Effect of Raising Nutritional Awareness Level on Height of Stunted School-aged Children

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ABSTRACT

*Stunting is a serious worldwide health issue, mainly due to chronic malnutrition which is often connected with a lack of nutritional awareness. So, the present study aimed to evaluate the effect of raising nutritional awareness among stunted children aged 6-12 years, and their mothers on catching up with children's growth rate and improving nutritional status among them. A pre and post-test study was conducted on fifty school-age children chosen randomly from the Short Stature Clinics at the National Nutrition Institute, Ministry of Health, Cairo, Egypt after undergoing a medical examination by the physicians and excluding those with chronic diseases, metabolic disorders, and hereditary bone diseases. Dietary intervention and a specific nutritional education program were delivered to the children and their mothers for six months. Anthropometric, laboratory, and dietary evaluations were made for children at baseline and after the intervention. The main results illustrate highly significant improvements in mothers' and children's awareness (p=0,000) and a significant decrease in the severity of stunting per age and sex (p= 0.031) for both boys and girls. In c**onclusion,** raising nutritional awareness and suitable dietary intervention may decrease stunting status among school-aged children. So, more research should be done on a wide range for a longer period to help school-age children catch up on the growth chart should be done.*

Keywords: *School-age, stunting, nutritional education, and dietary intervention.*

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Received: 10 August 2024
Accepted: 9 September 2024
Published online: 20 September 2024

Citation
Haggag MH; Hammad EM; Habib EE and Abd Elhady RM (2024): Effect of Raising Nutritional Awareness Level on Height of Stunted School-aged Children. BNNI (64) 35-52. doi: 10.21608/ bnni.2024.380627

INTRODUCTION

Stunting is a serious global health issue, with short- and long-term health implications such as delayed cognitive development, reduced productivity, and an increased risk of child morbidity and death **(Dewey and Begum, 2011; Ong *et al.,* 2013).** Growing knowledge of stunting's significance and severe consequences has resulted in its recognition as a major global healthcare priority and the target of global effort at the greatest levels with international goals set for 2025 and beyond **(de Onis and Branca, 2016).** The Sustainable Development Goals SDGs aim to reduce stunting to 89 million people by 2030 **(UNICEF, 2021).**

Many studies have reported that preventing stunting could be achieved through nutrition education, counseling, group therapy, home visits, and collaboration between health workers and cadres. Premarital education classes can also be beneficial for prospective couples **(Hanifah and Syahrizal, 2024).**

The school-age period is crucial for building up body stores of nutrients to support rapid growth during adolescence. Children's growing bodies demand more nutrients as they develop **(Saavedra and Prentice, 2023).** School-age children are the most significant component of Egyptian society. The number of children under the age of 15 in Egypt represents 35 % of the total population so society of Egypt is regarded as a youthful society in 2020**,** and the number of children from five to fourteen years old in Egypt represents 24.6 % **(CAPMAS, 2022).** The physical development and nutritional condition of school-aged children are regarded as critical because they reflect the overall health of the community. Good nutrition is also a predictor of good mental and physical development at all stages of life, particularly in the early years **(El-Din *et al.,* 2019).**

This study was conducted to implement a nutritional education program for mothers and children and evaluate the extent to which the intervention with a nutritional education program can improve stunting and nutritional status among them.

METHODOLOGY

Sampling:

The present pre and post-test study was chosen at random from the Short Stature Clinics in the National Nutrition Institute, Ministry of Health, Cairo, Egypt, after undergoing a medical examination by a specialist doctor.

Inclusion Criteria

Conduct on twenty-five boys and twenty-five girls of school-age children.

Exclusion Criteria

Children with chronic diseases, metabolic disorders, hereditary bone diseases, genetic bone diseases, and congenital disorders such as celiac disease and allergic patients.

Subjects underwent to:

The children and their mothers underwent a nutritional education program with follow-up for the children for six months.

1-Bone Age Status Evaluation: Plain X-rays on the wrist taken for selected cases were investigated following the guidelines **(Tanner et al., 1977).**

2-Anthropometric Measurements: The Raven Mini Meter was used to measure the height. The World Health Organization identified children with stunted growth (height below −2 SD) **(WHO, 2019)**.

3- Laboratory Investigations:

Hemoglobin, serum calcium, and serum thyroid function (TSH)) were analyzed pre- and post-intervention by the procedure described by **Drabkin, (1948), Kaplan and Pesce, (1996); Fisher, (1996)** respectively.

