Growth faltering in infants – what are the underlying factors?

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Background
Children who cannot keep a proper growth pattern may have growth faltering, which if started in infancy may lead to long-term sequelae, such as growth delay and permanent cognitive deficiencies.

Aim
The goal of this study was to detect the causes that contribute to failure to thrive among children in Egypt.

Participants and methods
This is a cross-section study that included 100 infants with faltering growth. Their ages ranged from 1 month to 2 years. Full history and clinical examination including all anthropometric measures were done for all infants in the study. Investigations included full blood count, stool analysis, urine analysis, in addition to any further investigation to prove the diagnosis.

Results
This study showed that 61% were males, whereas 39% were females. Poor oral intake was the most common complaint that was present in 90% of studied cases. Insufficient intake accounted for the most common etiology of faltering growth, whereas persistent or recurrent gastroenteritis was significantly related to growth faltering. Underweight was significantly related to maternal age between 18 and 30 years old. Stunting was more prevalent in preterm infants and those with poor dietary diversity, whereas wasting was significantly related to increase in family size.

Conclusion
Risk factors contributing to faltering growth were low maternal age for underweight, prematurity, and poor dietary diversity for stunting and birth order more than third child for wasting. Insufficient intake and gastroenteritis were the most important contributing factors of faltering growth.

Keywords:
Egypt, faltering growth, risk factors

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Background

Growth is a chief characteristic for children and is considered as a very interesting point for children's nutritional evaluation. Children whose weight or height for age was decreased and those who cannot keep a proper growth pattern are those who have faltering growth [1]. Growth measurements and the use of growth charts are considered to be a basic part of health monitoring for all children. Head circumference, weight, and length should be routinely measured at birth and then on an intermittent basis throughout the rest of infancy and childhood—most frequently in the second half of first year of life. Prenatal growth is the most important stage, accomplishing a rate that is rarely coordinated later. Infantile period is the second important period of growth, with the newborn child acquiring 20 cm per year during these first months, conflicting with 10–20 cm a year by the second year of life [2]. Monitoring of growth is well known as a significant means for evaluating the nutritional health of children throughout life, whatever the clinical condition, but unfortunately, it has often received less attention than other complicated examinations. Faltering growth that started early has been found to increase children's susceptibility to delayed motor and mental development [3,4]. Despite using faltering growth as a general definition, no exact definition is generally accepted till now. Thus, faltering growth has been used to cover a wide range of several anthropometric pointers, usually based on centile charts or *Z*-score for weight or height. There may be different causes, both disease-related and other not, for failure to thrive (FTT). Getting the definitive diagnosis is the most important parameter to ensure the correct treatment [5].

After confirmation of FTT by frequent valid measurements, early search should be done for the underlying causes of undernutrition, which may

include negligence, inattention to family food security, or underlying diseases. Insufficient intake of adequate calories is the most obvious cause for faltering growth, but disorders of absorption or metabolism are also probable [1].

Inability to achieve or keep proper weight is the first indication of faltering growth, and persistent undernutrition can negatively affect proper height, head circumference, and mental development or immune function in severe cases. Early recognition and management of the problems causing undernutrition are important. In most cases, an appropriate growth rate can be achieved with outpatient management based on good nutrition and family support. FTT in children can be easily managed by primary care physicians and rarely needs further consultations by other subspecialists [1].

Participants and methods

Study plan

This search is a cross-section search that included 100 infants with faltering growth attending the nutrition unit of a University Children Hospital, Egypt, from January 1 to December 31, 2018. Their ages ranged from 1 month to 2 years. They were 61 male and 39 females. This search was designed to detect reasons that cause faltering growth among infants. The study was approved by the Ethics Committee of the Faculty of Medicine (IRB no: 17100915).

Inclusion criteria

(1) Infants who are stunted, wasted, or underweight with *Z*-score below – 1 on their specific WHO charts were included.

Exclusion criteria

The following were the exclusion criteria:
(1) Neonates.
(2) More than 2 years of age.

Full history, examination, anthropometric measurements, and full laboratory investigations were done for all infants.

Statistical analysis

The data were tested for normality using the Anderson-Darling test and for homogeneity variances before further statistical analysis. Categorical variables were described by number and percentage, where continuous variables were described by mean and SD. χ^2 test and Fisher's exact test were used to compare between categorical variables. The comparison between continuous variables was done by *t*-test and analysis of variance test. A two-tailed *P* less than 0.05 was considered statistically significant. All analyses were performed with the IBM SPSS 20.0 software (SPSS inc, chicago-united states).

Results

Table 1
(1) Infants were less than 2 years of age, with a mean age of 11.44 ± 6.72 months.
(2) Faltering growth was widely distributed among males (61%) rather than in female (39%).
(3) Infants who were born prematurely represented ~68% of the studied cases, especially those of birth weight less than 2500 g, who represented 66% of the cases, and also those with a previous history of NICU admission, who represented 55% of the studied cases.
(4) Infants born through a cesarean section delivery represented 60% of the study cases.
(5) Infants born to a mother aged 18–30 years represented 75% and whose birth order was third child or more represent 45% of the studied cases.

