**Risk factors for stunting among school children**

**in Sohag governorate, Egypt**

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**ABSTRACT:**

**Objective:** Determining the prevalence and risk factors associated with stunting among school children in Sohag governorate, Egypt.

**Methods:** This is a cross sectional study that is carried out from January 2017 to May 2017 at Sohag governorate,. In this period, a total coverage of children from one urban and one rural school whom their parents accept to participate in the study were done. **Results:** A total of l786 child were enrolled in the study, (18.4%) were stunted (below 2 z score), about 76 (4.3%) children their stature were below 3z score. Factors which found to be significant in contributing to risk for stunting are parasite infestation [p = <0.001; odds ratio 1.8; 95 % conﬁdence interval (CI) (1.3-2.5)], anemia [p = <0.001; odds ratio 1.7; 95 % conﬁdence interval (CI) (1.3-2.7)], BMI [p = <0.001; odds ratio 1.2; 95 % conﬁdence interval (CI) (1.1-1.3)], more frequent gastroenteritis [p = 003; odds ratio 1.1; 95 % conﬁdence interval (CI) (1.06-1.2)] and familial short stature [p = 004; odds ratio 1.5; 95 % conﬁdence interval (CI) (1.2-2.1)] were independent factors of stunting between children. **Conclusion:** The study found that presence of family history of short stature, anemia, vitamin deficiency, parasitic infestations, frequent gastroenteritis and low BMI were the most important risk factors for childhood stunting among school children in Sohag governorate

**KEY WORDS:** Stunting, Familial short stature, Body Mass Index Vitamin deficiency, Gastroenteritis.

**Introduction:**

Stunted growth is defined as height for age z-score (HAZ) less than 2 standard deviations below the global median according to the [World Health Organization](https://en.wikipedia.org/wiki/World_Health_Organisation) (WHO) references**(1)**. Stunting affects up to 32% of children living in developing countries, representing a major public health problem with a great impact on child health and development in these countries**(2)**. Stunting has now been celebrated as a main global health primacy with the WHO objects to shrink stunting by 40% between 2010 and 2025**(3)**.

In stunted children, short stature is not commonly a problem in itself, but rather the stunting syndrome in which various pathological changes happen in the form of linear growth retardation, impaired cognitive development and reduced physical capacity of the children. The long-term consequences of stunting include reduced work capacity and increased risk of poor reproductive performance. Also, there is a positive association between stunting in childhood and adult life obesity and cardio-metabolic disorders. Moreover, stunting has also a trans-generational effect as mothers who were themselves stunted as children tend to have offspring with stunted growth, leading to an intergenerational cycle of growth impairment**(4)**.

Several risk factors for childhood stunted growth have been identified. Maternal malnutrition during pregnancy affects future child growth**(5)**. Childhood malnutrition either as inadequate overall caloric intake or deficiency in certain micronutrients is associated with growth failure **(6)**. Recurrent infections such as [diarrhea](https://en.wikipedia.org/wiki/Diarrhea) and [parasitic](https://en.wikipedia.org/wiki/Helminthiasis) infestations as a result of poor sanitary living conditions are major risk factors for stunted growth in children in developing countries**(7), (8)**.

Despite of numerous identifiable risk factors for childhood stunting, there is a wide variation in the impact of different risk factors in different regions even in the same country**(9), (10)**. Therefore, Identification of local and environmental risk factors is of a great importance to establish local preventive strategies against stunted growth. There are only few studies about the prevalence of stunted growth and local risk factors for it in Upper Egypt. To address this gap, we conducted this study to identify risk factors for stunting among school children in Sohag Governorate.

**Aim of the work:**

This study aimed at determining the prevalence and risk factors associated with stunting among school children in Sohag governorate, Egypt.

**Methodology:**

This is a cross sectional study that is carried out from January 2017 to May 2017 at Sohag governorate. In this period, a total coverage of children from one urban and one rural school whom their parents accept to participate in the study were done, children of both gender, age 4-12 year were recruited, The exclusion criteria were short stature children with known syndrome (Noonan, Russell Silver, Prader-willi), and children with contractures and kypho-scoliosis in whom height could not be measured. Protocol of the study was approved by the ethical committee at Sohag faculty of medicine.