4- Dietary Assessment: 24-hour recall, was done. 24-hour recall repeated with selected cases every month and at the end of the intervention. (1 time/month as well as at the end of intervention). The dietary intake included a detailed description of all food consumed including the cooking method, and the amount of each ingredient in the recipe was recorded. The intake of energy, iron, zinc, vitamin A, vitamin C, and other nutrients is computed through the compiled food composition tables **(National Nutrition Institute, 2006).** The adequacy of the diet consumed is assessed by comparing the energy and nutrient intake of the child with his recommended dietary allowances (RDA) **(Raymond and Morrow 2022).**

5- The Awareness Evaluation Pre- and Post-Intervention for Mothers and Children

All the children and their mothers received the nutritional awareness evaluation questionnaire. The nutritional awareness evaluation questionnaire for children differed from the questionnaire for their mothers. However, the nutritional awareness evaluation questionnaires before and after the nutritional intervention were identical. The research team designed two questionnaires each of which included 15 questions for mothers and their children about the importance of nutrition, some dietary practices, and nutritional elements for healthy growth. Also, about food groups and food exchange lists. The knowledge score for each answer was calculated as follows:

1 = Correct answer

0 = Wrong answer or does not know

The total score =15

The total knowledge scores were considered good if the score of the total knowledge was > 75 % (> 11), considered average if it equals 50-75% (7-11), and considered poor if it is less than 50% (<7). The questionnaire and scores were based on **(Diab, 2015).**

Nutritional Education

The program consisted of two modules offered in six sessions, including individual and group discussions carried out by the research team.

Module 1 covers basic nutrition in four sessions lasting one hour each. After these sessions, participants should understand the food guide pyramid and healthy plate, as well as food groups such as grains, fruits, vegetables, milk, meat and animal alternatives, fats and sweets, and fluids. They should also be aware of the serving sizes for each food item in each category.

Module 2: stunting (two sessions of one hour each). After these sessions, participants should be able to define stunting and identify associated risk factors.

Identify the importance of promoting a healthy lifestyle, including nutrition and exercise for preventing and treating stunting.

Diet Planned

Every child had a diet that was planned to confer the stunted school-age child's needs according

to gender, age, and activities using serving without supplementation.

Statistical Analysis:

The data was analyzed using the SPSS statistical program version 21. Results are presented as percentages and mean ± SD. The results were examined using the Compare Means (paired-samples T-test). Statistical significance will be assessed at $P < 0.05$ **(Snedecor and Cochran 1967).**

The Ethical issues:

The research of the General Authority for Hospitals and Educational Institutes (IN 000142/2023) was approved by the Scientific Research Morals Board.

RESULTS

Figure (1) illustrates that 80 % of the children in the study sample had estimated bone age status less than chronological age, and only 20 % had estimated bone age similar to chronological age.

Table (1), and Table (2), show statistical information about the severity of stunting for age-related height regarding sex, which demonstrate significance significant improvement in the stunting stage for both boys and girls with (P= 0.031)

Figure (2) demonstrates that there was a highly significant increase in both mother's and children's awareness after the intervention, where the awareness of the mothers before intervention was around 45.3 % ± 11.3 % SD then raised after the intervention to 94 % ± 6 % SD. On the other hand, the awareness of the children was pre-intervention was 52 % ± 12 % SD and increased to 95.3 % ± 4.6 % SD post the intervention.

Table (3) shows that the mean hemoglobin in the blood samples of the study sample children pre-intervention was 11.7 gm/dl ± 1.0 SD and improved post-intervention to 12.4 gm/dl ± 0.8 SD with significant results (p = 0.000), the mean serum calcium in the blood samples of the study sample children pre-intervention was 1.11mool / L ± 0.23 SD and post-intervention became 1.19mool / L / ± 0.16 SD without significant results (p = 0.362), and the mean thyroid stimulating hormone (TSH) level in the blood samples of the study sample children pre-intervention was 1.9 mIU / ml ± 0.9 SD and improved post-intervention

to 1.9 mIU / ml ± 0.8 SD without significant results (p = 0.714).

Table (4) shows 24-hour recall compared to RDA for pre- and post-intervention for all children of the study sample. With a highly significant increase in most food components intake for children compared to RDA, where the mean intake of calories before the intervention was 69.9 % of RDA / day with an increase post-intervention to 104.09 % of RDA / day with p. value equal to 0.000, The mean intake of protein which was 66.5 % of RDA / day with pre-intervention increased to 101.49 % of RDA / day post-intervention (p = 0.000). The intake average of Calcium before intervention was 34.07 % of RDA / day raised to 76.39 % of RDA / day post-intervention (p = 0.000).

