GROWTH PATTERNS AND NUTRITIONAL STATUS OF PRESCHOOLERS EXCLUSIVELY BREASTFED IN THE FIRST SIX MONTHS OF LIFE

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Abstract

Background: In Egypt 28% to 40% of children under-five of age are stunted reflecting a significant degree of chronic malnutrition which is a public health problem in Egypt.

Aim: To show how Egyptian children who are exposed to optimum infant feeding practices early in life grow.

Methods: One thousand children aged 6 to 60 months were selected from Gharbia governorate on the basis of being exclusively breastfed for the first six months of life. They were exposed to full anthropological examination of weight, length, head circumference and assessed for underweight using weight-for-age (W/A), stunting by length-for-age (L/A) wasting by weight-for-length (W/L) and obesity by body mass index for age (BMI/A) using standard techniques. The data was computed into the automated World Health Organization (WHO) computerized program and interpreted using the z-score curves of WHO.

Results: All of the cases plotted against the WHO growth charts showed no underweight or wasting but stunting was detected in 3.3% of cases. Peak of overweight (>+2SD) was 9.3% with no cases of obesity. Overweight was commoner among males and increased by 2-3 times among the urban and educated mothers.

Conclusions: There is a high prevalence of overweight with stunting due to poor weaning food practices. Breastfeeding in the first six months of life is the optimal feeding practice for ensuring adequate growth and development and prevention of underweight, wasting, severe stunting and obesity among our population.

Introduction

The World Health Organization (WHO) recommends that all children should be exclusively breastfed for the first six months of life. Hence they have launched the new Global child growth standards for infants and children up to the age of five. With these new WHO child growth standards it is now possible to show how children
should grow. They demonstrate for the first time ever that children born in different regions of the world and given the optimum start in life, through exclusive breastfeeding, have the potential to grow and develop irrespective of race and ethnicity but dependent only on their mother's milk and her feeding practices \(^{(1,2,3)}\).

In Egypt there is a serious problem of malnutrition evident by the high prevalence rate of stunting ranging from 28 to 40 percent in children under-five of age reflecting a high degree of chronic malnutrition. Also overall exclusive breastfeeding rates for the first six months of life in the Middle East region is around 30 percent and in Egypt is 16.7 to 30 percent \(^{(4)}\).

Although studies around the world have shown that promoting exclusive breastfeeding from birth to six months can effectively improve the health and nutritional status, this is still not demonstrated in Egypt and many countries in our region. Growth monitoring practices are defective in many regions around the world including the Eastern Mediterranean region. Reasons for this was the imperfect fitting of the previous growth curves and lack of nutritional surveillance information systems based on accurate growth data \(^{(5,6,7)}\).

Moreover there was lack of consistency in infant feeding recommendations that finally culminated with the worldwide consensus on the duration of exclusive breastfeeding and complementary feeding practices that result in the optimal growth and development of children. This has lead to the development of new growth charts around the world that can be used by all countries to compare and standardize their nutritional surveillance systems with other countries around the world, but still need further assessment \(^{(8,9,10)}\).

The aim of this study is to demonstrate the growth pattern and nutritional status of children under five of age who are exposed to exclusive breastfeeding in the first six months of life in Egypt and identify the pitfalls in growth assessment for the under five
based on the new growth standards for children.

**Subjects and Methods**

This is a cross sectional, observational and randomized anthropométrical small scale area study, that was conducted for 1000 Egyptian children over 6 months and under five years of age locally residing in Gharbia governorate from June 2009 to August 2010 and compiled and analyzed by the special methods from September 2010 to September 2011. They comprised 500 boys and 500 girls who basically received exclusive of full breastfeeding in their first 6 months of life. They were divided into: 600 children aged 6 months to 2 years and 400 children aged 2 to 5 years.

**Ethical considerations:** research participants were advised about possible benefits resulting from participation in the research. In the informed consent form, the degree of confidentiality was ensured. Written informed consent was waived as this was an anonymous survey method. We obtained consent from the Ministry of Health (MoH) directorate in both governorates.

They were selected from 2 districts: 6 districts in Gharbia governorate according to the birth rate in each district. In each district, maternal and child health centers (MCHs) with the highest birth rate were estimated and selected.

**Inclusion criteria** included healthy infants and children, age limit: from 6 months to 5 years, full term baby with normal birth weight, full or exclusive breastfeeding till 6 month.

