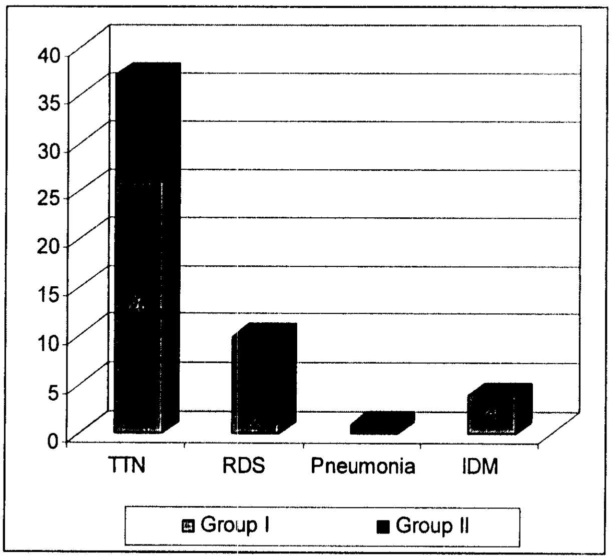

Fig (7): Diagnosis in both groups

Table (19): Relation between both groups regarding age on admission and gestational age in both groups

	Group I Mean ± SD	Group II Mean ± SD	T	P
Age on admission (in days)	0.03 ± 0.18	0.30 ± 0.98	-1.523	0.134
Gestational age (in weeks)	38.66 ± 1.38	34.40 ± 2.46	8.00	0.001

Table (19) shows that there was a high statistically significant difference in gestational age in both groups.

Table (20): Mean and SD of the anthropometric data of all patients at the ages of birth, 6, 12, 18 and 24 months

	Mean ± SD	Mean ± SD
Weight:	**(kg)**	**(percentile)**
At birth	3.04 ± 0.83	71.19 ± 28.79
At 6 months	7.39 ± 0.98	68.75 ± 27.2
At 12 months	9.99 ± 1.23	64.92 ± 26.69
At 18 months	11.64 ± 1.10	57.88 ± 23.48
At 24 months	12.91 ± 0.97	53.08 ± 20.39
Length:	**(cm)**	**(percentile)**
At birth	48.51 ± 1.58	68.62 ± 14.10
At 6 months	66.62 ± 2.81	50.85 ± 23.31
At 12 months	74.79 ± 2.65	52.4 ± 22.5
At 18 months	81.04 ± 2.39	53.94 ± 19.98
At 24 months	85.94 ± 2.32	54.04 ± 19.05
Head circumference:	**(cm)**	**(percentile)**
At birth	34.38 ± 0.79	85.5 ± 9.71
At 6 months	43.22 ± 1.25	64.17 ± 25.38
At 12 months	45.64 ± 1.08	63.85 ± 23.42
At 18 months	47.15 ± 0.96	64.33 ± 21.31
At 24 months	48.17 ± 0.93	64.37 ± 21.46
Weight for recumbent length percentile:		**(percentile)**
At birth	34.38 ± 0.79	50.88 ± 35.05
At 6 months	43.22 ± 1.25	50.71 ± 28.15
At 12 months	45.64 ± 1.08	69.48 ± 25.41
At 18 months	47.15 ± 0.96	75.54 ± 20.33
At 24 months	48.17 ± 0.93	78.62 ± 17.64

Table (20) shows the mean and SD of weight, length and head circumference in all patients in all visits. Also, weight, length and head circumference percentiles in all patients in all visits. It was marked that there was downward shift in weight, length and head circumference percentiles from birth till 24 months.

Table (21): Comparison between the rate of change in anthropometric data in between 6, 12, 18 and 24 months in all patients (n=52)

	Mean ± SD	t/z*	P
Weight (%): **0 - 6 months**	160.54 ± 71.72	-5.17*	0.001
6 - 12 months	253.32 ± 100.05	-5.31*	0.001
12 - 18 months	315.26 ± 130.67	-5.24*	0.001
18 - 24 months	363.18 ± 153.22	-5.17*	0.001
Length (%): **0 - 6 months**	37.37± 5.31	-2.54	0.014
6 - 12 months	54.24 ± 4.93	-2.79	0.007
12 - 18 months	67.14 ± 4.81	-4.14	0.001
18 - 24 months	77.26 ± 4.68	-4.57	0.001
Head circumference (%): **0 - 6 months**	25.77 ± 3.72	-2.84	0.001
6 - 12 months	32.83 ± 3.53	-3.91	0.001
12 - 18 months	37.22 ± 3.42	-4.89	0.001
18 - 24 months	40.19 ± 3.32	-4.94	0.001

Table (21) shows that the mean rate of change in weight, length and head circumference among all patients was statistically significantly high in all visits.

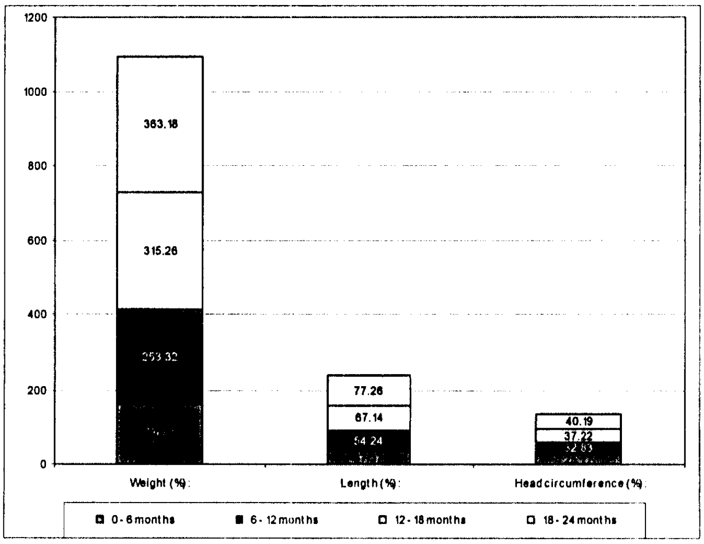

Fig (8): Comparison between the rate of change in anthropometric data in between the different visits in all patients

Table (22): Comparison between BSID-II scores at the ages of 6, 12, 18 and 24 months in all patients (n=52)

	6 months Mean ± SD	12 months Mean ± SD	18 months Mean ± SD	24 months Mean ± SD
Mental raw score	62.29 ± 4.37	90.25 ± 3.93	117.38 ± 4.30	138.85 ± 3.98
Mental develop. Age	5.88 ± 0.7	12.54 ± 1.07	19.04 ± 1.22	26.00 ± 1.48
Motor raw score	38.35 ±4.03	65.65 ± 2.35	76.98 ± 2.27	86.77 ± 2.36
Motor develop. Age	5.60 ± 0.77	12.48 ± 1.16	18.96 ± 1.74	25.06 ± 1.62

Table (22) shows that the mean of mental raw score, mental developmental age, motor raw score and motor developmental age was increasing in all visits in all patients.

Table (23): MDI and PDI scores at the ages of 6, 12, 18 and 24 months in all patients (n=52)

	Mean ± SD	t/z*	P
MDI: **At 6 months**	99.23 ± 8.33	2.15	0.037
At 12 months	106.77 ± 9.31	0.81	0.425
At 18 months	109.77 ± 8.61	0.77	0.444
At 24 months	111.69 ± 7.95	-0.569	0.569
PDI: **At 6 months**	95.31 ± 12.98	-1.35*	0.176
At 12 months	102.77 ± 12.05	-0.49*	0.622
At 18 months	106.92 ± 9.08	1.08	0.284
At 24 months	109.33 ± 8.34	-0.96*	0.336

Table (23) shows that the mean of mental developmental index (MDI) and psychomotor developmental index (PDI) was insignificantly increased among all patients in all visits.

Table (24): Comparison between the rate of change in MDI and PDI scores in between 6, 12, 18 and 24 months in all patients (n=52)

	Mean ± SD	t/z*	P
MDI (%): **6 - 12 months**	7.78 ± 6.90	-1.51*	0.130
12 - 18 months	10.96 ± 8.17	-1.64	0.107
18 - 24 months	12.99 ± 8.84	-1.66	0.104
PDI (%): **6 - 12 months**	8.63 ±12.10	-1.38*	0.166
12 - 18 months	13.78 ± 15.55	-0.69*	0.492
18 - 24 months	16.46 ± 16.19	-0.68	0.498

Table (24) shows that the mean rate of change in MDI and PDI was insignificantly increased among all patients in between different visits.

Table (25): Comparison of the anthropometric data at birth, 6, 12, 18 and 24 months between both groups

	Group I **N=32**	**Group II** **N=20**	**t/z***	**P**
	Mean ± SD	**Mean ± SD**		
Weight (kg):				
At birth	3.50 ± 0.52	2.29 ± 0.66	7.388	0.001
At 6 months	7.66 ± 0.89	6.94 ± 0.98	2.743	0.008
At 12 months	10.34 ± 1.14	9.43 ± 1.19	2.761	0.008
At 18 months	11.97 ± 1.07	11.11 ± 0.97	2.908	0.005
At 24 months	13.18 ± 1.0	12.49 ± 0.77	-2.520*	0.012
Length (cm):				
At birth	49.55 ± 0.78	46.85 ± 1.0	-5.912*	0.001
At 6 months	67.36 ± 2.02	65.43 ± 3.48	2.537	0.014
At 12 months	75.70 ± 2.08	73.33 ± 2.84	-2.793*	0.005
At 18 months	81.86 ± 1.97	79.72 ± 2.46	3.451	0.001
At 24 months	86.83 ± 1.8	84.53 ± 2.4	3.947	0.001
Head circumference (cm):				
At birth	34.89 ± 0.28	33.55 ± 0.63	-5.951*	0.001
At 6 months	43.5 ± 0.942	42.76 ± 1.55	-1.845*	0.065
At 12 months	45.88 ± 0.88	45.28 ± 1.27	-1.810*	0.070
At 18 months	47.34 ± 0.86	46.85 ± 1.07	1.841	0.072
At 24 months	48.39 ± 0.83	47.83 ± 1.00	-2.031*	0.042

Table (25) shows that all parameters were more increased in all visits in group I when compared to group II referred to their chronological ages, and the difference was statistically significant except head circumference. Also, group II patients became nearly equal to group I patients at the chronological age of 12 and 18 months regarding weight, length and head circumference.

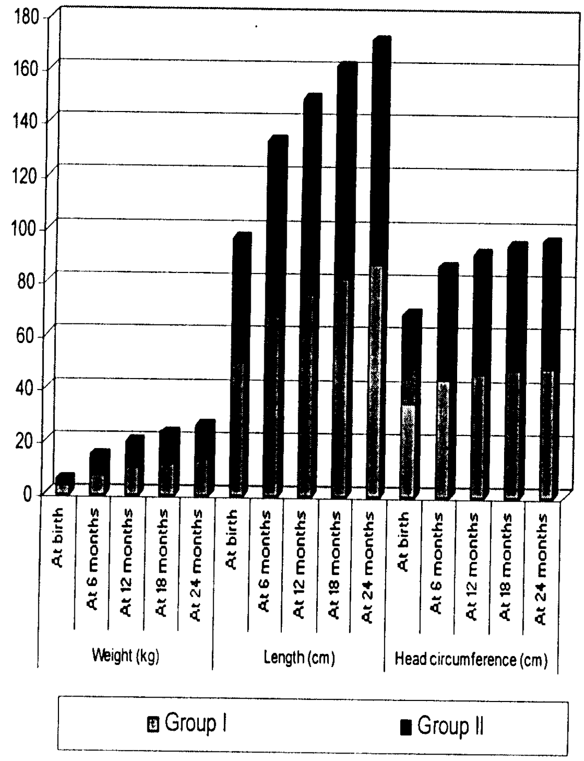

Fig (9): Comparison of the anthropometric data between both groups at different visits

Table (26): Comparison of the percentile charts at birth, at 6, 12, 18 and 24 months in percentile between both groups

	Group I N=32	Group II N=20	t/z*	P
	Mean ± SD	Mean ± SD		
Weight percentile:				
At birth	81.72 ± 25.98	54.35 ± 25.26	3.735	0.001
At 6 months	76.81 ± 22.21	55.85 ± 29.93	-2.589*	0.010
At 12 months	72.38 ± 23.14	53.0 ± 28.21	-2.492*	0.013
At 18 months	65.31 ± 21.63	46.0 ± 21.8	3.123	0.003
At 24 months	59.06 ± 19.61	43.5 ± 18.22	-2.610	0.009
Length percentile:				
At birth	68.63 ± 9.67	68.60 ± 19.51	-1.066*	0.286
At 6 months	59.22 ± 16.17	37.45 ± 26.93	-2.537	0.014
At 12 months	60.31 ± 17.04	39.75 ± 24.73	-2.793	0.007
At 18 months	61.09 ± 14.63	42.50 ± 22.33	-4.140	0.001
At 24 months	60.94 ± 13.53	43.0 ± 21.61	-4.567	0.001
Head circumference percentile:				
At birth	83.41 ± 5.28	88.85 ± 13.72	-0.776	0.437
At 6 months	71.41 ± 18.28	52.60 ± 30.91	-2.839	0.007
At 12 months	70.16 ± 17.71	53.75 ± 28.04	-3.905	0.001
At 18 months	69.69 ± 17.04	55.75 ± 24.88	-4.889	0.001
At 24 months	69.69 ± 17.41	55.85 ± 24.84	-4.936	0.001
Weight for recumbent length percentile:				
At birth	58.66 ± 32.27	38.45 ± 36.53	2.088	0.042
At 6 months	55.38 ± 28.67	43.25 ± 26.28	-1.692*	0.091
At 12 months	73.63 ± 24.12	62.85 ± 26.6	-1.550*	0.121
At 18 months	78.84 ± 20.56	70.25 ± 19.3	-1.768*	0.077
At 24 months	80.50 ± 17.64	75.6 ± 17.66	-1.121*	0.262

Table (26) shows that weight, length and head circumference percentiles were significantly increased in most of the visits of both group I and group II. The mean of weight, length and head circumference percentiles was within normal range (but with downward shift) in group I and group II patients, referred to their chronological ages in all visits.

Table (27): Rate of change in weight, length and head circumference in both groups

	Group I **N=32**	**Group II** **N=20**	**t/z***	**P**
	Mean ± SD	**Mean ± SD**		
Weight (%): **At 6 months**	122.53 ± 36.38	221.35 ± 72.94	-5.17*	0.001
At 12 months	200.18 ± 47.18	338.36 ± 104.26	-5.31*	0.001
At 18 months	247.57 ± 51.23	423.56 ± 146.58	-5.24*	0.001
At 24 months	283.29 ± 56.53	491.17 ± 172.57	-5.17*	0.001
Length (%): **At 6 months**	35.97 ± 4.18	39.62 ± 6.21	-2.54	0.014
At 12 months	52.82 ± 4.42	56.51 ± 4.97	-2.79	0.007
At 18 months	65.24 ± 4.03	70.19 ± 4.44	-4.14	0.001
At 24 months	75.27 ± 3.74	80.43 ± 4.32	-4.57	0.001
Head circumference (%): **At 6 months**	24.68 ± 2.9	27.51 ± 4.27	-2.84	0.007
At 12 months	31.49 ± 2.79	34.96 ± 3.59	-3.91	0.001
At 18 months	35.7 ± 2.69	39.66 ± 3.08	-4.89	0.001
At 24 months	38.7 ± 2.61	42.57 ± 2.97	-4.94	0.001

Table (27) shows that the mean of the rate of change in weight, length and head circumference was highly significantly increased in group II patients if compared to group I patients referred to their chronological ages in all visits.

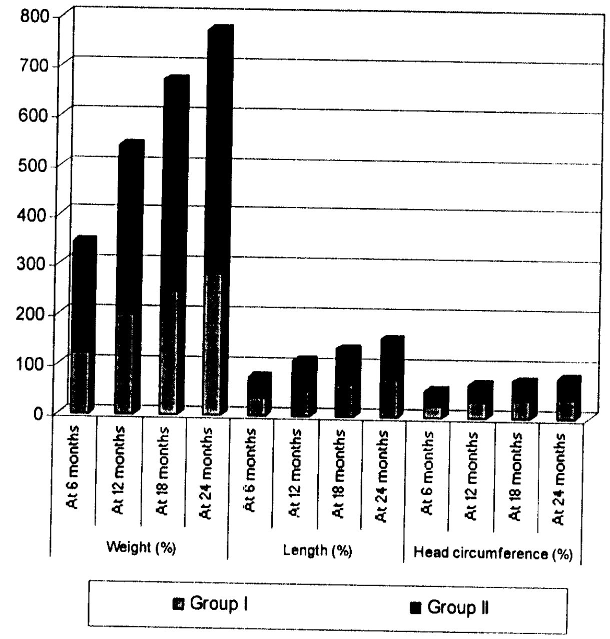

Fig (10): Rate of change in weight, length, and head circumference in both groups at different visits

Table (28): Comparison between group I and group II in rate of change in weight, length, and head circumference in between different visits

	Group I N=32		Group II N=20	
	t/z*	**P value**	**t/z***	**p value**
Weight: **0 – 6 months**	-26.176	0.001	-34.961	0.001
6 – 12 months	-34.105	0.001	-34.597	0.001
12 – 18 months	-22.359	0.001	-17.606	0.001
18 – 24 months	-4.962*	0.001	-3.947*	0.001
Length: **0 – 6 months**	-4.948*	0.001	-3.922*	0.001
6 – 12 months	-5.014*	0.001	-3.958*	0.001
12 – 18 months	-4.992*	0.001	-3.959*	0.001
18 – 24 months	-36.415	0.001	-24.405	0.001
Head circumference: **0 – 6 months**	-4.975*	0.001	-3.926*	0.001
6 – 12 months	-5.144*	0.001	-4.006*	0.001
12 – 18 months	-5.287*	0.001	-4.058*	0.001
18 – 24 months	-5.444*	0.001	-4.379*	0.001

Table (28) shows that the rate of change in weight, length and head circumference significantly increased in between all visits in group I as well as in group II with corrected ages.

Table (29): Rate of change in weight, length and head circumference in group I in relation to the use of mechanical ventilation (n=32)

	No (N=28)	Yes (N=4)	t/z*	P
	Mean ± SD	Mean ± SD		
Weight (%):				
At 6 months	121.95 ± 37.27	126.65 ± 33.96	-0.342*	0.732
At 12 months	199. 79 ± 47.85	202.85 ± 48.78	0.001*	1.000
At 18 months	247.38 ± 51.72	248.87 ± 55.15	0.001*	1.000
At 24 months	282.29 ± 56.91	289.48 ± 61.75	-0.257*	0.798
Length (%):				
At 6 months	35.68 ± 4.07	38.01 ± 5.08	-1.042	0.306
At 12 months	52.48 ± 4.33	55.19 ± 4.9	-1.157	0.256
At 18 months	64.99 ± 3.89	66.99 ± 5.22	-0.929	0.360
At 24 months	74.91 ± 3.49	77.76 ± 5.01	-1.452	0.157
Head circumference (%):				
At 6 months	24.66 ± 3.01	24.83 ± 2.36	-0.109	0.914
At 12 months	31.41 ± 2.87	32.03 ± 2.42	-0.407	0.687
At 18 months	35.61 ± 2.75	36.35 ± 2.45	-0.507	0.616
At 24 months	38.63 ± 2.66	39.22 ± 2.47	-0.423	0.675

Table (29) shows that the mean of the rate of change in all parameters in all visits was increased in group I patients who required mechanical ventilation more than in patients who didn't require mechanical ventilation but it was statistically insignificant. i.e. mechanical ventilation duration did not affect their rate of change.

Table (30): Rate of change in weight, length and head circumference in group II in relation to the use of mechanical ventilation

	No (N=14)	Yes (N=6)	t/z*	P
	Mean ± SD	Mean ± SD		
Weight (%):				
At 6 months	203.28 ± 51.92	275.58 ± 104.59	-1.091*	0.275
At 12 months	311.97 ± 81.04	417.52 ± 134.93	-1.489*	0.136
At 18 months	386.87 ± 113.77	533.64 ± 191.21	-1.441*	0.150
At 24 months	449.67 ± 132.69	615.67 ± 232.38	-1.353*	0.176
Length (%):				
At 6 months	40.00 ± 6.46	38.48 ± 5.89	0.464	0.648
At 12 months	56.74 ± 5.16	55.81 ± 4.85	0.356	0.726
At 18 months	69.78 ± 4.55	71.4 ± 4.35	-0.697	0.494
At 24 months	79.98 ± 4.46	81.81 ± 3.98	-0.817	0.425
Head circumference (%):				
At 6 months	27.68 ± 4.7	26.98 ± 2.97	0.311	0.759
At 12 months	34.89 ± 3.99	35.16 ± 2.36	-0.137	0.829
At 18 months	39.45 ± 3.39	40.32 ± 2.02	-0.539	0.596
At 24 months	42.31 ± 3.24	43.35 ± 2.05	-0.667	0.513

Table (30) shows that the mean of the rate of change in all parameters in most of the visits was increased in group II patients who required mechanical ventilation more than in patients who didn't require mechanical ventilation but it was statistically insignificant. Mechanical ventilation duration did not affect their rate of change.

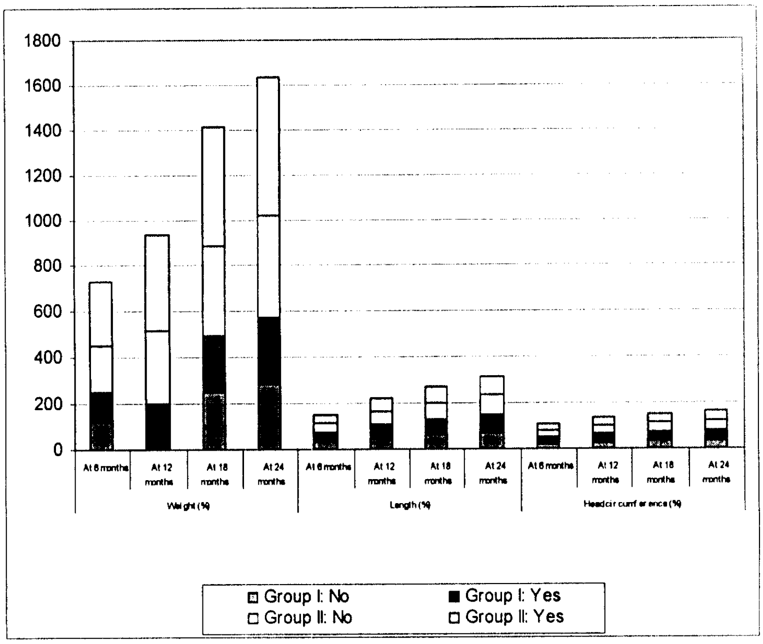

Fig. (11): Rate of change in anthropometric data in both groups at different visits in relation to the use of mechanical ventilation

Table (31): Rate of change in weight, length and head circumference in relation to Silverman retraction score in group I

Silverman	4	5	6	F/χ^2	P
	Mean ± SD	Mean ± SD	Mean ± SD		
Weight (%): **At 6 months**	123.02 ± 35.43	133.37 ± 38.79	111.99 ± 43.33	0.872*	0.832
At 12 months	200.96 ± 46.62	214.21 ± 49.34	182.95 ± 52.28	1.839*	0.607
At 18 months	248.53 ± 46.31	268.24 ± 58.50	221.09 ± 65.75	2.289*	0.515
At 24 months	283.21 ± 47.83	309.02 ± 67.57	254.25 ± 78.19	2.268*	0.519
Length (%): **At 6 months**	35.89 ± 4.13	36.09 ± 3.77	36.78 ± 5.76	0.255	0.857
At 12 months	52.51 ± 4.32	52.48 ± 4.55	54.78 ± 5.52	0.404	0.751
At 18 months	64.71 ± 3.65	65.79 ± 5.09	67.08 ± 4.82	0.553	0.650
At 24 months	74.55 ± 3.05	76.06 ± 4.94	77.13 ± 5.08	0.726	0.545
Head circumference (%): **At 6 months**	24.02 ± 3.24	25.59 ± 1.87	26.59 ± 1.47	1.463	0.246
At 12 months	30.81 ± 3.12	32.29 ± 1.43	33.54 ± 1.55	1.653	0.200
At 18 months	34.96 ± 2.92	36.60 ± 1.42	37.87 ± 1.59	2.124	0.120
At 24 months	38.03 ± 2.85	39.47 ± 1.41	40.77 ± 1.63	1.939	0.146

Table (31) shows that the mean for the rate of change in weight was insignificantly decreased with higher score of Silverman in group I in all visits.

Table (32): Rate of change in weight, length and head circumference in relation to Silverman retraction score in group II

Silverman	4	5	6	F/χ^2	P
	Mean ± SD	Mean ± SD	Mean ± SD		
Weight (%): **At 6 months**	194.53 ± 48.72	213.12 ± 71.20	286.96 ± 90.05	4.835*	0.089
At 12 months	297.45 ± 72.36	337.67 ± 113.30	429.15 ± 118.37	6.178*	0.046
At 18 months	360.40 ± 96.76	434.66 ± 161.36	553.64 ± 163.95	6.342*	0.042
At 24 months	417.85 ± 110.29	510.28 ± 193.61	637.16 ± 202.82	5.444	0.066
Length (%): **At 6 months**	39.79 ± 6.36	39.03 ± 5.46	39.73 ± 7.68	0.02	0.98
At 12 months	55.86 ± 3.58	57.37 ± 6.69	57.20 ± 7.02	0.181	0.836
At 18 months	68.89 ± 3.77	70.86 ± 4.02	72.49 ± 5.88	1.208	0.323
At 24 months	79.72 ± 2.92	78.69 ± 4.78	83.41 ± 5.88	1.802	0.195
Head circumference (%): **At 6 months**	26.77 ± 3.89	28.85 ± 6.11	28.06 ± 4.15	0.377	0.691
At 12 months	34.14 ± 3.05	35.59 ± 3.36	36.28 ± 3.49	0.664	0.527
At 18 months	38.69 ± 2.87	40.46 ± 4.00	41.17 ± 2.52	1.321	0.293
At 24 months	41.50 v 2.54	43.46 ± 4.02	44.21 ± 2.53	1.795	0.196

Table (32) shows that the mean for the rate of change in weight, length and head circumference was insignificantly increased in all visits with higher score of Silverman in group II without correction of age.