DISCUSSION

The present study in Tables (1 and 2) shows the severity of stunting for age-related height regarding sex illustrated highly significant improvement in the stunted growth levels for both boys and girls, which represented the effect of the nutritional intervention by raising nutritional awareness. All children had improvement in their height status and around 25 % of them moved from the worst stage of stunting to the least severe stage, however, there was no difference between boys and girls, and that is in line with the previous study which indicated a significant association (P < 0.01) between children's height, nutritional knowledge, reported behaviors, and general lifestyle, but no significant correlation with gender **(Sheta *et al.,* 2023).** There were no significant differences between stunted and normal-stature children in terms of gender, age, location of residence, parental education level, or parental work **(Hamed *et al.,* 2020).**

The present study reported that before intervention the nutrition awareness level of stunted children and their mothers were 52 %, and 45 % respectively as stated in Figure (2), and that emphasizes the relation between stunting in school-aged children and their mother's nutritional awareness. These results were supported by a study by **Soliman *et al.,* (2024)** who conducted a study on mothers' perceptions of healthy lifestyles among their primary school children with stunting and

discovered that more than 30% of the mothers included had a low comprehension of stunting. The mother's level of education influences the family's well-being, especially the nutritional state.

According to **Heni, *et al.*, (2022),** toddlers that are not stunted may have received adequate nutrition from their parents, including minerals, vitamins, lipids, carbs, and proteins. Stunted toddlers can be caused by a lack of attention from mothers to their children's nutritional and health needs, as well as viral diseases that hinder growth.

The present study found a highly significant raising in both mother and their child awareness after intervention ($p = 0.000$) which agreed with an earlier investigation that showed that the intervention led to a significant rise in nutritional awareness ratings **(Osei *et al.*, 2023).** AS well as the study which reported that the nutrition educational program was successful in increasing mothers' awareness, reported practice, and attitude toward their children suffering from short stature after educational program implementation compared to before educational program implementation **(Abdelbaky *et al.*, 2024)**.

The present study found that stunted children pre-intervention had less than RDA daily from the intake of calories, protein, carbohydrates, and fat, as stated in Table (4). These results were in match with **Mahfouz *et al.*, (2021)** who found that the mean values intake of calories, protein, fat, and carbohydrates per day were lower than the RDA among children suffering from stunting, where the mean intake of calories for stunted children was 74.19% from RDA per day. These values revealed statistically significant differences between children suffering from stunting and the control group that did not suffer from stunting.

The study indicated that pre-intervention Calcium intake among school-aged children was the lowest concerning % RDA / day, followed by Magnesium. Iron and Zinc intake exceeded RDA levels, and that was in line with **(Mahfouz *et al.*, 2021)** except for Zinc, where Zinc was 94.15 % of RDA per day for the stunted group, but in the present study, Zinc was 105.4 % of RDA daily.

The results of the iron consumption exceeded the RDA and were consistent with the Nigerian investigation by **Ejaz and Latif, (2010)** which revealed greater iron consumption in the investigated group diets, most likely because they ate a broader range of grains, the majority of which had more iron. However, the findings were in contrast to the study conducted on preschoolers in Jordan, which found inadequate iron consumption (25.2%) and the occurrence of anemia (57.3%) among them **(Khatib and Elmadfa, 2009).** Despite appropriate iron consumption, the study found that school-aged, stunted children had a mean hemoglobin level of 11.7 before intervention. Low consumption of animal protein, which may result in lower iron bioavailability, might explain these conflicts **(Prentice *et al.,* 2013).** Inadequate iron absorption may be due to inhibitors such as phytate and polyphenols found in plant-based meals. Regarding vitamin consumption **(Gibson *et al.,* 2006).** The current study found that a smaller percentage of school-aged children met the RDA for vitamin C bad habits spread in this group of age could interpret that result. The study's results were consistent with another study in Kenya, which found a lower intake of vitamin C due to a diet high in grain wheat maize and low in vitamin C-rich fruits and vegetables **(Bloss *et al.,* 2004).** The study findings contradicted the findings of **Mahfouz *et al.,* (2021)** who found that preschool children met the RDA of vitamin C due to Egypt's eating patterns and appropriate intake of vitamin C-rich fruits and vegetables.

