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Research Article

Assessment of Some Cognitive Disorders in Preterm Infants

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Abstract

Globally, prematurity is a major cause of death and a significant cause of long-term loss of human potential amongst survivors all around the world. Complications of preterm birth are the single largest direct cause of neonatal deaths, responsible for 35% of the world's 3.1 million deaths a year in almost all countries with reliable data. Preterm birth rates are increasing. An estimated 15 million babies are born too early every year. That is more than 1 in 10 babies. Almost 1 million children die each year due to complications of preterm birth. In addition to its significant contribution to mortality, the effect of preterm birth amongst some survivors may continue throughout life, impairing neuro developmental functioning through increasing the risk of cerebral palsy, learning impairment and visual disorders and affecting long-term physical health with a higher risk of non-communicable disease. The aim of this work is to assess the effect of prematurity on cognitive development in preterm infants at the first year of life and to evaluate the difference between preterm and full term regarding this development. This could help to maximize neurological development and reduce long term cognitive and behavioral problems. Forty -three premature infants (26 female and 17 male) were studied. Twenty-five full term infants of matched age and sex were included in the study as controls. All patients were neurologically free on clinical examination. Anthropometric measurement of patients were recorded at 3, 6, 9, 12 months old and included weight, recumbent length and head circumference. The Griffiths development scale was used to assess the cognitive and psychomotor development status of the infants. They covered locomotor skills, personal/social skills, hearing/speech, eye-hand coordination, and cognitive performance .Total intellectual quotients (IQ %) were calculated. The IQ of the studied patients at three months ranged from 61-132% (mean 103.63±14.90), at six months ranged from 51-140% (mean 112.43±22.10), at nine months 40-141% (mean 115.56 ± 27.92) and at twelve months ranged from 95-140% (mean 130.64 ± 14.06). Performance was the most affected parameter in preterm infants, also there was positive correlation between gestational age and IQ % at 6 and12 months, no correlation was found between IQ% and head circumference and IQ% at 6 and 12 months was higher than at 3 and 9 months in preterm infants.

Conclusion: Preterm infants have lower IQ scores than full term ones but this delay seems to resolve gradually with age, and at the end of the first year of life they become equal. In spite of the technological advances in neonatology and increased survival of preterm infants, there are still knowledge gaps in this area.

Introduction

Preterm birth is a childbirth occurring at less than 37 completed weeks or 259 days of gestation [1]. Preterm birth is a major challenge in prenatal health care. Most prenatal deaths occur in preterm infants, and preterm birth is an important risk factor for neurological impairment and disability. Preterm birth not only affects infants and their families [2]. Global incidence in 2010, almost 15 million infants were born prematurely worldwide. That is over one in ten babies born. South Asia and sub-Saharan Africa account for 60% of premature births, whilst the USA and Brazil are placed amongst the top ten countries with the highest premature birth rate with 517,000 and 279,300 premature births in 2010 [3]. Preterm delivery is not disease with a fixed set of outcome. Rather preterm delivery increases the risk of adverse outcomes they are also seen in term infant as respiratory distress syndrome -absorptive, digestive difficulties -hypoglycemia -hypocalcaemia -neonatal jaundice cognitive disorders [4]. Cognitive disorders is cognitive scores 1-2 standard deviations below the mean. Poor cognitive aptitude can lead to poor academic, and poor executive functioning [5]. Several antenatal factors have been associated with cognitive impairment, mostly related to social disadvantage. Fewer years of education, lack of antenatal care, steroid exposure, maternal smoking during pregnancy and preeclampsia also affect it [6]. More than three-quarters of premature babies can be saved with feasible, cost-effective care - e.g. antenatal steroid injections (given to pregnant women at risk of preterm labor to strengthen the babies' lungs), kangaroo mother care (the baby is carried by the mother with skin-to-skin contact and frequent breastfeeding) and antibiotics to treat newborn infections - even without the availability of neonatal intensive care. To reduce preterm birth rates, women -especially adolescents - need better access to family planning and increased empowerment, as well as improved care before, between and during pregnancies [7].