We elucidate all the study details to children parents,/guardians, then informed consent was taken. All the related terminologies were clearly defined. Data obtained included, age, residence, birth place, weight at birth, father and mother education, father and mother job, consanguinity between parents, familial short stature, child rank in family, family income, presence or absence of anemia, vitamin deficiency, parasitic infestation, frequency of common cold, frequency of enteritis, weight and height were measured (barefoot and in underwear) by trained medics. Measurements were recorded to the nearest 0.5 kg for weight and 1 cm for height. BMI was calculated (weight in kilograms divided by height squared in meters). Stunting was defined as height below two standard deviation (-2SD) or less than 3rd percentile for age and sex according to the WHO recommendation.

**Statistical analysis:**

Data was analyzed using SPSS computer program version 22.0. Quantitative data was expressed as mean ± standard deviation, median and range. We presented the qualitative data as percentage and numbers. We tested the data for normality by Shapiro-Wilk test, that direct us to use nonparametric tests such as Mann–Whitney test. Chi-Square test was used for comparison between qualitative variables. We considered the risk factors for short stature to include (i) paternal factors, familial short stature, degree of consanguinity between parents, rank in family and family income; (ii) child factors, presence of anemia, parasite infestation, vitamin deficiency, frequency of enteritis, common cold and BMI. The variable found significant by univariate analysis were further analyzed by multivariate analysis using logistic regression. All P value was two- sided and the significant level was set to be less than 0.05.

**Results:**

A total of l786 child were enrolled in the study, 329 (18.4%) were stunted (below 2 z score), about 76 (4.3%) children their stature were below 3z score, those group were excluded from the analysis. The characteristics of the studied group are described in Table 1, which showed that (50.2%) of the stunted group were male, their mean age was (8.01±2.9) with age range between 8 and 12 years. It also showed that 53.4% of the stunted children live in rural area and 46.6% in the urban area. With no significance difference observed between stunted and normal group related to gender, age, and weight at birth, place of residence, mother and father education, and mother and father job.

Associations between paternal and child factors and short stature were also determined (Table 2) Univariate analyses showed that familial short stature (p = <0.001), anemia (p=<0.001), parasite infestation (p = <0.001), vitamin deficiency (p=0.044), frequent common cold (p = 0.040), frequent gastroenteritis (p = 0.002), and BMI (p = <0.001) were signiﬁcantly associated with short stature, whereas consanguinity between parents, family income and child rank in family were not.

Factors which found to be significant in contributing to risk of short stature after univariate analysis were evaluated for possible association and interaction, by multivariate logistic regression analysis (table 3) showed that parasite infestation [p = <0.001; odds ratio 1.8; 95 % conﬁdence interval (CI) (1.3-2.5)], anemia [p = <0.001; odds ratio 1.7; 95 % conﬁdence interval (CI) (1.3-2.7)] , BMI [p = <0.001; odds ratio 1.2; 95 % conﬁdence interval (CI) (1.1-1.3)] , more frequent gastroenteritis [p = 003; odds ratio 1.1; 95 % conﬁdence interval (CI) (1.06-1.2)] and familial short stature [p = 004; odds ratio 1.5; 95 % conﬁdence interval (CI) (1.2-2.1)] were independent factors of stunting between children.

**Table (1): Socio demographic characterization of the studied population of children.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Short stature**  **≤2 Z score** | **Normal growth** | **P value** |
| **Age (year)**  Mean ± SD  Mode(Rang) | 8.01±2.9  8 (4-12) | 8.5±5.9  8 (4-12) | 0.23\*\* |
| **Gender**  Male  Female | 127(50.2)  126 (49.8) | 742 (50.9)  715 (49.1) | 0.830\* |
| **Residence**  Rural  Urban | 135 (53.4)  118 (46.6) | 740 (50.8)  717 (49.2) | 0.450\* |
| **Father education**  Illiterate  Read and write  Obligatory education  Faculty | 24 (9.5)  67 (26.5)  131(51.7)  31(12.3) | 166 (11.4)  388 (26.6)  733 (50.3)  170 (11.7) | 0.834\* |
| **Mother education**  Illiterate  Read and write  Obligatory education  Faculty | 23(9.1)  66 (26.1)  140 (55.3)  24 (9.5) | 166 (11.4)  399 (27.4)  736 (50.5)  156 (10.7) | 0.484\* |
| **Father Job**  Working  Not working | 232 (91.7)  21(8.3) | 1319(90.5)  138 (9.5) | 0.5548 |
| **Mother Job**  Working  Not working | 92 (36.4)  161(63.6) | 589(40.4)  868(59.6) | 0.223\* |

