Pattern of growth and development of premature children at the age of two and three years in Alexandria, Egypt (Part I)

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نمط النمو والتطور لدى الأطفال الخدّج (المبتسرين) في سن الثانية والثالثة بالإسكندرية ، جمهورية مصر العربية (الجزء الأول)

خديجة أمين خليل وشهيرة محمود العمراوي وعفاف جابر إبراهيم ونادية عبد المنعم الزيني وعزة الصديق قريو

أجريت هذه الدراسة بالإسكندرية وشملت ٦٨ طفلاً خديجاً (مبتسراً) (٣٢ من بينهم بلغوا الثانية من عمرهم ، و٣٦ بلغوا السنة الثالثة) . وكانت المجموعة الشاهدة مكونة من ضعفَي هذا العدد من الأطفال المولودين لتمام الحمل ، والمماثلين لمجموعة الخدّج في العمر والنوع . ولقد وُجد أن نمط النمو في مجموعة الشواهد أفضل منه بين الخدّج (المبتسرين) . كما تبيّن أن الخدّج أكثر تخلفاً بدرجة كبيرة ، من نظرائهم في المجموعة الشاهدة ، في بعض مجالات التطور مثل اللغة والتكيف الحركي الدقيق والمجال الشخصي الاجتماعي . وتوصي الدراسة بإتاحة الرعاية الطبية الجيدة من أجل القضاء على تأخر النمو والتطور بين الأطفال الخدّج (المبتسرين) .

A case-control study was conducted in Alexandria on 68 premature children: 32 of them at the age of 2 and 36 at the age of three years. The aim was to depict the pattern of growth and development among them. Controls were full-term children, who were double the number of prematures and matched by age and sex. It was found that the growth pattern of full-term children aged two and three years was better than that of prematures. Moreover, prematures were significantly delayed in some developmental areas as language, fine motor-adaptive sectors and personal-social domains than their corresponding controls. The study suggests that the provision of quality medical care could eliminate the growth and developmental lag of premature children.

Croissance et développement d'enfants prématurés âgés de deux et trois ans à Alexandrie (Egypte) (Première partie)

Une étude cas-témoin a été réalisée à Alexandrie auprès de 68 enfants prématurés: 32 d'entre eux avaient deux ans et 36 avaient trois ans. L'objectif était de décrire les caractéristiques de la croissance et du développement chez ces enfants. Les sujets témoins étaient des enfants nés à terme, en nombre double de celui des prématurés avec une répartition par âge et par sexe similaire à celle des prématurés. Il a été constaté que la croissance des enfants nés à terme âgés de deux et trois ans était meilleure que celle des prématurés. En outre, les prématurés présentaient un retard important dans certains domaines de leur développement tels que le langage, les facultés motrices/d'adaptation à un niveau plus avancé et dans leurs relations personnelles et sociales par rapport aux sujets témoins. L'étude donne à penser qu'on pourrait éliminer le retard de croissance et de développement des enfants prématurés en leur dispensant des soins médicaux de qualité.

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Introduction

Growth refers to the increase in body size or any of its parts resulting from cell multiplication. On the other hand, the term "development" refers to the increase in the skills and functions of organs [*1,2*].

Premature birth (before 37 full weeks of gestation) leads to disturbance in the normal rate of growth. The less a premature infant weighs at birth, the more profound the growth disturbance will be [*3*]. In the majority of cases, growth in height is as much affected as growth in size from the very beginning [*4*]. During the first three years of life, prematures are more likely to have lower average height and weight than full-term ones of the same age unless an allowance is made for the length of gestation [*5*].

Premature infants are at risk of developmental delay, and the actual developmental level corresponds to the degree of prematurity. Developmental delay in premature infants might be manifested as minor or major neurosensory deficit and impairment of intellectual or motor functions [*6–8*].

The present study was conducted to assess the effect of prematurity on the growth and development of premature children aged two and three years in Alexandria.

Subjects and methods

Case-control study was the method selected. The index cases included all premature children aged two and three years who were admitted to the neonatal unit of El-Shatby University Children's Hospital and were discharged alive over 2 six-month periods (1 November 1990 to 30 April 1991 and 1 November 1989 to 30 April 1990). At the time of delivery they had no major disabilities such as congenital anomalies that would affect their growth and development, and this was documented in their medical records. Parents were mailed a request to attend the Public Health Department, Faculty of Medicine, Alexandria University, accompanied by their index child.