Table 2
(1) Deficient or insufficient food intake accounted for the most common etiology of faltering growth, representing 60% of the studied cases, where 12% of them had rickets, 10% of them had Kwashiorkor, 12% of them were mentally

Table 1 Demographic data in the studied cases of faltering growth

	n (%)
Age in months	
Range	2+24
Mean±SD	11.44±6.72
Sex	
Male	61 (61)
Female	39 (39)
Residence	
Rural	89 (89)
Urban	11 (11)
Birth order	
First	20 (20)
Second	35 (35)
Third or more	45 (45)
Maternal age	
18-30 years	75 (75)
>30 years	25 (25)
Type of delivery	
NVD	40 (40)
CS	60 (60)

CS, cesarean section; NVD, normal veginal delivery.

retarded (cerebral palsy and Down syndrome), 9% of them had gastroesophageal reflux, and the remaining 17% had insufficient breastfeeding or diluted or overconcentrated formula.

(2) Overall, 18% of our studied cases complained of gastroenteritis, either persistent or recurrent, and 8% of them complained of mixed pneumonia and gastroenteritis.

(3) Malabsorption represented 14% of our studied cases, where 9% of them had cow milk allergy and 5% of them had celiac disease.

(4) Surgical cases represented 5% of our studied cases (two cases were due to intestinal obstruction with colostomy, congenital megacolon, malrotation, and short bowel syndrome).

Table 3

(1) Regarding breastfeeding, ~30% of the infants received exclusive breastfeeding (EBF) either up to 6 months (14%) or up to 2 years (16%).

(2) Regarding complementary feeding (70%), 53% of the cases started weaning before 6 months whereas 17% of the cases started it after the age of 6 months.

(3) Overall, 28% of the weaned infants (70% of the total infants) received formula feeding and fresh cow milk; 6% received breastfeeding, fortified cereals, and yoghurt; and the remaining 36% received formula-feeding plus fortified cereals and family food.

Table 2 Contributing factors to faltering growth in studied cases

	Number cases		*n* (%)
Insufficient or deficient intake	60	Mentally retarded	12 (12)
		Normal mentality	48 (48)
Gastroenteritis	18	Recurrent	11 (11)
		Persistent	7 (7)
Malabsorption	14	Celiac	5 (5)
		Cow milk allergy	9 (9)
Chronic medical (cardiorespiratory)			3 (3)
Surgical cases			5 (5)

Table 3 Type of feeding among the studied cases of faltering growth

Type of feeding	*n* (%)
Exclusive breastfeeding	30 (30)
Up to 6 months	14 (14)
More than 6 month	16 (16)
Complementary feeding	70 (70)
Formula feeding and fresh cow milk	28 (28)
Breastfeeding + fortified cereals, yoghurt	6 (6)
Formula feeding + fortified cereals and family food	36 (36)
Time of starting complementary feeding	70 (70)
<6 months	53 (53)
>6 months	17 (17)

Discussion

Growth faltering has a major heath concern for infants and children, especially for those less than 5 years of age as it can disturb the immune response, increasing the liability for severe infections, and increase under-5 mortality. Furthermore, growth faltering that is not managed early and properly may cause ongoing growth deficits, diminished physical activity, behavioral problems, learning disabilities, in addition to irreversible affection of cognitive and psychomotor development.

Our research demonstrated that faltering growth was common in males than in females. This result was confirmed with other studies [6,7] who stated that males are more liable to early childhood diseases, health problem, and harsh hazards of environment. On the contrary, Habibzadeh *et al.* [8], stated that such a dissimilarity is related to the social and cultural discrimination between sexes, where more attention is paid to the nutrition of male children than female children, which in turn may be the cause of FTT and other health problems in female infants.

This study revealed that faltering growth was more common in rural areas than urban areas. This agreed with other studies [9,10], which have stated that the reason for undernutrition among rural infants is food insecurity in rural population, in addition to the more prevalent maternal undernutrition in rural populations. Kavosi *et al.* [6], explained this great incidence of undernutrition in rural areas owing to ignorance, low social population, inadequate water supply, and the high prevalence of infectious disease among rural population.

Regarding birth order, we noticed that growth faltering was more common in one-third or more children. Same results were reported in other studies. [6,10,11].

This could be illustrated by the high economic burden for food consumption that these families could suffer from with each additional child, and so lead to inadequate nutritional status. In other words, poor distribution of household resources in between many children may lead to the low nutritional status, especially among poor families that cannot satisfy their nutritional supplies. In addition, large families who have more children usually have less time to take care of their infants. These previous data disagreed with Habibzadeh *et al.* [8], who stated that the first-order and second-order infants were more likely to have growth failure compared with the third-order child, owing to the more experience of mothers in feeding their infants and considered that birth order

seemed to be a protecting issue for development of children.