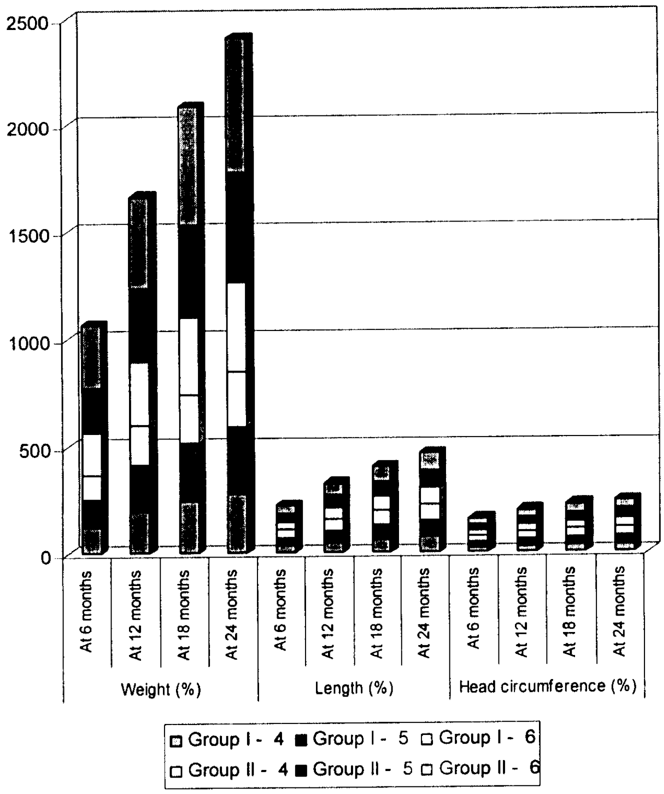

Fig. (12): Rate of change in anthropometric data in both groups at different visits in relation to Silverman scores

Table (33): Correlation between mechanical ventilation duration and O_2 supply duration and the rate of change in weight, length and head circumference in both groups

	Mechanical ventilation duration (days)				O_2 supply durations (days)			
	Group I (n=4)		Group II (n=6)		Group I (n=32)		Group II (n=20)	
	r	P	r	P	r	p	r	P
Weight (%): At 6 months	1.00		0.12	0.83	0.01	0.95	0.62	0.003
At 12 months	0.80	0.20	0.12	0.83	0.02	0.94	0.66	0.002
At 18 months	0.80	0.20	0.06	0.91	0.03	0.86	0.72	0.001
At 24 months	0.80	0.20	0.06	0.91	0.02	0.92	0.69	0.001
Length (%): At 6 months	0.80	0.20	-0.69	0.13	0.15	0.43	-0.19	0.42
At 12 months	1.00	-	-0.69	0.13	-0.04	0.85	-0.15	0.52
At 18 months	1.00	-	-0.69	0.13	-0.05	0.78	0.08	0.74
At 24 months	1.00	-	-0.65	0.17	0.06	0.74	0.11	0.64
Head circumference (%): At 6 months	0.95	0.05	-0.62	0.19	0.088	0.63	-0.06	0.81
At 12 months	0.95	0.05	-0.32	0.54	0.097	0.59	0.09	0.72
At 18 months	0.95	0.05	-0.35	0.49	0.067	0.71	0.18	0.46
At 24 months	0.95	0.05	-0.35	0.49	0.037	0.84	0.19	0.42

Table (33) shows that the relationship between mechanical ventilation duration and the rate of change in weight, length and head circumference was statistically insignificant in all visits in both groups except for head circumference in group I patients in all visits where it was significantly increased. Also the relationship between O_2 supply duration and the rate of change in weight, length and head circumference was insignificant in all visits in both groups except for weight in group II patients without age correction in all visits where it was highly significantly increased.

Table (34): Rate of change in weight, length and head circumference in group I in relation to the use of Surfactant

	No (N=31)	t/z*	P
	Mean ± SD		
Weight (%):			
At 6 months	121.41 ± 36.41	-0.921*	0.357
At 12 months	198.95 ± 47.43	-0.596*	0.551
At 18 months	246.45 ± 51.68	-0.704*	0.481
At 24 months	282.03 ± 57.08	-0.596*	0.551
Length (%):			
At 6 months	35.72 ± 4.00	-1.976	0.05
At 12 months	52.57 v 4.26	-1.812	0.08
At 18 months	64.99 ± 3.84	-2.03	0.05
At 24 months	75.01 ± 3.49	-2.345	0.026
Head circumference (%):			
At 6 months	24.59 ± 2.9	-0.998	0.326
At 12 months	31.39 ± 2.77	-1.208	0.236
At 18 months	35.59 ± 2.66	-1.311	0.2
At 24 months	38.59 ± 2.58	-1.311	0.2

Table (34) shows that the mean of the rate of change in length at 6, 18 and 24 months was increased in group I patients who was not given surfactant where it was statistically significant. Also, it was increased in weight and head circumference but statistically insignificant in all visits. Group I patients didn't receive surfactant except one patient.

Table (35): Rate of change in weight, length and head circumference in group II in relation to the use of surfactant

	No (N=16)	Yes (N=4)	t/z*	P
	Mean ± SD	Mean ± SD		
Weight (%):				
At 6 months	204.59 ± 55.24	288.4 ±104.63	-1.418*	0.156
At 12 months	312.66 ± 81.01	441.16 ± 135.69	-1.518*	0.129
At 18 months	383.61 ± 105.71	583.36 ± 194.02	-1.607*	0.108
At 24 months	441.99 ± 115.19	687.86 ± 240.39	-1.701*	0.089
Length (%):				
At 6 months	39.95 ± 6.44	38.32 ± 5.79	0.459	0.652
At 12 months	56.66 ± 5.07	55.89 ± 5.24	0.267	0.793
At 18 months	69.77 ± 4.54	71.86 ± 4.18	-0.837	0.414
At 24 months	80.14 ± 4.36	81.61 ± 4.56	-0.600	0.556
Head circumference (%):				
At 6 months	27.37 ± 4.71	28.04 ± 2.06	-0.273	0.788
At 12 months	34.8 ± 3.92	35.62 ± 2.11	-0.397	0.696
At 18 months	39.35 ± 3.3	40.93 ± 1.72	-0.915	0.372
At 24 months	42.22 ± 3.15	43.96 ± 1.76	-1.048	0.308

Table (35) shows that the mean of the rate of change in weight, length and head circumference in most of the visits was increased in group II patients with corrected age who received surfactant more than those who didn't receive surfactant but it was statistically insignificant.

Table (36): Rate of change in weight, length and head circumference in relation to diagnosis in all patients

	TTN (n=37) Mean ± SD	RDS (n=10) Mean ± SD	IDM (n=4) Mean ± SD	F/χ^2	P
Weight (%):					
At 6 months	139.87 ± 41.43	263.81 ± 80.39	98.41 ± 29.37	21.79*	0.001
At 12 months	223.58 ± 55.19	398.99 ± 116.99	167.98 ± 29.61	19.19*	0.001
At 18 months	273.82 ± 63.13	511.68 ± 161.37	215.31 ± 32.7	19.75*	0.001
At 24 months	315.93 ± 76.72	589.22 ± 191.73	243.42 ± 33.36	20.34	0.001
Length (%):					
At 6 months	36.85 ± 5.53	40.11 ± 5.06	36.63 ± 3.15	0.97	0.43
At 12 months	53.36 ± 4.76	57.91 ± 5.4	53.54 ± 1.93	1.94	0.12
At 18 months	66.09 ± 4.6	71.85 ± 4.08	65.67 ± 1.15	3.74	0.01
At 24 months	76.08 ± 4.06	82.21 ± 5.02	75.77 ± 1.27	4.45	0.004
Head circumference (%):					
At 6 months	25.15 ± 3.61	27.96 ± 4.33	26.99 ± 0.93	1.47	0.23
At 12 months	31.98 ± 3.27	35.77 ± 3.78	34.18 ± 1.00	3.01	0.03
At 18 months	36.36 ± 3.32	40.42 ± 3.00	38.14 ± 1.24	3.72	0.01
At 24 months	39.32 ± 3.06	43.43 ± 3.04	41.02 ± 1.28	4.13	0.006

* χ: value of Kurskoll Wallis test

Table (36) shows that there was statistically significant difference in the rate of change of weight, length and head circumference in most of the visits between different diagnoses.

Table (37): Comparison of the BSID-II scores between both groups

	Group I N=32	Group II N=20	t/z*	p
	Mean ± SD	Mean ± SD		
MDI: **At 6 months**	101.13 ± 7.64	96.2 ± 8.69	2.15	0.03
At 12 months	107.59 ± 8.04	105.45 ± 11.14	0.80	0.425
At 18 months	110.5 ± 7.52	108.6 ± 10.21	0.77	0.444
At 24 months	112.38 ± 7.44	110.6 ± 8.8	-0.569*	0.569
PDI: **At 6 months**	97.25 ± 13.15	92.2 ± 12.39	-1.35*	0.176
At 12 months	103 ± 12.93	102.4 ± 10.8	-0.494*	0.622
At 18 months	108 ± 9.26	105.2 ± 8.75	1.08	0.284
At 24 months	110.31 ± 9.04	107.75 ± 7.02	-0.962	0.336

Table (37) shows that the mean of mental developmental index and psychomotor developmental index was higher in group I patients if compared to group II patients with corrected ages in all visits, but with insignificant difference.

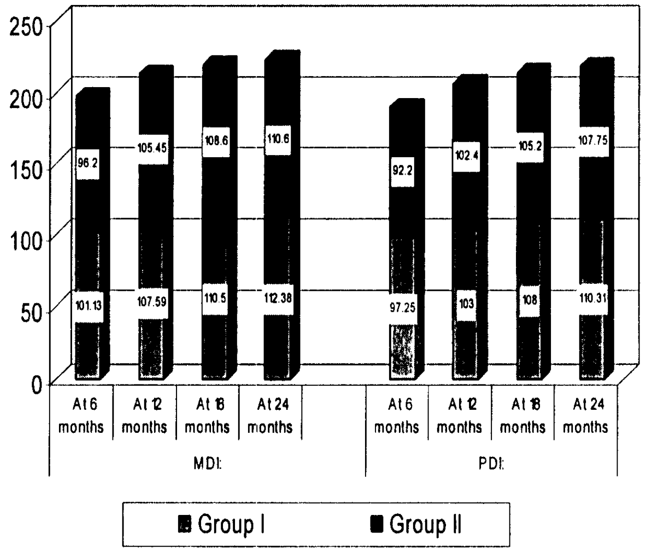

Fig. (13): Comparison of the BSID-II scores between both groups at different visits

Table (38): Rate of change in MDI and PDI in both groups

	Group I (N=32)	Group II (N=20)	t/z*	p
	Mean ± SD	Mean ± SD		
MDI (%):				
At 12 months	6.52 ± 5.28	9.78 ± 8.68	-1.52*	0.13
At 18 months	9.51 ± 6.54	13.27 ± 10.01	-1.64	0.107
At 24 months	11.41 ± 7.11	15.51 ± 10.79	-1.66	0.104
PDI (%):				
At 12 months	6.28 ± 8.31	12.39 ± 16.01	-1.39*	0.166
At 18 months	12.61 ± 15.52	15.66 ± 15.8	-0.69*	0.492
At 24 months	15.08 ± 15.92	18.67 ± 16.77	-0.68*	0.498

Table (38) shows that he mean of the rate of change in mental developmental index and psychomotor developmental index was higher in group II patients with corrected ages if compared to group I patients in all visits, but with insignificant difference.

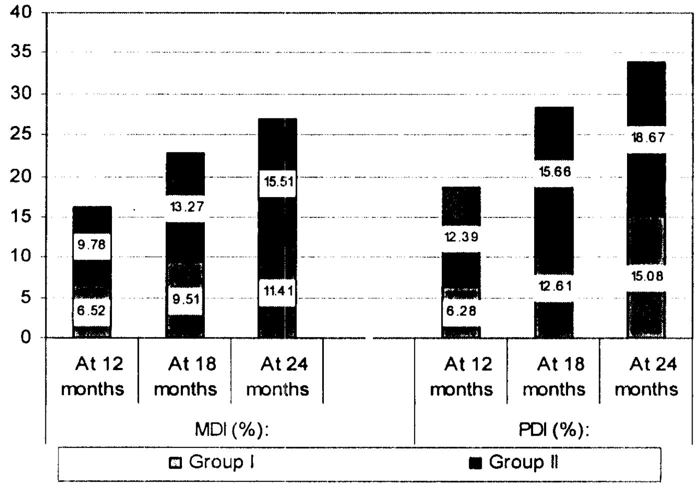

Fig (14): Rate of change in MDI and PDI scores in both groups at different visits

Table (39): Rate of change in MDI and PDI in group I in relation to the use of mechanical ventilation

	No (N=28)	Yes (N=4)	t/z*	p
	Mean ± SD	Mean ± SD		
MDI (%):				
At 12 months	6.46 ± 5.55	6.97 ± 3.29	-0.541*	0.588
At 18 months	9.68 ± 6.61	8.35 ± 6.84	0.375	0.711
At 24 months	11.78 ± 7.21	8.85 ± 6.72	0.764	0.451
PDI (%):				
At 12 months	5.51 ± 7.89	11.69 ± 10.44	-1.141*	0.254
At 18 months	9.71 ± 8.94	32.87 ± 33.84	-1.654*	0.098
At 24 months	12.56 ± 9.82	32.72 ± 35.77	-1.455*	0.146

Table (39) shows that the mean of the rate of change in mental developmental index and psychomotor developmental index in most of the visits were not affected in group I patients who required mechanical ventilation or in those who required mechanical ventilation with insignificant difference.

Table (40): Rate of change in MDI and PDI in group II in relation to the use of mechanical ventilation

	No (N=14)	Yes (N=6)	t/z*	p
	Mean ± SD	Mean ± SD		
MDI (%): **At 12 months**	11.31 ± 9.41	5.20 ± 3.65	-1.486	0.137
At 18 months	15.00 ± 11.07	8.08 ± 1.70	1.369	0.188
At 24 months	16.78 ± 12.09	11.73 ± 4.25	0.901	0.379
PDI (%): **At 12 months**	13.53 ± 18.26	8.98 ± 5.59	-0.393	0.694
At 18 months	15.82 ± 18.15	15.19 ± 5.76	-0.962	0.336
At 24 months	18.74 ± 19.05	18.48 ± 8.07	-1.267	0.205

Table (40) shows that the mean of the rate of change in mental developmental index and psychomotor developmental index in all visits was increased in group II patients with corrected age who didn't require mechanical ventilation more than those who required mechanical ventilation with insignificant difference.

Table (41): Rate of change in MDI and PDI according to Silverman retraction score in group I

Silverman	4	5	6	F/χ^2	P
	Mean ± SD	**Mean ± SD**	**Mean ± SD**		
MDI (%):					
At 12 months	7.02 ± 5.38	4.22 ± 4.74	8.14 ± 5.77	2.516*	0.472
At 18 months	11.22 ± 5.52	4.89 ± 6.27	8.54 ± 9.45	1.595	0.213
At 24 months	13.43 ± 6.63	5.73 ± 6.25	10.63 ± 7.95	2.060	0.128
PDI (%):					
At 12 months	7.06 ± 9.58	2.54 ± 5.55	8.89 ± 4.22	4.981*	0.173
At 18 months	11.45 ± 9.86	5.38 ± 8.22	12.04 ± 5.67	4.871*	0.182
At 24 months	14.05 ± 10.22	7.95 ± 8.72	13.94 ± 10.22	4.484*	0.214

Table (41) shows that the mean of the rate of change in MDI and PDI was insignificantly decreased in each visit with Silverman retraction score of 5 when compared to other Silverman scores in the same visit in group I patients.

Table (42): Rate of change in MDI and PDI in relation to Silverman retraction score in group II

Silverman	4	5	6	F/χ^2	P
	Mean ± SD	Mean ± SD	Mean ± SD		
MDI (%):					
At 12 months	12.31 ± 10.37	9.16 ± 6.54	4.73 ± 2.66	3.389*	0.184
At 18 months	15.26 ± 12.44	12.38 ± 7.47	9.61 ± 4.43	0.538	0.593
At 24 months	17.66 ± 13.68	12.89 ± 5.69	12.91 ± 5.77	0.453	0.643
PDI (%):					
At 12 months	16.65 ± 20.46	6.88 ± 6.35	7.44 ± 5.48	0.914*	0.633
At 18 months	18.92 ± 20.24	7.95 ± 6.98	14.66 ± 5.97	2.014*	0.365
At 24 months	21.77 ± 21.53	9.35 ± 2.76	19.32 ± 7.61	4.542	0.103

Table (42) shows that the mean of the rate of change in MDI was insignificantly decreased in all visits with higher scores of Silverman in group II with corrected age. Also, the mean of the rate of change in PDI was insignificantly decreased in each visit with Silverman retraction score of 5 when compared to other Silverman scores of the same visit.

Table (43): Correlation between mechanical ventilation duration and O_2 supply duration and the rate of change in MDI and PDI in both groups

	Mechanical ventilation duration (days)				O_2 supply duration (days)			
	Group I (n=4)		Group II (n=6)		Group I (n=32)		Group II (n=20)	
	R	p	r	P	r	p	r	P
MDI (%):								
At 12 months	0.00	1.00	-0.06	0.91	-0.17	0.35	-0.59	0.006
At 18 months	0.20	0.80	-0.52	0.29	-0.13	0.47	-0.52	0.02
At 24 months	0.20	0.80	-0.52	0.29	-0.15	0.43	-0.49	0.03
PDI (%):								
At 12 months	-0.20	0.80	-0.58	0.23	-0.01	0.96	-0.41	0.08
At 18 months	-0.60	0.40	-0.38	0.46	0.24	0.19	-0.30	0.19
At 24 months	-0.60	0.40	-0.13	0.80	0.29	0.09	-0.12	0.62

Table (43) shows that the relation between mechanical ventilation duration and the rate of change in MDI and PDI was statistically insignificant in all visits in both groups. Also, the relationship between O2 supply duration and the rate of change in PDI was statistically insignificant. But it had a negative correlation as regards MDI in group II patients in all visits i.e. more O2 supply duration was associated with low MDI.

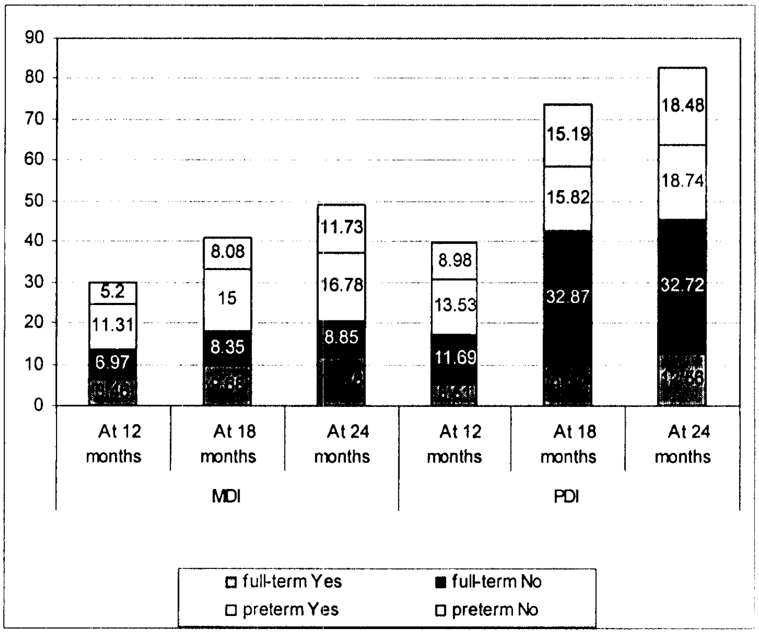

Fig. (15): Rate of change in MDI and PDI scores in both groups at different visits according to Silverman retraction scores

Table (44): Rate of change in MDI and PDI in group I in relation to the use of Surfactant

	No (N=31)	t/z*	P
	Mean ± SD		
MDI (%): **At 12 months**	6.5 ± 5.37	-1.139*	0.255
At 18 months	9.33 ± 6.56	-0.897	0.377
At 24 months	11.25 ± 7.17	-0.696	0.492
PDI (%): **At 12 months**	6.0 ± 8.29	-1.355*	0.175
At 18 months	12.46 ± 15.76	-1.138*	0.255
At 24 months	14.87 ± 16.15	-0.271	0.787

Table (44) shows that the rate of change in mental developmental index and psychomotor developmental index was increased in group I patients who were not given surfactant in all visits with insignificant difference.

Table (45): Rate of change in MDI and PDI in group II in relation to the use of surfactant

	No (N=16)	Yes (N=4)	t/z*	p
	Mean ± SD	Mean ± SD		
MDI (%): **At 12 months**	10.81 ± 9.3	5.67 ± 4.04	-1.088*	0.276
At 18 months	14.52 ± 1.88	8.27 ± 1.39	1.124	0.276
At 24 months	16.29 ± 11.93	12.43 ± 3.18	0.629	0.537
PDI (%): **At 12 months**	13.19 ± 17.68	9.19 ± 6.69	0.001*	1.000
At 18 months	16.14 ± 17.35	13.77 ± 8.37	-0.142*	0.887
At 24 months	19.09 ± 18.32	16.99 ± 9.89	-0.426*	0.670

Table (45) shows that the mean of the rate of change in mental developmental index and psychomotor developmental index was increased in all visits in group II patients with corrected age who did not receive surfactant more than those who received surfactant with insignificant difference.

Table (46): Relation between the rate of change in MDI and PDI and diagnoses in both groups

	TTN (n=37) Mean ± SD	RDS (n=10) Mean ± SD	IDM (n=4) Mean ± SD	F/χ^2	P
MDI (%): **At 12 months**	7.91 ± 6.39	5.61 ± 3.29	6.89 ± 7.08	5.11*	0.28
At 18 months	10.83 ± 7.61	9.21 ± 6.53	10.33 ± 8.04	3.62	0.01
At 24 months	12.89 ± 8.73	11.25 ± 6.62	12.49 ± 7.34	2.78	0.04
PDI (%): **At 12 months**	8.46 ± 11.26	6.82 ± 4.98	4.24 ± 5.08	6.59*	0.16
At 18 months	12.15 ± 11.26	10.14 ± 6.73	8.46 ± 7.11	6.96*	0.14
At 24 months	14.34 ± 12.14	13.32 ± 8.63	13.93 ± 7.43	5.72*	0.22

Table (46) shows that the relation between diagnoses and the rate of change in mental developmental index (MDI) was significant at 18 and 24 months. But it was statistically insignificant with psychomotor developmental index (PDI) in all visits. The mean of MDI and PDI was lower in cases of RDS and IDM respectively. TTN had the best rate of change in MDI and PDI.

DISCUSSION

DISCUSSION

Respiratory disorders are the most frequent cause of admission for special care in both term and preterm infants. As a result of important advances in understanding the pathophysiology of respiratory diseases, neonatal and infant deaths from early respiratory disease have declined markedly. The challenge is to continue to improve survival, but also to reduce short - and long - term complications related to early lung disease ***(Nelson, 2004).***

Follow up of the first survivors of modern neonatal care, that started in the 1970s, showed that preterm birth has an effect well into adulthood ***(Steward, et al., 1999).*** Advances in neonatal care since the early days have led to an increase of survival. Developmental sequelae, however, are still a major problem, mostly because babies who would previously have been expected to die are now surviving neonatal intensive care ***(Lorenz, 2000).***

Regular follow up assessments of those children at risk of neurodevelopmental impairment may allow the early detection of problems and the provision of medical, social, and educational support if required. Many signs of neurodevelopmental impairment are evident only after infancy, and follow up should continue until the child is at least 18 - 24 months old, corrected for gestation. Standardized, validated assessment tools to monitor developmental progress are available. Ideally, these follow up data should be included in the annual audit of activity and outcomes of neonatal units. Even in well resourced centers, it is often difficult to undertake comprehensive follow up programs ***(Michael et al., 2004).***

The link between poor growth and delayed brain development is well recognized and has been recently reviewed by ***Scrimshaw (1998).*** Although primary brain development and neurogenesis occur during the prenatal period, postnatal events include myelination of new axons, neuronal migration and formation of synaptic connections ***(Wauben and Wainwright 1999).***

For most preterm infants of > 32 weeks' gestation, survival and longer term neurodevelopment are similar to those of infants born at term. Overall, outcomes are also good for infants born after shorter gestations. Most infants survive without substantial neurodevelopmental problems and most go on to attend mainstream schools, ultimately living independent life ***(Michael et al., 2004).***

This study was thus designed to evaluate the effect of respiratory distress on infants' growth and development during four stations in the first two years of life in both full-term and preterm infants. Their mean age on admission was 0.13 ±0.63 days and mean gestational age of 37.02 ± 2.79 weeks.

In this study, the 52 studied patients were divided into two groups according to maturity. Group I included 32 patients, while group II comprised 20 patients. The degree of respiratory distress is assessed according to Silverman Retraction Score ***(Avery et al., 1973)***.

Results of the present study revealed that sex was not significantly different among group I patients compared to group II patients.

Social status of all patients was high. This could be one of the factors that they selected a private hospital with tertiary care in NICU. Also, this could be an explanation that 96.2% of the patients received proper prenatal care.

Concerning the method of delivery, 73.1% of the deliveries were caesarian section. This high percent may be due to high risk pregnancies. This is in contrary to the results of ***Chiong et al. (2003)*** who reported that 47.9% are delivering by C.S. and 44.9% are delivering vaginally.

The relation between the method of delivery and maturity was statistically significant in group I and group II patients, as 90% of preterm patients delivered by C.S. and 62.5% of full-term patients delivered vaginally.

The majority of the patients had moderate degree of respiratory distress with Silverman score between 4 to 6 which represents 96.9% of group I patients and 100% of group II patients and only one full-term patient with severe degree of respiratory distress with Silverman score of 8. The relation between Silverman score and maturity was insignificant. The commonest cause of respiratory distress in the present study was found to be transient tachypnea of newborn (78.1% was full-term and 55% was preterm). On the contrary, a study done by ***Iman et al. (2007)*** revealed that the commonest cause of respiratory distress in F.T. was neonatal pneumonia (18.7%) and respiratory distress syndrome in P.T. (32.2%). In our study, the relation between the diagnosis and maturity showed significant association.

Only 19.2% of all patients (30% of P.T. and 12.5% of F.T.) required mechanical ventilation. The mean of mechanical ventilation duration was 5.25 ± 3.30 in F.T. and 15.0 ±12.30 days in P.T. patients. Our results in mechanical ventilation duration was almost similar to the results obtained by ***Ogawa et al. (1993)*** with a mean 13.5 ± 21 in P.T. patients. In our study, the relation between mechanical ventilation duration and maturity was insignificant.

Concerning the oxygen supply duration, F.T. patients had mean of 2.41 ± 1.36 days, while P.T. patients had a mean of 6.25 ±7.64 days. ***Johnson et al. (2002)*** reported a longer duration of O_2 supply in P.T. patients.

In our study, the short durations of mechanical ventilation and O_2 supply duration may be attributable to early and good resuscitation in delivery room and proper prenatal care.