**Exclusion criteria** included child with chronic illness, or major congenital anomalies, perinatal insults, preterm, small for weight neonates or infants in the first six months of life exposed to regular pacifiers, bottles or infant milk formula.

Thorough clinical examination: and anthropometric assessment was performed for all children including: weight height (or length), mid-arm circumference, and BMI assessment using standardized methods described in WHO training modules for growth monitoring (11).

**Body weight** was obtained using a balance beam scale with non detachable weights. The zero weight on the scale’s horizontal beam was checked periodically. The scales were standardized by using standard weights. Subjects were weighed with minimal underclothing. The average of two or three weighing was recorded numerically to the nearest 10 g (0.01kg).

**Length/height measurement** boards were used and are designed to measure children under 2 years of age lying down...
(recumbent), and older children standing up. The board measured up to 120 cm (1.2 meters) readable to 0.1 of a centimeter. Mid Upper Arm Circumference (MUAC) was measured with the arm hanging loosely and comfortably at the side, in the midline of the posterior aspect of the arm (over the shoulder top), over the triceps muscle, at a level midway between the lateral projection of the acromion process at shoulder and the olecranon process of the ulna (at the point of the elbow). With the elbow flexed to 90°, the midpoint is determined by measuring the distance between the two landmarks using a tape measure calibrated in centimeters. Measurements are recorded to the nearest 0.5 mm.

**Automated WHO program** for data entry of child's age, weight, edema status, length/height and type of measurement (recumbent or standing) are the basic variables required to derive the most common nutritional status indicators, i.e. weight-for-age, height-for-age, weight-for-height and BMI-for-age. All software modules enable the user to derive nutritional status information (in z-scores and percentiles) for all indicators based on the WHO standards www.who.int/childgrowth/training.

Standard Growth charts were used in the study including WHO Z-scores growth charts for boys and and girls, from birth to 5 years: Length /Height-for-age; weight-for-age; weight-for-length/height; BMI-for-age; and mid upper arm circumferences-for-age.

**Statistical Methodology:** The data collected were tabulated and analyzed by statistical package (SPSS) version 11 on IBM compatible computer. Quantitative data: These data were expressed as mean (X) ± standard deviation (SD) and analyzed by applying student t-test for comparison of two groups of normally distributed variables and Mann Whitney (U) test for none normally distributed ones. All these tests were used as tests of significance at P<0.05, P<0.01 or P<0.001.

**Results**

The growth patterns are shown as follows: Figures (1a) and (1b) show the pattern of growth of weight-for-age (W/A) of the 6-60 months for the female and male study population respectively. There is an evident overlap with the shape of the curve of the WHO growth standard with some apparent dippings at the peak that required smoothening by statistical adjustments, but they were of no statistical significant difference.

Figures (2a) and (2b) show the pattern of growth of the length-for-age (L/A) for the
female and male study population, respectively, with a tendency to be narrow and peaked shift away (to the left of the curve) from the WHO growth standards. There is a statistical significant difference. The shift to the left indicates stunting which is significant particularly in the third year for females (3.5%) and second and third year for males (4.8% and 3%) at P<0.05 and P<0.001.

Figures (3a) and (3b) show the pattern of growth for weight-for-length (W/L) for the 6-60 months of age for the female and male study population, respectively. It overlaps with the shape of the curve of the WHO growth standard with a shift to the right but with no statistical significant difference at P>0.05.

Figures (4a) and (4b) show the pattern of growth of the body mass index (BMI) for the 24-60 months of age, female and male study population respectively. It deviated to the right of the WHO growth standard indicating a tendency to overweight but with no statistical significant difference P>0.05. Overweight peaked at ages 6-11, 12 to 24 months and the 4th year in boys and in the 2nd and 3rd year in girls. Figure (5) shows the distribution of our cases against the WHO growth charts for the mid-arm circumference. There was no deviation from the WHO standard.

Table (1) shows the nutritional indices for underweight, stunting, wasting and overweight.

Discussion
Several studies have examined the effect of breastfeeding on infant growth. The protective effects of breastfeeding and its high content of growth promotive factors make breastfed infants have higher growth rates in their early life compared with formula-fed infants.\(^7,13,14\)

Other studies have reported that the rate of weight gain in formula-fed infants is greater than that for breastfed infants during the first few months of growth\(^15\). Thus the effect of breastfeeding practices on infant growth remained controversial, until the release in 2006 of new WHO standards for assessing the growth and development of children under 5 years old, which revealed that the growth pattern of breastfed are unique especially in the very early months of life\(^16\).