Controls were selected from the paediatric outpatient clinic of El-Shatby University Children's Hospital, which was visited twice a week. They were double the number of the index group, matched by age and sex. Controls were full-term children either suffering from minor illnesses such as running nose or common cold, or accompanying their siblings, who were seeking services at the paediatric outpatient clinic.

The anthropometric measurements were obtained to assess the growth of the children using standard techniques [*9*]. They comprised measurements of weight, length or height, head circumference, chest circumference, mid-arm circumference and triceps skin-fold thickness which were performed on all children. Moreover, the Denver Development Screening Test (DDST) [*10*] was used to assess the developmental state of both prematures and their controls.

At the end of the work, data were coded and transferred onto a master sheet. The data were analysed using the *Epi Info/PC+* program. The mean and standard deviations were calculated and *t* test and chi-square test at 5% level of significance were performed. In addition, five percentiles (10%, 25%, 50%, 75% and 90%) of all anthropometric measurements for prematures and their controls at each age group were computed.

Results

The total number of prematures included in the present study was 68 children. Premature children aged two years at the time of

the study constituted 47.1% of the total sample, with a male to female ratio of 1.28:1. Those aged three years constituted 52.9%, with a male to female ratio of 0.89:1.

Growth measurements of prematures and their controls

Weight

For both two and three year old children, the percentile values of weight were higher for full-term controls than prematures. In addition, the mean weight values for the two groups of prematures were significantly lower than those of their controls. $t = 5.88$ and 4.27 respectively (Table 1, Fig. 1).

Length/height

The mean length/height as well as the length/height percentile values were generally higher for controls than for

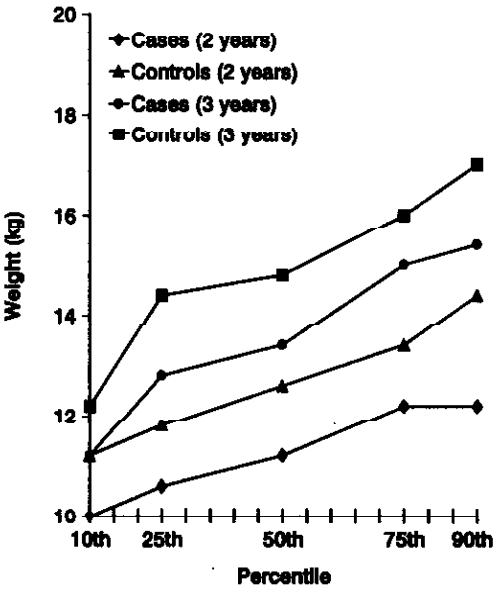

Figure 1 **Weight percentiles of premature children aged two and three years and their controls**

Table 1 **Mean and standard deviation of the different anthropometric measurements for prematures and their controls aged two and three years**

Anthropometric measurement	Mean and standard deviation for children aged two years		Mean and standard deviation for children aged three years	
	Prematures ($n = 32$)	Controls ($n = 64$)	Prematures ($n = 36$)	Controls ($n = 72$)
Weight (kg)	11.11 ± 0.89	12.35 ± 1.02	13.35 ± 1.47	14.6 ± 1.42
	$t = 5.88$*		$t = 4.27$*	
Length/height (cm)	82.27 ± 3.19	86.92 ± 3.26	89.69 ± 5.20	93.43 ± 4.79
	$t = 6.61$*		$t = 3.75$*	
Head circumference (cm)	46.38 ± 1.58	46.67 ± 1.19	48.04 ± 1.35	47.73 ± 1.36
	$t = 1.03$		$t = 1.13$	
Chest circumference (cm)	48.65 ± 1.70	49.27 ± 1.48	50.69 ± 1.81	50.36 ± 1.55
	$t = 1.86$		$t = 1.00$	
Mid-arm circumference (cm)	14.81 ± 0.72	15.14 ± 0.67	15.53 ± 0.89	15.54 ± 1.07
	$t = 2.17$*		$t = 0.23$	
Triceps skin-fold thickness (mm)	8.55 ± 0.36	8.82 ± 0.34	8.95 ± 0.40	9.12 ± 0.30
	$t = 3.62$*		$t = 2.57$	

* = *statistically significant*

prematures, both at the age of two and three years (Table 1, Fig. 2). Differences were statistically significant.

Head circumference

For those aged two years, the percentile and the mean head circumference values were generally higher for controls than for prematures. The reverse was found for the 3 year old group, where the percentiles as well as mean values of head circumference were generally higher for prematures than controls. The differences, however, were statistically insignificant (Tables 1 and 2).

Chest circumference

For children aged two years, the percentile values for chest circumference were higher for full-term children than for prematures. On the other hand, for three year old children, differences in the percentile were inconsistent. At both ages, differences in the mean values were statistically insignificant (Tables 1 and 3).

