Role of Food Insecurity and Anemia in The Occurrence of Stunting Among Children Under Five Years

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Abstract

Background: *Stunting is one of the most important public health concerns in Egypt. Childhood stunting increases the risk of morbidity and mortality in children, impairs mental development and affects their cognitive abilities.* ***The aim*** *of the present study was to explore the role of food insecurity and anemia in the occurrence of stunting among children under five years.* ***Subjects and Methods:*** *A case-control research design was used to conduct the present study. Study sample included 300 children under five years and their caregivers distributed equally in the form of case (150) and control (150) groups, were selected by a non-probability purposive sampling technique attending pediatric nutrition clinic for cases and general pediatric clinic, Zagazig University Hospital for control.* ***Tools of data collection:*** *Four tools were used for collecting data. Tool (Ⅰ): Interview questionnaire. Tool (Ⅱ): Household food insecurity access scale. Tool (Ⅲ): Scale of guidelines for measuring household and individual dietary diversity. Tool (Ⅳ): Physical assessment form.* ***Results:*** *The study results revealed that 54.0% of children in the case group were found to be food secure compared to 98.7% of control group. Furthermore, the majority of cases (80.0%) were below normal hemoglobin level compared to 47.3% of control group.* ***Conclusion:*** *The study concluded that there were positive correlations between stunting and food insecurity, and between stunting and anemia among children under five years.* ***Recommendations:*** *It is recommended that nutritional education promotes a well-balanced diet and healthy eating habits.*

Keywords: *Stunting, Food insecurity, Anemia, and Under five years children*

Introduction

Stunting in children constitutes a major public health problem worldwide, and particularly in developing countries ***(Danso & Appiah, 2023).*** It is defined as a child's height for age being more than two standard deviations below the WHO child growth standards median ***(WHO, 2006a).*** Stunting increases the risk of morbidity and mortality in children, as well as hindering mental development and affecting their cognitive abilities. It causes irreversible physical and mental damage to children. Stunting is associated with an underdeveloped brain, with long-lasting harmful consequences, including diminished mental ability and learning capacity, poor school performance in childhood, reduced earnings and increased risks of nutrition-related chronic diseases, such as diabetes, hypertension, and obesity in future ***(Wake et al., 2023).***

Furthermore, stunting is strongly linked to household food insecurity, which also increases the risk of anemia and other illnesses due to the inability to provide a diet that is sufficient in quality,

quantity, and diversity ***(Asiseh et al., 2018)***. Globally, food insecurity affected about 800 million people and about 2 billion people experience micronutrient deficiencies ***(Pérez-Escamilla, 2017).*** Food insecurity is a national public health problem defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways ***(Coleman et al 2018)***. Additionally, dietary diversity can predict quantity and quality of nutrition consumed at the individual or household level to ensure nutrient adequacy ***(Krasevec et al., 2017)***. Under five years children should consume a variety of diverse foods to support their motor development and prevent mental disorders (***Saaka et al., 2017).***

Additionally, childhood stunting and anemia have strong connections as there are similar risk factors between them such as food insecurity, dietary inadequacy, and infection. In addition to poverty, poor sanitation and hygiene, poor health service, lack of parental education which predispose children for the concomitant burden of stunting and anemia (***Mohammed et al., 2019).*** Anemia is a condition that happens when there are fewer red blood cells than usual or when their hemoglobin concentration is lower than usual ***(Liu et al., 2024).***

Building on previous studies explained the association between stunting, food insecurity and anemia one of these studies showed that children aged 2-5 years lived in food insecure households were experienced high-level co-morbid anemia and stunting than who lived in food secure households ***(Orsango et al., 2021).***

Community health nurses play an important role in preventing stunting by helping parents gain knowledge and more understanding about stunting. The CHN provides mechanisms for parental health education to achieve better understanding the definition, the causes, the characteristics, the impact, and prevention of stunting ***(Astarani et al., 2020*)*.*** The role of community health nurses in increasing information related to stunting prevention and meeting the information needs of families is very critical. The nurse provides promotive and preventive efforts to pregnant women, postpartum and breastfeeding mothers. In addition to providing promotive and preventive efforts to parents with children under five years in reducing stunting. As well as providing nutritional counseling, exclusive breastfeeding, and feeding practices for parents with children under five years ***(Hanifah & Astuti, 2023).***