**\*\*P- value was calculated by Mann-Whitney U test**

**\*P- value was calculated by Chi square test**

**Table (2): Univariate analyses of risk factors for stunting among study participants.**

|  |  |  |
| --- | --- | --- |
| **Variables** | **OR (CI 95%)** | **P - value** |
| **Consanguinity between parents**  **Yes 144(56.9%)**  **No 109 (43.1%)** | 1.2(0.89-1.5) | 0.269 |
| **Familial short stature**  **Yes 131(51.8%)**  **No 122 (48.2%)** | 1.7(1.43-2.2) | **< 0.001** |
| **Rank in family** | 0.96(0.86-1.1) | 0.453 |
| **Family income** | 1.1(0.95-1.2) | 0.291 |
| **Anemia**  **Yes 128 (50.6%)**  **No 125 (49.4%)** | 2.2 (1.5-2.9) | **< 0.001** |
| **Parasite infestation**  **Yes 145 (57.3%)**  **No 108 (42.7%)** | 2.1(1.6-2.7) | **< 0.001** |
| **Vitamin deficiency**  **Yes 133 (52.6%)**  **No120 (47.4%)** | 1.3(1.1-1.7) | **0.044** |
| **Frequency of common cold** | 1.2(1.1-1.3) | **0.040** |
| **Frequency of enteritis** | 1.3(1.2-1.4) | **0.002** |
| **BMI** | 1.2 (1.1-1.3) | **< 0.001** |

**Table (3): Multivariate logistic regression analysis.**

|  |  |  |
| --- | --- | --- |
| Characteristics | Adjusted OR (CI 95%) | P - value |
| Parasite infestation | **1.8 (1.3-2.5)** | **< 0.001** |
| Anemia | **1.7 (1.3-2.7)** | **< 0.001** |
| BMI | **1.2 (1.1-1.3)** | **< 0.001** |
| Frequency of enteritis | **1.1 (1.06-1.2)** | **0.003** |
| Familial short stature | **1.5 (1.2-2.1)** | **0.004** |
| Frequency of common cold | **1.1 (0.97-1.3)** | **0.113** |
| Vitamin deficiency | **1.2 (.89-1.7)** | **0.261** |

**Discussion:**

Children growth is a complex process that comprises genetic, nutritional and environmental factors. There are multiple risk factors that are considered to be affecting growth and contributing to stunting of children**(11)**. The current study tried to assess the prevalence of stunting, and to explore some of the risk factors for stunting among school children in Sohag Governorate.

This study establishes that 18.4% of the studied school children have height for age z-score (HAZ) less than 2 standard deviations. Though, this prevalence rate is lower than that found by El-Moselhy et al. (2011) who conducted a study on preparatory school children in Cairo and found that the prevalence of short stature was 34.1%**(12)**, Our finding is consistent with other studies done in other developing countries that demonstrated a similar prevalence rate of 19.8% among school children in Nigeria**(13)**, 16.64% among Kenyan school children**(14)**, and 17.9% among children in India **(15)**.The prevalence Variances in stunting among countries and between different population and districts within the same country suggest the role of socioeconomic factors**(11, 16,** and17**)**.

