Stunting Among Children Under Five Years: A Case-Control Study

Gharam Mahmoud Ibrahim Ibrahim [1], Amany Sobhy Sorour [2], Azhar Abdel-Fatah Mohamed Shehata[3]

1 Assistant Lecturer in Community Health Nursing, Faculty of Nursing, Zagazig University,
2 Professor of Community Health Nursing Faculty of Nursing at Zagazig University,
& 3 Assistant Professor of Community Health Nursing, Faculty of Nursing at Zagazig University

Abstract: Background: Childhood stunting remains a threatening nutritional problem and persistent global challenge. It is a major health problem affecting Egyptian children. The aim of the present study was to compare between case and control groups in relation to physical assessment, anthropometric measurements and anemia. Subjects and Methods: A case-control research design was used to conduct the current study where 300 children under five years and their caregivers distributed equally in the form of case (150) and control (150) groups. The study sample was selected by a non-probability purposive sampling technique attending pediatric nutrition clinic for cases and general pediatric clinic for controls, Zagazig University Hospital. Tools of data collection: Two tools were used for collecting data. Tool (I): Interview questionnaire. Tool (II): Physical assessment form. Results: The study results showed that 84.7% of case groups had abnormalities in hair compared to 12.7% of control groups. In addition to 80.7% of case groups children have abnormalities in lips, skin color and nail color compared to 10.0% of control groups. Concerning anthropometric measurements, 100.0% of children in case groups' height for age were below normal. Regarding the hemoglobin level, 80.0% of the cases were below normal compared to 47.3% of control groups. Conclusion: The study concluded that statistically significant differences were found between case and control groups regarding physical assessment, anthropometric measurements and hemoglobin level. Recommendations: It is recommended that periodic screening for young children allows early detection of stunting.

Keywords: Stunting, Children under five years.

1. Introduction

Stunting is seen as a public health threat and is associated with many health burdens over recent decades [1]. Evidence demonstrates that Africa and Asia were extremely affected by childhood stunting, accounting for almost 90% of all stunted children worldwide [2]. According to the WHO, a child whose height for age falls below -2 SD below WHO child growth standards median is considered stunted [3]. Childhood stunting reflects chronic undernutrition during the most critical periods of growth and development in early life. It is a physically displayed and important indicator of ongoing childhood malnutrition that can be seen and measured [4].
Furthermore, stunting is a condition of growth failure caused by malnutrition over a long time.

It is linked to low socioeconomic status, inadequate nutritional intake, poor maternal health, history of recurrent illness, and improper feeding habits during infancy and childhood. As well as poor housing conditions and poor quality and quantity of water are factors associated with stunting [5].

Additionally, stunting has many short- and long-term consequences. Short-term consequences include impaired brain and cognitive development, physical growth, and metabolic disorders in the body. Long-term consequences include decreased cognitive abilities and learning achievement, a low immune system, making children vulnerable to disease. Furthermore, it increases the risk for obesity, diabetes, heart and blood vessel disorders, cancer, stroke, and disabilities in old age [6]. Moreover, stunting increases the risk of perinatal death and premature death for women, decreases productivity and income in adults, and, if accompanied by excessive weight gain in childhood, results in an increased risk of chronic disease [7].

Childhood stunting is multifactorial in nature, so community health nurses coordinate efforts across many sectors like the health system, medical workforce, and policy. This cooperation is beneficial to allow reasonable, affordable, and efficient use of diagnostic equipment and medications at the primary health care level, specifically if the availability of such equipment is limited [8]. As well, community health nurses provide promotive and preventive efforts directed to pregnant, postpartum, and breastfeeding women, as well as parents with children under five years in reducing stunting [9].

Significance of the Study:

In 2020, 149.2 million under-five children were stunted worldwide, with Africa accounting for 40% of them [10]. Since 1990, the global number of stunted children has declined significantly. However, Africa is the only region that has seen an increase in stunted children despite a decrease in the prevalence of stunting [11]. The serious consequences of stunting have resulted in the setting of global nutrition goals to reduce the number of children under five who are stunted by 40% by 2025 [12]. This global objective has been in line with the United Nations Sustainable Development Goal 2 (SDG-2), which calls for the eradication of all forms of malnutrition by 2030 [13].