Mid-arm circumference

Full-term controls had generally higher values for mid-arm circumference as compared to prematures aged two and three years. However, the difference in the mean values was significant for those aged two years (t = 2.17) but insignificant for the older group of three years (t = 0.23) (Table 1, Figs. 3 and 4).

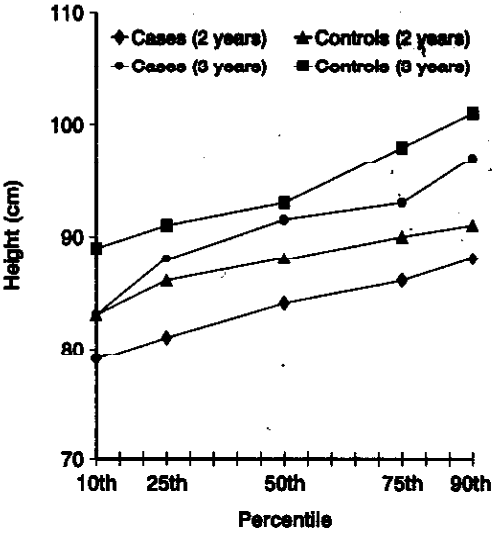

Figure 2 **Length/height percentiles of premature children aged two and three years and their controls**

Table 2 **Distribution of premature children aged two and three years and their controls according to their head circumference percentiles (cm)**

Percentile	Children aged two years		Children aged three years	
	Prematures (n = 32)	Controls (n = 64)	Prematures (n = 36)	Controls (n = 72)
10th	44.5	45.0	46.0	46.0
25th	45.0	46.0	47.3	47.0
50th	46.0	46.8	48.0	47.5
75th	47.3	47.5	48.5	48.5
90th	48.0	48.0	50.0	49.5
mean ± SD (cm)	46.38 ± 1.58	46.67 ± 1.19	48.04 ± 1.35	47.73 ± 1.36
t	1.03		1.13	

Triceps skin-fold thickness

Generally, the percentile values were higher for controls than for prematures. The mean skin-fold thickness for premature children aged two years and those aged three years were thinner than those of full-term children of the same age. These differences were statistically significant: $t = 3.62$ and 2.57 respectively (Table 1, Figs. 5 and 6).

Table 3 Distribution of premature children aged two and three years and their controls according to their chest circumference percentiles (cm)

Percentile	Children aged two years		Children aged three years	
	Prematures (*n* = 32)	Controls (*n* = 64)	Prematures (*n* = 36)	Controls (*n* = 72)
10th	46.5	47.5	48.0	48.5
25th	47.5	48.0	49.8	49.0
50th	49.0	49.5	50.8	50.8
75th	49.5	50.0	52.0	51.0
90th	50.0	51.0	53.0	52.0
mean ± SD (cm)	48.65 ± 1.70	49.27 ± 1.48	50.59 ± 1.81	50.36 ± 1.55
t	1.86		1.00	

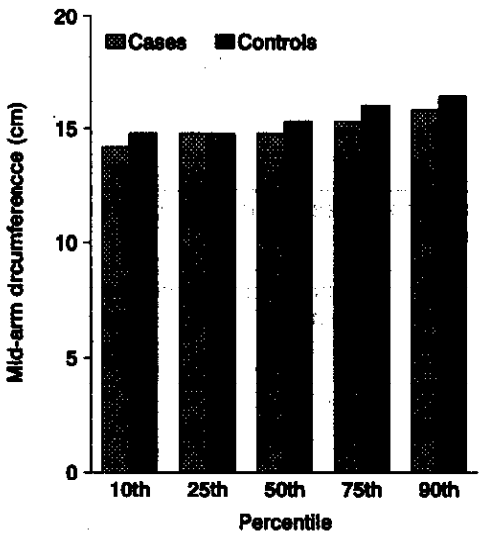

Figure 3 **Mid-arm circumference percentiles of premature children two years old and their controls**

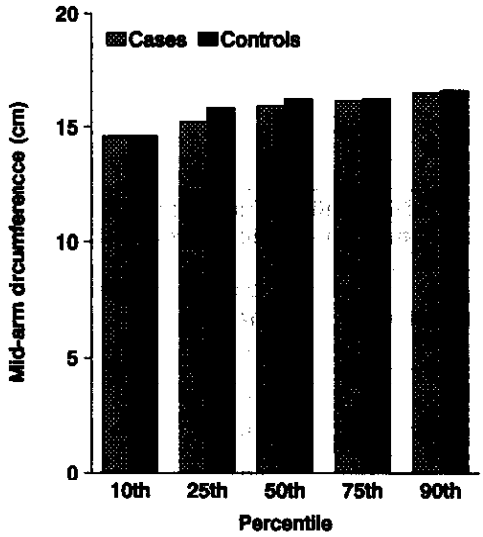

Figure 4 **Mid-arm circumference percentiles of premature children three years old and their controls**