Significance of Study

Stunting is not only a health problem at the regional level, but it has become a national health issue and an important health problem to be controlled immediately ***(Eliafiana & Fadilah, 2022).*** According to the 2018 Global Nutrition Report, 150.8 million (22.2%) of children under five had stunting. About 39% of globally stunted under-five children found in Africa ***(WHO, 2019).*** The rate of stunting in Egypt was reported to be 23.7%, making it a serious health issue affecting Egyptian children ***(Elmighrabi et al., 2023).*** Food insecurity emerges as a predictor for stunting among children. Governments and international organizations have implemented nutrition policies and interventions to reduce malnutrition ***(Tumilowicz et al., 2018)***. The United Nation established a goal to achieve zero hunger. More specifically, to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture ***(Nations, 2019).*** Additionally, in many studies children with anemia were at great risk to be stunted compared to non-anemic children ***(Taher et al., 2018)***.

Aim of the study:

This study aimed to explore the role of food insecurity and anemia in the occurrence of stunting among children under five years.

Research questions:

1- Is food insecurity associated with the occurrence of stunting among children under the age of five?
2- Is there a relation between the occurrence of stunting and anemia among children under the age of five?

Subjects and Methods:

Research design:

A case-control research design was used to achieve the aim of this study.

Study setting:

The present study was done at two settings:

- **The first setting:** Pediatric nutrition clinic, Zagazig University Hospital.
- **The second setting:** General pediatric clinic, Zagazig University Hospital.

Study subjects:

A non-probability purposive sample of 300 children under five years and their caregivers distributed equally in the form of case (150) and control (150) groups, who attended the above-mentioned clinics according to the following criteria:

- **Case group**

Children attended pediatric nutrition clinic; Zagazig University Hospital selected under the following **inclusion criteria**:

Their height for age was more than two standard deviations below the WHO Child Growth Standards median.

Exclusion criteria:

Those children suffered from any mental disorders, chronic diseases, or physical disabilities were excluded.

- **Control group**

Children attended general pediatric clinic; Zagazig University Hospital selected under the following **inclusion criteria**:

Normal height and weight according to their age.

Exclusion criteria:

Those children suffered from any mental disorders, chronic diseases, or physical disabilities were excluded.

Tools of data collection:

Four tools were used to collect necessary data.

I- ***Interview questionnaire:*** Developed by the researcher in the light of the present related literature and consisted of the following:

- ***Demographic data*****:** it involved;

- **Child data:** Included child's age, gender, and child rank.
- **Family data:** Encompassed parents' age, educational level, occupation, marital status of the mother, family income, family type, family size, and number of family rooms.

II- ***Household Food Insecurity Access Scale (HFIAS) (FANTA, 2007)*****:**

Food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS). The scale had a recall period of four weeks, including 9-items followed by questions about the frequency of occurrence. The HFIAS occurrence questions relate to three different domains of

food insecurity (access). These are namely

1) Anxiety and uncertainty about the household food supply
2) Insufficient Quality (includes variety and preferences of the type of food)
3) Insufficient food intake and its physical consequences.

Scoring system:

Each question was asked about the frequency of the experience and is scored as follows:
Response option
0 = No (Skip to...)
1 = Yes

- Frequency of occurrence

1=Rarely (once or twice in the past four weeks).
2=Sometimes (three to ten times in the past four weeks).
3=Often (more than ten times in the past four weeks).
The range of the HFIAS was between (0 to 27)

III- Scale of guidelines for measuring household and individual dietary diversity (FAO, 2010):

Dietary diversity questionnaire was involved to offer indicators of household food access or dietary quality. Dietary diversity was assessed using the 16-item questionnaire that aggregated to 12 food groups (cereals, white tubers and roots, vegetables, fruits, meat, eggs, fish and other seafood, legumes, nuts and seeds, milk and milk products, oils and fats, sweets, spices, condiments and beverages). This questionnaire measured the sum of diverse food categories, regardless of the amount consumed within the last 24 hours. FAO had chosen the recall period of 24 hours because it is less subject to recall error.