Aim of the study:

This study aimed to compare between case and control groups in relation to physical assessment, anthropometric measurements and anemia.

Research questions:

1- Are there differences between the two groups regarding family characteristics?

2- Are there differences between the two groups concerning children's growth and development and recurrent infection?

3- Are there differences between the two groups about physical assessment, anthropometric measurements and anemia?

2. Subjects and Methods:

Research design:

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

Study setting:

The present study was carried out 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 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 physical disabilities, chronic diseases, or mental disorders 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 physical disabilities, chronic diseases, or mental disorders were excluded.

Tools of data collection:

Two tools were used to collect necessary data.

I- Interview questionnaire: Developed by the researcher in the light of the existing related literature and contained the following parts:

Part 1: Demographic data: it involved two parts;

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

Part 2: Child and family history questionnaire:

- Case group: It included closed-ended questions about the family history of stunting, consanguinity, mother exposure to radiation, medications or complications during pregnancy. Additionally, pregnancy weeks, type and difficulty of labor, baby weight on birth. Moreover, type and duration of feeding, timing of child teething, crawling and walking. In addition to medical history such as recurrent episodes of infections. As well as signs of stunting and who first noticed, at what age, parent's knowledge and follow up, any medications or diets and any psychological trauma on child or parents due to stunting.
- Control group: It consisted of close-ended questions about family history of stunting, consanguinity, mother exposure to radiation, medications or complications during pregnancy. Additionally, pregnancy weeks, type and difficulty of labor, baby weight on birth. As well as, type and duration of feeding, timing of child teething, crawling and walking. In addition to medical history such as recurrent episodes of infections.

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

- General assessment findings: Such as
  - Head for (shape and size, hair color and texture, dandruff)
  - Eye for (sunken, secretion, inflammation)
  - Mouth for (lip color, lesions, dental caries).
  - Skin for (color, lesions, wounds)
  - Nails for (color, strength)
- Anthropometric measurements:

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

Scoring system:

The normal values were set according to the percentiles stated 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" [14].

Hemoglobin level:

This was accomplished using a hemoglobinometer to determine the hemoglobin content of the blood by spectrophotometric methods.

Scoring system:

Anemia was diagnosed based on the Egyptian reference values [15].

Content Validity:

The tool was revised by a panel of three experts from the department of pediatric nursing, Cairo University, community health medicine, Suez Canal University and community health nursing, Ain Shams University. They assessed the tools for relevance, clarity, application, understandability and comprehensiveness. This constituted the content validation of tool.

Field work:

After permission was granted to continue with the study, the researcher met with the physicians and nurses of pediatric nutrition clinic and general pediatric clinic each clinic separately, describing the study aim and procedures, additionally the data collection forms. Through collaboration 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 clarified 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 needed time for tool of 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 twice a week every Saturday and Thursday from 9 AM to 1 PM. The needed time for tool of data collection for each mother 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 filled in the questionnaire from the care giver then performed physical assessment of the child. Then the researcher measured the wight of the child using a digital weight scale, measured the height, head and arm circumference using measuring tape. Additionally, the researcher measured the hemoglobin level of the child by hemoglobinometer.

- The child's weight was measured using a calibrated digital scale placed on a flat surface. To ensure accuracy, shoes and heavy clothing were removed, and the child stood still before the researcher took and recorded the measurement.
- The child's height was taken by placing a measuring tape on the wall, ensuring the child stood upright with their heels against the wall and their eyes facing forward. A flat object was gently placed on the top of the child's head to mark the exact height before the measurement was recorded.
- The child's head circumference was measured with a measuring tape, positioned above the eyebrows, over the ears, and around the back of the head, ensuring it was not too tight or too loose before recording the measurement.
- The child's mid-upper arm circumference was measured by finding the midpoint between the shoulder and elbow, then wrapping a measuring tape around the arm at that point, ensuring it was not too tight or too loose before recording the measurement.
- The child's hemoglobin level was measured with a portable hemoglobinometer. After cleaning the finger, a sterile lancet was used to collect a blood sample, which was placed on a test strip. The reading was recorded, and used materials were disposed of properly.