On the other hand, after intervention the intake of all nutrients of RDA daily increased with significant value ($p < 0.050$) conferring equate intake of calories, protein, carbohydrates, fat, Calcium, Magnesium, Iron, Zinc, Vitamin A, Vitamin C, Vitamin B1, and Vitamin B2 except for the intake Calcium raised of RDA daily with significant value ($p < 0.050$) but without confer the daily need of the RDA, which might interpreted with low income, price raised of milk and milk products. The significant difference between nutrient intake before and after intervention demonstrated that the food habits changed significantly and led to a

substantial improvement in the heights of school-aged children. This study aligns with **Osei *et al.*, (2023)** revealed that the intervention resulted in a significant increase in nutritional knowledge, frequency of dairy product consumption, animal protein, and fruits. Furthermore, the prevalence of underweight and overweight/obesity among school children reduced dramatically following the intervention. Also, **Khalid *et al.*, (2024)** reported that the health education program increased the orphanage children's knowledge of nutrition and behaviors for preventing nutritional diseases.

Present findings show that before the intervention, the majority of the children in the research group had an estimated bone age that was lower than their chronological age. This result aligns with a study in the US that reported that in a cohort of children living in rural Ecuador, bone age measured using a tablet was lower in stunted children and was linked with their diet **(Nicholas *et al.*, 2020).**

CONCLUSION

About half of the school-age stunted children's parents had a low level of education, and most of them did not have adequate money, and the children with a mean age of 10.1 ± 2.2 years had nutritional intervention. The nutritional intervention was evaluated, and the results demonstrate that raising awareness enhances stunting status among school-aged children.

RECOMMENDATIONS

- Implementing more nutritional education initiatives for schoolchildren, teachers, and parents to promote their healthy status and growth.
- Providing routine height measurements for school-age children in schools, as well as health facilities and maternal and childcare centers.
- Giving deserved counseling to stunted school-age children to improve their adapting skills and emphasize the necessity of commitment to an integrated healthy lifestyle including early and adequate sleep, appropriate exercise, and diet according to individual needs.

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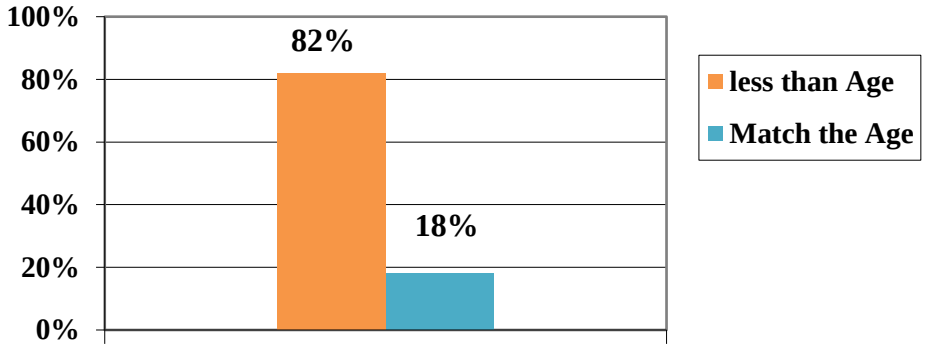

Figure (1): Study Sample Bone Age Status.

Table (1): The Severity of Stunting for Age-Related Height Regardless of Sex for Boys

Boys						P value
Height per age z score	SD	**Pre**		**Post**		
		No	**%**	**No**	**%**	0.031
	-3 SD	9	36.0	6	24.0	
	-2 SD	16	64.0	16	64.0	
	-1SD	0	0.0	3	12.0	

Table (2): The Severity of Stunting for Age-Related Height Regardless of Sex for Girls

Girls						P value
Height per age z score	SD	Pre		Post		
		No	%	No	%	
	-3 SD	14	56.0	9	36.0	0.031
	-2 SD	11	44.0	15	60.0	
	-1SD	0	0.0	1	4.0	

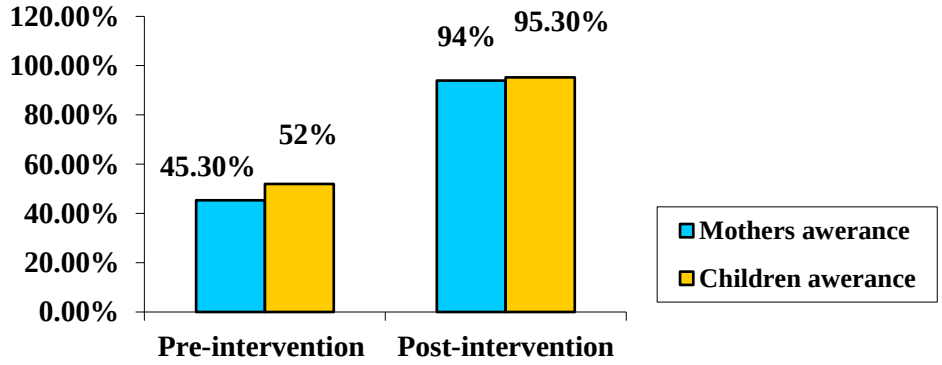

Figure (2): The Awareness Evaluation Pre- and Post-Intervention for the Study Sample Mothers and Children.