Scoring system:

Calculated values for the household dietary diversity variable by summing all 12 food groups.

- Each food group consumed scored 1 point.
- If a food group was not consumed, it scored 0 points.

Scores were within the following range: (0-12)

***IV- Physical assessment form*:** It was designed by the researcher to record child's:

- *Anthropometric measurements*:

Such as height, weight, mid-arm circumference and head circumference. These measurements were compared to relating age standard measurements using related charts.

Scoring system:

The normal values were set according to the percentiles reported by the WHO manual: "WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for height and body mass index-for-age: methods and development ***(WHO, 2006a).***

- ***Hemoglobin level:***

This was done using a hemoglobinometer to verify the hemoglobin content of the blood by spectrophotometric methods.

Scoring system:

Anemia was diagnosed corresponding to the Egyptian reference values ***(Mansour et al., 2022).***

Content validity and reliability

The tool was revised by a panel of three experts from the department of community health nursing, Ain Shams University, community health medicine, Suez Canal University, and

pediatric nursing, Cairo University where the panel reviewed the tools connects for relevance, comprehensiveness, clarity, and understandability. The reliability of this tool was tested through measuring its internal consistency Coefficient Alpha (Cronbacks): Household food insecurity access scale showed a good level of internal consistency (Cronbach's Alpha: 0.957).

Field work:

Once permission was approved to proceed with the study, the researcher met with the physicians and nurses of pediatric nutrition clinic and general pediatric clinic each clinic separately, clarified the study aim and procedures, in addition to the data collection forms. Through cooperation between the physicians and nurses in both clinics and the researcher, the researcher spent time with each caregiver of case and control groups to be familiar with the researcher. The researcher explained the aim and procedures of the study and asked for their acceptance in filling the questionnaire.

The measurement of the study tool was carried out from the first of November 2023 to the end of April 2024 (six months).

Case group: The researcher went to the pediatric nutrition clinic two times a week every Sunday and Tuesday from 9 AM to 1 PM. The required time for data collection for each caregiver and the assessment form of the child was about 40-45 minutes, around 3-4 caregivers and their children met a day.

Control group: The researcher went to the general pediatric clinic two times a week every Saturday and Thursday from 9 AM to 1 PM. The required time for data collection for each caregiver and the assessment form of child was about 35-40 minutes, around 4-5 caregivers and their children met a day.

In both clinics the researcher completed the questionnaire from the caregiver. Then the researcher measured the wight of the child using a digital weight scale, measured the height, head and arm circumference using measuring tape. Moreover, the researcher measured the hemoglobin level of the child by hemoglobinometer.

- The child's weight was measured using a calibrated digital scale on a flat surface, with shoes and heavy clothing removed, ensuring the child stood still before the researcher recorded the reading.
- The child's height was measured using a measuring tape stuck to the wall, ensuring the child stood straight with heels against the wall and eyes looked straight ahead, while a flat object was used to mark the top of the head before recording the measurement.
- The child's head circumference was measured using a measuring tape, positioned above the eyebrows, over the ears, and around the most prominent part of the back of the head, ensuring it was neither too tight nor too loose before recording the measurement.
- The child's mid-upper arm circumference was measured by locating the midpoint between the shoulder and elbow, then wrapping a measuring tape around the arm at this point, ensuring it was neither too tight nor too loose before recording the measurement.
- The child's hemoglobin level was measured using a portable hemoglobinometer. After cleaning the finger, a sterile lancet was used to obtain a blood sample, which was placed on a test strip. The reading was recorded, and used materials were properly disposed of.

Pilot study:

The pilot study was done on a sample of 15 cases to 15 controls and their care givers representing 10% of the calculated total sample size. The aim was to test the clarity and applicability of the data collection forms and to assess the time required for filling them in. The

children and their caregivers involved in the pilot study were included in the main study sample, since there was no modification in the tool of data collection.