Pilot study:

The pilot study was performed 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 applicability and clarity of the data collection forms and to estimate the time required for filling them in. The

children and their caregivers encompassed 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 permitted by the Research Ethics Committee (REC) in the faculty of Nursing, Zagazig University. Then the official permission was gained 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 explaining the aim and procedures of the study. Afterword, the researcher met with the physicians and nurses of both pediatric nutrition clinic and general pediatric clinics each clinic separately with the approval letter. After that, 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. Then, 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 notified 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 and medians for quantitative variables. Qualitative categorical variables were compared using the chi-square test. Statistical significance was considered at p-value <0.05.

3. 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 Mean±SD	23.0-46.0 31.9±5.0		25.0-46.0 30.1±4.2			
Mother education: Illiterate Read/write Basic Secondary University	 3 19 31 56 41	 2.0 12.7 20.7 37.3 27.3	 0 2 11 59 78	 0.0 1.3 7.3 39.3 52.0	37.87	<0.001*
Mother job: Housewife Working	 130 20	 86.7 13.3	 108 42	 72.0 28.0	9.84	0.002*
Current marital status: Unmarried Married	 8 142	 5.3 94.7	 6 144	 4.0 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 35-<45 45+	 58 76 13	 39.5 51.7 8.8	 86 59 5	 57.3 39.3 3.3	11.11	0.004*
Min-max Mean±SD	24.0-53.0 35.9±5.6		27.0-48.0 33.9±4.3			
Father education: Illiterate Read/write Basic Secondary University	 10 30 33 37 37	 6.8 20.4 22.4 25.2 25.2	 0 4 11 40 95	 0.0 2.7 7.3 26.7 63.3	66.46	<0.001*
Father job: Employee Manual worker Craftman	 29 74 44	 19.7 50.3 29.9	 92 31 27	 1.3 20.7 18.0	54.46	<0.001*

(*) 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 Sufficient	 150 0	 100.0 0.0	 132 18	 88.0 12.0	19.15	<0.001*
Family type: Nuclear Extended Single parent	 78 64 8	 52.0 42.7 5.3	 112 32 6	 74.7 21.3 4.0	17.04	<0.001*
Crowding index: <2 2+	 71 79	 47.3 52.7	 130 20	 86.7 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: Family history of stunting and pregnancy and labor characteristics among children in the case and control groups

Family history of stunting, pregnancy and labor characteristics	GROUP				X^2 test	p-value
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Family history of stunting:						
No	138	92.0	147	98.0		
Yes	12	8.0	3	2.0	5.68	0.02*
In:						
Father	1	8.3	0	0.0	0.27	0.61
Mother	1	8.3	0	0.0	0.27	0.61
Siblings	3	25.0	0	0.0	0.94	0.33
Uncles/aunts	5	41.7	1	33.3	0.07	0.79
Cousins	2	16.7	2	66.7	3.07	0.08
Pregnancy X-ray exposure:						
No	148	98.7	146	97.3		
Yes	2	1.3	4	2.7	0.68	0.41
Pregnancy medications:						
No	133	88.7	140	93.3		
Yes	17	11.3	10	6.7	1.99	0.16
Pregnancy complications:						
No	143	95.3	146	97.3		
Yes	7	4.7	4	2.7	0.85	0.36
Pregnancy weeks:						
<37	26	17.3	5	3.3		
37-40	104	69.3	114	76.0	17.06	<0.001*
>40	20	13.3	31	20.7		
Mode of labor:						
Normal vaginal	69	46.0	42	28.0		
Cesarean	81	54.0	108	72.0	10.43	0.001*
Labor complications:						
No	97	64.7	109	72.7		
Yes	53	35.3	41	27.3	2.23	0.14

(*) Statistically significant at p<0.05

Table 5 demonstrates that 8.0% of case group had family history of stunting compared to 2.0% of control group. A statistically significant difference was found between the family history of stunting of the two groups (p= 0.02). Furthermore 69.3% of pregnancy weeks in case group were 37-40 w compared to 76.0% of control group. A statistically significant difference was found between the pregnancy weeks of the two groups (p= 0.02). No statistically significant differences were found between the two groups regarding pregnancy X-ray exposure, pregnancy medications, pregnancy complications and labor complications.