The relation between Silverman Retraction Scores and use of mechanical ventilation was highly significant in group I and group II patients. As 20 full-term patients (out of 32) had Silverman score of 4, where only one of them required mechanical ventilation. On the other hand, 5 preterm patients (out of 20) had Silverman score of 6, where 4 of them required mechanical ventilation. Which means, the higher the Silverman Retraction Score, the higher the possibility to require mechanical ventilation. This is in agreement with the results obtained in a study done in Trinidad by ***Ali (2003)*** who found that 41% of the babies with acute respiratory disorders required assisted ventilation. But the relation between Silverman

Retraction Scores and the use of surfactant was insignificant in both group I and group II patients.

Concerning the weight and weight percentiles, both were highly significantly increased, and showing downward shift starting from birth and throughout the next four visits at 6, 12, 18 and 24 months in both group, at their chronological ages. This downward shift may be due to different types of feeding and recurrent infections. The mean of weight percentiles at birth, 6, 12, 18 and 24 months was within normal range in both groups but still higher in group I patients. Also, group II patients reached the average percentile (50th) of the healthy full-term infants at the chronological age of 6 months regarding the weight. This is in contrary to ***Forslund and Bjerre (1985)*** who stated that at 9 and 18 months of chronological age, preterm infants' weight and length had no difference than that of full-term infants if corrected to their gestational age. But, it was in agreement with ***Piekkala et al. (1989)*** who stated that the small for gestational age preterm infants remained smaller than control infants in all measures throughout their first two years of life.

Concerning the length and length percentiles, both were highly significantly increased, and showing downward shift starting from birth and throughout the next four visits at 6, 12, 18 and 24 months in both groups at their chronological ages. The mean of height percentiles at 6, 12, 18 and 24 months was in the lower normal range in group II patients and higher in group I patients. Group II patients didn't reach the average percentile (50th) of healthy full-term infants at the chronological age of 24 months. This finding is reinforced by ***Piekkala et al. (1987),*** who stated that the length of the survivors with RDS was satisfactory even if their heights remained below that of full-term patients. But this contradict the results obtained by ***Forslund and Bjerre (1985).***

Concerning the head circumference and head circumference percentiles, they were significantly increased, and showing downward shift after birth and throughout the next four visit in both groups at their chronological ages. The mean of head circumference percentiles at 6, 12, 18 and 24 months in group II patients, was in the average (50th) of normal range and higher in group I patients. In contrast to our results, ***Bucher et al. (2002)*** reported that at the corrected age of 24 months, preterm infants had significantly lower head circumference.

Concerning the weight for recumbent length percentiles, they were insignificantly lower in group II patients compared to group I patients in all visits. Again, this is in contrast to the results of

Bucher et al. (2002). But it agrees with ***Casey et al. (1991)*** who concluded that preterm infants have different patterns of growth than term infants during the first 3 years of life, even with plotting corrected for gestational age. This could be explained by the lower mean of length in group II patients, compared by the higher mean in group I patients. While there is a little difference in weight between group II and group I patients.

The current study showed that the mean rate of change in weight, length and head circumference was highly significantly different in group II patients compared to group I patients referred to their chronological ages in all visits. This may be due to the higher velocity of growth in group II infants. This is in agreement with ***Kwinta et al. (2002)*** who said that the newborn between 29-32 weeks of gestation have faster growth rate than other newborns. Also, the rate of change in weight, length and head circumference in between the different visits was highly significant in both group I and group II patients.

The relation between the use of mechanical ventilation and the mean rate of change in weight, length and head circumference was insignificantly different in patients who required mechanical ventilation and those who didn't require, in both group I and group

II patients in all visits. It means that mechanical ventilation has no adverse effect on growth. The same result was obtained when we tested the relation between Silverman Retraction Scores and the mean rate of change in weight, length and head circumference in both group I and group II patients in all visits. Regarding the relation between O_2 supply duration and mechanical ventilation duration and the rate of change in weight, length and head circumference, it was insignificantly different in both group I and group II patients in all visits except in group II patients' weight at 6, 12, 18 and 24 months and group I patient's head circumference at 6, 12, 18 and 24 months where they were significantly different. ***Askie et al. (2003)*** stated that O_2 supply conferred no significant benefit with respect to growth.

The use of Surfactant is tested in relation to the rate of change in weight, length and head circumference in both group I and group II patients where it was insignificant in all visits except in group I patients' length at 6, 18 and 24 months where it was significantly different. On the other hand, ***Dambeanu et al. (1997)*** confirmed that the use of surfactant in the delivery-room is able to improve the clinical conditions of the babies, but without the complete support of neonatal intensive care it does not resolve the problem of survival and unfavourable outcome in the babies with the lowest gestational ages.

To sum up, the studied anthropometric measurements in both groups had insignificant relation with Silverman Retraction Scores, use of mechanical ventilation, mechanical ventilation duration, O_2 supply duration and use of Surfactant. All these factors may reflect the degree of respiratory distress in patients of both groups. There was a marked catch-up of weight in both groups which could be attributed to the high socio-economic level of the patients.

The cognitive function and psychomotor development were assessed by using BSID-II which is one of the most widely used tools to study infant global development.

The mean values of MDI scores at 6 months were significantly lower in group II patients with corrected age, but the mean values of PDI scores at 6 months were insignificantly lower in group II with corrected age compared to group I patients. Similar results were obtained by ***Hopkins et al. (2004)*** who found that neurocognitive sequelae occurred in 73% of ARDS survivors at hospital discharge and 46% at one year. ***Herridge et al. (2003)*** confirmed the same results and said that survivors of ARDS have persistent functional disability one year after discharge from the intensive care unit. The means values of MDI and PDI scores of group II patients with corrected age became closer to those of group I patients at the following visits at 12, 18 and 24 months, but still the difference insignificant. Also, the rate of change in MDI and PDI scores in group II patients with corrected age was insignificantly higher compared to group I patients. This is in agreement with ***Gortner et al. (2003)*** who found that no significant differences regarding neurodevelopmental outcome at 22 months were observed between preterm infants.

In this study, the relation between the use of mechanical ventilation and mean rate of change in MDI scores in group II patients with corrected age, was insignificantly lower compared to group II patients who didn't require mechanical ventilation. The same result was obtained in MDI scores of group I patients who required mechanical ventilation compared to patients who didn't require mechanical ventilation. This is in agreement with ***Linda et al. (1982)*** who reported that when the scores were not corrected for the degree of prematurity, the group II infants had significantly lower cognitive (MDI) and motor (PDI) scores at 2 years of age. When the scores were corrected for prematurity, only the motor developmental scores of the group II group were lower than those of the group I.

Regarding the relation between Silverman Retraction Scores and the rate of change in MDI and PDI scores in group I patients, it was insignificantly different in all visits. But it was insignificantly lower in the rate of change in MDI of group II patients with Silverman score of 6 at 12, 18 and 24 months. This is in agreement with ***Linda et al. (1982)*** who said that the severity of respiratory distress is an important factor in predicting any neurodevelopmental delay.

In this work, the relation between the mechanical ventilation duration and the rate of change in MDI and PDI was insignificant in all visits in both group I and group II patients. Also, the same results were obtained regarding the relation between the O_2 supply duration and the rate of change in MDI and PDI in both group II and group I patients in all visits except in the rate of change in MDI scores in group II patients in all visits, where it had a negative correlation. However, ***Askie et al. (2003)*** said that O_2 supply conferred no significant benefit with respect to development. This is in contrary to ***Piekkala et al. (1987)*** who found that the developmental scores of preterm infants were significantly poorer than those of full-term at 2 years for gross motor.

The use of surfactant is tested in relation to the rate of change in MDI and PDI in both group I and group II patients where it was insignificantly different in all visits. These results agree with ***Dambeanu et al. (1997)*** who confirmed that the use of surfactant alone without the complete support of the neonatal intensive care, does not resolve the problem of the survival and unfavourable outcome in preterm babies.

However, only 3(9.4%) full-term patients and 2(10%) preterm patients showed mild developmental delay at 24 months of age with MDI and PDI scores between 90-99 which are far from the significantly handicapped range (<70) on the Bayley scales. They had mental and motor developmental ages between 22 to 23 months at 24 months of age.

These patients had low Apgar scores at 1-min which may be due to exposure to perinatal fetal distress.

On the other hand, most of the patients had high scores of MDI and PDI, which may be attributed to early intervention in the postneonatal period and due to the high quality services offered by the neonatal intensive care unit in the attending hospital. Also, high educational level of the parents played an important role in improving the outcome at the age of 24 months.

To sum up, the studied neurodevelopmental scores (MDI and PDI) had insignificant relation with Silverman Retraction Scores, use of mechanical ventilation, mechanical ventilation duration and the use of surfactant. All these factors may reflect the degree of respiratory distress in patients of both groups. Most patients survive without substantial neurodevelopment problems.

SUMMARY

SUMMARY

Respiratory distress is encountered frequently in newborns. Because respiratory distress in the newborn may be a potentially life threatening condition, physicians are expected to assess and manage affected infants promptly. The key to successful management of the infant who has respiratory distress is based on the ability to obtain a complete maternal and newborn history, a thorough clinical examination and early intervention and management.

The study aimed to evaluate the impact of respiratory distress on growth and development (mental and motor) in newborns.

The study was conducted on 52 newborns suffering from different degrees of respiratory distress according to Silverman Retraction Score. They were recruited from the intensive care unit of a private hospital. They were subdivided into two groups, group I, with 32 full-term infants and group II, with 20 preterm infants. The two groups were balanced by sex, parity and socioeconomic status and were studied at 6, 12, 18 and 24 months after birth.

All patient were subjected in each visit to the followings:

- Assessment of weight, length and head circumference using the Egyptian growth charts.

- Neurodevelopmental assessment using BSID-II (mental and motor scales).

The results of our study revealed that the majority of the patients had a moderate degree of respiratory distress. The commonest cause of respiratory distress was transient tachypnea of newborn.

As regards the use of mechanical ventilation, only 19.2% of all patients required mechanical ventilation. The mean of mechanical ventilation duration and O2 supply duration was increased in group II patients compared to group I patients. The relation between the mechanical ventilation duration and O2 supply duration and maturity was insignificant. But the relation between Silverman Retraction Scores and the use of mechanical ventilation was highly significant in group I and group II patients.

Following the weight, length and head circumference, all were significantly increased at 6, 12, 18 and 24 months after birth in both groups at their chronological ages. It was observed that the mean rate of change in weight, length and head circumference was highly significantly different in group II patients compared to group I patients referred to their chronological ages in all visits. Also, the rate of change in some items was highly significantly different in between the different visits in both groups.

The studied anthropometric measurements in both groups had insignificant relation with Silverman Retraction Scores, use of mechanical ventilation, mechanical ventilation duration, O2 supply duration and the use of surfactant.

Regarding the neurodevelopmental assessment, the MDI scores in group II patients with corrected age at 6 months were significantly lower compared to group I patients. MDI and PDI scores in group II patients with corrected age became near to those of group I patients at the following visits at 12, 18 and 24 months and the difference is insignificant. The rate of charge in MDI and PDI scores in both groups was higher in group II patients with corrected age compared to group I patients, but the difference was insignificant.

The studied neurodevelopmental scores (MDI and PDI) in both groups had insignificant relation with Silverman Retraction Scores, use of mechanical ventilation, mechanical ventilation duration and the use of surfactant.

Overall, the neurodevelopmental outcomes were good for patients in both groups and most infants survive without substantial neurodevelopmental problems.

CONCLUSION

CONCLUSION

The present follow-up evaluation of growth, development and neurodevelopmental outcomes up to the age of 24 months found no adverse effects on infants exposed to postneonatal respiratory distress, neither for preterm or full-term patients. The performance of the full-term infants' group with respiratory distress suggests that their motor and mental Bayely scores are comparable to those of average, healthy full term infants of the same age. On the other side, after correction of age of preterm infants' group with respiratory distress, they performed in the average range compared to healthy full-term infants on Bayley scale.

Birth weight rather than gestational age predicted the growth outcome in preterm infants. Respiratory distress had no impact on the future growth of the infants in the present study. Prematurity as such does not seem to influence the growth of preterm infants.

RECOMMENADTIONS

RECOMMENDATONS

- Prenatal care is important to predict the possible risk factors that may lead to respiratory distress at birth.
- Early detection, diagnosis and management of respiratory distress could minimize the occurrence of irreversible effects on neurodevelopment of the infants.
- Neurodevelopmental assessment and early intervention should be a strategy to all Neonatal Intensive Care Units with tertiary care.
- Use of Bayley Scale as a prognostic tool in patients with respiratory distress associated with any neurodevelopmental delay.
- Environmental stimulation and parental health education are crucial in the intervention programs of any neurodevelopment delay.
- Further studies with larger sample size, longer follow up duration and more adjusted confounding variables are needed to assess the effect of postneonatal respiratory distress on mental, motor and behavioral development.
- Centralize high risk pregnancies and births in tertiary perinatal

centers with top-level neonatal intensive care provided for a reasonable patient population.

- Follow-up of those patients needs to be extended until school age and preferable to adulthood, as all types of cognitive impairment may not yet be evident at 5 years of age.

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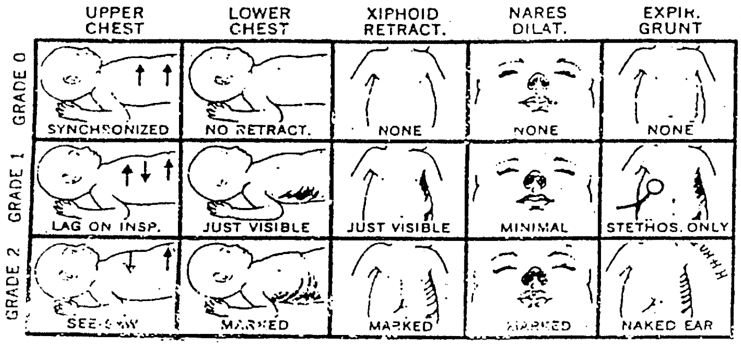
APPENDICES

Appendix (1): Silverman Retraction Scores (Evaluation of Respiratory Status)

Feature Observed	Score 0	Score 1	Score 2
Chest Movement	Synchronized Respiration	Lag on Respirations	Seesaw Respirations
Intercostal Retractions	Non	Just Visible	Marked
Xiphoid Retractions	None	Just Visible	Marked
Nares Dilatation	None	Minimal	Marked
Expiratory Grunt	None	Audible-Stethoscope	Audible-Unaided Ear
Total Score of 0 indicates no respiratory distress. **Total score of 4-6 indicates moderated distress.** **Total Score of 7-10 indicates severe distress.**			Total Silverman Score

(Avery et al., 1973)

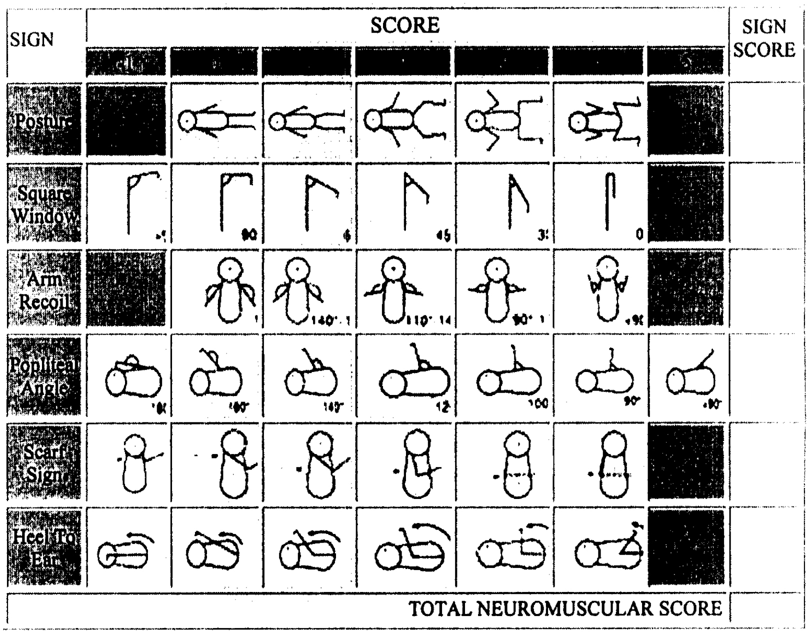
SILVERMAN-ANDERSEN RETRACTION SCORE



APPENDIX (2): New Ballard score

Use this score sheet to assess the gestational maturity of your baby. At the end of the examination the total score determines the gestational maturity in weeks.

NEUROMUSCULAR MATURITY



SIGN	SCORE							SIGN SCORE
	-1						5	
Posture								
Square Window	>9	90	6	45	3	0		
Arm Recoil		1	140°-1	110°-14	90°-1	<9		
Popliteal Angle	18	160°	140°	12	100	90°	<90°	
Scarf Sign								
Heel To Ear								
TOTAL NEUROMUSCULAR SCORE								

PHYSICAL MATURITY

SIGN	SCORE							SIGN SCORE
	-1	0	1	2	3	4	5	
Skin	Sticky, friable, transparent	gelatinous, red, translucent	smooth pink, visible veins	superficial peeling &/or rash, few veins	cracking, pale areas, rare veins	parchment, deep cracking, no vessels	leathery, cracked, wrinkled	
Lanugo	none	sparse	abundant	thinning	bald areas	mostly bald		
Plantar Surface	heel-toe 40-50mm: -1 <40mm: -2	>50 mm no crease	faint red marks	anterior transverse crease only	creases ant. 2/3	creases over entire sole		
Breast	imperceptable	barely perceptable	flat areola no bud	stippled areola 1-2 mm bud	raised areola 3-4 mm bud	full areola 5-10 mm bud		
Eye/Ear	lids fused loosely: -1 tightly: -2	lids open pinna flat stays folded	sl. curved pinna; soft; slow recoil	well-curved pinna; soft but ready recoil	formed & firm instant recoil	thick cartilage ear stiff		
Genitals (Male)	scrotum flat, smooth	scrotum empty, faint rugae	testes in upper canal, rare rugae	testes descending, few rugae	testes down, good rugae	testes pendulous, deep rugae		
Genitals (Female)	clitoris prominent & labia flat	prominent clitoris & small labia minora	prominent clitoris & enlarging minora	majora & minora equally prominent	majora large, minora small	majora cover clitoris & minora		
TOTAL PHYSICAL MATURITY SCORE								

MATURITY RATING

TOTAL SCORE (NEUROMUSCULAR + PHYSICAL)	WEEKS
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

(Ballard et al; 1991)

APPENDIX (3): Data sheet

NEONATAL CARE UNIT

PATIENT INFORMATION

Date : Day ☐☐ Month ☐☐ Year 2 0 0 ☐

Patient's Name First ☐ Middle ☐ Last ☐

Date of birth Day ☐☐ Month ☐☐ Year 2 0 0 ☐

Sex M F Age Years ☐☐ months ☐☐ days ☐☐

Mother's Name First ☐ Middle ☐ Last ☐

Mother's Education high ☐ middle ☐ low ☐ Occupation ☐

Father's Education high ☐ middle ☐ low ☐ Occupation ☐

Address R ural U rban S emi-urban

Telephone ☐

Maternal Information

Blood Group A B O AB + - Rh

Prenatal Care Y N

Fetal Presentation V ertex B reech

PROM Y N

Duration of rupture of membranes ☐☐ hours

Method of delivery V aginal C section

Forceps used Y N

Vacum extraction Y N

Consanguinity Y N

I.V.F Y N

Multiple Pregnancy Y N

Placenta Previa Y N

Maternal fever Y N

Eclampsia Y N

Gestational Hypertension Y N

Maternal UTI Y N

Gestational Diabetes Y N

Diabetes Mellitus Y N

Thyroid problems Y N

Hypertension Y N

Hematologic Y N

Renal disease Y N

Liver Disease Y N

Allergy/Asthma Y N

Cardiac diseases Y N

Admission & Resuscitation Information

	Day	Month	Year
Date of admission	☐☐	☐☐	☐☐

Age on admission ☐☐ days

Gestational age ☐☐ weeks

Birth Weight ☐☐☐☐ g

Out come of
- Single pregnancy
- Twin Pregnancy
- TRiple Pregnancy
- Quadriplate

Supplemental oxygen	Y	N
Bagging	Y	N
Cardiac massage	Y	N
Intubation	Y	N
Urine passed	Y	N
Meconium Passed	Y	N

MEDICATION

Adrenaline	Y	N
HCO^3	Y	N
Naloxone	Y	N

Color Pink PAle Blue

Cried within ☐☐ MIN

Normal respiration after ☐☐ MIN

Apnea	Y	N
Grunting	Y	N
Seizure	Y	N

APGAR SCORE	MIN 1	MIN 5	MIN 10
Heart rate	☐	☐	☐
Respiration	☐	☐	☐
Tone	☐	☐	☐
Reflex irritability	☐	☐	☐
Color	☐	☐	☐
Total	☐	☐	☐

Initial Examination

VITAL SIGNS

Temp. ☐☐.☐ °C

SaO_2 ☐☐☐

Heart Rate (Beats/min) ☐☐☐

Respiratory rate (breaths/min) ☐☐☐

Weight ☐☐☐☐ g

Lengh ☐☐.☐ cm

Head Circum ☐☐.☐ cm

CHEST EXAM

Tachypnea Y N

Grunting Y N

Retraction Y N

Air Entry diminished Y N

Thoracic Asym Y N

Down's Score ☐☐

CARDIAC EXAM

Poor Peripheral perfusion Y N

Femoral Pulse R ight L eft "X" if Abnormal

Tachycardia Y N >160/min

Braycardia Y N <100/min

ABDOMINAL EXAM

Distension Y N

Liver Enlarged Y N

Spleen Enlarged Y N

NEUROLOGICAL EXAMINATION

Lethargy Y N

Irritability Y N

Poor sucking Y N

Seizure Y N

Jitteriness Y N

Decreased Spontaneous movement Y N

Increased Muscle tone Y N

Moro N ormal A bnormal

Suckling N ormal A bnormal

Grasping N ormal A bnormal

Meconium stained aspirate Y

Admission Diagnosis

LBW Y N

IUGR Y N

Apnea Y N

TTN Y N

IDM Y N

Jaundice Y N

Other Birth Injuries Y N

VLBW Y N

RDS Y N

Asphyxia Y N

TORCH Inf Y N

DIC Y N

ELBW Y N

Pneumonia Y N

PPH Y N

Seizure Y N

Sepsis Y N

Incompatibility Y N

MECHANICAL VENTILATION AND O$_2$ SUPPLY

Mechanical ventilation Y N

Period of stay on M.V. ☐☐ days

Period of stay on 02 supply after M.V. ☐☐ days

Survanta therapy Y N

APPENDIX (4): Social Status of the Family

(Park and Park, 1979)

1. Educational Level

Illiterate	1	Father
Primary	2	
Preparatory	4	
Secondary	5	Mother
University	7	

2. Occupation

Manual or unskilled worker	1	Father
Industrial worker	2	
Skilled worker	4	
Semiprofessional	5	Mother
Professional	7	

Scoring

1.Low : < 8
2.Middle : 9 - 18
3.High : 19 - 28

Appendix (5): Instructions for parents before test

إرشادات للأمهات قبل إجراء الإختبارات

- نقوم بعمل دراسة عن تأثير إجهاد التنفس عند الولادة على النمو والتطور للطفل خلال العامين الأولين (عند ٦-١٢-١٨-٢٤ شهر).
- يتم الكشف مجاني.
- يتم عمل اختبارات تسمى Bayley scale للنمو العقلي والحركي للطفل وهى عبارة عن مجموعة من الألعاب والحركات مع دراسة رد فعل الطفل خلال إجرائها.
- بعد كل زيارة يتم إبلاغ الأهل نتيجة الاختبارات (ومكتوبة إذا طلبت).
- ضرورة استكمال كافة الزيارات (٤ زيارات) خلال السنتين الأوليين لمتابعة النمو العقلى والحركى.
- يفضل إبلاغ الطبيب المعالج للطفل بنتيجة الاختبارات.
- الاشتراطات المطلوبة قبل الاختبار:

١- يتم إرضاع الطفل قبل الاختبار بساعة على الأقل وساعتين على أقصى تقدير.

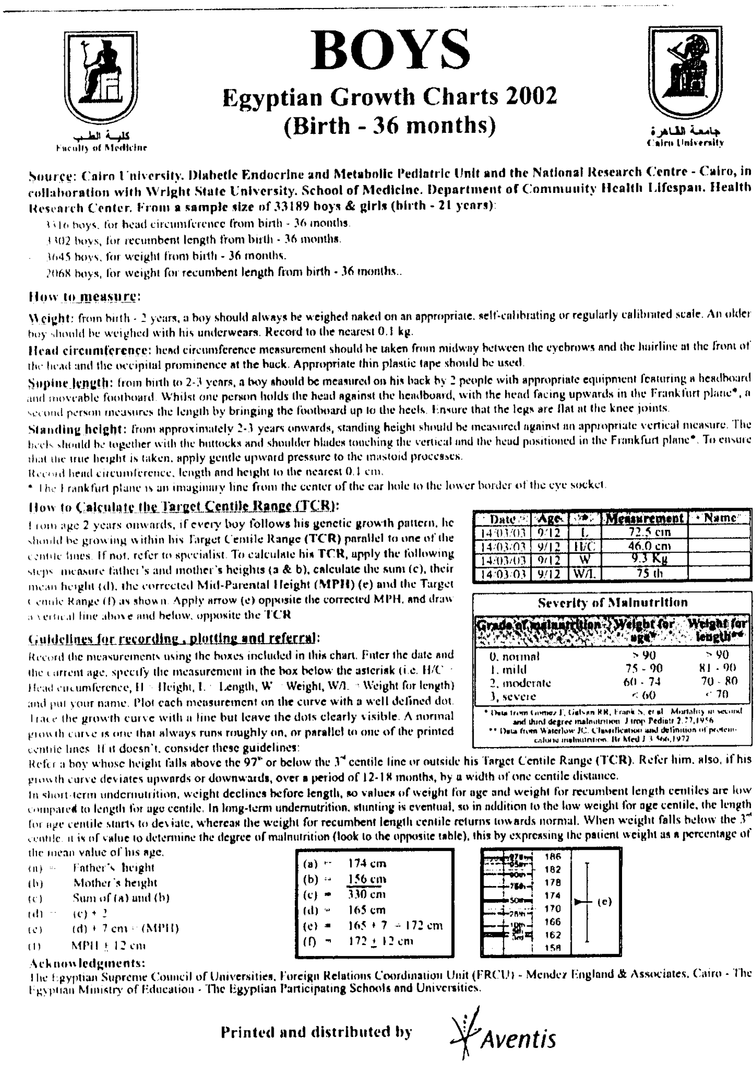
٢- لابد أن ينام الطفل فترة كافية قبل الاختبار.