Administrative and Ethical considerations:

Firstly, the research protocol was approved by the Research Ethics Committee (REC) in the faculty of Nursing, Zagazig University. Afterward the official permission was obtained from Head of Pediatrics Department Zagazig University Hospital based on a letter issued from the postgraduate's department at the Faculty of Nursing, Zagazig University clarifying the aim and procedures of the study. Then, the researcher met with the physicians and nurses of both pediatric nutrition clinic and general pediatric clinics each clinic separately with the approval letter. Then, the researcher explained the aim of the study, the nature of the tool used for data collection and gave them a copy of the tool and the formal letter. After that, the agreement of participant caregivers was taken after a full explanation of the aim of the study. Participants were given the opportunity to refuse participation, and they were informed that they could withdraw at any time of the data collection interviews and procedures; also, they were assured that the information would be confidential and used for research purposes only. The researcher assured maintaining anonymity and confidentiality of the subject's data.

Statistical analysis:

Data entry and statistical analysis were done using the SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the developed tools through their internal consistency. Qualitative categorical variables were compared using the chi-square test. Spearman rank correlation was used for the assessment of the inter-relationships between quantitative variables and ranked ones. To identify the independent predictors of the risk of stunting, multiple logistic regression analysis was used. Statistical significance was considered at p-value <0.05.

Results:

Table 1: Demographic characteristics of children in the case and control groups

Demographic characteristics	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Age (years):						
2-<3	50	33.4	43	28.7		
3-<4	62	41.3	73	48.7	1.65	0.44
4-<5	38	25.3	34	22.7		
Min-max	2.0-5.0		2.0-5.0			
Mean±SD	3.4±0.7		3.4±0.8		0.06	0.800
Gender:						
Male	71	47.3	76	50.7		
Female	79	52.7	74	49.3	0.33	0.56
Birth order:						
First	22	14.7	43	28.7		
Middle	40	26.7	29	19.3	9.14	0.01*
Last	88	58.6	78	52.0		

(*) Statistically significant at p<0.05

Table 1 shows that 58.6% of case group were last birth order compared to 52.0% of control group. A statistically significant difference was found between the birth order of the two groups (p= 0.01). No statistically significant differences were found between the two groups regarding age and gender.

Table 2: Demographic characteristics of children's mothers in the case and control groups

Demographic characteristics of children's mothers	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		**Control** (n=150)			
	No.	%	No.	%		
Mother age:						
<30	51	34.0	81	54.0		
30-<40	88	58.7	69	46.0	20.12	<0.001*
40-<50	11	7.3	0	0.0		
Min-max	23.0-46.0		25.0-46.0			
Mean±SD	31.9±5.0		30.1±4.2			
Mother education:						
Illiterate	3	2.0	0	0.0		
Read/write	19	12.7	2	1.3		
Basic	31	20.7	11	7.3	37.87	<0.001*
Secondary	56	37.3	59	39.3		
University	41	27.3	78	52.0		
Mother job:						
Housewife	130	86.7	108	72.0		
Working	20	13.3	42	28.0	9.84	0.002*
Current marital status:						
Unmarried	8	5.3	6	4.0		
Married	142	94.7	144	96.0	0.30	0.58

(*) Statistically significant at p<0.05

Table 2 reveals that statistically significant differences were found among mothers of both groups regarding age, education, and job (p= <0.001, 0.002).

Table 3: Demographic characteristics of children's fathers in the case and control groups

Demographic characteristics of children's fathers	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Father age:						
<35	58	39.5	86	57.3		
35-<45	76	51.7	59	39.3	11.11	0.004*
45+	13	8.8	5	3.3		
Min-max	24.0-53.0		27.0-48.0			
Mean±SD	35.9±5.6		33.9±4.3			
Father education:						
Illiterate	10	6.8	0	0.0		
Read/write	30	20.4	4	2.7		
Basic	33	22.4	11	7.3	66.46	<0.001*
Secondary	37	25.2	40	26.7		
University	37	25.2	95	63.3		
Father job:						
Employee	29	19.7	92	1.3		
Manual worker	74	50.3	31	20.7	54.46	<0.001*

Craftman	44	29.9	27	18.0		

(*) Statistically significant at p<0.05

Table 3 explains that statistically significant differences were found among fathers of both groups regarding age, education, and job (p= 0.004, <0.001).