Table 6: Growth and development and recurrent infections among children in the case and control groups

Growth and development and recurrent infections	GROUP				X^2 test	p-value
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Newborn weight:						
Abnormal	74	49.3	6	4.0		
Normal	76	50.7	144	96.0	78.82	<0.001*
Infant feeding:						
Breast	110	73.3	117	78.0		
Completely artificial	9	6.0	0	0.0	9.28	0.01*
Both	31	20.7	33	22.0		
Breastfeeding years:						
Min-max	0.0-2.0		1.0-2.0			

Mean±SD	1.0±0.3		1.8±0.4		312.56	<0.001*
Delayed dentition:						
Yes	136	90.7	16	10.7		
No	14	9.3	134	89.3	192.03	<0.001*
Delayed crawling:						
Yes	141	94.0	69	46.0		
No	9	6.0	81	54.0	82.29	<0.001*
Delayed walking:						
Yes	145	96.7	24	1.0		
No	5	3.3	126	84.0	198.40	<0.001*
Recurrent infections:						
No	57	38.0	123	82.0		
Yes	93	62.0	27	18.0	60.50	<0.001*
No. of episodes:						
2	20	21.5	26	96.3		
3	53	57.0	1	3.7	49.54	<0.001*
4	20	21.5	0	0.0		

(*) Statistically significant at p<0.05

Table 6 illustrates that there were statistically significant differences between case and control groups in relation to growth and development (newborn weight, infant feeding, breastfeeding years, dentition, crawling, and walking) and recurrent infection (p= <0.001, 0.01).

Table 7: Details of stunting and its consequences among children in the case group (n=150)

Details of stunting and its consequences	Frequency	Percent
Parents noticed:		
Comparatively slower growth	45	30.0
Comparatively shorter stature	90	60.0
Recurrent infections	15	10.0
Stunting first discovered by:		
Mother	58	38.7
Father	2	1.3
Physician	90	60.0
Age at diagnosis (years):		
<3	91	60.7
3+	59	39.3
Min-max	2-4	
Mean±SD	2.9±0.6	
Median	3.0	
Parents aware of stunting	55	36.7
Compliance with follow-up	65	43.3
Treatments given	2	1.3
Follow special dietary regimen	150	100.0
Child exposed to bully	90	60.0
Parents feel stress	82	54.7

Table 7 reveals that the same percentage, (60.0%) of parents noticed that their children were comparatively shorter stature, and the cases first discovered by the physician. Additionally, 60.7% of them were diagnosed before the age of three. As well as one hundred percent (100%) of them follow a special dietary regimen.

Table 8: Physical assessment of children in the case and control groups

Physical assessment	GROUP				X^2 test	p-value
	Case (n=150)		Control (n=150)			
	No.	%	No.	%		
Abnormalities in:						
Head shape	0	0.0	0	0.0	--	--
Head size	0	0.0	0	0.0	--	--
Hair	127	84.7	19	12.7	155.63	<0.001*
Eyes	59	39.3	2	1.3	66.86	<0.001*
Mouth	77	51.3	9	6.0	75.38	<0.001*
Lips	121	80.7	15	10.0	151.13	<0.001*
Skin surface	43	28.7	6	4.0	33.39	<0.001*
Skin color	121	80.7	15	10.0	151.13	<0.001*
Nails shape	116	77.3	11	7.3	150.54	<0.001*
Nails color	121	80.7	15	10.0	151.13	<0.001*

Body straightness	0	0.0	0	0.0	--	--
Any abnormal finding	131	87.3	23	15.3	155.63	<0.001*

(*) Statistically significant at p<0.05

Table 8 explains that the majority of children in the case group have abnormality in hair (84.7%) compared to (12.7%) of control group. In addition to (80.7%) of case group children have abnormalities in lips, skin color and nail color compared to (10.0%) of control group. Statistically significant differences were found between case and control groups regarding physical assessment (p= <0.001).