Patients and Methods

This randomized controlled clinical study included 43 premature infants, admitted and attended to pediatric departments of Qena university hospital, South Valley University and Nag Hammady hospital, ministry of health. They were assessed at birth, 3, 6, 9 and at 12 months old, and 25 full term infants as a control group matched with age and sex. The patients were classified into groups according to social status into low, medium and high socioeconomic status according to Fahmy & El-Sherbini [8]. All patients were neurologically free on clinical examination. Patients with congenital anomalies, special dysmorphic feature, or patients taken medicine known to influence cognitive development as anti epileptic drugs were excluded from the study. Anthropometric measurement of patients were recorded at 3, 6, 9, 12 months old and included weight, recumbent length and head circumference. The Griffiths development scale translated and standardized for the Egyptian reference population (version 1989), were used to assess the cognitive and psychomotor development status of the infants. They covered locomotor skills, personal/social skills, hearing/ speech, eye - hand coordination, and cognitive performance. Total intellectual quotients (IQ%) were calculated by dividing the number of items successfully executed by the infants age (in months) [9]. The study was done after a written consent from the parents, and under the approval of Ethics Committee of Qena University Hospital.

Statistical Analysis

The study data were statistically analyzed using the Statistical Package for Social version program (SPSS program-version 17.0 - SPSS Inc., Chicago, IL. USA). The difference between cases and control as regards quantitative variables was done using ANOVA, F test and Kruskal Wallis. For testing association between categorized variables chi square and Monte Carlo were used. Pearson's correlation test was done to study possible correlation between quantitative variables. Statistical significance was assessed at P<0.05. All calculated P values were two-tailed.

Results

Table 1: Demographic information of the studied group.

	Preterm Infants (n=43)		Control (n=25)		Tests	
					X^2 or t	*P*-value
Age						
Range	32-36		38-43		13.140	<0.001*
Mean±SD	35.14±1.37		39.88±1.54			
Sex						
Female	26(38.2%)		7(10.3%)		6.671	<0.05*
Male	17(25.0%)		18(26.5%)			
Incubation						
Range	1-39		2-4		2.286	<0.05*
Mean± SD	12.13±7.90		3±1.15			
Single or Twin or Triplet						
Single	25	36.8	21	30.9	6.004	<0.05*
Twine	12	17.6	4	5.9		
Triplet	6	8.8	0	0.0		
Feeding						
Breast	9	13.2	16	23.5	13.186	<0.001*
Formula	13	19.1	2	2.9		
Mixed	21	30.9	7	10.3		
Labor						
CS	22	32.4	19	27.9	4.074	<0.05*
Norma vaginal delivery	21	30.9	6	8.8		

Maternal Medical Condition						
Good	39	57.4	24	35.3	0.652	NS
Preeclampsia	4	5.9	1	1.5		
History of recurrent infection	21	30.9	4	5.9	7.332	<0.05*
History of steroid exposure	4	5.9	2	2.9	0.033	NS
History of blood transfusion	4	5.9	0	0.0	2.471	NS
Iron intake	18	26.5	4	5.9	4.831	<0.05*
Social Class						
Low	4	5.9	1	1.5	0.960	NS
Medium	14	20.6	7	10.3		
High	25	36.8	17	25.0		

Table 2: Mean±SD locomotor development in studied preterm infants and controls.

Locomotor	Groups					
	Preterm Infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	T	P-value
At 3 month	43	7.14±1.21	25	10.58±1.77	9.449	<0.001*
At 6 month	40	14.8±2.32	25	18.76±2.45	6.544	<0.001*
At 9 month	32	22.09±3.59	25	28.44±2.69	7.367	<0.001*
At 12 month	11	32.18±4.29	25	34.76±2.3	2.359	<0.05*

Table 1 & Table 2 showed the Mean±SD locomotor development in studied group. It was found that there was highly statistical significant difference with P<0.001 in locomotor development at 3, 6 and 9 months old in preterm infants compared to control group. At 12 months the difference was statistically significant with P<0.05 between preterm infants with Mean±SD of 32.18±4.29 and control group with mean±SD of 34.76±2.30.