Table 4: Family characteristics of children in the case and control groups

Family characteristics	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Income:						
Insufficient	150	100.0	132	88.0		
Sufficient	0	0.0	18	12.0	19.15	<0.001*
Family type:						
Nuclear	78	52.0	112	74.7		
Extended	64	42.7	32	21.3	17.04	<0.001*
Single parent	8	5.3	6	4.0		
Crowding index:						
<2	71	47.3	130	86.7		
2+	79	52.7	20	13.3	52.48	<0.001*

(*) Statistically significant at p<0.05

Table 4 clarifies that one hundred percent (100%) of case group compared to 88% of control group, their income was insufficient (p= <0.001). Statistically significant differences were found between both groups in relation to income, family type and crowding index (p= <0.001).

Table 5: Food security and dietary diversity of children in the case and control groups

Food security and dietary diversity	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		**Control (n=150)**			
	No.	%	No.	%		
Food security:						
Secure	81	54.0	148	98.7		
Insecure	69	46.0	2	1.3	82.83	<0.001*
Foods (diversity):						
Cereals	150	100.0	150	100.0	--	--
Rooty vegetables	93	62.0	137	91.3	36.08	<0.001*
Vit A vegetables	8	5.3	51	34.0	39.01	<0.001*
Green leafy vegetables	52	34.7	104	69.3	36.11	<0.001*
Other vegetables	150	100.0	150	100.0	--	--
Vit A fruits	13	8.7	59	39.3	38.67	<0.001*
Organic meat	8	5.3	10	6.7	0.24	0.63
Fresh meat	42	28.0	109	72.7	59.86	<0.001*
Eggs	29	19.3	129	86.0	133.71	<0.001*
Fish	28	18.7	33	22.0	0.51	0.47
Legumes	103	68.7	144	96.0	38.52	<0.001*
Dairy products	50	33.3	136	90.7	104.64	<0.001*
Fat/oils	150	100.0	150	100.0	--	--
Sweets	150	100.0	150	100.0	--	--
Spices	150	100.0	150	100.0	--	--

Fast food	31	20.7	24	16.0	1.09	0.30

Table 5 continue:

Diverse diet: No Yes	 135 15	 90.0 10.0	 19 131	 12.7 87.3	 179.54	 <0.001*

(*) Statistically significant at p<0.05

Table 5 displays that 54.0% of children in case group were found to be food secure compared to 98.7% of control group. Furthermore, 90.0% of case group children experienced no diverse diet compared to 12.7% of control group. Statistically significant differences were found between case and control groups in relation to food security and diverse diet in favor of control group (p= <0.001).

Table 6: Comparison of anthropometric measurements and hemoglobin among children in the case and control groups

Anthropometric measurements and hemoglobin	**GROUP**				**X^2 test**	**p-value**
	Case (n=150)		**Control (n=150)**			
	No.	%	No.	%		
Height for age: Normal Below normal (<95th percentile/z-score)	 0 150	 0.0 100.0	 150 0	 100.0 0.0	 300.0	 <0.001*
Weight for age: Normal Below normal (<95th percentile/z-score)	 7 143	 4.7 95.3	 150 0	 100.0 0.0	 273.25	 <0.001*
BMI: Normal Below normal (<95th percentile/z-score)	 76 74	 50.7 49.3	 150 0	 100.0 0.0	 98.23	 <0.001*

Table 6 continued:

MAC: Normal Below normal (<95th percentile/z-score)	 41 109	 27.3 72.7	 150 0	 100.0 0.0	 171.20	 <0.001*
HC: Normal Below normal (<95th percentile/z-score)	 150 0	 100.0 0.0	 150 0	 100.0 0.0	 --	 --
Hb: Normal Below normal	 30 120	 20.0 80.0	 79 71	 52.7 47.3	 34.60	 <0.001*

(*) Statistically significant at p<0.05

Table 6 shows that 100.0% of children in case group's height for age were below normal. Additionally, 95.3% of them were below normal weight for age. Regarding HB The majority of cases (80.0%) were below normal compared to 47.3% of control group (p= <0.001).