Regarding the maternal age, the highest group of infants with growth faltering was for mothers between 18 up to 30 years old. This was in agreement with other studies [8,11], which attributed this to that period of age represents the peak of childbearing in addition to the lack of maternal experience in this young age group.

Cesarean sections were more liable to growth faltering (60%) than those delivered by normal vaginal delivery. Our study showed that the most common contributing factor for faltering growth was insufficient oral intake. This was in agreement with other studies [12,13], which attributed that to the lack of parent's knowledge about proper feeding techniques which may lead to feeding refusal and feeding difficulties in their infants. Common mistakes occur in breastfeeding regarding proper way and difficulty in swallowing. Parents may also have less knowledge about appropriate formula mixing, proper milk intake, or appropriate complementary feeding practice. For toddlers, there are problems in transition to solid foods, which results in inadequate intake [14]. In addition, the parent's actions and feeding lifestyle during the time of meal can change an infant's eating behavior [15].

Gastroenteritis represents the second contributing factor for growth faltering among our studied cases, representing 18%. Some have recurrent, whereas others have persistent gastroenteritis. The relationship between malnutrition and gastroenteritis is owing to the influence of nutrition on the immune system, formation of digestive enzymes, and integrity of absorptive surface of the intestine in addition to maintaining healthy gut microbiome. This intimate relationship is also known as diarrhea-malnutrition cycle, which leads to decreased absorption of proteins by 43%, carbohydrates by 42%, and fats by 72%, respectively [16].

Malabsorption owing to cow milk allergy represented 9% of our studied cases. Gastrointerstinal tract symptoms and signs of cow milk allergy are due to inflammation, dysmotility, or both. The signs include difficulty of swallowing, vomiting, regurgitation, stomach upset, early satiety, anorexia, diarrhea (with or without malabsorption or protein loss), rectal bleeding, FTT, abdominal ache, severe colic, or intractable constipation, and these manifestations can lead to growth faltering [17]. In addition, the state of chronic inflammation of the intestinal mucosa may result in reduced bioavailability or much loss of nutrients owing to affection of intestinal permeability that causes inadequate growth in children with food allergies. These patients with cow milk allergy are sometime accompanied with low albumin level; which is a rare condition [18].

In our study, celiac disease represented 5% of our studied cases. This is higher than the known prevalence of celiac disease in children, representing 1–2%, but we should take in consideration that this study was done on those with growth faltering. 'Classical' celiac disease that is marked by diarrhea, gaseous distension, and growth retardation is usually manifested in young children [19,20]. Celiac disease should also be suspected in children with growth faltering, prolonged malaise, unanticipated weight loss, repeated aphthous ulcer, anemia, or increased liver enzymes. Moreover, there are disorders related to celiac disease such as autoimmune thyroiditis, dermatitis herpetiform, and type 1 diabetes [21]. Faltering growth in young children or stunting growth between older children is considered as one of three main clinical presentations of celiac disease in children [22].

EBF for more than 6 months represented 16% of our cases. This may be explained by the ignorance of mother about the schedule of weaning or may be related to the poverty and low socioeconomic status. Energy gap that occur after 6 months owing to failure of breast milk to produce daily needs of the infant in this period can explain the liability of those infants to have FTT. On the contrary, complementary feeding at age less than 4 months was started for 53% of our studied infants. This agreed with Habibzadeh *et al.* [8] and Asfaw *et al*. [11], who stated that children living in developing countries are introduced directly to the routine homemade food like cereal or starchy crops, which is one of the main reasons for the great prevalence of child malnutrition, morbidity, and mortality [7]. Complementary feeding is important when breast milk alone can no longer satisfy the nutritional needs of the growing infant. Too early or late introduction may negatively affect the child nutritional state. Especially in developing countries, introduction of complementary food too early may cause frequent occurrence of contamination and increase the risk of gastrointerstinal tract and respiratory infections. Thus, the issue of weaning and the risk of morbidity and mortality associated with early introduction of complementary foods are more in developing countries. This issue has divided the public health experts, and there are disagreements about the correct time of introduction of complementary food. Our study results support other studies [23], which insist on EBF during the first 6 months, as this safeguards the babies against infections, and that it does not cause inadequate nutritional intake, rather termination of EBF during the first 4 months could cause underweight.

Conclusion

The most reliable risk factors contributing to faltering growth were low maternal age for underweight, prematurity for stunting, and birth order more than third child for wasting. Insufficient intake and gastroenteritis were the most important contributing factors of faltering growth. Poor dietary diversity was an essential factor the development of stunting.

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Conflicts of interest

There are no conflicts of interest.

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