Table 3: Mean± SD Personal -social development in studied preterm infants and controls.

Personal -Social	Groups					
	Preterm Infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	T	P-value
At 3 month	43	7.72±1.44	25	10.84±1.97	7.509	<0.001*
At 6 month	40	15.55±2.73	25	18.64±1.8	5.017	<0.001*
At 9 month	32	23.28±3.64	25	27.24±2.18	4.8	<0.001*
At 12 month	11	33.09±4.16	25	33.96±1.54	0.924	NS

Table 3 showed the Mean±SD personal -social development in studied group. It was found that there was high statistically significant difference with P<0.001 in personal -social development at 3, 6 and 9 months in preterm and control group. But at 12 months there was no statistically significant difference in personal -social development between preterm infants with Mean±SD of 33.09±4.16 and control group with Mean±SD of 33.96 ±1.54.

Table 4: Mean±SD Performance development in studied preterm infants and controls.

Performance	Groups					
	Preterm Infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	T	P-value
At 3 month	43	6.49±1.44	25	9.6±1.71	8.028	<0.001*
At 6 month	40	13.6±2.91	25	17±1.68	5.308	<0.001*
At 9 month	32	20.97± .28	25	24.8±1.44	4.285	<0.001*
At 12 month	11	30.91 4.32	25	31.2±1.85	0.286	NS

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Table 4 showed the Mean±SD performance development in studied group. It was found that there was high statistically significant difference with P<0.001 in performance development at 3- 6 and 9 months old between preterm infants and control group. While at 12 months the difference was statistically insignificant.

Table 5: Mean± SD hearing- language development in studied preterm infants and controls.

Hearing-Language	Groups					
	Preterm infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	T	P-value
At 3 month	43	7.74±1.47	25	11.04±1.86	8.091	<0.001*
At 6 month	40	16.08±2.93	25	17.96±2.05	2.811	<0.05 *
At 9 month	32	24.06±4.11	25	26.12±2.01	2.295	<0.05*
At 12 month	11	33.91±3.02	25	33.48±2.29	0.469	NS

Table 5 showed the Mean±SD hearing- language development in studied group. It was found that there was high statistically significant difference with P<0.001 in hearing- language development at 3 months old between preterm infants and control group. At 6 -9 months the difference was statistically significant with P<0.05. At12 month's hearing- language development was statistically insignificant difference in preterm infants with Mean± SD of 33.91±3.02 and control group with Mean± SD of 33.84±2.29.

Table 6: Mean±SD eye -hand coordination development in studied preterm infants and controls.

Eye -Hand Coordination	Groups					
	Preterm Infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	T	P-value
At 3 month	43	7.4±1.12	25	10.4±1.78	8.569	<0.001*
At 6 month	40	15.15±2.44	25	17.56±1.66	4.337	<0.001*
At 9 month	32	22.5±5.45	25	25.24±1.51	2.436	<0.05*
At 12 month	11	33.91±5.45	25	31.8±2.29	1.653	NS

Table 6 showed the Mean±SD eye -hand coordination development in studied group. It was found that there was highly statistical significant difference with P<0.001 in eye -hand coordination development at 3 -6 months in preterm infants compared to control group. At the age of 9 months there was statistically significant difference with P<0.05. When the preterm infants and control group reach 12 months the difference were statistically insignificant

Table 7: Mean±SD Griffiths scale in studied preterm infants and controls.