We did not find significant effects of age, sex and place of residency on childhood stunting. Although there is strong evidence that low birth weight was associated with poor height gain throughout childhood and reduced final adult height**(18),** our study also did not find significant effect of birth weight or place of delivery on the childhood stunting. Furthermore, this study did not show significant effects of the parental education or parental jobs on children stature. Similarly, the study did not find any association between family income and stunting in children. These results indicate short stature may not be reflection of poverty and unavailability of food, but it would rather be an indirect result for unhealthy nutritional habits and lack of family awareness about healthy nutrition required for growth of children.

Suitable nutrition is vital for optimal growth. Balanced healthy diet, containing adequate calories from carbohydrates, fat and proteins as well as sufficient in vitamins and minerals, is essential for growth. Malnutrition is a main risk factor for stunting syndrome among children in the developed countries. Malnourished children tend to have multiple macro nutrient and micronutrient deficiencies and impaired immunity with frequent infections leading to stunting growth**(6), (19)**.

Our results demonstrated that children with short stature tend to have lower body mass index. As Body mass index is a pointer for nutritional status in children, this finding suggests that Malnutrition is an important risk factor for stunting in children. We also identify that vitamins deficiency and anemia among school children were associated with stunted growth. Several studies found that multiple micronutrient deficiencies as vitamin A, Iron, Zinc are associated with short stature and stunting syndrome in children**(5, 20 and 21)**. However, there is no strong evidence that correction of these micronutrients deficiencies increase the height of children suggesting that there are associations rather than causal relationships.

The findings of this study provide evidence that parasitic infestation is one of the causal factors of stunting among the children. Unhygienic living condition especially in rural areas in developing countries like in Upper Egypt is still a major cause for recurrent gastroenteritis and parasitic infestation among children**.** In a previous study conducted in Sohag governorate, 38.5% of children had parasitic infestation; 31.6% of them had stunted growth(22). The relationship between parasitic infestation and short stature was demonstrated in studies conducted in different tropical and subtropical countries**(23, 24)**. Parasites can interfere with digestion and absorption depriving children from essential nutrients required for growth.

The study showed that frequent gastroenteritis was associated with increased risk of stunting. Gastroenteritis is a common childhood infection especially in areas with poor hygiene and sanitation. Although gastroenteritis has a small short term effect on growth because catching up of growth usually occur after acute episodes , some studies found that recurrent episodes of gastroenteritis have a cumulative effect leading to a small but measurable effect on growth**(25, 26)**. Moreover, frequent exposure to enteric pathogens even if asymptomatic, may have a long term effect on gut structure and function leading to villous atrophy with chronic inflammation of small intestine with modest malabsorption. In the context of poverty with diet lacking or marginally containing essential nutrients, this mild form of malabsorption may exacerbate growth failure and result in short stature**(27, 28)**.

In line with the findings of El-Moselhy et al. (2011)**(12)**, this research observed that family history of short stature was associated with children short stature. This can be explained by social and traditional values in our community where short men prefer to marry even shorter women making the genetic pool for the offspring more toward the short side. Consanguineous marriage especially first cousin marriage is common in our community and it carries a greater risk on the offspring due to the deleterious effect of some recessive gene. It was very important to address the effect of consanguinity on childhood stunting in this study.

Though, we did not notice a significant consequence of consanguinity on childhood stunting. There is no agreement on the influence of marriage between consanguineous persons on the anthropometric measurements and low growth in children.

In line with our results, some studies show no significant effect of consanguinity on anthropometric measurement of children**(29, 30 and 31)**.On the other hand, An Egyptian study by Belal and Omar (2006) indicated that a trivial but statistically significant depression has been perceived for all investigated anthropometric measurements in the children of consanguineous parents **(32)**. Similarly, El-Moselhy et al. (2011) revealed that positive parental consanguinity was a significant risk factor for the low growth status among students and the risk increases if the parents were first cousin**(12)**.

**Conclusion:**

In conclusion, the study found that presence of family history of short stature, anemia, vitamin deficiency, parasitic infestations, frequent gastroenteritis and low BMI were the most important risk factors for childhood stunting among school children in Sohag. Therefore, we suggest that screening and treatment of parasitic infestation, provision of iron and multivitamin supplementations as well as education of children and parents about healthy nutrition basis should be a part of school health programs to prevent short stature among school children.

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