In our study we noticed that the pattern of growth in early infancy fitted more with the WHO-CGS at this age period as our cases were evenly distributed allover the centile curves.
using the Z-score system of the WHO-CGS. We found that 1.2 and 3 percent of children aged 6-11 and 12-24 months of age respectively fell below the -2 SD whereas none of our sampled exclusively breastfed children aged 24-35, 36-47 and 48 to 60 months fell below the -2 Z-score of the WHO-CGS. This is contradistinction to the national surveys in Egypt that showed that for the 6-11 and 12 to 24 months age group 5.2% and 7.5% of children were below -2 SD. Underweight was detected in 5.9% to 6.5% among the 24-60 months age groups in the EDHS of 2008\(^{(4)}\). While the EDHS of 2005\(^{(17)}\) which used the National Child Health Standards NCHS as a reference detected higher rates of underweight at -2 Z-score ranging from 8.9% to 9.8%, for children aged 6-11 months and 7.0% to 9.3% for children aged 12-23 months and 6.4% for children 24-35 months and 4.2% for children 36-47 months and 4.9% for children aged 48-60 months.

The difference in underweight between the demographic survey in 2005 and that in 2008 cannot be explained by the differences in the growth charts used only, but rather the improvement in the early feeding practices that was seen with the doubling in the exclusive breastfeeding rates from 2005 to 2008. The latter was associated with a one half to a one third decrease in the underweight. While further increase of exclusive breastfeeding, as shown in our study, can have a significant effect on prevention of underweight. UNICEF reported that promoting breastfeeding and appropriate complementary practices contributed to the reduction of infant mortality rates as compared to other intervention programs in child health\(^{(17)}\).

Stunting assessed in our study by length-for-age (L/A), using the Z-score system of the WHO-CGS revealed no severe stunting. Only 4.8% of males in the second year and 3.0% and 3.5% of the males and females (respectively) in the third year fell below the -2 Z-score. While the EDHS (2008) which used the WHO-CGS as their reference showed that 10.6% to 11% for children aged 6-11 months and up to 22.9% of children aged 12 to 24 months and 16.8% of children aged 24-35, 36-47 were severely stunted\(^{(4)}\). Stunting at or below -2 SD peaked to 22% for the 6-11 months age group and to 40.8% for children aged 12-23 months and
34.9%, 31.8% and 24.3% for children aged 24-35, 36-47 and 48-60 months\(^{(4)}\).

The EDHS is representative of the national population and reflects the high degree of severe stunting among Egyptian children under five of age indicating chronic malnutrition. This was not seen in our population of exclusively breastfed in the first six months. This is explained by the protective effect of breastfeeding against severe disease and micronutrient deficiency states especially iron and vitamin A deficiency.

Wasting assessed by weight-for-length (W/L) showed that less than one percent of our population under study in either governorate fell below -2 SD. This is contradistinction to the EDHS studies in 2005 and 2008 that showed rates ranging from 5.2% to 8.2% in the under two of age and 3-5 of age respectively \(^{(4,17)}\).

Also the body mass index for age (BMI) used as an index of obesity showed that 9.6% of our population plotted against the WHO growth charts overweight. This was common among males from 6 to 24 months (10.7%) and in the 4\(^{th}\) year (15%) and among females in the 3\(^{rd}\) year (14%). However there were no cases of obesity.

The findings of overweight probably reflect poor complementary feeding habits with over feeding of dairy products especially buffalo milk in the second half of the first year and second year. Buffalo milk is commonly consumed in rural communities and has a higher content of fat than cow's milk. This could explain the stunting that followed the overweight in the following period of growth. Overweight is shown to have an inhibiting effect on linear growth as the excess insulin cross reacts with the receptors of the insulin like growth factor (IGF-1) blocking its effect on epiphyseal cartilage \(^{(19,20,21)}\).

Several workers have demonstrated that overweight and stunting should be a priority for public policies. Stunting is a serious problem that impedes child growth and development. The high rate of 'overweight' was a false impression, the fact is the dyad of 'stunting overweight', that should be addressed by increasing protein and other nutrients in the diet at an early age and reducing over intake of dairy fats \(^{(22,23)}\).

Early infant nutrition has significant short and long-term health
consequences for the individual. Interventions early in life are important in protecting the infant against infection and promoting healthy immune system development and are thought to have life time programming effects on cardiovascular health, metabolism, bone health, immune function, and neurological development.