Total / IQ %	Groups					
	Preterm Infants		Control		T-test	
	N	Mean±SD	N	Mean±SD	t	P-value
At 3 month	43	36.49±5.72	25	52.04±8.6	-5.37	<0.001*
IQ %		103.63±14.9		132.36±9.72	-4.891	<0.001*
At 6 month	40	75.18±11.57	25	89.92±7.92		
IQ %		112.43±22.1		135.36±9.72	-4.158	<0.001*
At 9 month	32	112.91±17.37	25	131.84±7.97		
IQ %		115.56±27.92		139.08±4.67	-2.027	NS
At 12 month	11	164±17.63	25	165.2±8.28		
IQ %		130.64±14.06		137.56±6.63		

Table 7 showed the Mean±SD Griffiths scale and IQ in studied group as regarding these table the Griffiths scale and IQ% at 3, 6 and 9months were highly statistical significant difference with P< 0.001 between control group and preterm infants. But at 12 months old no statistically significant difference in total score of the Griffiths scale and IQ% between control group with mean± SD of 165.20 ±8.28 (IQ =137.56%±6.63%) and preterm infants with mean± SD of 164.00 ±17.63 (IQ =130.64%±14.06%) Figure 1-3.

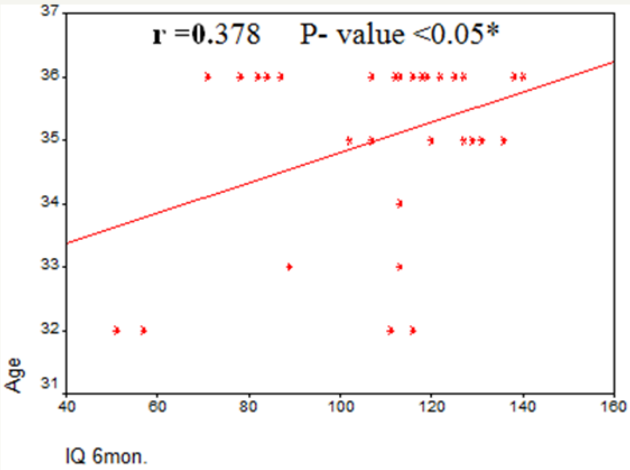

Figure 1: Correlation between IQ at 6 months and gestational age in studied preterm infants.

Significant positive correlations with P<0.05 between IQ% at 6 months old and gestational age in preterm infants.

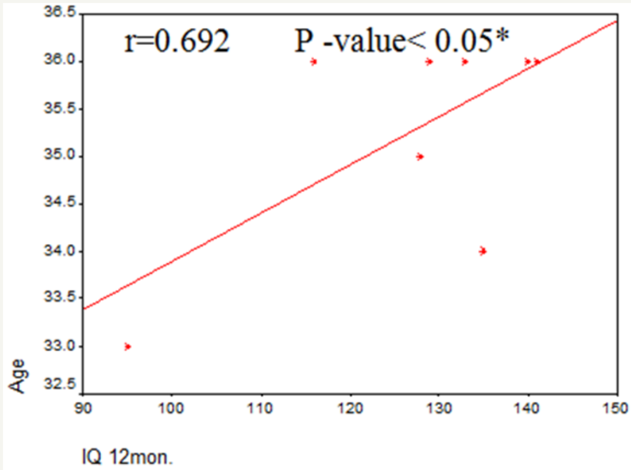

Figure 2: Correlation between IQ at 12 months and gestational age in studied preterm infants.

Significant positive correlations with P<0.05 between IQ at 12 months old and gestational age in preterm infants.