Table (3): Blood Analysis of the Study Sample

Analysis	Normal level	Pre	Post	P value
		Mean± SD	Mean± SD	
Hemoglobin	11.5-15.5	11.7± 1.0	12.4± 0.8	**0.000**
Serum Calcium	1.13-1.35	1.11± 0.23	1.19±0.16	**0.362**
TSH	**0.5-5.90**	**1.9± 0.9**	**1.9± 0.8**	**0.714**

Table (4): Twenty-four Hours Recall Compared to RDA for Pre and Post Intervention for the Study Sample

Food Content	RDA	Pre		Post		P value
		Mean± SD	% of RDA	Mean± SD	% of RDA	
Calories (kcal/d)	2125	1485.5±483.7	69.9	2212.01±387.9	104.09	**0.000**
Protein (g/d)	79.68	53.98±21.71	66.5	80.87±20.50	101.49	**0.000**
Carb. (g/d)	318.75	209.53±69.29	65.7	330.36±55.12	103.64	**0.000**
Fat (g/d)	59.0	47.55±13.3	80.6	63.01±**9**.5	106.77	**0.001**
Calcium (mg/d)	1150	391.9±128.3	34.07	878.54±235.1	76.39	**0.000**
Magnesium (mg/d)	185	78.9±23.9	42.6	197.23±43.60	106.61	**0.000**
Iron (mg/d)	9	11.93±4.54	132.5	18.48±5.25	205.33	**0.000**
Zinc (mg/d)	6.5	6.85±2.51	105.4	9.17±2.94	141.07	**0.000**
Vitamin A (µg/d)	500	263.5±75	52.7	581.48±120.8	116.29	**0.006**
Vitamin C (mg/d)	35	34.77±14	99.3	75.94±21.62	216.97	**0.000**
Vitamin B1 (mg/d)	0.75	0.46±0.22	61.0	0.87±0.15	116.0	**0.000**
Vitamin B2 (mg/d)	**0.75**	**0.44±0.17**	**58.7**	**1.04±0.14**	**138.66**	**0.000**

تأثير رفع مستوى الوعي الغذائي على الطول لدى الأطفال المصابين بقصر القامة في سن المدرسة

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2. قسم التغذية الاكلينيكية بالمعهد القومي للتغذية، وزارة الصحة القاهرة، مصر.

الملخص العربي

يعد قصر القامة مشكلة صحية خطيرة في جميع أنحاء العالم، ويرجع ذلك أساسا الى سوء التغذية المزمن الذي غالبا ما يرتبط بنقص الوعي الغذائي. لذا هدفت الدراسة الحالية إلى تقييم أثر رفع الوعي الغذائي لدى الأطفال الذين يعانون من قصر القامة في سن المدرسة وأمهاتهم في اللحاق بمعدل النمو وتحسين الحالة التغذوية بينهم. أجريت دراسة قبل وبعد التطبيق على خمسين طفلاً في سن المدرسة تم اختيارهم عشوائياً من عيادات قصر القامة التابعة للمعهد القومي للتغذية، وزارة الصحة القاهرة، مصر، بعد خضوعهم للفحص الطبي من قبل طبيب متخصص واستبعاد الأطفال المصابين بأمراض مزمنة، واضطرابات التمثيل الغذائي، وأمراض العظام الوراثية. تم تقديم التدخل الغذائي بما في ذلك برنامج التثقيف الغذائي المحدد لكل من الأطفال وأمهاتهم لمدة ستة أشهر. تم اجراء تقييمات للقياسات البشرية والمختبرية والغذائية للأطفال قبل وبعد التدخل. توضح النتائج الرئيسية للتثقيف الغذائي تحسن ذات دلالة معنوية في وعي كل من الأمهات والأطفال، وانخفاض كبير في شدة قصر القامة حسب العمر والنوع بنتائج ذات دلالة معنوية لكل من الأولاد والبنات. في الختام، أظهرت النتائج أن رفع مستوى الوعي الغذائي التدخل الغذائي المناسب قد يقلل من حالة قصر القامة بين الأطفال في سن المدرسة.لذا، توصي الدراسةبإجراء المزيد من الأبحاث على نطاق واسع لفترة أطول لمساعدة الأطفال في سن المدرسة على اللحاق بمخطط النمو.

الكلمات المفتاحية: سن المدرسة، قصر القامة، التثقيف الغذائي، و التدخل الغذائي.