The significant difference in underweight between the demographic survey in 2005 and that in 2008 cannot be explained by the differences in the growth charts used only, but the main differences between our population and that of EDHS (2005) and (2008) is that exclusive breastfeeding for the first 6 months in the former was 16.7% and in the latter was 30% compared to 100% our population.

Lartey at al. who followed 216 normal Ghanaian children from one month of age to 18 months observed that the rates of diarrhea increased if the complementary foods were introduced between four and six months. They stressed that introducing complementary feeding after six months of age improved growth by lessening morbidity.

De Onis et al. compared the WHO Growth Standard with NCHS growth reference on a study population in Bangladesh. They noted that the prevalence of underweight during the first six months was much higher when based on the WHO standard.

Also, Dewey et al. showed that breastfeeding had a major role on the growth of infants especially in the first three months and most of the breastfed cases were growing well and fitted to higher centiles. They explained their results by the fact that breast milk contains sufficient energy and nutrients that ensure suitable growth for infants in the first six months.

In relation to stunting, our findings are in agreement with De Onis who showed that the WHO Growth Standard when compared to the NCHS growth reference in a study conducted for a population in Bangladesh; resulted in a high prevalence of stunting for all age groups.

Dewey et al. have characteristically demonstrated higher early growth rates among exclusively breasted and this could explain the higher detection rate of stunting when using the new WHO growth charts.

Hereditary and racial factors also play a role in the apparent stunting noted as shown in a study of Saudi children below 5 years of age who were shorter
than the reference population, using the growth charts of the United States (US)\(^{(29)}\).

The extent of stunting seen in the EDHS of both demographic surveys indicate the magnitude of chronic malnutrition in our country which can be reversed to almost nil if all children are exclusively breastfed in the first six months and continue to breastfeed for two years with adequate complementary foods with less buffalo milk.

Breastfeeding reduces the risk of both under nutrition and overweight later in childhood. In disadvantaged populations, exclusive breastfeeding is associated with less growth faltering during early infancy \(^{(30)}\) and continued breastfeeding through the second year of life enhances linear growth \(^{(31)}\). In industrialized countries such as the U.S., rates of both underweight and overweight are greatest in infants never breastfed \(^{(32)}\). Several meta-analyses have concluded that breastfeeding is protective against child obesity \(^{(30,31)}\) particularly when breastfeeding duration is more than 6 months \(^{(33,34)}\) although the mechanisms underlying this relationship are still unclear \(^{(35)}\). However some studies show that breastfeeding has a decreasing effect on the mean of BMI throughout the life course of children \(^{(36)}\).

We conclude that growth patterns of breastfed children are linked with improving early infant feeding practices by exclusive breastfeeding in the first six months of life and improving complementary feeding practices particularly the over intake of Buffalo milk in the first and second year of life. This can prevent stunting and growth and development of our population.

**References**


Fig.(1) Diagrammatic representation of the pattern of growth of the 6-60 months study population for the weight-for-age (W/A) for females (A) and males (B) against the WHO under-five child growth curves.

Fig.(2) Diagrammatic representation of the pattern of growth of the 6-60 months study population for length-for-age (L/A) of females (A) and males (B) against the WHO under-five child growth curves (There is a significant shift in L/A curve at P value is 0.00 <0.05).

Fig.(3) Diagrammatic representation of the pattern of growth of the 6-60 months study population for the weight for length (W/L) of females (A) and males (B) against the WHO under-five child growth curves (the difference is significant at P>0.05.)

Fig.(4) Diagrammatic representation of the pattern of growth of the 6-60 months study population for the body mass index for age (BMI) for females (A) and males (B) against the WHO under-five child growth curves.
Fig. (5) Diagrammatic representation of the pattern of growth of the 6-60 months study population for mid-arm circumference for age (MUAC/A) against the WHO under-five child growth curves.
**Table (1):** Nutritional status of the under five population by their characteristics according to the Z-score system of WHO growth standards.