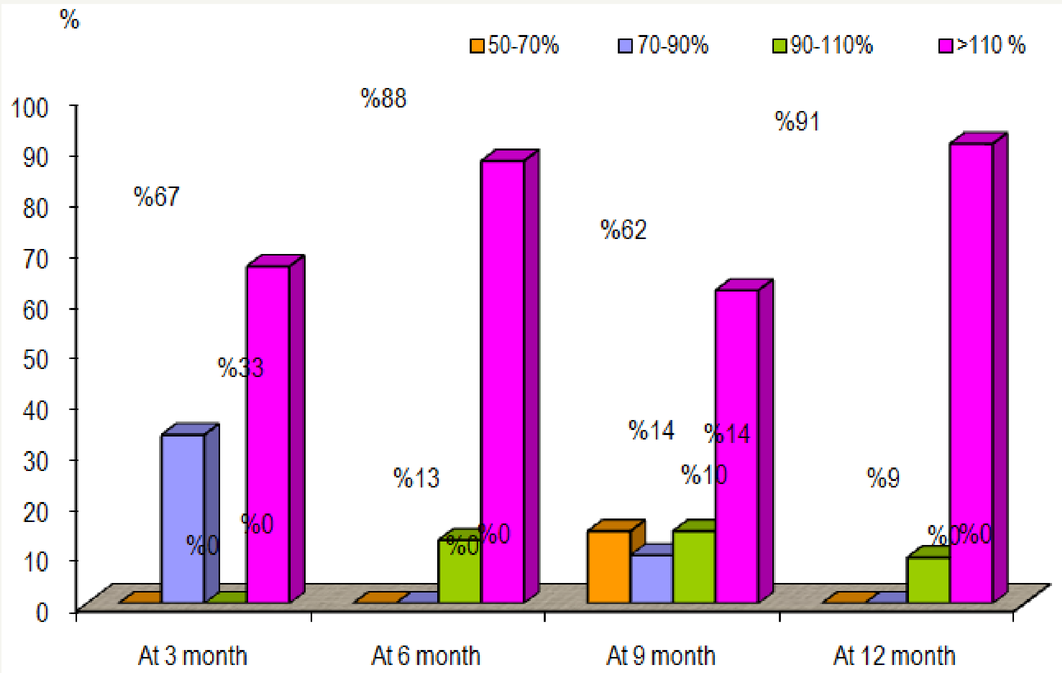

Figure 3: The percentage of patients with different IQ % grading.

The percentage of patient with different IQ grading. It was found that at 3 months 67% of preterm infants have IQ >110% and 33% have IQ of 70 -90% while 0% have IQ of 90- 110% and 50-70%. At the age of 6 months about 88 % of preterm infants have IQ >110% and 13 % have IQ of 90-110% while 0% have IQ 70- 50% and 50- 70 %. When 9 months about 62% have IQ >110% , 14% have IQ 90-110% also 14% have IQ of 50- 70% while <10% have IQ of 70-90%. While at 12 months about 91 % have IQ >110% and about 9% have IQ of 90- 110% while IQ 70-90% and 50-70% was 0%.

Discussion

From conception to adulthood, human development is characterized by increasing differentiation and integration of physical and behavioral functioning. It is assumed that development results from maturation and learning processes that built upon existing neurobiological and somatic structures, through complex interactive exchanges between genetic, neurobiological, neurophysiological, psychological, and social systems. With increasing age, self-regulative capacities will also shape development from infancy to adulthood [10]. As a consequence of premature birth, natural developmental processes are disturbed; especially when infants are born so soon that they need intensive care treatment. Many very preterm children born between 25 and 30 weeks gestation nowadays can survive with this treatment [11]. New knowledge about brain development highlights the

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importance of the last 4 to 5 weeks of gestation. During this period, the fetus experiences impressive brain maturation. Brain weight increases by approximately one-third, and dramatic increases in gyri and sulci are noted. In addition, axons and dendrites experience rapid growth, and the subplate neurons begin to regress, and interconnections between the thalamus and the cerebral cortex develop [12]. Therefore, a large portion of brain development and networking takes place in the last weeks of gestation [13]. Disturbances in the early developmental stages of the brain could affect some of the basic building blocks that are formed during this period of brain growth, but still need further development. All neuromotor, cognitive, and socioemotional capacities need to develop further into more complex functions after hospital discharge of preterm children. As a consequence, a wide variety of problems are to be expected at older ages [10]. This study followed 43 premature infants, with minimal intercurrent conditions, free from acute clinical or neurological disease and meeting rigid exclusion criteria, admitted and attended to pediatric departments of Qena university hospital, South Valley University and Nag Hammady hospital, Ministry of health. They were assessed at birth, 3, 6, 9 and at 12 months old, and 25 full term infants as a control group matched with age and sex, Due to the high prevalence of preterm birth and the importance of its associated disorders and its undesirable effects on society and limited researches about this issue, this study was conducted with the aim of surveying the relationship of preterm birth and the IQ and to assess some cognitive disorders in preterm infant compared to full term infants.