٣- ألا يكون مريضا أو بعد التطعيم أو فى فترة تسنين (وجود ألم).

٤- ضرورة الالتزام بميعاد الاختبار.

5- ضرورة التوقيع على الـ consent

APPENDIX (6): Growth charts



كليـة الطـب
Faculty of Medicine

BOYS

Egyptian Growth Charts 2002
(Birth - 36 months)

جامعة القاهرة
Cairo University

Source: Cairo University. Diabetic Endocrine and Metabolic Pediatric Unit and the National Research Centre - Cairo, in collaboration with Wright State University. School of Medicine. Department of Community Health Lifespan. Health Research Center. From a sample size of 33189 boys & girls (birth - 21 years):

3316 boys, for head circumference from birth - 36 months.
3302 boys, for recumbent length from birth - 36 months.
3645 boys, for weight from birth - 36 months.
2068 boys, for weight for recumbent length from birth - 36 months..

How to measure:

Weight: from birth - 2 years, a boy should always be weighed naked on an appropriate, self-calibrating or regularly calibrated scale. An older boy should be weighed with his underwears. Record to the nearest 0.1 kg.

Head circumference: head circumference measurement should be taken from midway between the eyebrows and the hairline at the front of the head and the occipital prominence at the back. Appropriate thin plastic tape should be used.

Supine length: from birth to 2-3 years, a boy should be measured on his back by 2 people with appropriate equipment featuring a headboard and moveable footboard. Whilst one person holds the head against the headboard, with the head facing upwards in the Frankfurt plane*, a second person measures the length by bringing the footboard up to the heels. Ensure that the legs are flat at the knee joints.

Standing height: from approximately 2-3 years onwards, standing height should be measured against an appropriate vertical measure. The heels should be together with the buttocks and shoulder blades touching the vertical and the head positioned in the Frankfurt plane*. To ensure that the true height is taken, apply gentle upward pressure to the mastoid processes.

Record head circumference, length and height to the nearest 0.1 cm.

* The Frankfurt plane is an imaginary line from the center of the ear hole to the lower border of the eye socket.

How to Calculate the Target Centile Range (TCR):

From age 2 years onwards, if every boy follows his genetic growth pattern, he should be growing within his Target Centile Range (TCR) parallel to one of the centile lines. If not, refer to specialist. To calculate his TCR, apply the following steps: measure father's and mother's heights (a & b), calculate the sum (c), their mean height (d), the corrected Mid-Parental Height (MPH) (e) and the Target Centile Range (f) as shown. Apply arrow (e) opposite the corrected MPH, and draw a vertical line above and below, opposite the TCR

Date	Age	*	Measurement	* Name
14/03/03	9/12	L	72.5 cm	
14/03/03	9/12	H/C	46.0 cm	
14/03/03	9/12	W	9.3 Kg	
14/03/03	9/12	W/L	75 th	

Guidelines for recording, plotting and referral:

Record the measurements using the boxes included in this chart. Enter the date and the current age, specify the measurement in the box below the asterisk (i.e. H/C = Head circumference, H = Height, L = Length, W = Weight, W/L = Weight for length) and put your name. Plot each measurement on the curve with a well defined dot. Trace the growth curve with a line but leave the dots clearly visible. A normal growth curve is one that always runs roughly on, or parallel to one of the printed centile lines. If it doesn't, consider these guidelines:

Severity of Malnutrition

Grade of malnutrition	Weight for age*	Weight for length**
0. normal	> 90	> 90
1. mild	75 - 90	81 - 90
2. moderate	60 - 74	70 - 80
3, severe	< 60	< 70

* Data from Gomez F, Galvan RR, Frank S, et al. Mortality in second and third degree malnutrition. J trop Pediatr 2:77,1956

** Data from Waterlow JC. Classification and definition of protein-calorie malnutrition. Br Med J 3:566,1972

Refer a boy whose height falls above the 97^{th} or below the 3^{rd} centile line or outside his Target Centile Range (TCR). Refer him, also, if his growth curve deviates upwards or downwards, over a period of 12-18 months, by a width of one centile distance.

In short-term undernutrition, weight declines before length, so values of weight for age and weight for recumbent length centiles are low compared to length for age centile. In long-term undernutrition, stunting is eventual, so in addition to the low weight for age centile, the length for age centile starts to deviate, whereas the weight for recumbent length centile returns towards normal. When weight falls below the 3^{rd} centile, it is of value to determine the degree of malnutrition (look to the opposite table), this by expressing the patient weight as a percentage of the mean value of his age.

(a) = Father's height
(b) = Mother's height
(c) = Sum of (a) and (b)
(d) = (c) ÷ 2
(e) = (d) + 7 cm = (MPH)
(f) = MPH ± 12 cm

(a) = 174 cm
(b) = 156 cm
(c) = 330 cm
(d) = 165 cm
(e) = 165 + 7 = 172 cm
(f) = 172 ± 12 cm

Acknowledgments:

The Egyptian Supreme Council of Universities, Foreign Relations Coordination Unit (FRCU) - Mendez England & Associates, Cairo - The Egyptian Ministry of Education - The Egyptian Participating Schools and Universities.

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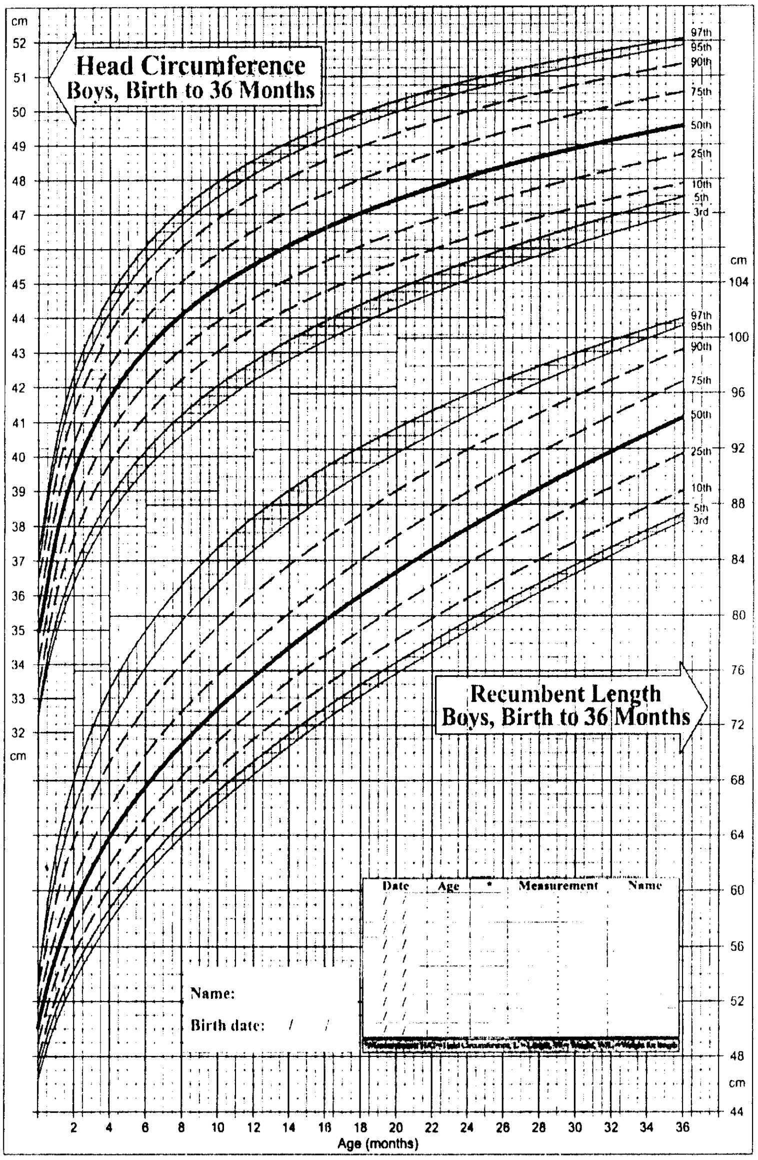
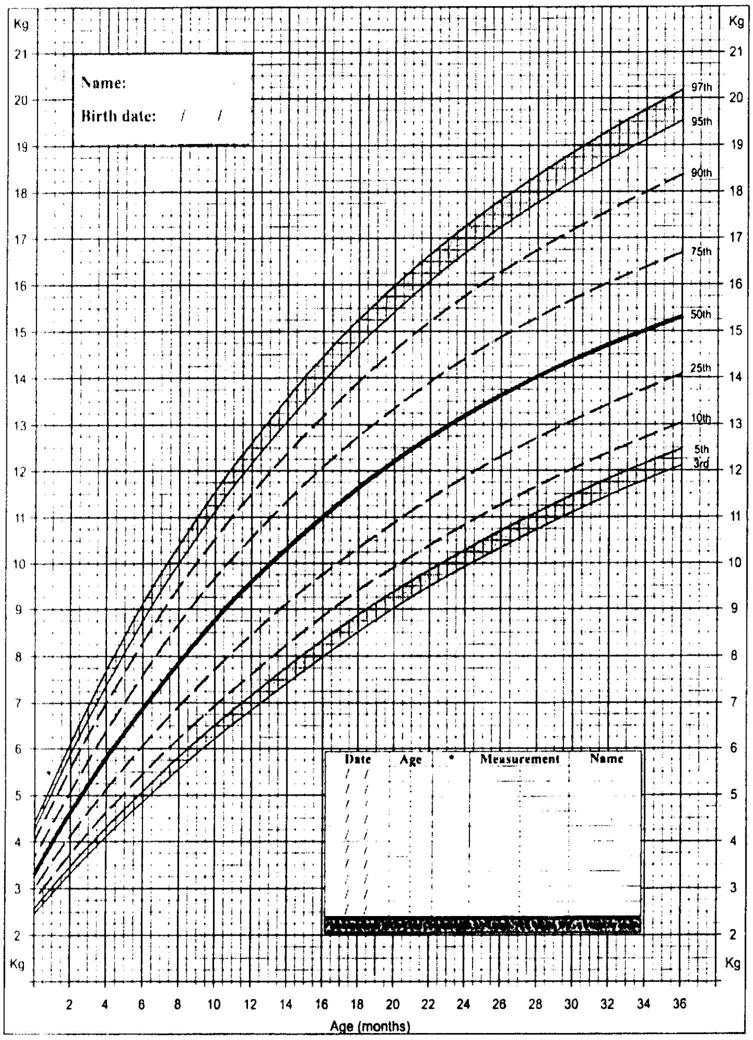
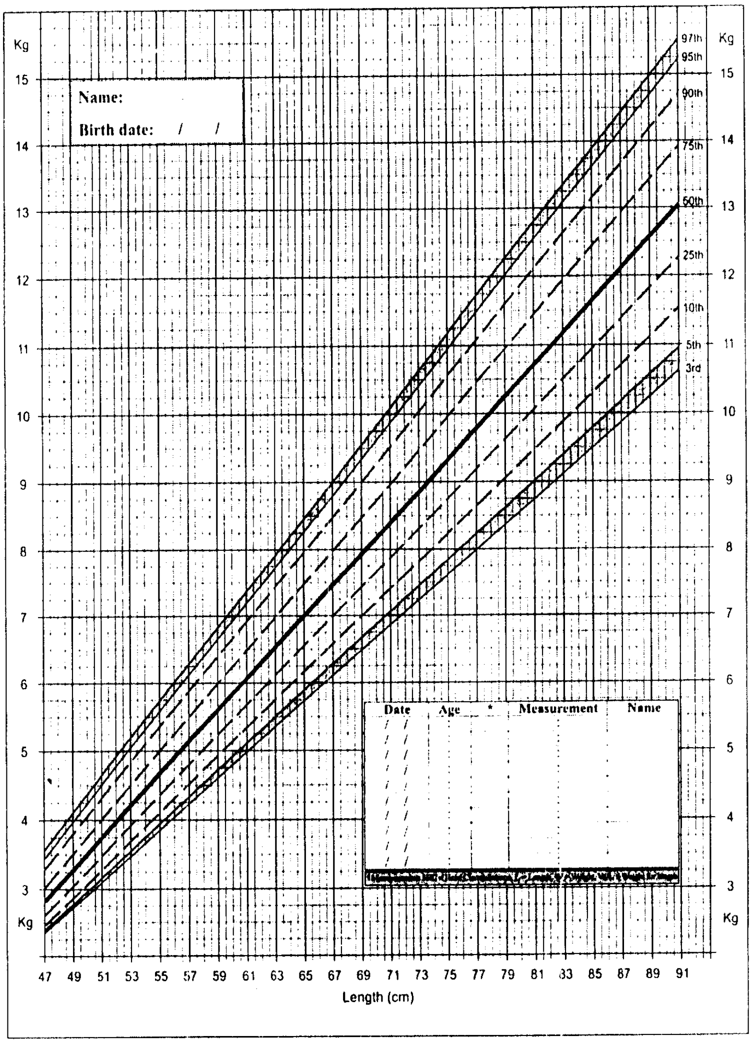

Head Circumference
Boys, Birth to 36 Months
Recumbent Length
Boys, Birth to 36 Months
cm
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
cm
97th
95th
90th
75th
50th
25th
10th
5th
3rd
cm
104
100
96
92
88
84
80
76
72
68
64
60
56
52
48
cm
44
Name:
Birth date: / /
Date
Age
*
Measurement
Name
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
Age (months)

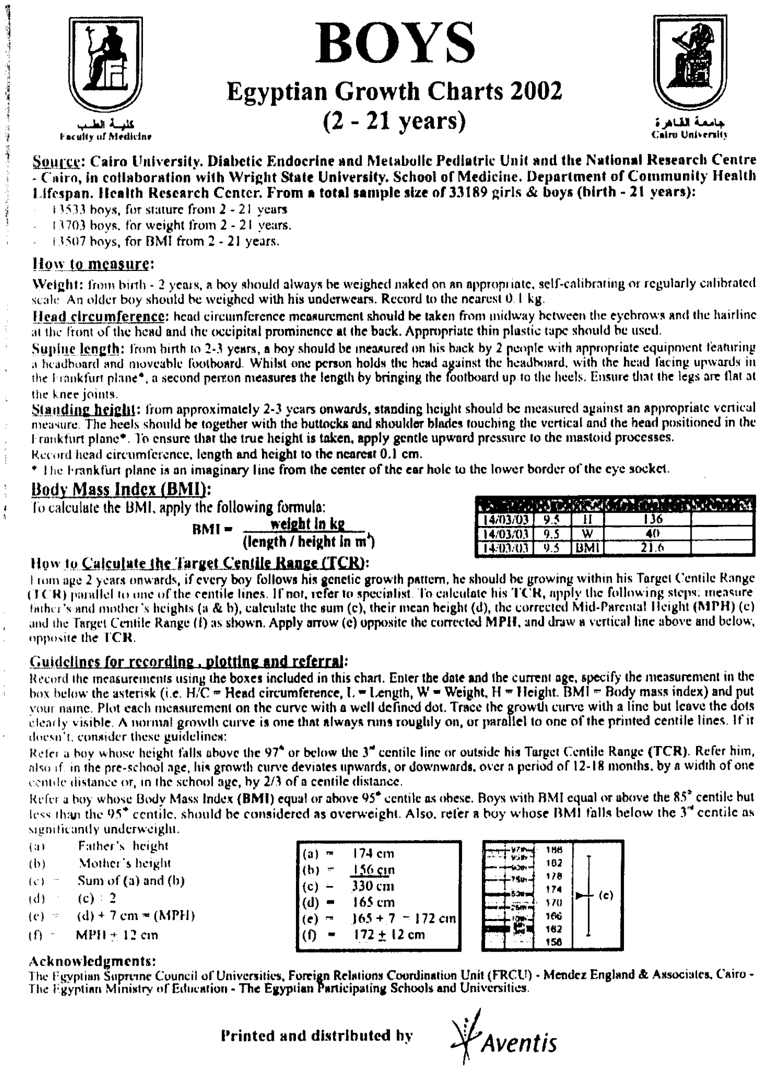
Weight-for-Age Percentiles:
Egyptian Boys, Birth to 36 Months



Weight-for-Recumbent Length Percentiles: Egyptian Boys, Birth to 36 Months



APPENDIX (6): Growth charts cont'



كلية الطب
Faculty of Medicine

BOYS

Egyptian Growth Charts 2002
(2 - 21 years)

جامعة القاهرة
Cairo University

Source: Cairo University. Diabetic Endocrine and Metabolic Pediatric Unit and the National Research Centre - Cairo, in collaboration with Wright State University. School of Medicine. Department of Community Health Lifespan. Health Research Center. From a total sample size of 33189 girls & boys (birth - 21 years):

- 13533 boys, for stature from 2 - 21 years
- 13703 boys, for weight from 2 - 21 years.
- 13507 boys, for BMI from 2 - 21 years.

How to measure:

Weight: from birth - 2 years, a boy should always be weighed naked on an appropriate, self-calibrating or regularly calibrated scale. An older boy should be weighed with his underwears. Record to the nearest 0.1 kg.

Head circumference: head circumference measurement should be taken from midway between the eyebrows and the hairline at the front of the head and the occipital prominence at the back. Appropriate thin plastic tape should be used.

Supine length: from birth to 2-3 years, a boy should be measured on his back by 2 people with appropriate equipment featuring a headboard and moveable footboard. Whilst one person holds the head against the headboard, with the head facing upwards in the Frankfurt plane*, a second person measures the length by bringing the footboard up to the heels. Ensure that the legs are flat at the knee joints.

Standing height: from approximately 2-3 years onwards, standing height should be measured against an appropriate vertical measure. The heels should be together with the buttocks and shoulder blades touching the vertical and the head positioned in the Frankfurt plane*. To ensure that the true height is taken, apply gentle upward pressure to the mastoid processes.

Record head circumference, length and height to the nearest 0.1 cm.

* The Frankfurt plane is an imaginary line from the center of the ear hole to the lower border of the eye socket.

Body Mass Index (BMI):

To calculate the BMI, apply the following formula:

$$\text{BMI} = \frac{\text{weight in kg}}{(\text{length / height in m}^2)}$$

14/03/03	9.5	H	136	
14/03/03	9.5	W	40	
14/03/03	9.5	BMI	21.6	

How to Calculate the Target Centile Range (TCR):

From age 2 years onwards, if every boy follows his genetic growth pattern, he should be growing within his Target Centile Range (TCR) parallel to one of the centile lines. If not, refer to specialist. To calculate his TCR, apply the following steps: measure father's and mother's heights (a & b), calculate the sum (c), their mean height (d), the corrected Mid-Parental Height (MPH) (e) and the Target Centile Range (f) as shown. Apply arrow (e) opposite the corrected MPH, and draw a vertical line above and below, opposite the TCR.

Guidelines for recording , plotting and referral:

Record the measurements using the boxes included in this chart. Enter the date and the current age, specify the measurement in the box below the asterisk (i.e. H/C = Head circumference, L = Length, W = Weight, H = Height. BMI = Body mass index) and put your name. Plot each measurement on the curve with a well defined dot. Trace the growth curve with a line but leave the dots clearly visible. A normal growth curve is one that always runs roughly on, or parallel to one of the printed centile lines. If it doesn't, consider these guidelines:

Refer a boy whose height falls above the 97th or below the 3rd centile line or outside his Target Centile Range (TCR). Refer him, also if, in the pre-school age, his growth curve deviates upwards, or downwards, over a period of 12-18 months, by a width of one centile distance or, in the school age, by 2/3 of a centile distance.

Refer a boy whose Body Mass Index (BMI) equal or above 95th centile as obese. Boys with BMI equal or above the 85th centile but less than the 95th centile, should be considered as overweight. Also, refer a boy whose BMI falls below the 3rd centile as significantly underweight.

(a) Father's height
(b) Mother's height
(c) = Sum of (a) and (b)
(d) = (c) : 2
(e) = (d) + 7 cm = (MPH)
(f) = MPH ± 12 cm

(a) = 174 cm
(b) = 156 cm
(c) = 330 cm
(d) = 165 cm
(e) = 165 + 7 = 172 cm
(f) = 172 ± 12 cm

97th
95th
90th
75th
50th
25th
10th
5th
3rd
186
182
178
174
170
166
162
158
(e)

Acknowledgments:
The Egyptian Supreme Council of Universities, Foreign Relations Coordination Unit (FRCU) - Mendez England & Associates, Cairo - The Egyptian Ministry of Education - The Egyptian Participating Schools and Universities.

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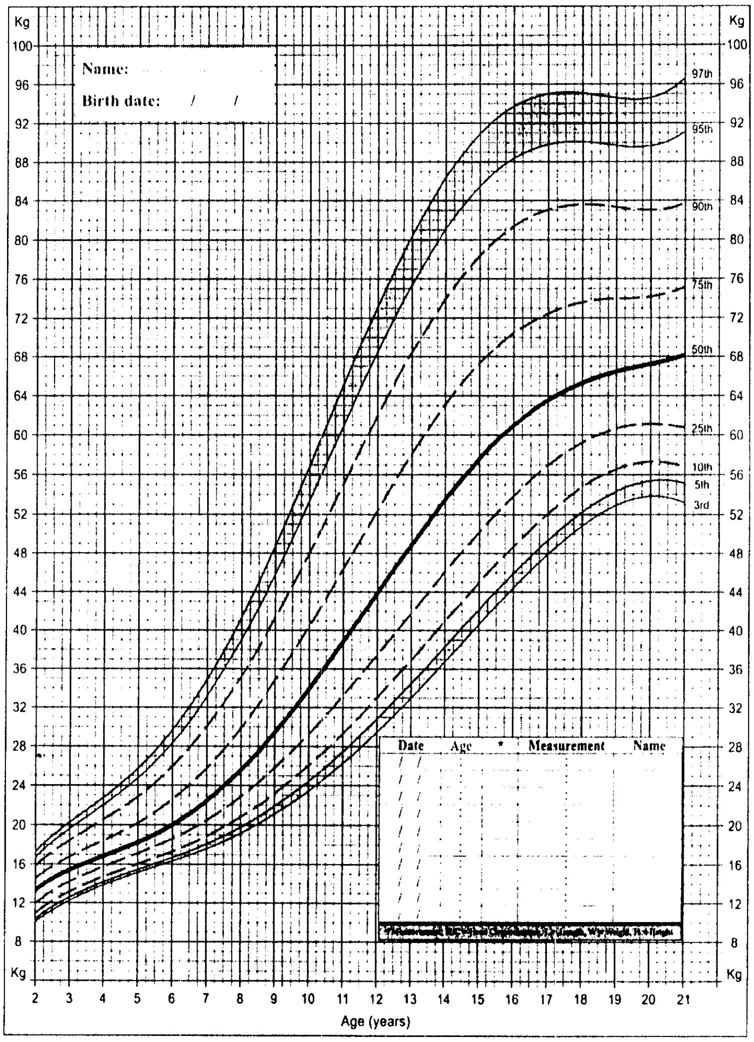
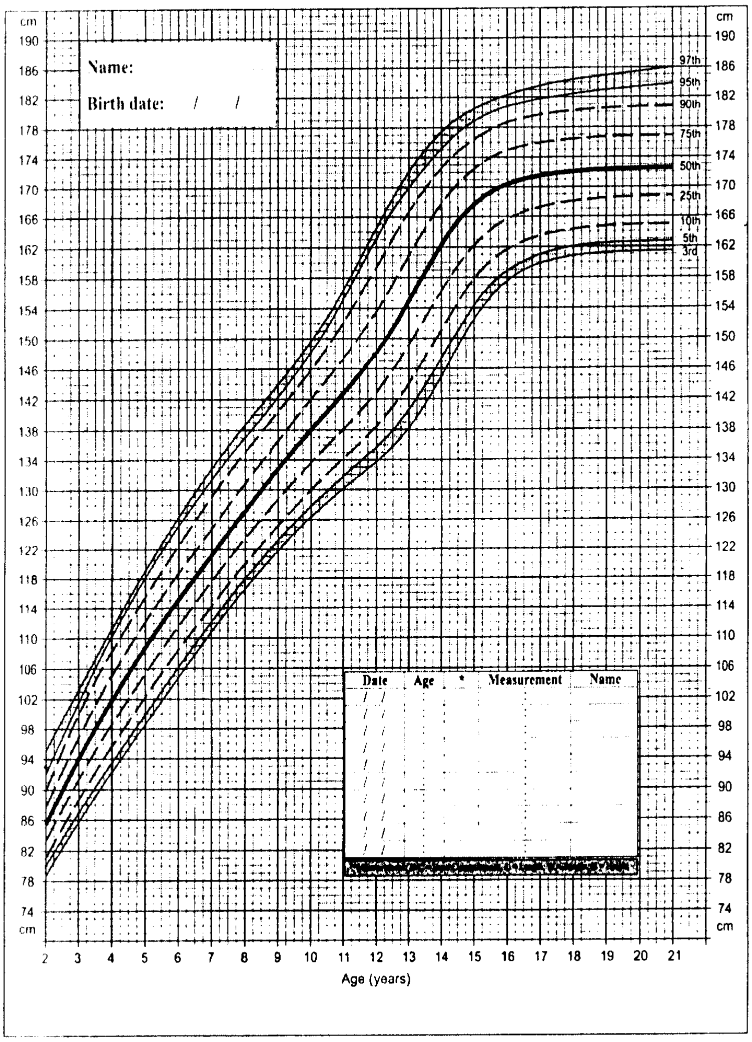
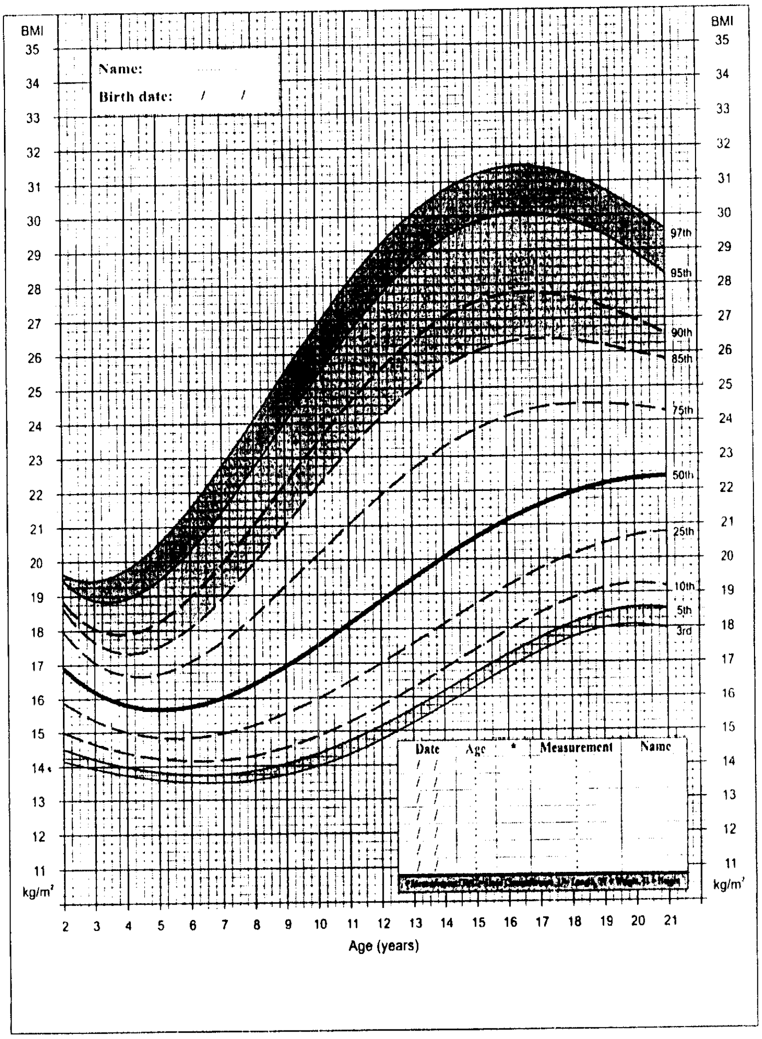
Weight-for-Age Percentiles:
Egyptian Boys, 2 to 21 Years