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Weight-for-age</th>
<th>Length/height-for-age</th>
<th>Weight-for-length/height</th>
<th>BMI-for-age</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>% &lt; -3SD</td>
<td>% &lt; -2SD</td>
<td>% &lt; -1SD</td>
<td>% &lt; 0</td>
</tr>
<tr>
<td>Total (6-60)</td>
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<td>1.5</td>
<td>0</td>
<td>1.7</td>
</tr>
<tr>
<td>(6-11)</td>
<td>0</td>
<td>1.2</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>(12-23)</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2.7</td>
</tr>
<tr>
<td>(24-35)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.3</td>
</tr>
<tr>
<td>(36-47)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(48-60)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
</tr>
</tbody>
</table>

| Gender (male) | Total (6-60) | 0 | 0 | 0 | 2.7 | 0 | 0.8 | 6.2 | 0 | 9.3 |
| (6-11) | 0 | 0 | 0 | 1.2 | 0 | 0 | 9.6 | 0 | 10.2 |
| (12-23) | 0 | 0 | 0 | 4.8 | 0 | 1.6 | 3.8 | 0 | 10.8 |
| (24-35) | 0 | 0 | 0 | 3 | 0 | 0 | 1.5 | 0 | 3 |
| (36-47) | 0 | 0 | 0 | 0 | 0 | 0 | 1.9 | 0 | 3.8 |
| (48-60) | 0 | 0 | 0 | 2.2 | 0 | 2.2 | 15.6 | 0 | 15.6 |

| Gender (female) | Total (6-60) | 0 | 3.1 | 0 | 0.6 | 0 | 1.4 | 3.3 | 0 | 6 |
| (6-11) | 0 | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.3 |
| (12-23) | 0 | 6.1 | 0 | 0.6 | 0 | 3.3 | 1.1 | 0 | 6.7 |
| (24-35) | 0 | 0 | 0 | 3.5 | 0 | 1.8 | 3.5 | 0 | 14 |
| (36-47) | 0 | 0 | 0 | 0 | 0 | 0 | 3.8 | 0 | 11.5 |
| (48-60) | 0 | 0 | 0 | 0 | 0 | 0 | 2.4 | 0 | 2.4 |
أنماط النمو والحالة الغذائية للأطفال عن طريق الرضاعة الطبيعية خالصة على سن الخامسة من العمر

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الأقسام طبيب الأطفال في كلية الطب جامعة بنها، جامعة بنها، جامعة القاهرة

الملخص

الخلفية: تتراوح نسبة التقلص من 28% إلى 40% في الأطفال المصريين دون سن الخامسة من العمر وهو يعكس سوء تغذية مزمن والذي يعد مشكلة قومية خطيرة لمستقبل أبنائنا.

الهدف: دراسة تأثير ممارسات تغذية الرضع على أنماط نمو الأطفال الذين يتعرضون للرضاعة في وقت مبكر من الحياة.

طرق البحث: وقد تم اختيار ألف طفل تتراوح أعمارهم بين 6 و 60 شهرا من محافظة الغربية قد تعرضوا إلى الرضاعة الطبيعية الخالصة في الأشهر السبع الأولى من الحياة. وقد قمنا بفحصهم بالقياسات الأنثروبولوجية الكاملة من الوزن والطول، ومؤشر النحافة (نقص الوزن بالنسبة للطول) والسمة من قبل مروا كتلة الجسم بالنسبة للعمر باستخدام التقنيات القياسية. تم تغذية القياسات في بيانات النمو الآلي من منظمة الصحة العالمية وتفسيرها باستخدام أحدث الخرائط النموية باستخدام المنحنات المعتمدة على الإحراز المعياري.

وأظهرت نتائج البحث تطابق معدلات نمو الأطفال الرضع طبيعياً بمخططات النمو من منظمة الصحة العالمية فإن حالات نقص في الوزن أو الهزال أو السمنة كانت شبه منعدمة و قد وجدنا زيادة في الوزن الزائد بنسبة 9.3 و 4% تقلزم وقد تطابق ذلك مع دراسات في دول أخرى كثيرة ويشير إليه بخلاص "الأوزن الزائد مع التقلزم" و يفسر بالعادات الخاطئة في النظام الغذائي التي تعتمد على الأطعمة التي تحتوي على دهون ابن حيواني بالخصوص الجاموسية مع نقص في البروتينات.

الاستنتاجات: الرضاعة الطبيعية في الأشهر السبع الأولى من الحياة هو ممارسة التغذية المثلى لضمان النمو الملائم والتنمية والوقاية من التقلزم، ونقص الوزن والبدانة بين الأطفال.

التوصيات: حكومتنا يجب أن تستثمر في تعزيز الرضاعة الطبيعية الخالصة منذ الولادة وحتى سنة أشهر بعد إجازة الوضع مفتوحة الأجر إلى 6 شهور فهي استراتيجية الأكثر فعالية وكفاءة لتحسين معدلات السوء التغذية المزمن بين الأطفال دون سن الخامسة من العمر في بلدنا.