In the present study, cognitive development and psychomotor development status of preterm infants were evaluated by Griffith developmental scale [9]. The evaluation included locomotor skill, personal/social skills, hearing/speech, eye-hand coordination, and cognitive performance.

In the present study the incubation duration was statistically significant in preterm than full term infants which may affect the later on cognitive development (Table 1) this was in agreement with McMahon et al. [14], who reported that the excess noise typically experienced by NICU infants disrupts their growth and development, putting them at risk for cognitive disabilities.

In the present study preterm delivery was common in multiple pregnancy than term delivery (Table 1) this was in agreement with Krupa et al. [15] who reported that multiple pregnancies (twins, triplets, etc.) are a significant factor in preterm birth.

In the present study breast feeding was higher frequency than formula and mixed feeding in full term than in preterm suggesting that breastfeeding, particularly when it is prolonged, is associated with better child cognitive development (Table 1) this was in agreement with Maria et al. [16] who reported that breastfeeding is associated with improved cognitive development, one potential mechanism for an effect of breastfeeding on cognitive development is that breast milk contains higher concentrations of essential long-chain polyunsaturated fatty acids than formula milk. These have been shown to be essential for brain development, and this is particularly important in the preterm baby.

In the present study recurrent infection was higher in preterm than full term infants which may has a role in cognitive delay in preterm (Table 1) this was in agreement with Smith [17] who reported that infections are likely to affect children's development through several different mechanisms. Reduced dietary intake may occur secondary to anorexia or malabsorption, actual nutrient loss may occur secondary to protein-losing enteropathy, and increased demands may be present due to fever and the immune response. There is also the suggestion that the immune response itself may directly affect cognition and mood. Anaemia and iron deficiency can also occur secondary to infection.

In the present study 5.9% of preterm infants received blood transfusion and 26.5% received iron supplement while in full term no one received blood and 5.9% received iron supplement this indicate that iron deficiency play a role in cognitive development (Table 1) this was in agreement with Moffatt et al. [18] who reported that iron deficiency detrimentally affects child development ,and also in agreement Porges et al. [19] who reported that infants with iron-deficiency anemia had prolonged latency in auditory brain stem responses, which remained after correction, providing evidence that the central nervous system is affected in iron-deficiency anaemia. Iron-deficient infants also have reduced vagal tone, which remains after correction of iron deficiency. Reduced vagal tone has been linked to behavior changes, including poorer developmental outcome.

In the present study low social class was common in preterm infants than full term ones indicate that social class affect cognitive development (Table 1) this was in agreement with Sarah [20] who reported that low birth weight, because of premature birth or a poorly nourished mother, does affect intellectual development, but this effect is not so great as social class.

Concerning motor development skill in preterm infants there was a large difference between pre and full term groups at 3,6,9 months while at 12 months the difference was little (Table 2). This was in agreement with van [21] who reported that the gross motor developmental profile of preterm infants may reflect a variant of typical gross motor development, which seems most likely to be specific for this population. Our study also was in agreement with Sônia et al. [22] who reported that abnormal assessment at 3 and 9 months of age evolved to normal motor developmental outcome in 80% at 4 years of age. They conclude that any motor involvement is early and transitory, not being detected by more extended follow-up periods.

Our study was also in agreement with Campbell et al. [23] who reported that a tendency for the motor performance of infants to improve over the first year of life. Maternal over protectiveness may prevent preterm Infants' exploration of the environment with several motor strategies, integrating and refining neural input and output, may not lead to better neurologic development. The absence of a complex, variable motor repertoire at this particular age might hamper infants' abilities to interact with the surrounding world. This implies that the quality of the early motor repertoire is a measure of the extent to which spontaneous movements

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facilitate or inhibit infants' interactions during a phase in which sensorimotor activity drives perceptual and cognitive development was reported by Janneke et al. [24].