Development of prematures aged two and three years and their controls

Table 4 shows the performance of prematures and their controls on the Denver Development Screening Test (DDST). The majority (92.2%) of the two-year old controls had normal achievements on the DDST as compared to 71.9% of corresponding prematures. Moreover, prematures who had

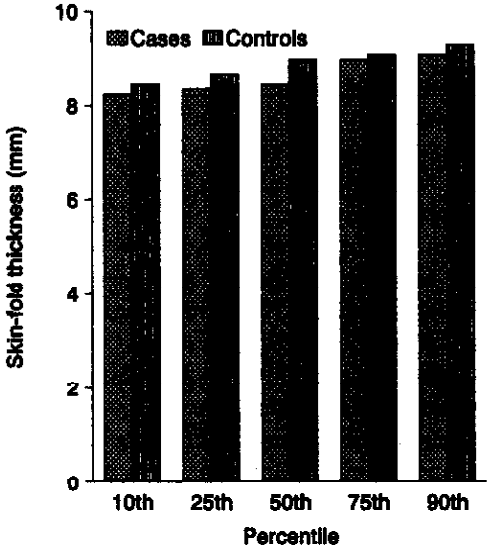

Figure 5 **Triceps skin-fold thickness percentiles of premature children two years old and their controls**

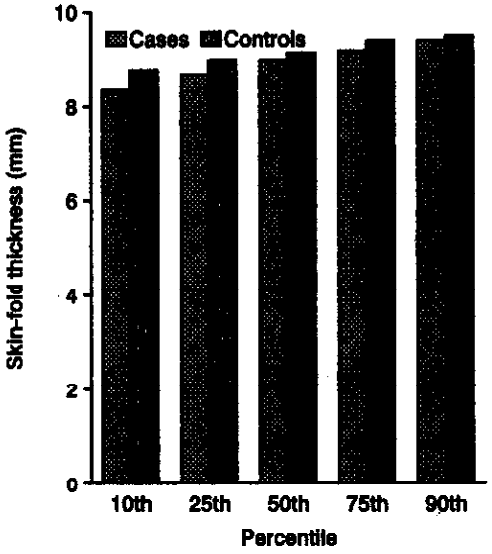

Figure 6 **Triceps skin-fold thickness percentiles of premature children three years old and their controls**

Table 4 **Distribution of premature children aged two and three years and their controls according to their performance of the Denver Developmental Screening Test (DDST)**

DDST performance	Children aged two years				Children aged three years			
	Prematures		Controls		Prematures		Controls	
	No.	%	No.	%	No.	%	No.	%
Normal	23	71.9	59	92.2	28	77.8	70	97.2
Questionable	7[1]	21.9	5[1]	7.8	4[2]	11.1	2[2]	2.8
Abnormal	2[3]	6.3	0	0	4[4]	11.1	0	0
TOTAL	32	100	64	100	36	100	72	100
	$\chi^2_2 = 8.41$				$\chi^2_2 = 12.00$			

1. Questionable in language and fine motor-adaptive sectors
2. Questionable in fine motor-adaptive sector
3. Abnormal in language and fine motor-adaptive sectors
4. Abnormal in fine motor-adaptive, language and personal-social sectors

abnormal performance in language or fine motor-adaptive sectors constituted 6.3% compared to none of the controls. In addition, 7.8% of controls had questionable performance in language or fine motor-adaptive sectors as compared to 21.9% of prematures. These differences were statistically significant: $\chi_2^2 = 8.41$.

A similar pattern was revealed among children aged three years. Equal proportions (11.11%) of prematures had an abnormal or questionable performance, while none of full terms had an abnormal performance, and only 2.78% had a questionable one. These differences were statistically significant: $\chi_2^2 = 12.00$.

Discussion

There are inconsistent results as regards the long-term impact of prematurity on physical growth [*6*]. Furthermore, the risk of neurologic and developmental impairment is increased for the small prematures who survive, particularly if they had a complicated neonatal course [*11*]. In this study, both the growth and development achieved by prematures at the age of two and three were investigated.