Table 9: 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	0	0.0	150	100.0		
Below normal (<95th percentile/z-score)	150	100.0	0	0.0	300.0	<0.001*
Weight for age:						
Normal	7	4.7	150	100.0		
Below normal (<95th percentile/z-score)	143	95.3	0	0.0	273.25	<0.001*
BMI:						
Normal	76	50.7	150	100.0		
Below normal (<95th percentile/z-score)	74	49.3	0	0.0	98.23	<0.001*
MAC:						
Normal	41	27.3	150	100.0		
Below normal (<95th percentile/z-score)	109	72.7	0	0.0	171.20	<0.001*
HC:						
Normal	150	100.0	150	100.0	--	--
Below normal (<95th percentile/z-score)	0	0.0	0	0.0		
Hb:						
Normal	30	20.0	79	52.7		
Below normal	120	80.0	71	47.3	34.60	<0.001*

(*) Statistically significant at p<0.05

Table 9 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). Statistically significant differences were found between case and control groups concerning anthropometric measurements and Hb level

5. Discussion:

Stunting is one of the most significant indicators of malnutrition, which is a condition of linear growth failure or inability to accomplish potential height for a particular age. It is considered the best indicator of child well-being [16]. Although the world's achievements regarding improving nutrition and associated health problems over recent years, malnutrition, including stunting, is still a public health danger [17].

Concerning the differences between the case and control groups in relation to family characteristics, the current study results showed that statistically significant differences were found regarding parents' age, education, job, income, crowding index, and family history of stunting. Probable causes of such results might be due to these being key socioeconomic and environmental factors that may contribute to the occurrence of stunting by influencing children's nutrition, access to healthcare, living conditions, and overall growth and development.

The results of the current study were in the same context with a study conducted by Akombi et

al. [18] in Sub-Saharan Africa, which found that low parental education was reported as one of the consistent factors associated with increasing stunting in children under five years. In the same regard, Tahangnacca et al. [19] in Indonesia reported that low parental education was an important factor causing stunting among children under five years. In the same vein, a study conducted in Indonesia by Laksono et al. [20] concluded that lower maternal education was associated with a higher risk of childhood stunting.

Seedhom et al. [21] in Minia, Egypt found that the prevalence of stunting among children was higher in those of non-working mothers than those of working mothers. In the same vein, a study done by Delgado et al. [22] in a rural area of Peru found that stunting was highly prevalent among children of non-working mothers compared to those of working mothers.

This contrasts with Grover et al. [23] in India, which found that the length for age of infants was controlled better in housewife mothers than those of infants with working mothers. Additionally, a study conducted by Chávez-Zárate et al. [24] in Peru showed that there was no association found between maternal employment status and occurrence of stunting in children 6 to 36 months of age.

This difference might be attributed to housewives being able to dedicate more time to closely monitoring their child's health, diet, and overall well-being. This includes ensuring timely meals or breastfeeding. In addition, housewives often prepare meals at home, which may be more nutritious compared to processed or store-bought food.

The findings of the current study were in agreement with a study conducted by Chowdhury et al. [25] in Bangladesh, which found that children in the poorest households were more than two times as likely to be stunted compared to children in the richest households. In the same vein, Akombi et al. [26] in Nigeria showed that children from poor households were at a greater risk of being stunted and severely stunted than children from richer households. Furthermore, children born to educated parents were less likely to be stunted when compared with children born to uneducated parents.

Similarly, in Egypt, a study conducted by Sharaf et al. [27] found that children from low-income/educational households were more likely to have a worse HAZ score than those from high-income/educational households. Another study carried out by Rahman and Hossain [28] in Bangladesh found that the wealth index of the family and parental education were very important determinants of the z-score of height-for-age among children. In the same vein, a study done in Bangladesh by Abdulla et al. [29] demonstrated that the higher the parental education, the higher the child's HAZ score. Moreover, children of high-income families had better HAZ scores than children from the poorest families.

Indriani et al. [30] in Nganjuk, East Java, conducted a study revealing that there was an association between family size and stunting. Family size ≥5 was a statistically significant risk factor for stunting. The result of the ongoing study was in the same line with a study conducted by Mahmoud et al. [31] in Egypt, which explained that the presence of a family history of short stature were strong risk factors for stunting.

Relating to the differences between the two groups about child's growth and development and recurrent infections, the existing study results demonstrated that statistically significant differences were found regarding growth and development (delayed dentition, crawling, walking) and recurrent infections. This might be due to stunting being often caused by prolonged inadequate intake of essential nutrients and insufficient breastfeeding. Deficient intake of nutritious food during the critical period of life can negatively affect normal growth and development and impair child immunity, causing recurrent infections.