As regarding personal -social and performance development skills large difference between preterm and full term was at 3, 6 and 9 months (show more delay in performance development), and no difference was detected between them at 12 months (Table 3 & 4), our study was in agreement with Barbara [25] he reported that the group of premature infants and controls improved their performance over time in the neuropsychological abilities investigated and, in some skills such as visual perception.

As regarding hearing, language development skills our study revealed that large difference between preterm and full term was at 3 months, while at 6 and 9 months the difference was little and no difference was detected between them at 12 months (Table 5). A child's speech and language development goes through two phases early in life. In the first two to three years of life there is a predominantly "receptive" period. During this time speech centers are developing in the brain as nerve connections and networks are forming. Adequate hearing, especially hearing for speech sounds, is critical for these pathways to develop properly. The first two to three years of life represent a "window" of time during which these speech centers form. If hearing is diminished for long periods the speech areas form abnormally. Even if hearing is adequate beyond this two to three year "window", the child's speech may "catch up" slowly or incompletely. The second phase of speech and language is "expressive," during which the child begins to make speech sounds and use words. This may begin as early as one year of age. However, use of words in phrases and sentences usually becomes more obvious after age two years. Therefore, problems with hearing that interfere with speech development may not be detected until after the critical window of the receptive language phase [26].

Our study was in agreement with Betty [27] who reported that speech and language impairments of both simple and complex language functions are common among preterm infants. Risk factors include lower gestational age and increasing illness severity including severe brain injury. Even in the absence of brain injury, however, altered brain maturation and vulnerability imposed by premature entrance to the extra uterine environment is associated with brain structural and microstructural changes.

Our study was also in agreement with McMahon et al. [14] who reported that preterm infants in the neonatal intensive care unit (NICU) often close their eyes in response to bright lights, but they cannot close their ears in response to loud sounds. The sudden transition from the uterus to the overly noisy world of the NICU increases the vulnerability of these high-risk newborns. There is a growing concern that the excess noise typically experienced by NICU infants disrupts their growth and development, putting them at risk for hearing, language, and cognitive disabilities. Preterm neonates are especially sensitive to noise because their auditory system is at a critical period of neurodevelopment, and they are no longer shielded by maternal tissue. Also our study was in agreement with Dieter et al. [28] who reported that deficits in speech articulation and prereading skills were three to five times more frequent in very preterm children.

Also our study was in agreement with Saigal [29] who reported that the lower the birth weight and gestational age, the greater the probability of delay in several different stages of language development including: delays in pre-linguistic markers such as recognizing objects and pictures, obeying verbal commands and executing simple acts by 12 months' corrected age. If language delay is detected a possible association with auditory deficiency should be investigated because if this is the case audiological intervention can improve prognosis. Language difficulties can persist until school age and compromise development, but our study was in disagreement with the last part of Saigal [29] results, and this delay seems to resolve gradually with age and improvement has happened in hearing, language development at the end of the first year.

But our study was in disagreement with the first part of Miguel et al. [30] result who reported that there was no significant delay in communicative, lexical or grammatical development of PR children. Even when comparisons were performed between full term and very preterm children, differences were not significant. Regression analyses indicate that gestures and early word comprehension predict very early word production development, but their effect disappears with time.

As hand-eye coordination is the ability of the vision system to coordinate the information received through the eyes to control, guide, and direct the hands in the accomplishment of a given task, such as handwriting or catching a ball. Hand-eye coordination uses the eyes to direct attention and the hands to execute a task Monique [31], eye -hand coordination development skill in preterm was delayed with large degree in 3,6 months old improving slightly at 9 months but still lower, while at 12 months this delay seems to resolve gradually revealing that no differences between preterm and full term (Table 6), our result was in agreement with Monique31who reported that in preterm infants low eye-hand coordination/fine motor scores are likely to be due to their extreme prematurity.

Cognitive problems without major motor deficits are the predominant neurodevelopmental sequela in children born preterm. These impairments become more evident at 3, 6, 9 months (performance development more affected) and improved at 12 months (Table 7), this was in agreement with Ruth et al. [32] who reported that premature birth disrupts brain development, leading to suppressed neurogenesis, decreased myelination, and white matter disturbances.