Table 7: Relations between anthropometric measurements and hemoglobin and food security

Anthropometric measurements and hemoglobin	**Food security**				**X^2 test**	**p-value**
	Secure		**Insecure**			
	No.	%	No.	%		
Height for age:						
Normal	165	72.1	6	8.5		
Below normal	64	27.9	65	91.5	89.45	<0.001*
Weight for age:						
Normal	154	67.2	3	4.2		
Below normal	75	32.8	68	95.8	86.30	<0.001*
BMI:						
Normal	195	85.2	31	43.7		
Below normal	34	14.8	40	56.3	50.21	<0.001*
MAC:						
Normal	183	79.9	8	11.3		
Below normal	46	20.1	63	88.7	110.40	<0.001*
HC:						
Normal	229	100.0	71	100.0		
Below normal	0	0.0	0	0.0	--	--
Hb:						
Normal	107	46.7	2	2.8		
Below normal	122	53.3	69	97.2	45.17	<0.001*

(*) Statistically significant at p<0.05

Table 7 indicates that statistically significant relations were found between anthropometric measurements and Hb with food security (p= <0.001). It is obvious that higher percentage of children (91.5%) who were below normal height for age, and below normal Hb level (97.2%) were having food insecurity.

Table 8: Correlation between children's scores food security and dietary diversity and their anthropometry and lab results

Anthropometry and lab results	Spearman's rank correlation coefficient	
	Food insecurity	Dietary diversity
Height	-.607**	.623**
Weight	-.685**	.709**
BMI	-.742**	.750**
MAC	-.747**	.753**
HC	-.301**	.363**
Hb	-.284**	.157**

(**) Statistically significant at p<0.01

Table 8 illustrates that statistically significant positive correlations between dietary diversity with height (r=.623), weight (r=.709), and Hb (r=.157). Statistically significant negative correlations between food insecurity and height (r=-.607), weight (r=-.685), and Hb (r=-.284).

Table 9: Best fitting multiple logistic regression model for the presence of stunting

	Wald	Df	P	OR	95.0% CI for OR	
					Upper	Lower
Constant	22.27	1	0.00	31.26		
+ve family history	17.18	1	0.00	35.56	6.57	192.52
Consanguinity	10.84	1	0.00	8.60	2.39	30.98
Food security	8.64	1	0.00	0.10	0.02	0.47
Diverse diet	70.19	1	0.00	0.01	0.00	0.03
Nagelkerke R Square: 0.747						
Hosmer and Lemeshow Test: p=0.930						
Omnibus Tests of Model Coefficients: p<0.001						
Variables not in the model: child gender, parents age and education, income, consanguinity						

Table 9 displays that positive family history and consanguinity were statistically significant independent positive predictors for the presence of stunting. Conversely, food security and diverse diet were statistically significant independent negative predictors for the presence of stunting. The model explains 0.747% of the variation in this score as the value of r-square indicates.

Discussion

Stunting in children is a major public health problem. It has been linked to food insecurity, lack of knowledge in child feeding, poor health care and illness. In addition, child stunting has been associated with many behavioral, socioeconomic, environmental factors, including insufficient sanitation and hygiene, and living in a rural area ***(Rwanda, 2014).***

Concerning answering the research question about the association between the occurrence of stunting among children under five years and food insecurity, the current study results revealed that statistically significant differences were found between the two groups in relation to food security and diverse diet in favor of control group. This might be due to that frequent hunger hindered growth and development. Additionally, limited access to diverse, nutrient-rich foods resulted in inadequate nutrition, making children more prone to illnesses including

stunting. These factors collectively stunt physical and cognitive growth in children.

Similar results have been found by ***Agho et al. (2019)*** in Gicumbi district, Rwanda found that moderate and severe household food insecurity were associated with both stunted and severely stunted infants and young children in Gicumbi. In the same vein, a study conducted in Bangladesh by ***Ali et al. (2019)*** explained that household food insecurity and poor diverse food were associated with high prevalence of stunting among children aged 6-59months.