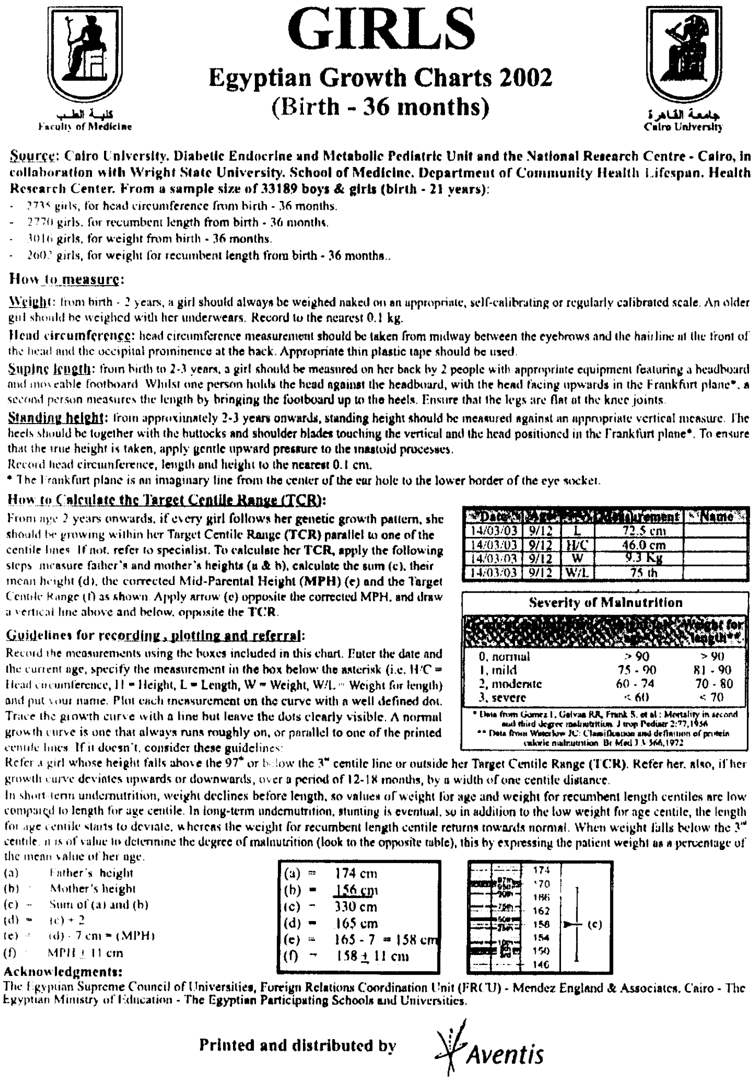
Stature-for-Age Percentiles: Egyptian Boys, 2 to 21 Years



Body Mass Index-for-Age Percentiles: Egyptian Boys, 2 to 21 Years



APPENDIX (6): Growth charts cont'



كلية الطب
Faculty of Medicine

GIRLS

Egyptian Growth Charts 2002
(Birth - 36 months)

جامعة القاهرة
Cairo University

Source: **Cairo University. Diabetic Endocrine and Metabolic Pediatric Unit and the National Research Centre - Cairo, in collaboration with Wright State University. School of Medicine. Department of Community Health Lifespan. Health Research Center. From a sample size of 33189 boys & girls (birth - 21 years):**

- 2735 girls, for head circumference from birth - 36 months.
- 2770 girls, for recumbent length from birth - 36 months.
- 3016 girls, for weight from birth - 36 months.
- 2602 girls, for weight for recumbent length from birth - 36 months..

How to measure:

Weight: from birth - 2 years, a girl should always be weighed naked on an appropriate, self-calibrating or regularly calibrated scale. An older girl should be weighed with her underwears. Record to the nearest 0.1 kg.

Head circumference: head circumference measurement should be taken from midway between the eyebrows and the hairline at the front of the head and the occipital prominence at the back. Appropriate thin plastic tape should be used.

Supine length: from birth to 2-3 years, a girl should be measured on her back by 2 people with appropriate equipment featuring a headboard and moveable footboard. Whilst one person holds the head against the headboard, with the head facing upwards in the Frankfurt plane*, a second person measures the length by bringing the footboard up to the heels. Ensure that the legs are flat at the knee joints.

Standing height: from approximately 2-3 years onwards, standing height should be measured against an appropriate vertical measure. The heels should be together with the buttocks and shoulder blades touching the vertical and the head positioned in the Frankfurt plane*. To ensure that the true height is taken, apply gentle upward pressure to the mastoid processes.

Record head circumference, length and height to the nearest 0.1 cm.

* The Frankfurt plane is an imaginary line from the center of the ear hole to the lower border of the eye socket.

How to Calculate the Target Centile Range (TCR):

From age 2 years onwards, if every girl follows her genetic growth pattern, she should be growing within her Target Centile Range (TCR) parallel to one of the centile lines. If not, refer to specialist. To calculate her TCR, apply the following steps: measure father's and mother's heights (a & b), calculate the sum (c), their mean height (d), the corrected Mid-Parental Height (MPH) (e) and the Target Centile Range (f) as shown. Apply arrow (e) opposite the corrected MPH, and draw a vertical line above and below, opposite the TCR.

Date	*Age*	[illegible]	Measurement	*Name*
14/03/03	9/12	L	72.5 cm	
14/03/03	9/12	H/C	46.0 cm	
14/03/03	9/12	W	9.3 Kg	
14/03/03	9/12	W/L	75 th	

Guidelines for recording, plotting and referral:

Record the measurements using the boxes included in this chart. Enter the date and the current age, specify the measurement in the box below the asterisk (i.e. H/C = Head circumference, H = Height, L = Length, W = Weight, W/L = Weight for length) and put your name. Plot each measurement on the curve with a well defined dot. Trace the growth curve with a line but leave the dots clearly visible. A normal growth curve is one that always runs roughly on, or parallel to one of the printed centile lines. If it doesn't, consider these guidelines:

Severity of Malnutrition

[illegible]	[illegible]	Weight for length**
0, normal	> 90	> 90
1, mild	75 - 90	81 - 90
2, moderate	60 - 74	70 - 80
3, severe	< 60	< 70

* Data from Gomez F, Galvan RR, Frank S. et al : Mortality in second and third degree malnutrition. J trop Pediatr 2:77,1956

** Data from Waterlow JC: Classification and definition of protein calorie malnutrition. Br Med J 3:566,1972

Refer a girl whose height falls above the 97th or below the 3rd centile line or outside her Target Centile Range (TCR). Refer her, also, if her growth curve deviates upwards or downwards, over a period of 12-18 months, by a width of one centile distance.

In short-term undernutrition, weight declines before length, so values of weight for age and weight for recumbent length centiles are low compared to length for age centile. In long-term undernutrition, stunting is eventual, so in addition to the low weight for age centile, the length for age centile starts to deviate, whereas the weight for recumbent length centile returns towards normal. When weight falls below the 3rd centile, it is of value to determine the degree of malnutrition (look to the opposite table), this by expressing the patient weight as a percentage of the mean value of her age.

(a) Father's height
(b) = Mother's height
(c) = Sum of (a) and (b)
(d) = (c) ÷ 2
(e) = (d) - 7 cm = (MPH)
(f) = MPH ± 11 cm

(a) = 174 cm
(b) = 156 cm
(c) = 330 cm
(d) = 165 cm
(e) = 165 - 7 = 158 cm
(f) = 158 ± 11 cm

Acknowledgments:
The Egyptian Supreme Council of Universities, Foreign Relations Coordination Unit (FRCU) - Mendez England & Associates, Cairo - The Egyptian Ministry of Education - The Egyptian Participating Schools and Universities.

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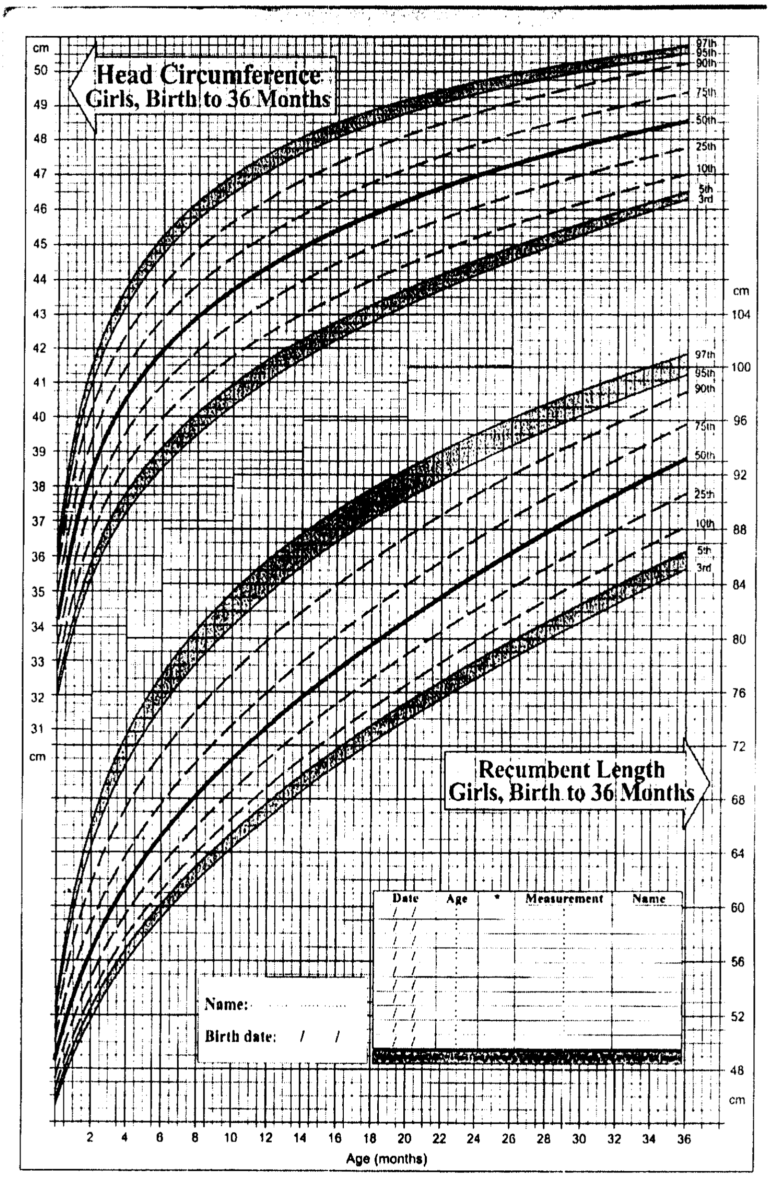
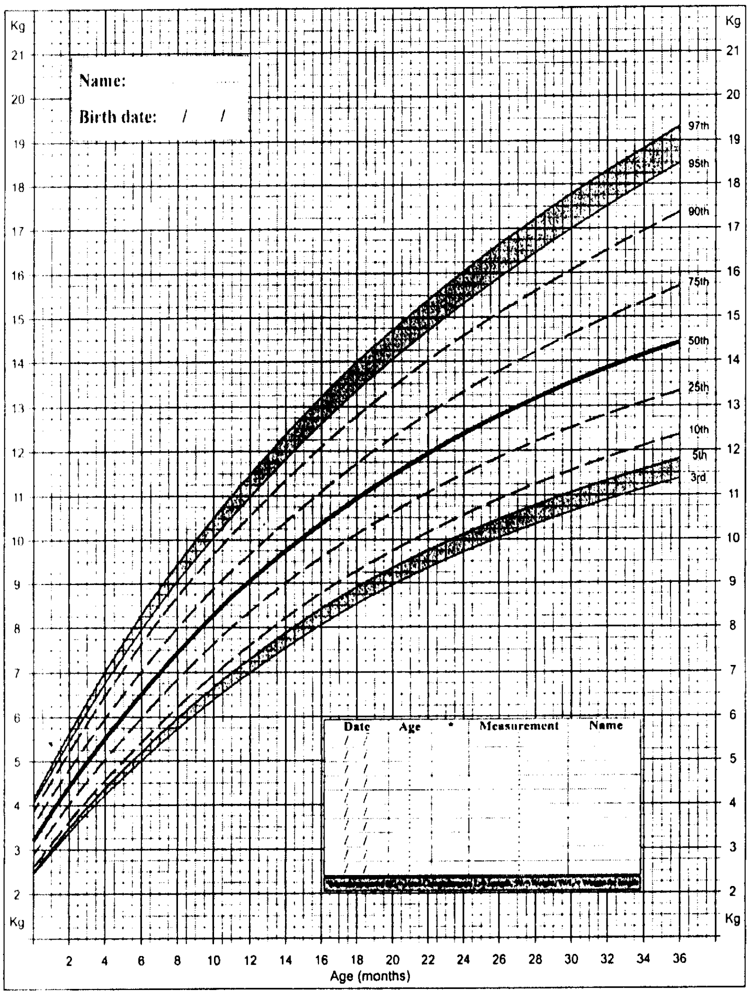
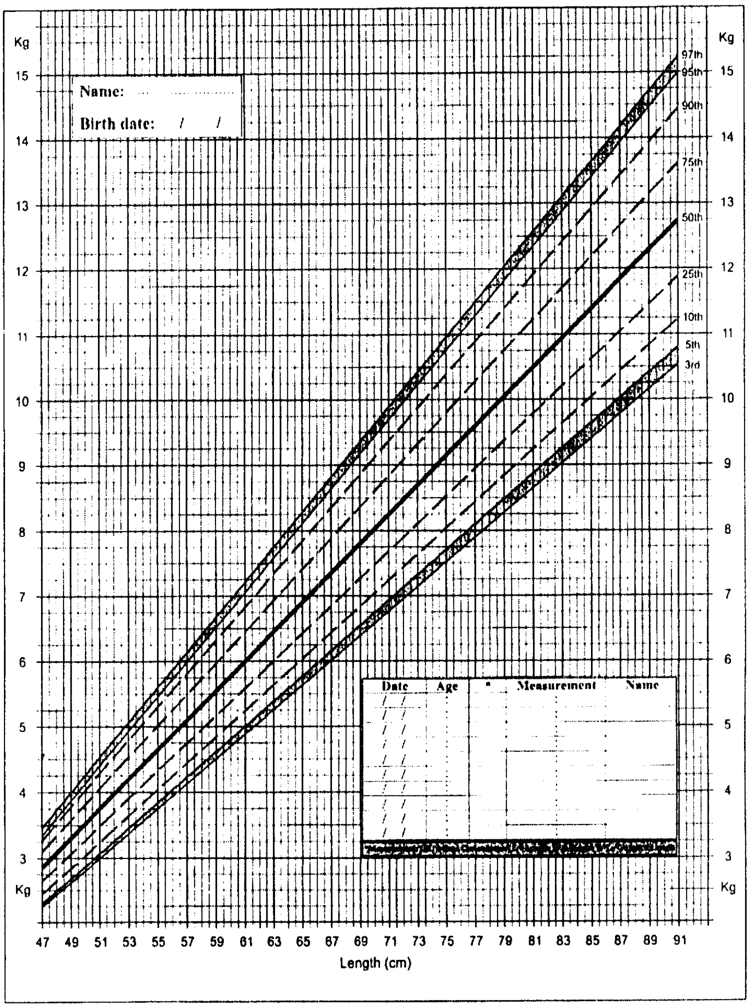

Head Circumference
Girls, Birth to 36 Months
Recumbent Length
Girls, Birth to 36 Months
cm
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
cm
104
100
96
92
88
84
80
76
72
68
64
60
56
52
48
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Date
Age
*
Measurement
Name
Name:
Birth date: / /
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
Age (months)

Weight-for-Age Percentiles: Egyptian Girls, Birth to 36 Months



Weight-for-Recumbent Length Percentiles: Egyptian Girls, Birth to 36 Months



APPENDIX (6): Growth charts cont'

كلية الطب
Faculty of Medicine

GIRLS

Egyptian Growth Charts 2002
(2 - 21 years)

جامعة القاهرة
Cairo University

Source: Cairo University. Diabetic Endocrine and Metabolic Pediatric Unit and the National Research Centre - Cairo, in collaboration with Wright State University. School of Medicine. Department of Community Health Lifespan. Health Research Center. From a total sample size of 33189 girls & boys (birth - 21 years):

- 13809 girls, for stature from 2 - 21 years
- 13933 girls, for weight from 2 - 21 years.
- 13762 girls, for BMI from 2 - 21 years.

How to measure:

Weight: from birth - 2 years, a girl should always be weighed naked on an appropriate, self-calibrating or regularly calibrated scale. An older girl should be weighed with her underwears. Record to the nearest 0.1 kg.

Head circumference: head circumference measurement should be taken from midway between the eyebrows and the hairline at the front of the head and the occipital prominence at the back. Appropriate thin plastic tape should be used.

Supine length: from birth to 2-3 years, a girl should be measured on her back by 2 people with appropriate equipment featuring a headboard and moveable footboard. Whilst one person holds the head against the headboard, with the head facing upwards in the Frankfurt plane*, a second person measures the length by bringing the footboard up to the heels. Ensure that the legs are flat at the knee joints.

Standing height: from approximately 2-3 years onwards, standing height should be measured against an appropriate vertical measure. The heels should be together with the buttocks and shoulder blades touching the vertical and the head positioned in the Frankfurt plane*. To ensure that the true height is taken, apply gentle upward pressure to the mastoid processes.

Record head circumference, length and height to the nearest 0.1 cm.

* The Frankfurt plane is an imaginary line from the center of the ear hole to the lower border of the eye socket.

Body Mass Index (BMI):

To calculate the BMI, apply the following formula:

$$\text{BMI} = \frac{\textbf{weight in kg}}{\textbf{(length / height in m}^2\textbf{)}}$$

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14/03/03	9.5	H	136	
14/03/03	9.5	W	40	
14/03/03	9.5	BMI	21.6	

How to Calculate the Target Centile Range (TCR):

From age 2 years onwards, if every girl follows her genetic growth pattern, she should be growing within her Target Centile Range (TCR) parallel to one of the centile lines. If not, refer to specialist. To calculate her **TCR**, apply the following steps: measure father's and mother's heights (a & b), calculate the sum (c), their mean height (d), the corrected Mid-Parental Height (MPH) (e) and the Target Centile Range (f) as shown. Apply arrow (e) opposite the corrected **MPH**, and draw a vertical line above and below, opposite the TCR.

Guidelines for recording, plotting and referral:

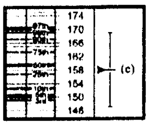
Record the measurements using the boxes included in this chart. Enter the date and the current age, specify the measurement in the box below the asterisk (i.e. H/C = Head circumference, L = Length, W – Weight, H = Height, BMI = Body mass index) and put your name. Plot each measurement on the curve with a well defined dot. Trace the growth curve with a line but leave the dots clearly visible. A normal growth curve is one that always runs roughly on, or parallel to one of the printed centile lines. If it doesn't, consider these guidelines:

Refer a girl whose height falls above the 97th or below the 3rd centile line or outside her Target Centile Range (TCR). Refer her, also if, in the pre-school age, her growth curve deviates upwards, or downwards, over a period of 12-18 months, by a width of one centile distance or, in the school age, by 2/3 of a centile distance.

Refer a girl whose Body Mass Index (**BMI**) equal or above 95th centile as obese, Girls with BMI equal or above the 85th centile but less than the 95th centile should be considered as overweight. Also, refer a girl whose BMI, falls below the 3rd centile as significantly underweight.

(a) – Father's height
(b) Mother's height
(c) Sum of (a) and (b)
(d) – (c) + 2
(e) = (d) - 7 cm = (MPH)
(f) = MPH ± 11 cm

(a) = 174 cm
(b) = 156 cm
(c) = 330 cm
(d) = 165 cm
(e) = 165 - 7 = 158 cm
(f) = 158 ± 11 cm



Acknowledgments:
The Egyptian Supreme Council of Universities, Foreign Relations Coordination Unit (FRCU) - Mendez England & Associates, Cairo - The Egyptian Ministry of Education - The Egyptian Participating Schools and Universities.

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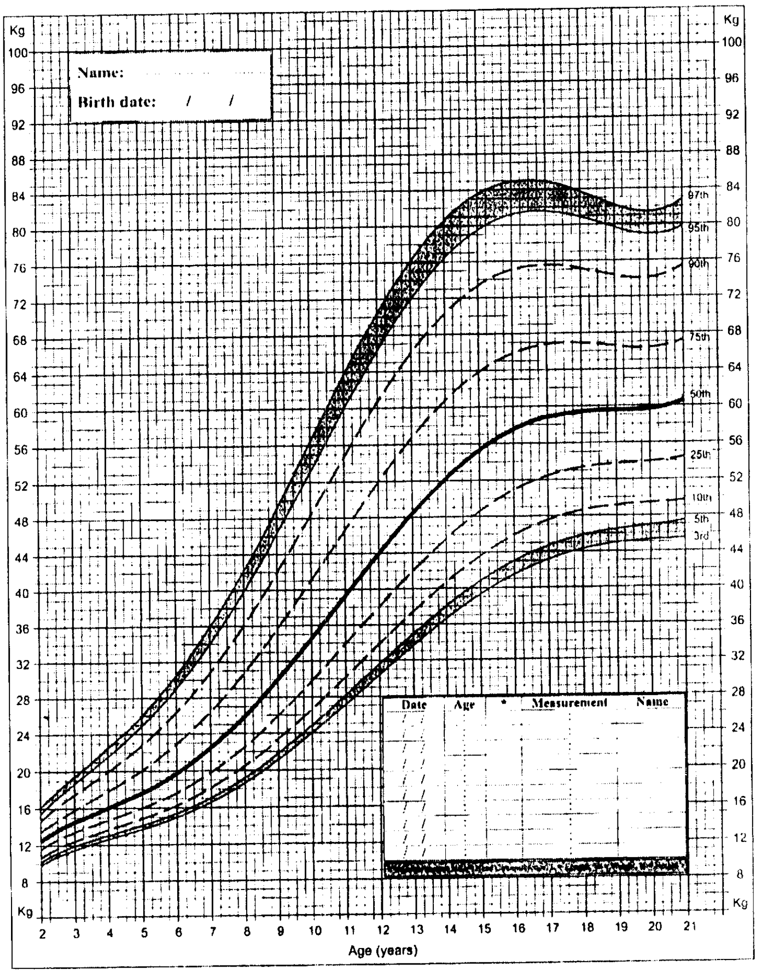
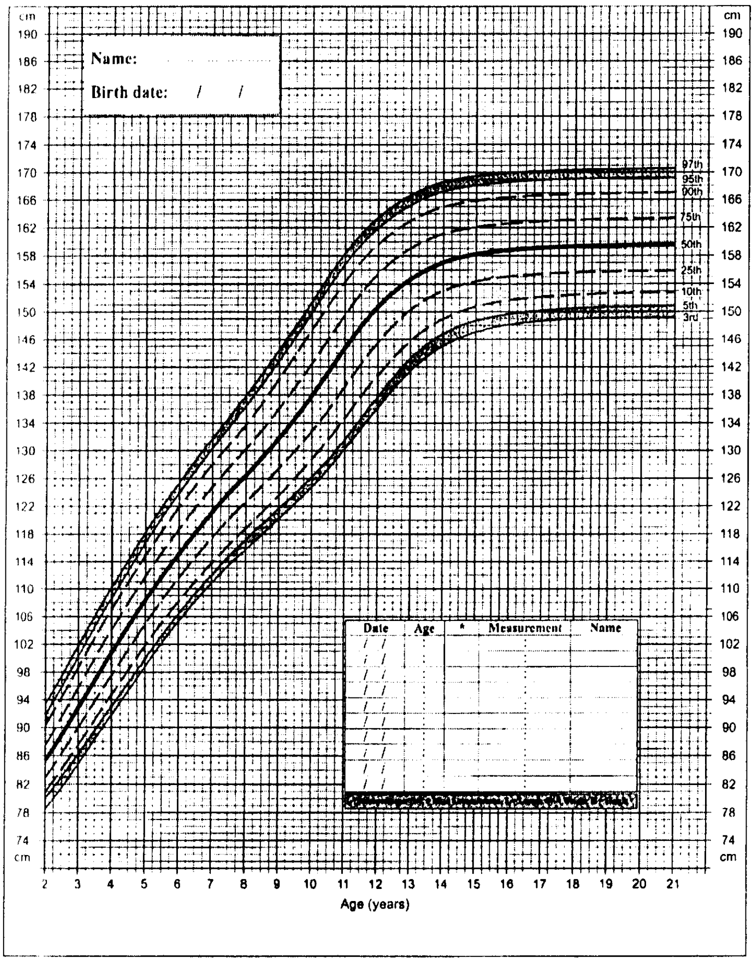
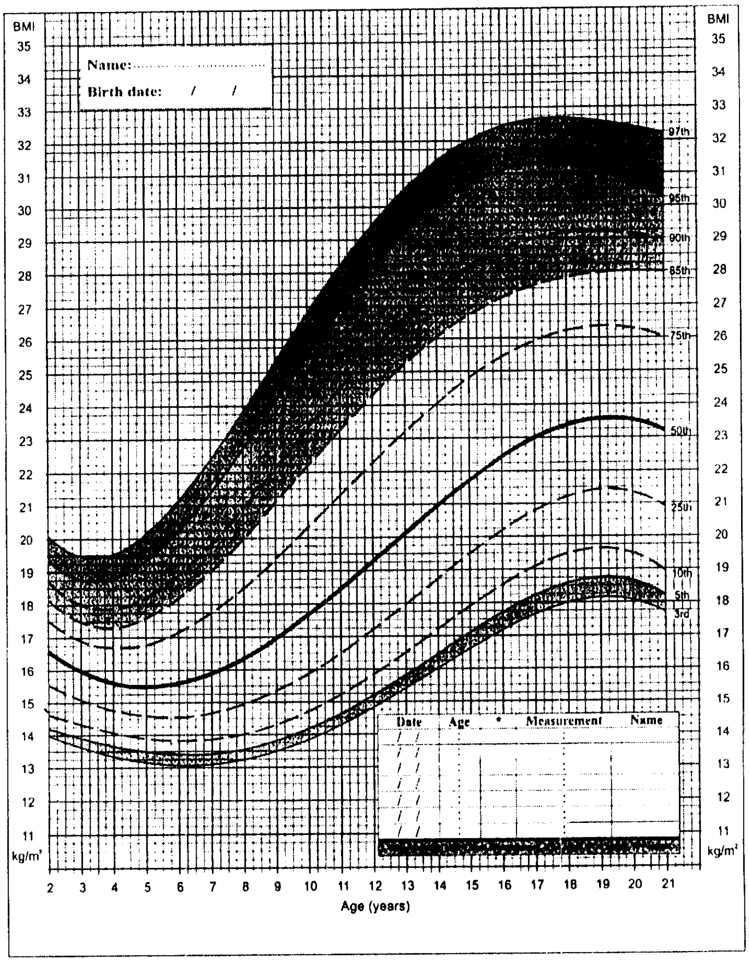
Weight-for-Age Percentiles: Egyptian Girls, 2 to 21 Years