The increased survival rate of infants with ever more reduced gestational age draws greater interest concerning the influence of prematurity on child development, leading to increasing research about the uniqueness of this population [33]. Our study showed that there was positive correlation between gestational age and IQ at 6 and12 months (Figure 1 & 2), this was in agreement with Olga et al. [34] who reported that several possible explanations for the effect of gestational age on developmental scores, it is possible this association might be explained, in part, by higher risk for mild brain injury in infants who are less mature at the time of labor, delivery, and the early postpartum period. Subclinical injury can occur during fetal life, such as with undetected placental insufficiency, even when intrauterine growth restriction is not present. Furthermore, postnatal signs of mild neurologic impairment such as self-limited apneic episodes or a single aspiration event are sometimes missed. It is clear that infants born during the late preterm period are at increased risk for adverse neurologic events compared with full-term infants. Adaptation to extrauterine life improves as neurologic development continues over this period.

It was in agreement with Melissa et al. [35] who reported that quantitative MRI data indicate that total brain volume increases linearly with increasing gestational age. In the last half of gestation are major organizational events in the development of neurons and glia at the cellular and molecular level. The cerebellum is also actively growing and developing, with 25% of its growth occurring after late preterm gestations.

Our study was also in agreement with Shenkin et al. [36] who reported that it is well established that children born small for gestational age or preterm (<37 weeks) have lower cognitive ability than their appropriate-for-gestational-age or term counter parts.

Our result was in agreement with Matte et al. [37] who reported that IQ scores varied by gestational age, even among healthy children born at ≥37 completed weeks of gestation.

It is very difficult to predict the ideal growth rate for a preterm newborn because growth is a continuous, complex process that results from the interaction of genetic, nutritional, hormonal and environmental factors.

In case of premature children, who generally exhibit weight, length and head circumference below the minimum normal percentile on postnatal growth curves, catch-up growth (Catch-up: also called growth recovery or accelerated growth. Characterized by a growth rate that is faster than expected, i.e. accelerated growth velocity, occurring after a period of slow or absent growth, allowing a previous deficit to be recovered.) Allow them to match their growth to that of children born full term during the first years of their lives [38].

In our study no correlation was found between IQ and head circumference as IQ reflect the function of the brain while head circumference measure head size only. It was in agreement with Rafaela et al. [39] who reported that very premature children had lower weight and head circumference at all ages tested. Head circumference at birth was not related to outcomes at school age.

Intelligence is a mental ability and includes several aspects such as reasoning, planning, problem solving and abstract thinking, using language, and learning. In the present study IQ levels were slightly but significantly lower in the preterm group than the healthy controls it was in agreement with Van et al. [21] and Johnson [40] who reported that children born preterm have lower IQ scores than their term peers, even in the absence of brain lesions and/or severe disability. But in disagreement with Christina et al. [41] who reported that no significant difference in the two studied groups telling the fact that there was no significant association between the IQ score and premature birth.

At the present study IQ at 6 and 12 months was higher than at 3and 9 months (Figure 3) it may be explained by the effect of environmental factors rather than gestational age at this period, as the effect of incubation or NICU stay and low birth weight in the first 3 months, while after 6 months the stores of iron and other elements start to decrease and teething with its decreased immunity and repeated infections affect that period until 12 months.

The limitation of our study is that there was a relatively high rate of loss to follow up in the total group of 43 infants. Several infants were not assessed at all study moments in the first year.

In spite of the technological advances in neonatology and increased survival of preterm infants, there are still knowledge gaps in this area, it is important to consider that follow-up only until to 1 years of age is insufficient for the detection of development problems such as bimanual skills, behaviour, and visual-motor integration abnormalities, more research is needed to improve our understanding of the developmental mechanisms of preterm infants.

Conclusion

Preterm infants have lower IQ scores than full term ones but this delay seems to resolve gradually with age, and at the end of the first year of life they become equal. In spite of the technological advances in neonatology and increased survival of preterm infants, there are still knowledge gaps in this area.

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