In the same line, a study conducted by ***Trisasmita et al. (2020)*** in Indonesia showed that there was a strong association between dietary diversity and stunting in children aged 6–59 months. In addition, a study conducted by ***Gassara and Chen. (2021)*** in Sub-Saharan Africa showed that household food insecurity and dietary diversity were significantly associated with stunting in children under 5 years of age. Moreover, ***Fufa (2022)*** carried out a study in Dibate district of Ethiopia reported that stunting was significantly associated with poor household dietary diversity. In the same context, a study conducted in N'Djamena—Chad by ***Gassara et al. (2023)*** revealed that children aged 12 to 59 months from severe household food insecurity were more at risk of being stunted than those from food-secure households

On the contrary, ***Osei et al. (2010)*** conducted a study in Kailali District, Nepal found that household food insecurity was not associated with stunting or anemia among children aged 6 to 23 months. Furthermore, in Cambodia a study carried out by ***McDonald et al. (2015)*** showed that neither household food security nor dietary diversity status was significantly associated with child stunting, or anemia. Moreover, a study conducted in Thailand by ***Roesler et al. (2019)*** explained that there was no association between household food insecurity and stunting among children under five years.

From the researcher's point of view the absence of a consistent association between the results might be due to the difference in the study settings. In addition, in some cases families facing food insecurity might prioritize nutrition for young children, even at the expense of other household members, protecting them from stunting. Additionally, some families might manage food insecurity in ways that reduce its impact, like relying on community support or government programs.

Regarding answering the research question about the relation between the occurrence of stunting and anemia among children under the age of five, the present study results showed that the majority of cases were below normal hemoglobin level compared to control group. Such a result was attributed to that anemia often coexists with other micronutrient deficiencies that directly contribute to stunting as: Zinc Deficiency which is essential for cell division, and skeletal growth. In addition to vitamin A deficiency which impacts cell growth and immunity. As well as folate and vitamin B12 deficiencies which influence overall growth ***(WHO, 2006b).*** Another explanation, inadequate dietary intake of critical nutrients for growth and hemoglobin production can lead to both malnutrition as stunting and anemia in children.

In the same context, a meta-analysis conducted by ***Melku et al. (2018)*** in Ethiopia showed that two times higher odds of anemia were noted among stunted young children. in the same vein, a study conducted in Sub-Saharan Africa by ***Moschovis et al. (2018)*** demonstrated that children who had stunting were more are at highest risk to be anemic. These findings are in accordance with a study conducted by ***Endris et al. (2022)*** in Ethiopia explained that higher odds of anemia were found among stunted under five children. Moreover, ***Gaston et al. (2022)*** conducted a cross-sectional study in Lesotho and discovered a substantial positive correlation between anemia and stunting. The correlation confirmed that the two disorders were classified as connected health issues in children under the age of five.

The results of the current study were in the same line with a study conducted by ***Yang et al, (2019)*** in China demonstrated that high prevalence of household food insecurity associated with poor dietary diversity, stunting and anemia in children aged 3-5 years. In the same context, ***Belachew and Tewabe (2020)*** carried out a study in Ethiopia revealed that there were strong associations between stunting, poor dietary diversity, household food insecurity, and anemia among under-five children.

The results of the current study showed that, positive family history and consanguinity were statistically significant independent positive predictors for the presence of stunting. This might be due to that presence of genetic predispositions, inherited disorders, shared environmental or nutritional factors all might increase the risk of stunting. These findings were consistent with previous study conducted in Egypt by ***Mahmoud et al. (2017)*** demonstrated that parental consanguinity and family history of short stature were strong risk factors for stunting

Conclusion:

Based on the results of the present study, it could be concluded that there were positive correlations between stunting and food insecurity, and between stunting and anemia among children under five years. Statistically significant differences were found between case and control groups in relation to food security and diverse diet in favor of control group. Regarding the hemoglobin level, the majority of cases were below normal compared to control group.

Recommendations:

In view of the main results of the study the following recommendations were derived and suggested:

- Stunting needs integrated nutrition intervention that aims to improve child nutrition.
- Nutritional education promotes a well-balanced diet and healthy eating habits.
- Regular screening for young children permits early detection of stunting.
- Further studies are needed to investigate the consequences of stunting.
- Replicate the study on a large scale and in other settings to allow generalization of results.

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