Stature-for-Age Percentiles:
Egyptian Girls, 2 to 21 Years

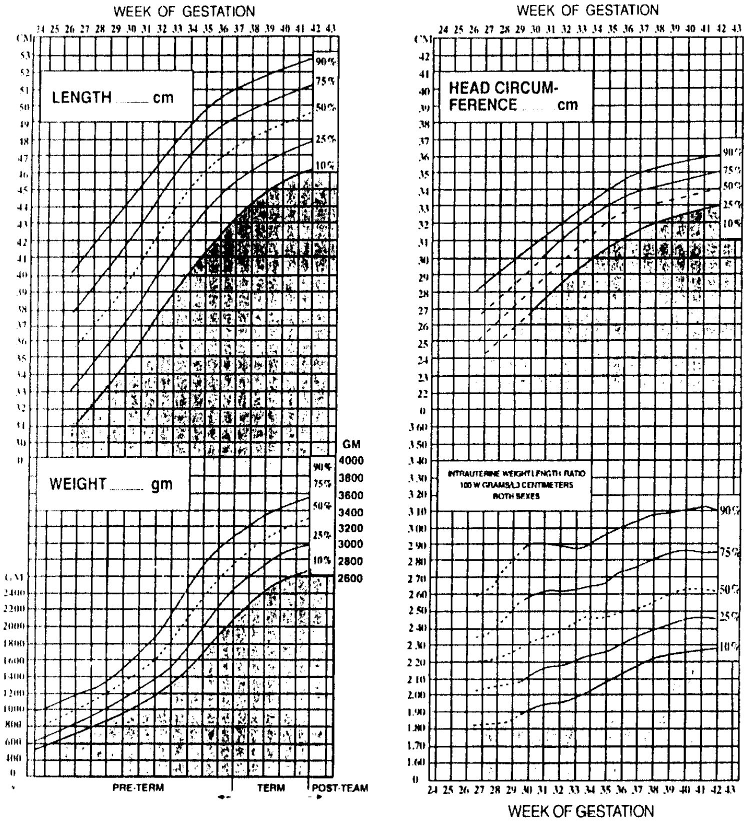


Body Mass Index-for-Age Percentiles: Egyptian Girls, 2 to 21 Years



APPENDIX (7): Birth charts

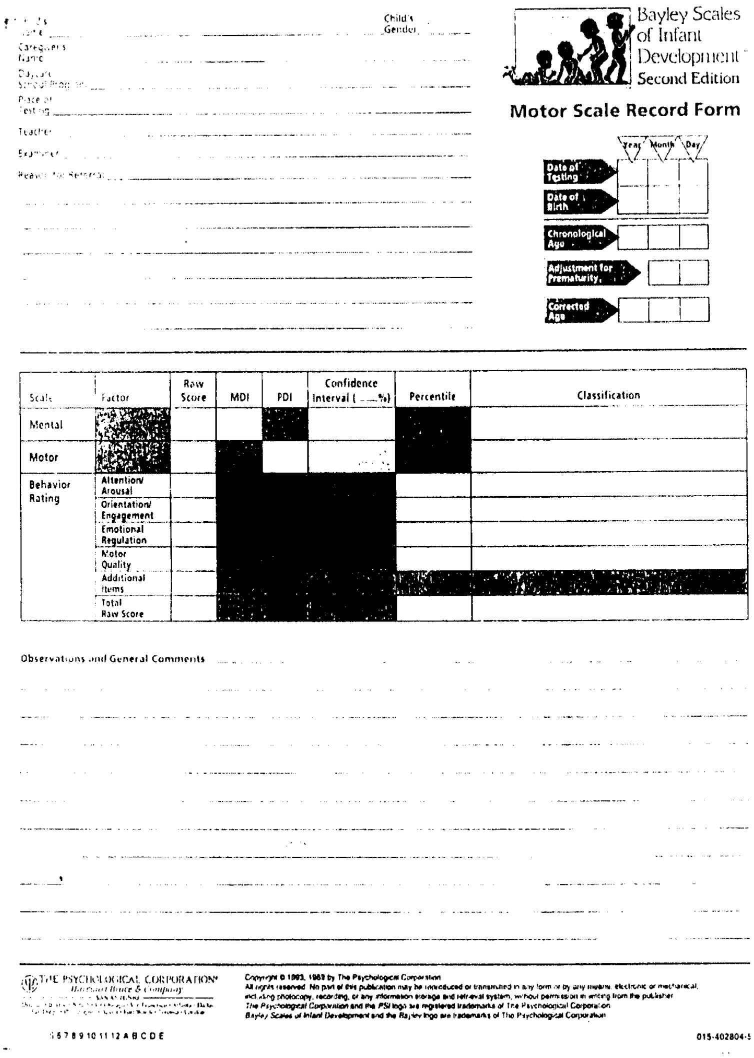
CLASSIFICATION OF NEWBORNS-
BASED ON MATURITY AND INTRAUTERINE GROWTH
Symbols: X-1st Exam O-2nd Exam



	1st Exam (X)	2nd Exam(O)
LARGE FOR GESTATIONAL AGE(LGA)		
APPROPRIATE FOR GESTATIONAL AGE(AGA)		
SMALL FOR GESTATIONAL AGE (SGA)		
Age at Exam	hrs	hrs
Signature of Examiner	M.D.	M.D.

Adapted from Lubchenco Lo. Hansman C and Boyd E: pediatr. 1966:37:403 Battaglia FC and Lubchenco L.O: J pediatr. 1967: 71:159

APPENDIX (8) Bayley scale-motor cont'



Child's Name
Child's Gender
Caregiver's Name
Daycare/School Program
Place of Testing
Teacher
Examiner
Reason for Referral

Bayley Scales of Infant Development
Second Edition

Motor Scale Record Form

	Year	Month	Day
Date of Testing			
Date of Birth			
Chronological Age			
Adjustment for Prematurity			
Corrected Age			

Scale	Factor	Raw Score	MDI	PDI	Confidence Interval (___%)	Percentile	Classification
Mental	▨			▨		▨	
Motor	▨		▨			▨	
Behavior Rating	Attention/ Arousal		▨	▨	▨		
	Orientation/ Engagement		▨	▨	▨		
	Emotional Regulation		▨	▨	▨		
	Motor Quality		▨	▨	▨		
	Additional Items		▨	▨	▨	▨	▨
	Total Raw Score		▨	▨	▨		

Observations and General Comments

THE PSYCHOLOGICAL CORPORATION®
Harcourt Brace & Company

5 6 7 8 9 10 11 12 A B C D E

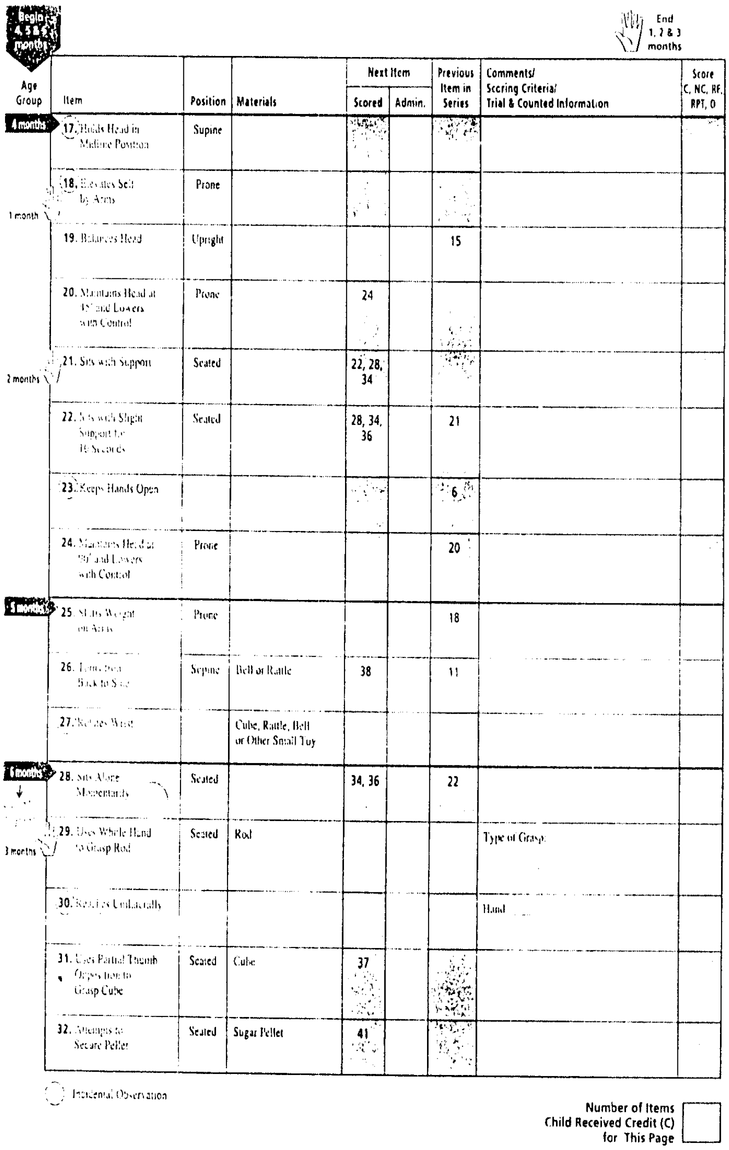
015-402804-5

Begin 1, 2 & 3 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin.	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
1 month	1. Thrusts Arms in Play	Supine						
	2. Thrusts Legs in Play	Supine						
	3. Lifts Head When Held at Shoulder	Supine		4, 5, 7	15			
	4. Holds Head Erect for 3 Seconds (Vertical Position)	Upright at Shoulder		5, 7		3		
	5. Adjusts Posture When Held at Shoulder	Upright at Shoulder		7		4		
	6. Hands are Fisted							
2 months	7. Holds Head Erect and Steady for 15 Seconds	Upright at Shoulder				5		
	8. Lifts Head (Dorsal Suspension)	Upright						
	9. Holds Legs Up for 2 Seconds	Supine						
	10. Makes Crawling Movements	Prone						
3 months	11. Turns from Side to Back	Supine						
	12. Attempts to Bring Hand to Mouth							
	13. Retains Ring	Supine	Ring with String					
	14. Adjusts Head to Ventral Suspension	Prone				8		
	15. Holds Head Steady While Being Moved	Upright at Shoulder				7		
	16. Displays Symmetric Movements	Supine						

○ Incidental Observation

Number of Items Child Received Credit (C) for This Page ☐



Begin 4, 5 & 6 months

End 1, 2 & 3 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin.	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
4 months	17. Holds Head in Midline Position	Supine						
1 month	18. Elevates Self by Arms	Prone						
	19. Balances Head	Upright				15		
	20. Maintains Head at 45° and Lowers with Control	Prone		24				
2 months	21. Sits with Support	Seated		22, 28, 34				
	22. Sits with Slight Support for 10 Seconds	Seated		28, 34, 36		21		
	23. Keeps Hands Open					6		
	24. Maintains Head at 90° and Lowers with Control	Prone				20		
5 months	25. Shifts Weight on Arms	Prone				18		
	26. Turns from Back to Side	Supine	Bell or Rattle	38		11		
	27. Rotates Wrist		Cube, Rattle, Bell or Other Small Toy					
6 months	28. Sits Alone Momentarily	Seated		34, 36		22		
3 months	29. Uses Whole Hand to Grasp Rod	Seated	Rod				Type of Grasp:	
	30. Reaches Unilaterally						Hand	
	31. Uses Partial Thumb Opposition to Grasp Cube	Seated	Cube	37				
	32. Attempts to Secure Pellet	Seated	Sugar Pellet	41				

○ Incidental Observation

Number of Items Child Received Credit (C) for This Page ☐

Begin 7 & 8 months

End 4, 5 & 6 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin.	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
	33. Pulls to Sitting Position	Supine		45				
	34. Sits Alone for 30 Seconds	Seated		36		28		
7 months 4 months	**35.** Sits Alone While Playing with Toy	Seated	Rabbit, Bell, Rattle or Other Small Toy			34		
	36. Sits Alone Steadily	Seated				35		
	37. Uses Pads of Fingertips to Grasp Cube	Seated	Cube			31		
	38. Turns from Back to Stomach	Supine	Bell or Rattle			26		
	39. Grasps Foot with Hands	Supine	Facial Tissue					
	40. Makes Early Stepping Movements	Standing			44			
5 months	**41.** Uses Whole Hand to Grasp Pellet	Seated	Sugar Pellet	49, 56		32		
8 months	**42.** Attempts to Raise Self to Sit	Supine	Bell or Rattle					
	43. Moves Forward Using Prewalking Methods	Seated	Bell or Rattle			25		
	44. Supports Weight Momentarily	Standing		46, 53		40		
	45. Pulls to Standing Position	Supine				33		
	46. Shifts Weight While Standing	Standing		53		44		
	47. Raises Self to Sitting Position	Supine	Bell or Rattle			42		
6 months	**48.** Brings Spoons or Cubes to Midline	Seated	2 Spoons or Cubes					

Number of Items
Child Received Credit (C)
for This Page [ ]

Begin 10, 11, 12, 13 & 14-16 months

End 7, 8, 9 & 10 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin.	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
9 months	49. Uses Partial Thumb Opposition to Grasp Pellet	Seated	Sugar Pellet	56		41		
	50. Raises Trunk While Sitting Alone	Seated	Bell			36	**Scoring Criterion:** 1 of 2 Trial 1 ___ 2___	
10 months 7 months	51. Moves from Sitting to Creeping Position	Seated	Bell			50		
	52. Raises Self to Standing Position	Supine	Bell or Rattle			47		
	53. Attempts to Walk	Standing		60, 61		46		
11 months	54. Walks Sideways While Holding on to Furniture	Standing				53		
	55. Sits Down	Standing						
	56. Uses Pads of Fingertips to Grasp Pellet	Seated	Sugar Pellet			49		
	57. Uses Partial Thumb Opposition to Grasp Rod	Seated	Rod			29		
12 months	58. Grasps Pencil at Farthest End	Seated	Pencil & Paper	70				
	59. Stand Up!	Seated		68		52		
8 months	60. Walks with Help	Standing		61, 62 63		54		
13 months	61. Stands Alone	Standing		62, 63		60		
9 months	62. Walks Alone	Standing		63		61	Number of Steps ___	
14-16 months	63. Walks Alone with Good Coordination	Standing	Any toy that interests child			62	Number of Steps _____	
10 months	64. Throws Ball	Standing	Ball					

Incidental Observation

Number of Items Child Received Credit (C) for This Page ☐

Begin 17-19, 20-22, 23-25 & 26-28 months

End 11, 12, 13 & 14-16 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
	65. Squats Briefly	Standing				55		
17-19 months	66. Walks Up Stairs with Help	Standing	Stairs & any toy that interests child	79	69			
	67. Walks Backward	Standing	Pull Toy			63	Number of Steps ____	
	68. Stands Up II	Standing				59		
11 months	69. Walks Down Stairs with Help	Standing	Stairs & any toy that interests child	80		66		
20-22 months	70. Grasps Pencil at Middle	Seated	Pencil & Paper	74, 75, 90		58		
	71. Walks Sideways	Standing	Pull Toy			67		
12 months	72. Stands on Right Foot with Help	Standing			82			
	73. Stands on Left Foot with Help	Standing			83	72		
	74. Uses Pads of Fingertips to Grasp Pencil	Seated	Pencil & Paper	75, 90		70		
23-25 months	75. Uses Hand to Hold Paper in Place	Seated	Pencil & Paper	90				
13 months	76. Places 10 Pellets in Bottle in 60 Seconds	Seated	12 Sugar Pellets, Bottle &			56	Number of Pellets	
	77. Runs with Coordination	Standing	Ball			71		
26-28 months	78. Jumps off Floor (Both Feet)	Standing	Jumping Rope					
14-16 months	79. Walks Up Stairs Alone, Placing Both Feet on Each Step	Standing	Stairs & any toy that interests child	95	80	69		
	80. Walks Down Stairs Alone, Placing Both Feet on Each Step	Standing	Stairs & any toy that interests child		81	79		

Incidental Observation

Number of Items Child Received Credit (C) for This Page ☐

Begin 29-31, 32-34, 35-37 & 38-42 months

End 17-19, 20-22, 23-25 & 26-28 months

Age Group	Item	Position	Materials	Next Item Scored	Next Item Admin.	Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, O
	81. Jumps from Bottom Step	Standing	Stairs			78		
17-19 months	**82.** Stands Alone on Right Foot	Standing				73		
	83. Stands Alone on Left Foot	Standing				82		
29-31 months	**84.** Walks Forward on Line	Standing	Tape Measure		85	77		
	85. Walks Backward Close to Line	Standing	Tape Measure			84		
20-22 months	**86.** Swings Leg to Kick Ball	Standing	Ball			83		
	87. Jumps Distance of 4 Inches	Standing	Tape Measure			78	**Scoring Criterion:** 1 of 3 Trials ≥ 4" Trial 1___ 2___ 3___	
32-34 months	**88.** Laces Three Beads	Seated	2 Shoe Strings & 8 Square Beads				Number of Beads _____	
	89. Walks on Tiptoe for Four Steps	Standing	Tape Measure	99		85	**Scoring Criterion:** 4 Steps Number of Steps _____	
	90. Grasps Pencil at Nearest End	Seated	Pencil & Paper	93		74		
35-37 months	**91.** Imitates Hand Movements	Seated			98		**Scoring Criterion:** 2 of 3 Trial 1___ 2___ 3___	
	92. Tactilely Discriminates Shapes	Seated	2 Pegs, 2 Cubes, 2 Square Pieces (from Blue Block Set) & Shield				**Scoring Criterion:** 2 of 3 Peg___ Cube___ Square___	
23-25 months	**93.** Manipulates Pencil in Hand	Seated	Pencil & Paper			90		
	94. Stands Up III	Standing				68		
	95. Walks Up Stairs, Alternating Feet	Standing	Stairs & any toy that interests child		108	80		
38-42 months	**96.** Copies Circle	Seated	Pencil & Paper		104			
26-28 months	**97.** Uses Eye-Hand Coordination in Tossing Ring	Standing	Rod, Pegboard & Ring (without String)					

Number of Items Child Received Credit (C) for This Page ☐

End 29-31, 32-34, 35-37 & 38-42 months

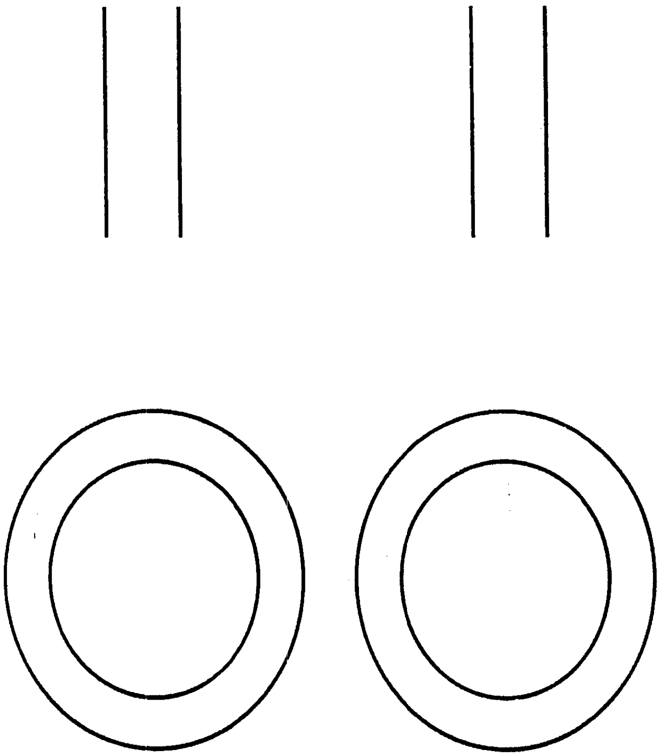
Age Group	Item	Position	Materials	Next Item		Previous Item in Series	Comments/ Scoring Criteria/ Trial & Counted Information	Score C, NC, RF, RPT, 0
				Scored	Admin.			
	98. Imitates Postures	Standing				91	**Scoring Criterion:** 2 of 3 Trial 1___ 2___ 3___	
	99. Walks on Tiptoe for 9 Feet	Standing	Tape Measure			89		
	100. Stops from a Full Run	Standing	Tape Measure				**Scoring Criterion:** 2 of 3 ≤ 2 Steps Steps needed to stop Trial 1___ 2___ 3___	
29-31 months	101. Buttons One Button	Seated	Button Sleeve					
	102. Stands Alone on Left Foot for 4 Seconds	Standing			103	83		
	103. Stands Alone on Right Foot for 4 Seconds	Standing				102		
	104. Copies Plus Sign	Seated	Pencil & Paper		111	96		
	105. Traces Designs	Seated	Tracing Sheet & Pencil			104	**Scoring Criterion:** 2 of 3 Square___ Circle___ Diamond___	
	106. Jumps Over Rope	Standing	Jumping Rope			87	**Scoring Criterion:** 8 inches 2 inches: Trial 1___ 2___ 4 inches: Trial 1___ 2___ 6 inches: Trial 1___ 2___ 8 inches: Trial 1___ 2___	
32-34 months	107. Hops Twice on One Foot	Standing	Tape Measure	110		103	Number of Hops ___	
	108. Walks Down Stairs, Alternating Feet	Standing	Stairs & any toy that interests child			95		
	109. Jumps Distance of 24 Inches	Standing	Tape Measure			106	**Scoring Criterion:** 1 of 3 ≥ 24" Inches: _____ Trial 1___ 2___ 3___	
	110. Hops Five Feet	Standing	Tape Measure			107	Distance: ___	
35-37 & 38-42 months	111. Copies Square	Seated	Pencil & Paper			105		

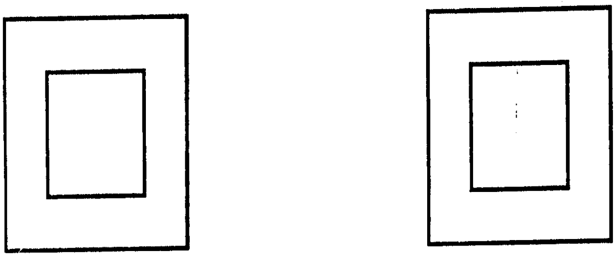
Number of Items Child Received Credit (C) ☐

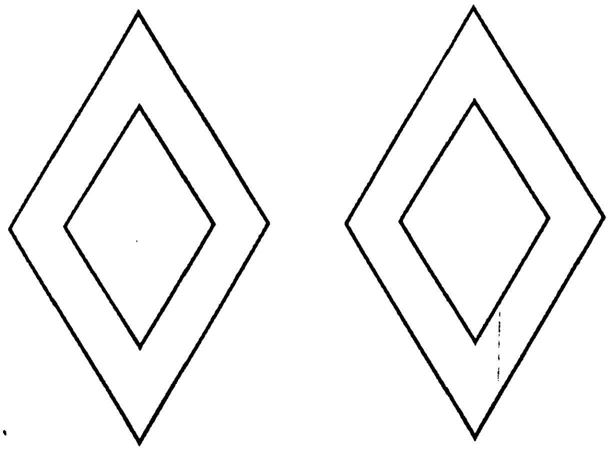
Developmental
Second Edition

Traces Design
Item 105

Child's Name: ______________________ Examiner's Name ______________________







APPENDIX (9): Bayley scoring system

9 Months 8 months 16 days–9 months 15 days

Table A.1. Index Score, Equivalents of Raw Scores

Index	Mental			Motor			Index
	Raw	Confidence Interval		Raw	Confidence Interval		
Score	Score	90%	95%	Score	90%	95%	Score
50	47	50-65	50-67	35	50-66	50-68	50
51	48	50-66	50-68	36	50-66	50-68	51
52	49	51-67	50-69	37	51-67	50-69	52
53	50	52-68	50-70	38	52-68	50-70	53
54	51	53-69	51-71	39	53-69	51-71	54
55	52	54-70	52-72	-	-	-	55
56	53	55-71	53-73	40	55-71	53-73	56
57	54	55-71	53-73	41	56-72	54-74	57
58	55	56-72	54-74	-	-	-	58
59	-	-	-	42	57-73	55-75	59
60	56	58-74	56-76	-	-	-	60
61	-	-	-	-	-	-	61
62	57	60-76	58-78	43	60-76	58-78	62
63	-	-	-	-	-	-	63
64	58	61-77	59-79	-	-	-	64
65	-	-	-	44	62-78	60-80	65
66	59	63-79	61-81	-	-	-	66
67	-	-	-	-	-	-	67
68	60	65-81	63-83	45	65-81	63-83	68
69	-	-	-	-	-	-	69
70	61	66-82	64-84	-	-	-	70
71	-	-	-	46	67-83	65-85	71
72	62	68-84	66-86	-	-	-	72
73	-	-	-	-	-	-	73
74	63	70-86	68-88	47	70-86	68-68	74
75	-	-	-	-	-	-	75
76	64	72-88	70-90	-	-	-	76
77	-	-	-	48	73-89	71-91	77
79	65	73-89	71-91	-	-	-	78
79	-	-	-	-	-	-	79
80	56	75-91	73-93	49	75-91	73-93	80
81	-	-	-	-	-	-	81
82	67	77-93	75-95	50	77-93	75-95	82
83	-	-	-	-	-	-	83
84	68	78-94	76-96	-	-	-	84
85	-	-	-	51	79-95	77-97	85
86	-	-	-	-	-	-	86
87	69	81-97	79-99	-	-	-	87
88	-	-	-	52	82-98	80-100	88
89	70	83-99	81-101	-	-	-	89
90	-	-	-	-	-	-	90
91	71	84-100	82-102	53	84-100	82-102	91
92	-	-	-	-	-	-	92
93	-	-	-	-	-	-	93
94	72	87-103	85-105	54	87-103	85-105	94
95	-	-	-	-	-	-	95
96	73	39-105	87-107	-	-	-	96
97	-	-	-	55	89-105	87-107	97
98	-	-	-	-	-	-	98
99	74	91-107	89-109	-	-	-	99