The results of the current study were in the same vein with a study conducted by Dwivedi et al. [32] in Bangladesh, which explored that children with stunting had lower motor scores than non-stunted children. The study showed that stunting before the age of 2 was a predictor of delays in motor development. In the same context, a study conducted by Mustakim et al. [33] in Surabaya, Indonesia, found that children aged 1-3 years who were stunted had a greater risk

of experiencing delays in motor development, both gross and fine motor.

Berhanu et al. [34] in Ethiopia showed that poor breastfeeding practices, poor socio-economic status, and low parental education were some of the factors precipitating stunting in preschool children. Similarly, Manggala et al. [35] in Bali, Indonesia, clarified that early cessation of breastfeeding, low paternal education, and short maternal stature were risk factors for stunting in children aged 24-59 months. In the same vein, Mediani [36] in Indonesia found that recurrent infections, early termination of breastfeeding, short stature of the parents, low paternal education, and large family size were predictors of stunting among children under five years.

Regarding the differences between the two groups in relation to physical assessment, anthropometric measurements, and hemoglobin level, the present study results revealed that statistically significant differences were found between the case and control groups. The majority of the case group's height, weight for age, and Hb level were below normal compared to the control group. From the researcher's perspective, such results might be due to the physiological effects of co-occurring stunting and anemia causing such changes in physical assessment, anthropometric measurements, and hemoglobin level.

In the same vein, Maqbool et al. [37] mentioned that assessment included anthropometrics such as height, weight, stature, head, and arm circumference. In addition to the general physical examination, such as examination of skin, hair, and teeth, this included an assessment for pallor, edema, skin rash, thinning of hair, and evidence of specific nutritional deficiencies. All were assessments of nutritional and growth status, which were essential parts of clinical evaluation for young children. In the same context, Thakur et al. [38] added that physical changes like pallor, along with skin and hair changes, were significantly more in all grades of malnutrition, including stunting.

These findings were consistent with a study conducted by Gupta [39] in Punjab, India, where the researcher used an inspection method for nail beds of children to ascertain pallor, indicating the presence of anemia, and anthropometric measurements by measuring height and weight of children to indicate the presence of stunting. The study found an overall prevalence of 28.6% of stunting among children between 2 years old and below 5 years of age, in addition to a higher prevalence of 36.5% of stunting among anemic children, making a significant correlation between anemia and stunting among preschool children.

In the same context, a study conducted by Rahman et al. [40] in Bangladesh showed that the prevalence of anemia was markedly high among stunted children in the age group 6–59 months compared to non-stunted children. Additionally, in Indonesia, a study conducted by Ayukarningsih et al. [41], who used anthropometric measurements to diagnose stunting by measuring length, height, weight, and mid-upper arm circumference and comparing it to WHO growth standards.

Similarly, a cross-sectional study conducted by Mohammed et al. [42] in Ethiopia found that a quarter of children were concurrently anemic and stunted. The study found many factors linked to concurrent anemia and stunting, one of them being the low education level of the caregivers. Additionally, Christian et al. [43] in Ghana showed that stunting and anemia were found to be co-occurring among young children. The study found that a high-wealth household and mothers or caregivers who had high education were protective against the co-occurrence of stunting and anemia. In the same vein, a cross-sectional study conducted by Gaston et al. [44] in Lesotho showed that a significant positive association was found between anemia and stunting. The association confirmed that the two diseases were considered interrelated health problems in children under five years.

6. Conclusion

Based on the results of the current study, it could be concluded that children under five years who suffered from stunting had abnormalities concerning physical assessment, anthropometric

measurements and hemoglobin level compared to non-stunted children. Statistically significant differences were found between case and control groups regarding physical assessment, anthropometric measurements and hemoglobin level.

Recommendations:

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

- Stunting requires integrated nutrition intervention that focuses on improving child nutrition.
- Nutritional education promotes balanced diet and healthy eating habits
- Periodic screening for young children allows early detection of stunting.
- Further studies are recommended to explore the consequences of stunting.
- Replicate the study on a large scale and in other settings to permit generalization of results.

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