Fitzhardinge pointed out in 1975 that most premature infants show normal growth attainment at the first and second years of life [*12*]. However, Blackman stated (in 1991) that although these children may have catch-up growth in early childhood, they will tend to remain of a shorter stature than full-term ones [*13*]. The present study showed that prematures were found to be of a significantly lower weight and shorter stature than their full-term mates. This was in accordance with other studies that have revealed that prematures, as a group, will continue to be of a lower weight and shorter stature through the age of three years [*5, 8, 14, 18*]. Moreover, Abbassy et al. [*19*], in their extensive longitudinal study of the growth pattern among prematures and full-term children, added that the difference in weight and height between the two groups is likely to remain so till the age of 5 years.

Regarding head circumference, Sehsah revealed that premature children had a smaller head circumference than full-term ones during the first year of life [*14*]. During the second year of life, the head circumference of prematures increases at a lower rate than that of full-term children [*19*]. In the present study, the observed difference in mean head circumference at two years of age between prematures and controls was 0.29 centimetres. This is much smaller than the difference (1.3 centimetres) observed by Abbassy et al. [*19*]. In the present study, by three years of age, the head circumferences in prematures and full-term infant become comparable. It seems that between two and three years of age, the head circumference of prematures increases at a faster rate than that of full-term infants, so that by three years of age they have comparable head circumferences [*17, 19*].

In the present study, chest circumference increases in a pattern that is similar to that of the head. Abbassy et al. reported that during the second year of life, the increment in chest circumference is lower for premature children than full-term babies. On the other hand, at the age of three years, premature children were found to have higher percentile values of chest circumference and an insignificantly higher mean chest circumference compared to their controls. They found that from the third year onwards, the increment in chest circumference is higher for prematures than mature children and by the end of the fourth year both groups enjoy a nearly equal chest circumference [*19*].

The study revealed lower percentile values and significantly lower mean values for mid-arm circumference for prematures aged two years when compared to term controls. This reflects the same trend observed by Sehsah at 1 year of age [*14*]. At the age of three years, the percentile values and the mean mid-arm circumference remained lower, though insignificantly, for premature children.

At two and three years of age, the mean values for triceps skin-fold thickness were significantly lower for prematures than their controls ($t = 3.62$ millimetres and 2.57 millimetres, respectively). This appears to be in line with the findings of Elliman et al. [*16*]. Their work, however, was conducted on babies who were originally of low birth weight rather than prematures.

The study of the physical growth of premature infants assumes increasing importance as evidence suggests that early growth has a prognostic significance for later neurobehavioural outcome [*20*]. A significant relationship was demonstrated between very low birth weight (VLBW) children and poor neurobehavioural outcome (1993). This may lead later on to learning difficulties and inadequate school performance [*21*].

The DDST is the most popular screening test used to assess young infants (1995). In the present study, this tool has been used to assess the development of premature children. DDST revealed that the development of premature children is significantly delayed in the second and third years of life than that of full-term children of similar age. ($\chi_2^2 = 8.41$ and $\chi_2^2 = 12.00$, respectively). These findings highlight the contribution of prematurity to delayed development. Such delay was observed by Sehsah at 1 year of age [*14*]. The findings of the present study are in accordance with those of Abbassy et al; they assume that the genetic and environmental factors responsible for prematurity will continue to exert their effects on the development of prematures causing its delay [*19*]. Although this assumption is plausible, the impact of prematurity and its complications on future development remains quite possible. On the other hand, the observation of Vohr and William contradict the results of the present study. They have stated that although prematures are known to be neurodevelopmentally immature at birth, developmental catching-up occurs over the first two years of life [*22*]. The same findings were also revealed by Behrman et al. and Dunham [*23. 6*]. However, developmental catching-up was conditioned by the absence of perinatal complications as well as the presence of appropriate family interaction that foster normal development. The use of corrected age and allowing for the lag would allay undue anxiety, particularly with regard to minor delays.

Conclusion

It could be concluded from the present study that prematurity does affect both growth and development of children up to the age of three years.

Recommendations

Infant care

Prematurely born infants should be closely observed. Their regular monitoring for growth and development using special charts offers a simple method for early detection of growth retardation and developmental delay. Such conditions should be dealt with appropriately and immediately by competent and experienced specialists.

Health education

Mothers of premature infants should be educated about the extreme vulnerability of their children, as well as their high nutritional requirements, so as to foster normal growth and development.

Specialized care for prematures

Specialized centres should offer services for prematurely born children with gross physical retardation as well as developmental delay. The provision of medical care of the highest quality by the most efficient expertise could eliminate the growth and developmental lag of premature children and ensure their comparability with full-term ones.

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