Table A.1 Index Score, Equivalents of Raw Scores *(continued)*

Index Score	Mental Raw Score	Mental Confidence Interval 90%	Mental Confidence Interval 95%	Motor Raw Score	Motor Confidence Interval 90%	Motor Confidence Interval 95%	Index Score
100	-	-	-	-	-	-	100
101	75	93-109	91-111	56	93-109	91-111	101
102	-	-	-	-	-	-	102
103	76	95-111	93-113	-	-	-	103
104	-	-	-	57	95-111	93-113	104
105	77	96-112	94-114	-	-	-	105
106	-	-	-	-	-	-	106
107	78	98-114	96-116	-	-	-	107
108	-	-	-	58	99-115	97-117	108
109	79	100-116	98-118	-	-	-	109
110	-	-	-	-	-	-	110
111	80	101-117	99-119	59	101-117	99-119	111
112	-	-	-	-	-	-	112
113	-	-	-	-	-	-	113
114	81	104-120	102-122	-	-	-	114
115	-	-	-	60	105-121	103-123	115
116	82	106-122	104-124	-	-	-	116
117	-	-	-	-	-	-	117
118	83	107-123	105-125	61	107-123	105-125	118
119	-	-	-	-	-	-	119
120	84	109-125	107-127	-	-	-	120
121	-	-	-	-	-	-	121
122	85	111-127	109-129	62	111-127	109-129	122
123	-	-	-	-	-	-	123
124	86	112-128	110-130	-	-	-	124
125	-	-	-	63	113-129	111-131	125
126	87	114-130	112-132	-	-	-	126
127	-	-	-	64	115-131	113-133	127
128	-	-	-	-	-	-	128
129	68	117-133	115-135	-	-	-	129
130	-	-	-	65	117-133	115-135	130
131	89	118-134	116-136	-	-	-	131
132	-	-	-	-	-	-	132
133	90	120-136	118-138	66	120-136	118-138	133
134	-	-	-	-	-	-	134
135	91	122-138	120-140	-	-	-	135
136	-	-	-	67	122-138	120-140	136
137	92	124-140	122-142	-	-	-	137
138	-	-	-	-	-	-	138
139	93	125-141	123-143	68	125-141	123-143	139
140	-	-	-	-	-	-	140
141	94	127-143	125-145	-	-	-	141
142	-	-	-	69	128-144	126-146	142
143	95	129-145	127-147	-	-	-	143
144	-	-	-	-	-	-	144
145	96	130-146	128-148	70	130-146	128-148	145
146	97	131-147	129-149	-	-	-	146
147	98	132-148	130-150	71	132-148	130-150	147
148	99	133-149	131-150	-	-	-	148
149	100	134-150	132-150	72	134-150	132-150	149
150	101	135-150	133-150	73	134-150	132-150	150

Table B.2. Raw Score Equivalents for Developmental Ages for the Mental and Motor Scales

Developmental Age in Months	Mental Scale	Motor Scale	Developmental Age in Months
<1	0-13	0-10	<1
1	14-21	11-14	1
2	22-31	15-21	2
3	32-40	22-27	3
4	41-51	28-32	4
5	52-60	33-37	5
6	61-65	38-43	6
7	66-70	44-50	7
8	71-74	51-55	8
9	75-77	56	9
10	78-80	57-60	10
11	81-86	61-63	11
12	87-90	64-66	12
13	91-93	67	13
14	94-97	68-69	14
15	98-101.	70-71	15
16	102-106	72-73	16
17	107-111	74-75	17
18	112-115	76	18
19	116-119	77	19
20	120-122	78	20
21	123-125	79-80	21
22	126-128	81-82	22
23	129-131	83	23
24	132-134	84-85	24
25	135-137	86-87	25
26	138-140	88-89	26
27	141-143	90-91	27
28	-	92	28
29	144-145	93	29
30	146-147	94	30
31	148	95	31
32	149-150	96	32
33	151	97	33
34	152	98	34
35	153-154	99	35
36	155-157	100	36
37-39	158-162	101-103	37-39
40-42	163-165	104-105	40-42
42+	166-178	106-111	42+

APPENDIX (10): Bayley tools

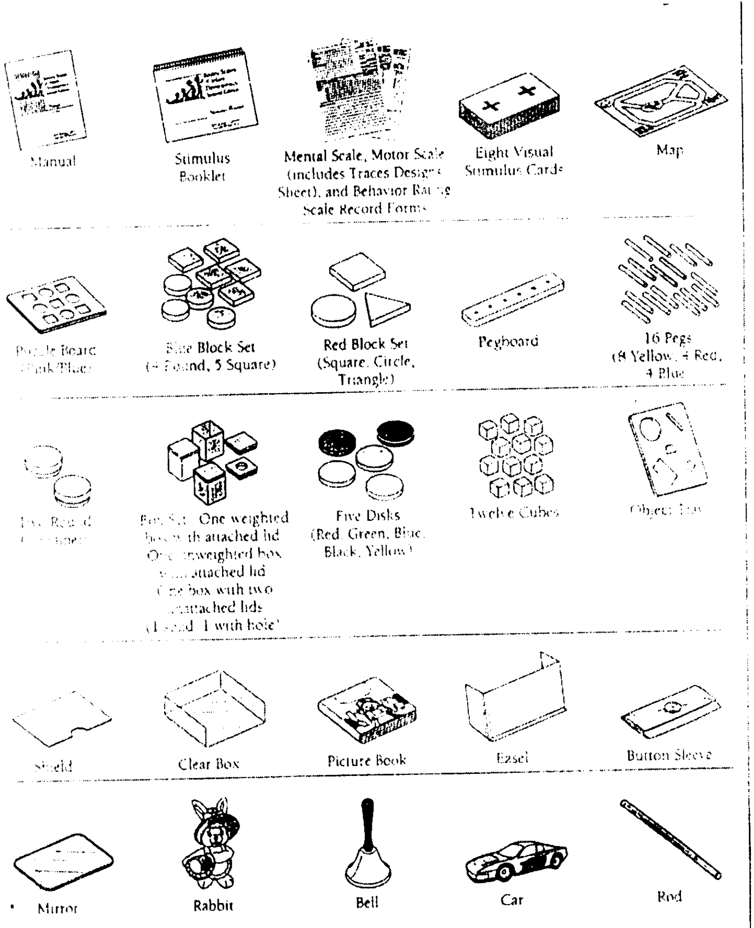
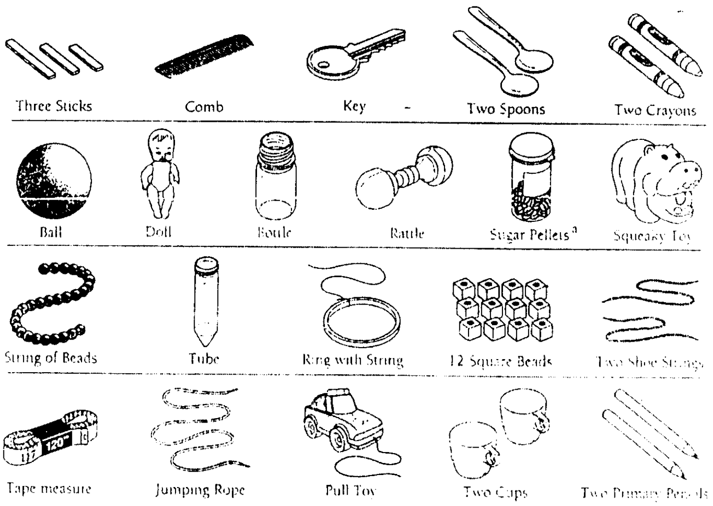


Figure 3.1. Test Materials



Additional required materials not provided in the test kit include:

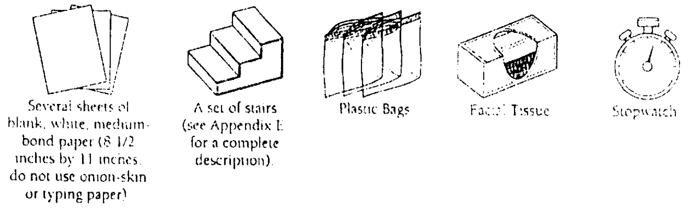


Figure 3.1. Test Materials *(continued)*

[a] The sugar pellets are commercially available candy that dissolve quickly. Inform the caregiver that you will attempt to keep the child from putting the pellet into his or her mouth but that if the child should ingest it, the pellet will dissolve and not harm the child.

APPENDIX (11): Raw data of full-term patients

Data form - Patient and maternal information for full-term

Case No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	F	3	Y	V	Y	V	N	N	N	N	N	N	N	N
2	F	3	Y	V	Y	V	N	N	N	N	N	N	N	N
3	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
4	M	3	Y	V	N	V	N	N	N	N	N	N	N	N
5	F	3	Y	V	N	V	N	N	N	N	N	N	N	N
6	M	3	Y	V	N	V	N	N	N	N	N	N	N	N
7	F	3	Y	V	N	V	N	N	N	N	Y	N	N	N
8	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
9	M	3	Y	V	N	C	N	N	N	N	N	N	N	N
10	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
11	M	3	Y	V	N	C	N	N	N	N	Y	N	N	N
12	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
13	M	3	Y	V	N	C	N	N	N	N	Y	N	N	N
14	M	3	Y	V	N	C	N	N	N	N	Y	N	N	N
15	M	3	Y	V	N	V	N	N	N	N	N	N	N	N
16	F	3	Y	V	N	V	N	N	Y	N	N	N	N	N
17	F	3	Y	V	N	V	N	N	N	N	N	N	N	N
18	M	3	Y	V	N	C	N	N	Y	N	N	N	N	N
19	M	3	Y	V	N	V	N	N	N	N	Y	N	N	N
20	M	3	Y	V	N	C	N	N	N	N	Y	N	N	N
21	F	3	Y	V	N	C	N	N	Y	N	Y	N	N	N
22	M	3	Y	V	N	V	N	N	N	N	N	N	N	N
23	F	3	Y	V	N	C	N	N	N	N	N	N	N	N
24	F	3	Y	V	N	C	N	N	N	N	N	N	N	N
25	F	3	Y	V	N	C	N	N	N	N	N	N	N	N
26	F	3	Y	V	N	C	N	N	Y	N	N	N	N	N
27	F	3	Y	V	N	C	N	N	Y	N	Y	N	N	N
28	M	3	N	B	N	C	N	N	Y	N	Y	N	N	N
29	M	3	N	B	N	C	N	N	N	N	N	N	N	N
30	M	3	Y	V	N	C	N	N	N	N	Y	N	N	Y
31	M	3	Y	V	N	C	N	N	Y	N	Y	N	N	N
32	M	3	Y	V	N	V	N	N	N	N	N	N	N	N

Data form - Patient and maternal information for full-term

Case No.	15	16	17	18	19	20	21	22	23	24	25
1	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	Y	N	N	N	N	N	N	N
9	N	N	Y	N	N	N	N	N	N	N	N
10	N	N	Y	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N
20	Y	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	Y	N
22	N	N	N	Y	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	Y	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N
30	Y	N	N	N	N	Y	N	N	N	Y	N
31	Y	N	Y	N	Y	N	N	N	N	N	N
32	N	N	N	N	N	N	N	N	N	N	N

Data form - Admission and resuscitation information for full-term

No.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
1	0	40	3.1	50	35	S	Y	N	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
2	0	40	3.6	50	35	S	Y	Y	N	Y	Y	Y	N	P	1	1	N	Y	N	5	9
3	0	40	3.02	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
4	0	40	3.3	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	8
5	0	40	3.75	50	35	S	Y	N	N	N	Y	Y	N	P	1	1	N	Y	N	7	9
6	0	40	3.9	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
7	0	40	3.49	49	35	S	Y	Y	N	N	N	N	N	P	5	5	Y	Y	N	2	6
8	0	38	3.8	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
9	0	38	3.9	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
10	0	38	4.15	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
11	0	38	3	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
12	0	38	3	49	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	7	9
13	0	38	4.75	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	8
14	0	40	3.5	50	35	S	Y	N	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
15	0	40	3.3	49	34.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	5	10
16	0	40	3	49	34.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
17	0	40	3.34	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
18	0	40	3.6	50	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
19	0	38	3	48	34	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	7	9
20	0	37	3.4	48	34.5	S	Y	Y	N	Y	Y	Y	N	P	1	1	N	Y	N	4	8
21	0	38	3.3	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
22	0	37	4.11	48	34	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	5	8
23	0	37	3.5	49	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	5	9
24	0	39	4.25	51	35.5	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
25	0	38	3.5	50	35	S	Y	N	N	N	Y	N	N	P	1	1	N	Y	N	6	9
26	0	37	2.7	48	34.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
27	0	40	3.71	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
28	1	37	2.75	48	34.5	S	Y	Y	N	Y	Y	N	N	P	1	1	N	Y	N	6	9
29	0	41	4.3	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
30	0	37	2.75	50	35	S	Y	Y	N	N	Y	Y	N	P	1	5	N	Y	N	6	9
31	0	38	4.25	50	35	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
32	0	37	2.6	48.5	34.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9

Data form - Initial examination data for full-term

Case No.	47	48	49	50	51	52	53	54	55	56	57	58	59
1	36.2	97	138	60	Y	Y	Y	Y	N	4	N	Y	N
2	36	95	144	65	Y	Y	Y	Y	N	5	N	Y	N
3	36.5	92	125	60	Y	Y	Y	Y	N	4	N	Y	N
4	36	94	141	80	Y	Y	Y	Y	N	5	N	Y	N
5	36	95	140	60	Y	Y	Y	Y	N	4	N	Y	N
6	36	96	138	60	Y	Y	Y	Y	N	4	N	Y	N
7	35	95	110	100	Y	Y	Y	Y	N	8	N	Y	N
8	36.7	96	128	72	Y	Y	Y	Y	N	5	N	Y	N
9	36.3	97	139	66	Y	Y	Y	Y	N	4	N	Y	N
10	36.5	99	138	60	Y	Y	Y	Y	N	4	N	Y	N
11	36.8	95	120	70	Y	Y	Y	Y	N	4	N	Y	N
12	36.5	100	136	65	Y	Y	Y	Y	N	4	N	Y	N
13	36.6	97	136	80	Y	Y	Y	Y	N	6	N	Y	N
14	36	99	130	60	Y	Y	Y	Y	N	4	N	Y	N
15	36.5	100	130	60	Y	Y	Y	Y	N	4	N	Y	N
16	37	99	129	70	Y	Y	Y	Y	N	4	N	Y	N
17	36.8	100	148	60	Y	Y	Y	Y	N	4	N	Y	N
18	35.5	90	131	68	Y	Y	Y	Y	N	4	N	Y	N
19	35	90	102	62	Y	Y	Y	Y	N	4	N	Y	N
20	35	96	126	62	Y	Y	Y	Y	N	6	N	Y	N
21	36.2	98	141	65	Y	Y	Y	Y	N	4	N	Y	N
22	36.8	100	130	64	Y	Y	Y	Y	N	6	N	Y	N
23	36	100	131	60	Y	Y	Y	Y	N	4	N	Y	N
24	35	95	126	62	Y	Y	Y	Y	N	4	N	Y	N
25	36.9	99	133	101	Y	Y	Y	Y	N	4	N	Y	N
26	35.5	92	118	65	Y	Y	Y	Y	N	5	N	Y	N
27	36.5	95	120	67	Y	Y	Y	Y	N	5	N	Y	N
28	36.2	94	121	95	Y	Y	Y	Y	N	6	N	Y	N
29	36.8	94	144	64	Y	Y	Y	Y	N	6	N	Y	N
30	35.5	94	115	62	Y	Y	Y	Y	N	4	N	Y	N
31	36.2	95	125	65	Y	Y	Y	Y	N	4	N	Y	N
32	36	93	126	60	Y	Y	Y	Y	N	5	N	Y	N

Data form - Initial examination data for full-term

Case No.	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y
3	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
7	N	N	N	N	Y	N	Y	N	Y	Y	Y	Λ	Λ	Λ	N
8	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y
18	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y
30	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
32	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N

Data form - Mechanical ventilation, O_2 Supply data and diagnosis for full-term

Case No.	75	76	77	78	79
1	N	0	1	N	1
2	N	0	2	N	1
3	N	0	3	N	1
4	N	0	3	N	1
5	N	0	1	N	1
6	N	0	3	N	1
7	Y	3	3	N	1
8	N	0	4	N	6
9	N	0	1	N	6
10	N	0	2	N	6
11	N	0	3	N	1
12	N	0	7	N	1
13	N	0	4	N	1
14	N	0	1	N	1
15	N	0	2	N	1
16	N	0	3	N	1
17	N	0	3	N	1
18	N	0	2	N	1
19	N	0	4	N	1
20	Y	9	5	Y	2
21	N	0	2	N	1
22	N	0	2	N	6
23	N	0	2	N	1
24	N	0	1	N	1
25	N	0	2	N	1
26	N	0	1	N	1
27	N	0	2	N	1
28	Y	7	3	N	2
29	N	0	1	N	1
30	N	0	1	N	1
31	Y	2	4	N	1
32	N	0	2	N	1

Bayley scale (mental and motor scores) and anthropometric data at the age of 6 months

No.	R.S	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centile	cm	Centile	Centile
1	59	92	5	39	97	6	6	25	65	50	42	50	10
2	65	105	6	40	100	6	8.5	99	68	75	45	95	85
3	66	107	7	39	97	6	7.5	90	68	75	43	75	50
4	66	107	7	36	88	5	8.25	90	70	75	43	50	50
5	63	100	6	41	104	6	7	75	68	75	42	50	25
6	61	96	6	40	100	6	7.5	75	68	50	44	75	40
7	57	88	5	32	< 50	4	7	75	65	50	43	75	50
8	68	111	7	42	108	6	7.25	60	69	60	44	75	15
9	54	82	5	36	88	5	9.35	97	69.5	75	44.5	80	90
10	69	113	7	38	94	6	8	95	66	65	44.5	95	90
11	63	100	6	43	111	6	7.75	75	66	30	43	50	75
12	64	102	6	39	97	6	7.8	90	69	80	44	90	50
13	64	102	6	36	88	5	8	85	65	25	44.5	80	90
14	65	105	6	48	126	7	7.25	60	70	75	44	75	10
15	64	102	6	37	91	5	9	97	70	75	45	90	80
16	63	100	6	36	88	5	8.25	97	68	75	43	75	75
17	57	88	5	42	108	6	6.25	40	65	50	42.5	65	20
18	63	100	6	42	108	6	7.25	70	69	70	45	90	20
19	47	83	4	23	66	3	8	97	67	75	43.5	90	75
20	59	92	5	41	104	6	6.25	40	63	25	42	50	25
21	55	84	5	31	73	4	7.5	70	65	10	43	40	75
22	61	96	6	38	94	6	7	50	63	10	45	90	75
23	53	80	5	32	76	4	6.25	20	60	3	40.5	5	75
24	58	90	5	35	85	5	6.5	40	65	20	41.5	15	25
25	62	98	6	39	97	6	5.8	15	61	3	41.5	15	25
26	63	100	6	38	94	6	5	5	61	3	41.5	15	3
27	67	109	7	39	97	6	6.75	50	64	15	41.5	40	50
28	70	116	7	41	104	6	7.8	90	64	50	44	90	95
29	57	88	5	35	85	5	7.6	75	69	65	44	75	30
30	61	96	6	39	97	6	7.6	75	69	70	43.5	70	35
31	66	107	7	37	91	5	8.25	90	67	50	43.5	60	80
32	62	98	6	36	88	5	8.75	95	69	70	44	75	85

Bayley scale (mental and motor scores) and anthropometric data at the age of 12 months

No	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centil	cm	Centil	Centile
1	90	107	12	67	109	13	7.8	15	72	40	44	40	20
2	93	113	13	66	105	12	11	95	76	75	47	95	90
3	92	111	13	65	101	12	10.5	90	76	75	45	70	80
4	91	109	13	63	93	11	11.5	90	78	75	45.5	50	90
5	90	107	12	67	109	13	9	75	76	75	44.5	50	35
6	87	99	12	65	101	12	10.25	70	76	50	46.5	75	70
7	84	90	11	62	< 50	11	10	80	74	50	45.5	75	80
8	93	113	13	67	109	13	10	60	76	50	46.5	75	50
9	82	86	11	62	89	11	12	95	78	75	47	80	95
10	95	117	14	64	97	12	11	95	76	75	47	95	95
11	88	102	12	68	113	14	10.6	75	75	40	45.5	50	90
12	91	109	13	65	101	12	10.25	70	78	80	45.5	80	60
13	95	117	14	66	105	12	10.5	90	73.5	50	45.5	80	95
14	89	105	12	63	93	11	10.7	75	73	25	46.5	75	97
15	94	115	14	68	113	14	9.7	50	80	85	46.5	75	25
16	88	102	12	64	97	12	12.7	97	78	75	47.5	90	112
17	89	105	12	69	117	14	11	95	76	75	45.5	75	95
18	90	107	12	66	105	12	8.75	40	73	50	45.5	70	50
19	93	113	13	68	113	14	10	60	77	70	47	85	55
20	89	105	12	65	101	12	11.5	90	77	65	46.5	75	95
21	91	109	13	67	109	13	10.5	90	75	65	45.5	80	90
22	94	115	14	66	105	12	9.7	50	74	35	46	65	75
23	86	96	11	65	101	12	8.35	20	72	35	44	40	40
24	94	115	14	67	109	13	12.5	97	80	90	46.5	90	85
25	90	107	12	66	105	12	11.7	102	76	75	46.5	90	107
26	89	105	12	63	93	11	9.8	80	75	65	45.5	80	75
27	87	99	12	64	97	12	9.25	55	72	35	46.5	90	80
28	99	127	15	72	129	16	9.5	50	76	55	46	60	50
29	91	109	13	67	109	13	11.6	95	77.5	70	46	65	80
30	90	107	12	64	97	12	9.75	55	76	55	44.5	25	55
31	91	109	13	69	117	14	10.25	70	75.5	50	45.5	50	90
32	93	113	13	66	105	12	9.25	45	75	45	45.5	50	50

Bayley scale (mental and motor scores) and anthropometric data at the age of 18 months

No.	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centile	cm	Centile	Centile
1	119	113	19	76	103	18	9.25	10	81	60	45.5	40	10
2	119	113	19	77	107	19	13	95	82	75	48.5	95	97
3	119	113	19	77	107	19	12	80	81	60	46.5	70	90
4	117	109	19	74	95	17	13.5	85	86	80	47	50	90
5	118	111	19	79	115	21	11.5	70	83	80	46.5	65	70
6	114	103	18	77	107	19	12.25	65	83	70	48	75	75
7	110	95	17	73	91	16	11.75	75	80	50	47	80	90
8	120	115	20	78	111	20	11.75	50	83	70	48	75	65
9	108	91	17	73	91	16	14	90	83	65	48.5	80	112
10	122	119	20	76	103	18	13	90	82	75	48	90	97
11	116	107	19	79	115	21	12.5	75	81	40	47	50	95
12	120	115	20	77	107	19	11	80	82	75	47	80	60
13	123	121	21	78	111	20	11.8	75	80	50	47	75	80
14	116	107	19	75	99	17	12	60	80	40	48	75	90
15	122	119	20	81	123	22	11.75	50	86	80	48	75	40
16	116	107	19	76	103	18	14	90	84	75	48.5	85	105
17	121	117	20	82	127	22	12.5	80	82	60	46.5	60	90
18	116	107	19	80	119	21	11	50	80	55	46.5	70	75
19	118	111	19	79	115	21	12	60	84	75	48.5	80	65
20	119	113	19	76	103	18	13	80	83	65	48	75	95
21	122	119	20	78	111	20	12.25	80	80	55	47	80	95
22	122	119	20	78	111	21	11.5	45	80	40	47.5	60	85
23	112	99	18	77	107	19	10	20	78	35	45.5	45	55
24	123	121	21	77	107	19	13.35	95	86	90	48	90	90
25	115	105	18	77	107	19	12.6	85	81.5	70	48.5	95	97
26	117	109	19	75	99	17	11.3	65	81	65	47	80	75
27	111	97	17	74	95	17	10.7	40	78.5	40	48	90	80
28	120	115	20	82	127	22	11	40	81.5	50	47.5	60	55
29	116	107	19	78	111	20	12.5	70	83	65	47.5	60	85
30	120	115	20	75	99	17	11.4	45	82	55	46	25	70
31	118	111	19	80	119	21	11.75	55	81	45	47	50	85
32	119	113	19	78	111	20	11	40	81	45	47	50	60

Bayley scale (mental and motor scores) and anthropometric data at the age of 24 months

No	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Lengt
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centil	cm	Centile	cm	Centile	Centile
1	142	118	27	86	107	25	10.5	10	86	60	46.5	40	15
2	140	114	26	87	110	25	14.5	90	89	75	49.5	95	97
3	139	112	26	87	110	25	13.25	75	86	60	47.5	65	90
4	139	112	26	84	100	24	14.5	75	91	75	48	50	90
5	141	116	27	89	117	26	12.75	60	88	80	48	75	70
6	135	104	25	87	110	25	13.25	50	88	70	49	75	75
7	131	96	23	82	92	22	13	70	86	60	48	75	85
8	142	118	27	89	117	26	12.75	45	88	70	49	75	60
9	131	96	23	83	96	23	15	80	88	65	49.5	80	104
10	143	120	27	86	107	25	14.5	90	87	75	49	90	104
11	139	112	26	89	117	26	13.25	50	88	50	48	50	75
12	143	120	27	88	113	26	13.25	75	88	80	48	75	80
13	145	124	29	89	117	26	13	70	85	50	48	75	90
14	138	110	26	85	103	24	13	50	85	40	49	75	90
15	145	124	29	90	121	27	13	50	90	80	49	75	50
16	136	106	25	85	103	24	15	80	88	70	49.5	85	104
17	141	116	27	93	132	29	13.25	75	86	60	47.5	60	90
18	139	112	26	91	125	27	12	40	85	50	48	75	70
19	140	114	26	90	121	27	13	45	88	70	49.5	80	70
20	140	114	26	86	107	25	14.25	70	88	70	49	75	90
21	142	118	27	87	110	25	13	70	85	50	48.5	85	90
22	142	118	27	89	117	26	12.5	40	85	40	48.5	65	75
23	135	104	25	86	107	25	11.5	25	84	40	46.5	35	65
24	142	118	27	87	110	25	14.8	90	90	85	49	90	97
25	137	108	25	86	107	25	13.25	75	86.5	70	49.5	95	90
26	135	104	25	84	100	24	12.75	60	85	55	48	75	85
27	131	96	23	83	96	23	12	40	83.5	40	49	90	80
28	141	116	27	90	121	27	12.5	40	86.5	50	48.5	65	65
29	140	114	26	87	110	25	13.75	65	87.5	65	48.5	60	90
30	140	114	26	84	100	24	12.9	45	86	50	47	25	80
31	138	110	26	89	117	26	13.25	50	86	50	48	50	85
32	142	118	27	87	110	25	12.5	40	85.5	45	48	50	75

APPENDIX (12) : Raw data of preterm patients

Data form - Patient and maternal information for preterm

Case No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
33	F	3	Y	V	N	C	N	N	N	N	N	N	N	Y
34	F	3	Y	B	N	C	N	N	N	Y	N	N	N	N
35	M	3	Y	V	N	C	N	N	N	Y	Y	N	N	N
36	F	3	Y	V	N	C	N	N	N	N	N	N	N	N
37	M	3	Y	V	N	C	N	N	Y	N	N	N	N	N
38	M	3	Y	V	Y	C	N	N	N	N	Y	N	N	N
39	M	3	Y	V	N	C	N	N	N	Y	N	N	N	N
40	M	3	Y	V	N	C	N	N	N	Y	N	N	N	N
41	M	3	Y	V	Y	C	N	N	N	N	N	N	N	Y
42	F	3	Y	V	N	V	N	N	N	N	N	N	N	N
43	M	3	Y	V	Y	C	N	N	N	N	N	N	N	N
44	M	3	Y	V	N	C	N	N	N	N	Y	N	N	N
45	M	3	Y	V	N	C	N	N	Y	N	Y	N	N	N
46	F	3	Y	V	Y	V	N	N	Y	N	N	N	N	N
47	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
48	F	3	Y	V	N	C	N	N	N	N	Y	N	N	N
49	M	3	Y	V	N	C	N	N	N	N	Y	N	N	Y
50	F	3	Y	V	Y	C	N	N	N	N	Y	N	N	N
51	F	3	Y	V	N	C	N	N	Y	N	Y	N	N	N
52	M	3	Y	V	N	C	N	N	N	N	N	N	N	N

Data form - Patient and maternal information for preterm

Case No.	15	16	17	18	19	20	21	22	23	24	25
33	Y	N	N	N	N	N	N	N	N	Y	N
34	N	N	N	N	N	N	N	N	N	N	N
35	N	N	N	N	N	N	N	N	N	N	N
36	N	N	N	N	N	N	N	N	N	N	N
37	N	N	Y	N	N	N	N	N	N	N	N
38	Y	N	N	N	N	Y	N	N	N	N	Y
39	N	Y	N	N	N	N	N	N	N	N	N
40	N	Y	N	N	N	N	N	N	N	N	N
41	Y	N	N	N	N	N	N	N	N	N	N
42	N	N	N	N	N	N	N	N	N	N	N
43	N	N	N	N	N	N	N	N	N	N	N
44	N	N	N	N	N	N	N	N	N	Y	N
45	Y	N	N	N	N	N	N	N	N	N	N
46	N	N	Y	Y	N	N	N	N	N	N	N
47	N	N	N	N	N	N	N	N	N	N	N
48	Y	N	N	N	N	N	N	N	N	Y	N
49	Y	N	Y	N	N	N	N	N	N	N	N
50	N	N	N	N	N	N	N	N	N	N	N
51	N	N	N	N	N	N	N	N	N	N	N
52	N	N	N	N	N	N	N	N	N	N	N

Data form - Admission and resuscitation information for preterm

No.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
33	4	36	2.85	49	35	S	Y	N	N	N	Y	Y	N	P	1	1	N	N	N	7	9
34	0	36	2.5	47	33.5	T	Y	N	N	N	Y	Y	N	P	1	1	N	Y	N	7	9
35	0	36	2.5	47	34	T	Y	N	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
36	0	35	2.25	46	33	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	8
37	0	34	2.25	46	33	S	Y	Y	N	Y	Y	Y	N	P	1	1	N	Y	N	3	7
38	0	32	1.6	46	33	S	Y	Y	N	Y	Y	Y	N	P	5	5	N	Y	N	2	8
39	0	32	1.27	45.5	32.5	T	Y	Y	N	Y	Y	N	N	P	1	1	N	Y	N	2	5
40	0	32	1.39	46	33	T	Y	Y	N	Y	Y	Y	N	P	5	5	N	Y	N	4	7
41	0	34	1.57	46.5	33.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
42	0	36	3.5	49	35	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	7	9
43	0	34	2.45	46	33	S	Y	Y	N	N	Y	N	N	P	5	5	N	Y	N	6	8
44	2	36	3	48	34	S	Y	Y	N	Y	Y	Y	N	P	1	1	N	Y	N	6	9
45	0	32	1.24	45.5	32.5	S	Y	Y	N	Y	Y	N	N	P	1	1	N	Y	N	2	9
46	0	32	1.9	46	33.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	5	7
47	0	36	1.8	46.5	33.5	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
48	0	36	2.85	47.5	34	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	2	9
49	0	36	3.15	48	34	S	Y	Y	N	N	Y	N	N	P	1	1	N	Y	N	6	9
50	0	36	2.1	47	34	S	Y	Y	N	N	N	N	N	P	1	1	N	Y	N	6	9
51	0	36	2.63	48	34	S	Y	Y	N	N	Y	Y	N	P	1	1	N	Y	N	6	9
52	0	36	3.4	47.5	34	S	Y	N	N	N	Y	N	N	P	1	1	N	Y	N	7	9

Data form - Initial examination data for preterm

Case No.	47	48	49	50	51	52	53	54	55	56	57	58	59
33	35.5	99	128	60	Y	N	Y	Y	N	4	N	Y	N
34	36	97	132	60	Y	Y	Y	Y	N	4	N	Y	N
35	36.2	99	128	64	Y	Y	Y	Y	N	4	N	Y	N
36	35	93	132	66	Y	Y	Y	Y	N	5	N	Y	N
37	35.9	95	125	60	Y	Y	Y	Y	N	6	N	Y	N
38	35.8	92	127	65	Y	Y	Y	Y	N	6	N	Y	N
39	35	94	160	65	Y	Y	Y	Y	N	6	N	Y	N
40	35	99	149	65	Y	Y	Y	Y	N	5	N	Y	N
41	35	99	126	60	Y	Y	Y	Y	N	4	N	Y	N
42	36	96	142	64	Y	Y	Y	Y	N	4	N	Y	N
43	36.2	95	128	86	Y	Y	Y	Y	N	6	N	Y	N
44	36.8	99	127	64	Y	Y	Y	Y	N	4	N	Y	N
45	36	99	120	60	Y	Y	Y	Y	N	6	N	Y	N
46	36	99	153	65	Y	Y	Y	Y	N	5	N	Y	N
47	35	100	138	60	Y	Y	Y	Y	N	4	N	Y	N
48	36.2	95	133	65	Y	Y	Y	Y	N	4	N	Y	N
49	35	95	118	68	Y	Y	Y	Y	N	4	N	Y	N
50	35	90	120	60	Y	Y	Y	Y	N	4	N	Y	N
51	36.3	98	131	60	Y	Y	Y	Y	N	4	N	Y	N
52	36.3	99	107	80	Y	Y	Y	Y	N	5	N	Y	N

Data form - Initial examination data for preterm

Case No.	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
33	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
34	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
35	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
36	N	N	N	N	N	Y	Y	N	N	N	N	N	A	A	N
37	N	N	N	N	Y	N	Y	N	N	Y	N	A	A	A	N
38	N	N	N	N	Y	N	Y	N	N	Y	N	A	A	A	N
39	N	N	N	N	Y	N	Y	N	N	Y	N	A	A	A	N
40	N	N	N	N	Y	N	Y	N	N	Y	N	A	A	A	N
41	N	N	N	N	N	Y	Y	N	N	Y	N	A	A	A	N
42	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
43	N	N	N	N	Y	N	Y	N	N	Y	N	A	A	A	N
44	N	N	N	N	Y	N	N	N	N	Y	N	A	A	A	N
45	N	N	N	N	Y	N	Y	N	N	N	N	A	A	A	N
46	N	N	N	N	Y	N	Y	N	N	N	N	A	A	A	N
47	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
48	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
49	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
50	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
51	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
52	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N

Data form - Mechanical ventilation, O_2 Supply data and diagnosis for preterm

Case No.	75	76	77	78	79
33	N	0	2	N	1
34	Y	1	5	Y	2
35	N	0	9	N	2
36	N	0	2	N	6
37	N	0	1	N	1
38	N	0	2	N	1
39	N	0	1	N	1
40	N	0	2	N	1
41	N	0	1	N	1
42	N	0	2	N	1
43	N	0	2	N	1
44	N	0	1	N	1
45	N	0	2	N	1
46	N	0	2	N	1
47	N	0	1	N	1
48	Y	7	3	N	2
49	N	0	1	N	1
50	N	0	1	N	1
51	Y	2	4	N	1
52	N	0	2	N	1

Bayley scale (mental and motor scores) and anthropometric data at the age of 6 months

No.	R.S	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centile	cm	Centile	Centile
33	63	100	6	40	100	6	8	95	67	70	43	75	80
34	60	94	5	32	76	4	6	25	65	25	42.5	35	5
35	59	92	5	41	104	6	7	75	65	50	41	25	50
36	62	98	6	38	94	6	7	55	66	35	43.5	70	45
37	67	109	7	39	97	6	5.5	10	63	25	40.5	20	7
38	59	92	5	39	97	6	5.5	15	64	35	41.5	40	3
39	65	105	6	40	100	6	8.75	102	70	65	44	90	80
40	64	102	6	42	108	6	8	95	71.5	75	44	90	35
41	65	105	6	40	100	6	8.8	95	73	75	46	97	50
42	62	98	6	38	94	6	8.5	99	71.5	75	44	90	55
43	59	92	5	35	85	5	6.5	50	64	40	42	50	45
44	61	96	6	35	85	5	7	75	66	60	43.5	80	45
45	65	105	6	43	111	6	7.25	80	64	40	44	90	80
46	64	102	6	41	104	6	6.8	60	64.5	40	44	90	55
47	64	102	6	41	104	6	7.25	60	69	70	44.5	80	20
48	70	116	7	46	120	7	7	50	67.5	50	43.5	65	25
49	65	105	6	41	104	6	9	97	66	75	43.5	65	99
50	65	105	6	34	82	5	7.7	75	68	55	41.5	20	50
51	63	100	6	38	94	6	8.25	90	67.5	50	43	50	80
52	65	105	6	41	104	6	7.3	65	66	35	43	50	50

Bayley scale (mental and motor scores) and anthropometric data at the age of 12 months

No	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centile	cm	Centile	Centile
33	92	111	13	66	105	12	10.7	95	76	75	46	85	70
34	87	99	12	67	109	13	8.5	30	72	40	44.5	50	40
35	86	96	11	68	113	14	10	60	72	15	45.5	50	90
36	87	99	12	64	97	12	9	50	70	20	47	95	85
37	81	84	11	61	81	11	9	40	69	5	43.5	10	90
38	85	93	11	62	89	11	9	40	72	20	44.5	25	60
39	88	102	12	65	101	12	8	15	69	5	44	15	50
40	89	105	12	64	97	12	7.5	10	69.5	5	44	15	25
41	92	111	13	65	101	12	9.5	50	73	25	45	40	75
42	86	96	11	62	89	11	10	60	77	65	46.5	75	60
43	90	107	12	67	109	13	10.5	75	77	70	46	65	75
44	88	102	12	65	101	12	11	85	75	50	46	60	95
45	86	96	11	62	89	11	8	20	73	25	45	40	7
46	88	102	12	67	109	13	9.8	75	75.5	60	43.5	25	70
47	94	115	14	64	97	12	7.5	10	72	35	43.5	30	10
48	96	120	14	70	121	15	10.75	90	76	75	46	85	90
49	96	120	14	67	109	13	11.6	90	77.5	70	48	95	75
50	88	102	12	64	97	12	8.4	25	72	35	44.5	55	45
51	100	129	15	68	113	14	9.8	75	72	35	46	85	90
52	96	120	14	70	121	15	10	65	77	65	46.5	75	55

Bayley scale (mental and motor scores) and anthropometric data at the age of 18 months

No.	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Lengt
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centil	cm	Centile	Centile
33	120	115	20	77	107	19	12	80	82	75	47.5	85	80
34	116	107	19	77	107	19	10.25	25	79	40	46	50	50
35	116	107	19	78	111	20	11.5	50	79	25	47	50	90
36	113	101	18	75	99	17	11	50	77	25	48	90	90
37	106	87	16	72	87	16	10.5	30	76	10	45.5	15	85
38	110	95	17	74	95	17	11	40	79	25	46	25	75
39	115	105	18	77	107	17	10	20	77	10	46	25	55
40	116	107	19	75	99	17	10	20	77	10	46	25	50
41	120	115	20	76	103	18	11.5	40	79	25	46.5	40	70
42	114	103	18	74	95	17	12.25	65	83	65	47.5	70	80
43	115	105	18	78	111	20	12	60	84	75	47.5	65	70
44	111	97	17	76	103	18	12.75	75	82	55	47.5	65	95
45	114	103	18	74	95	17	10.25	25	80	40	46.5	40	40
46	118	111	19	77	107	19	11.25	60	80	55	45.5	35	75
47	121	117	20	76	103	18	9.25	10	78	35	45.5	40	25
48	123	121	21	80	119	21	12	80	81.5	70	47.5	85	90
49	125	125	21	79	115	21	12.25	65	83	70	49.5	95	80
50	115	105	18	77	107	19	9.75	20	77.5	40	46	55	55
51	126	127	22	78	111	20	11.25	60	77.5	35	47.5	85	90
52	122	119	20	81	123	22	11.5	45	83	65	48	75	60

Bayley scale (mental and motor scores) and anthropometric data at the age of 24 months

No	R.S.	Development					Growth						
		Mental			Motor		Weight		Length		H.C.		wt/Length
		MDI	D.A.	R.S.	PDI	D.A.	KG	Centile	cm	Centile	cm	Centile	Centile
33	141	116	27	87	110	25	13.5	80	87	75	48.5	85	90
34	142	118	27	88	113	26	11.5	25	84	45	47	50	50
35	142	118	27	89	116	26	13	45	84	25	48	50	90
36	135	104	25	85	103	24	12.5	50	80	25	49	90	97
37	128	90	22	82	92	22	11.75	25	81	10	46.5	20	85
38	130	94	23	83	96	23	12	30	84	25	47	20	70
39	138	110	26	87	110	25	11.75	25	82	15	47	25	75
40	137	108	25	85	103	24	11.75	20	81	10	47	25	75
41	142	118	27	86	107	25	12.5	40	85	30	47.5	40	75
42	136	106	25	84	100	24	13.25	50	88	70	48.5	70	75
43	138	110	26	87	110	25	13	45	88	70	48.5	65	70
44	134	102	24	87	110	25	14	70	87	55	48.5	65	95
45	137	108	25	84	100	24	11.75	25	85	40	47.5	40	20
46	138	110	26	87	110	25	12.5	55	85	50	46.5	40	80
47	142	118	27	86	107	25	11.5	25	83	35	46.5	40	60
48	144	122	29	89	117	26	13	70	86	65	48.5	85	85
49	143	120	27	89	117	26	13.5	60	88	70	50	97	80
50	135	104	25	86	107	25	11.5	25	83.5	40	47	50	65
51	142	118	27	87	110	25	12.5	60	83.5	35	48.5	85	90
52	142	118	27	89	117	26	13	45	85.5	70	49	75	85

ARABIC SUMMARY

الملخص العربي

تعد أمراض الجهاز التنفسي التي تصيب الأطفال حديثي الولادة بإجهاد في التنفس من أكثر الأسباب شيوعاً لدخول هؤلاء الأطفال إلى وحدات رعاية حديثي الولادة. وتكثر أعراض الإجهاد في التنفس في هذه الحالات كما تطول فترة احتياج هؤلاء الأطفال إلى الأكسجين المساعد مما قد يؤثر على النمو والتطور في هؤلاء الأطفال.

ومع التقدم المضطرد في وحدات رعاية الأطفال حديثي الولادة زاد عدد الأطفال القابلين للإعاشة وظهور بعض المضاعفات التي قد تؤدى إلى خلل في نمو وتطور هؤلاء الأطفال. وتتباين هذه المضاعفات أو ذلك الخلل من وحدة إلى أخرى ومن بلد إلى آخر.

الهدف من البحث:

هدفت هذه الدراسة إلى معرفة تأثير ودرجة الإجهاد في التنفس التي تصيب الأطفال حديثي الولادة على النمو الجسماني ومستوى التطور الذهني لديهم.

تصميم وطرق البحث:

اشتملت هذه الدراسة على ٥٢ مريضاً من الأطفال المصابين بإجهاد في التنفس فور الولادة من مرضى وحدة الرعاية المركزة للأطفال حديثي الولادة بإحدى المستشفيات الخاصة.

وقد تمت دراستهم على هيئة مجموعتين:

المجموعة الأولى: اشتملت على ٣٢ طفلاً من الأطفال حديثي الولادة كاملي النمو والذين يعانون من إجهاد في التنفس بدرجات متفاوتة.

المجموعة الثانية: اشتملت على ٢٠ طفلاً غير مكتملي النمو ويعانون من إجهاد في التنفس بدرجات متفاوتة.

تعددت أسباب الإجهاد في التنفس نتيجة أمراض مختلفة مثل سرعة التنفس المؤقت لدى حديثي الولادة، متلازمة الضيق التنفسي، ارتفاع الضغط الرئوي أو الالتهاب الرئوي.

وتم قياس درجة الإجهاد في التنفس لدى هؤلاء الأطفال باستخدام مقياس سيلفرمان.

كما تم تحديد معايير وخصائص لانتقاء هذه الحالات وكذلك معايير أخرى لاستبعاد الحالات التي لا تتناسب مع طبيعة البحث.

وفى بداية الدراسة تم عمل الآتي لجميع الحالات التي خضعت للدراسة:

- أخذ تاريخ مرضى كامل للأمهات قبل وأثناء وبعد الولادة.
- أخذ تاريخ مرضى كامل للأطفال أثناء وبعد الولادة.
- فحص طبي شامل لجميع الأطفال.

بالإضافة إلى متابعة المرضى خلال فترة الحجز بوحدة الرعاية المركزة للأطفال حديثي الولادة لتحديد التشخيص المطابق لإصابتهم بإجهاد في التنفس.

وبعد خروج الحالات من المستشفى تمت متابعة الأطفال خلال السنتين الأوليين من العمر حسب جدول زمني عند ٦، ١٢، ١٨ ثم ٢٤ شهراً بعد الولادة. وخلال كل زيارة تم عمل الآتي لجميع الأطفال:

- تحديد مقاييس النمو الجسماني (الوزن - الطول - محيط الرأس) ومقارنة هذه المقاييس بمنحنى النمو المصري.
- قياس التطور الذهني والحركي عن طريق مقياس بيلى لتطور وارتقاء الطفل.

وقد أظهرت النتائج إصابة معظم هؤلاء الأطفال بدرجة متوسطة من الإجهاد في التنفس حسب مقياس سيلفرمان. وكان السبب الرئيسي لأعراض إجهاد التنفس هو حالات سرعة التنفس المؤقت لدى حديثي الولادة.

ومن نتائج الدراسة احتياج نسبة ١٩,٢% من الأطفال في عينة البحث إلى أجهزة التنفس الصناعي التقليدية. وكان متوسط الفترة الزمنية لاحتياج هؤلاء الأطفال لأجهزة التنفس الصناعي أو للأكسجين المساعد - أعلى في الأطفال غير مكتملي النمو. وأثبتت الدراسة وجود علاقة ذات دلالة إحصائية بين الاحتياج إلى أجهزة التنفس الصناعي ومقياس سيلفرمان لدرجة الإجهاد في كلا المجموعتين.

وأظهرت الدراسة وجود زيادة في مقاييس النمو لدى هؤلاء الأطفال - كلا المجموعتين - في خلال الزيارات الأربعة بنسب اختلاف ذات دلالة إحصائية - وذلك حسب العمر الزمني لأطفال المجموعتين. وكان هناك اختلاف ذو دلالة إحصائية عالية لمعدل التغير في مقاييس النمو عند الأطفال غير مكتملي النمو مقارنة بالأطفال مكتملي النمو خلال الزيارات الأربعة.

وأثبتت العلاقات الإحصائية المختلفة بين مقاييس النمو لدى الأطفال في كلا المجموعتين وكل من مقياس سيلفرمان واستخدام أجهزة التنفس الصناعي والفترة الزمنية لهذا الاستخدام وكذلك الفترة الزمنية لاستخدام الأكسجين المساعد - أثبتت عدم وجود علاقة أو دليل قاطع على تأثير هذه العوامل على مقاييس النمو لدى الأطفال في كلا المجموعتين.

وكذلك فقد كان هناك ارتفاع ملحوظ في معدل التغير في مقاييس بيلى لارتقاء الطفل المتمثلة في المقياس الذهني والحركي لدى الأطفال المصابين بإجهاد في التنفس سواء مكتملي النمو أو غير مكتملي النمو بعد تصحيح العمر الرحمي - وذلك خلال الزيارات الأربعة.

كما لم تثبت وجود علاقة بين مقاييس ببيلى لدى هؤلاء الأطفال في كلا المجموعتين وكل من مقياس سيلفرمان واستخدام أجهزة التنفس الصناعي والفترة الزمنية لهذا الاستخدام.

وعلى ضوء نتائج الدراسة فقد استنتجنا عدم وجود دليل قاطع على تأثير الإصابة بإجهاد التنفس في الأطفال مكتملي وغير مكتملي النمو - على كل من مقاييس النمو الجسماني أو مقاييس ببيلى لمهارات التطور الذهني والحركي عند هؤلاء الأطفال.

المستخلص العربى

تعد أمراض الجهاز التنفسى التى تصيب الأطفال حديثى الولادة بإجهاد فى التنفس من أكثر الأسباب شيوعاً لدخول هؤلاء الأطفال إلى وحدات رعاية حديثى الولادة، وتكثر أعراض الإجهاد فى التنفس فى هذه الحالات كما تطول فترة احتياج هؤلاء الأطفال إلى الأكسجين المساعد مما قد يؤثر على النمو والتطور فى هؤلاء الأطفال.

تهدف هذه الدراسة إلى معرفة تأثير ودرجة الإجهاد فى التنفس التى تصيب الأطفال حديثى الولادة على النمو الجسمانى ومستوى التطور الذهنى لديهم.

اشتملت هذه الدراسة على ٥٢ مريضاً من الأطفال المصابين بإجهاد فى التنفس فور الولادة من مرضى وحدة الرعاية المركزة للأطفال حديثى الولادة بإحدى المستشفيات الخاصة.

وقد تمت دراستهم على هيئة مجموعتين :

المجموعة الأولى: اشتملت على ٣٢ طفلاً من الأطفال حديثى الولادة كاملى النمو والذين يعانون من إجهاد فى التنفس بدرجات متفاوتة.

المجموعة الثانية: اشتملت على ٢٠ طفلاً غير مكتملى النمو (الخدج) ويعانون من إجهاد فى التنفس بدرجات متفاوتة

تعددت أسباب الإجهاد فى التنفس نتيجة أمراض مختلفة مثل سرعة التنفس المؤقت لدى حديثى الولادة، متلازمة الضيق التنفسى، ارتفاع الضغط الرئوى أو الإلتهاب الرئوى. وتم قياس درجة الإجهاد فى التنفس لدى هؤلاء الأطفال باستخدام مقياس سيلفر مان.

تمت متابعة الأطفال خلال السنتين الأولبين من العمر حسب جدول زمنى عند ٦ ، ١٢، ١٨ ثم ٢٤ شهراً بعد الولادة، وخلال كل زيارة تم عمل الآتى لجميع الأطفال:

- تحديد مقاييس النمو الجسمانى (الوزن – الطول – محيط الرأس) ومقارنة هذه المقاييس بمنحنى النمو المصرى.
- قياس التطور الذهنى والحركى عن طريق مقياس بييلى لتطور وارتقاء الطفل.

وأظهرت الدراسة وجود زيادة فى مقاييس النمو لدى هؤلاء الأطفال – كلا المجموعتين – فى خلال الزيارات الأربعة بنسب اختلاف ذات دلالة إحصائية – وذلك حسب العمر الزمنى لأطفال المجموعتين. وكان هناك اختلاف ذو دلالة إحصائية عالية لمعدل التغير فى مقاييس النمو عند الأطفال غير مكتملى النمو مقارنة بالأطفال مكتملى النمو خلال الزيارات الأربعة.

وكذلك فقد كان هناك ارتفاع ملحوظ فى معدل التغير فى مقاييس بييلى لارتقاء الطفل المتمثلة فى المقياس الذهنى والحركى لدى الأطفال المصابين بإجهاد فى التنفس سواء مكتملى النمو أو غير مكتملى النمو بعد تصحيح العمر الرحمى – وذلك خلال الزيارات الأربعة.

وعلى ضوء نتائج الدراسة فقد استنتجنا عدم وجود دليل قاطع على تأثير الإصابة بإجهاد التنفس فى الأطفال مكتملى وغير مكتملى النمو – على كل من مقاييس النمو الجسمانى أو مقاييس بييلى لمهارات التطور الذهنى والحركى عند هؤلاء الأطفال.

الكلمات الكاشفة : النمو ● التطور العصبى ● الخدج ● كاملى النمو ● متابعة ● النتيجة المحصلة ● إجهاد التنفس ● مقياس بييلى.

شكر

أشكر السادة الأساتذة الذين قاموا بالإشراف وهم:

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صفحة العنوان: دراسة ومتابعة النمو والتطور في الأطفال حديثي الولادة المصابين بإجهاد في التنفس

اسم الطالب: مجدي عبد العزيز عبد الخالق

الدرجة العلمية: دكتوراه الفلسفة في دراسات الطفولة

القسم التابع لها: قسم الدراسات الطبية

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سنة المنح: ٢٠٠٧

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موافقة مجلس الجامعة
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معهد الدراسات العليا للطفولة
قسم الدراسات الطبية

دراسة ومتابعة النمو والتطور فى الأطفال حديثى الولادة المصابين بإجهاد فى التنفس

رسالة مقدمة من

الطبيب/ مجدى عبد العزيز عبد الخالق
بكالوريوس الطب والجراحة وماجستير طب الأطفال

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