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Malnutrition as a Barrier to Quality Education: A Sociological Perspective from the Drought-Affected Areas of Tharparkar

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Abstract

This research was intended to determine the incidences of malnutrition and its effects on the academic performance of primary school students in Tharparkar District, Sindh, Pakistan. Almost half of Sindh's children under the age of five suffer from malnutrition, a condition that is very common in the province. Two hundred children between the age group 10 and 13 years were chosen in vulnerable communities where malnutrition is very much common. Anthropometric data was measured on the height of the participants, weight, and Body Mass Index (BMI) according to the WHO (2007) standards. The study established that most of the students were stunted, underweight and wasted. The ASER (Annual Status of Education Report) was used to measure academic competence in reading, writing, and comprehension. The findings revealed that most students were able to read and write letters or words but had a challenge with sentences and paragraphs and simple arithmetic operations. Malnutrition was found to have a considerable correlation with poor academic performance, which proves that poor nutritional condition impacts negatively on learning capability, focus and academic performance. The qualitative interviews of teachers, parents, and headteachers also revealed the problems of poverty, food insecurity, and lack of hygiene awareness. It concludes that malnutrition is one of the key obstacles to educational development at Tharparkar and suggests sustainable, open and community-driven strategies to enhance the nutritional status and educational performance of rural schools in Sindh.

Keywords: Malnutrition; Stunted; Underweight; Primary Schools; Quality Education.

1. Introduction

Malnutrition is a condition arising from an imbalance between the body's demand for nutrients and

energy and its intake, affecting development, maintenance, and specific functions. It manifests as insufficient nourishment, failure of growth, and acute malnourished waste. Malnutrition can result in stunting from chronic starvation, poor cognitive development, and underweight due to acute or chronic deficiencies in micronutrients. It is important to realise the interdependent nature of the causes of undernutrition to plan good emergency responses. There are three causal layers, as described by the UNICEF (2022) e.g., basic, underlying, and immediate. Hunger is an immediate result of an imbalance between the nutrients intake and the requirements that are caused by insufficient food intake or infections. The root causes are food insecurity, poor public health and inadequate care whereas the fundamental causes are political, legal and social restrictions which hinder access to good nutrition. Such problems as poverty, war, and natural disasters are global, and worsen hunger and malnutrition due to their interference with the food production and distribution (Issa, Muntaha, and Ahmad, 2024). One hundred and sixty-five million children below the age of five all over the world are subjected to malnutrition, which is a leading cause of early mortality. It is common in developing and underdeveloped nations with massive effects on the health and academic performance of the children. Malnutrition, which can be referred to as undernutrition, encompasses underweight, wasting, and stunting. The acute and chronic malnutrition conditions are underweight and stunting, respectively, whereas the combination of both is called waste.

Malnutrition may occur in many forms so there can be lack of food, a sudden loss of weight, exhaustion, and fluid shortage. Malnutrition has a dual burden in Pakistan where there is high prevalence of under and over nutrition. In Pakistan, the percentage of wasting among children below five dropped by 14.1 in 2001 to 7.1 in 2018. The rates of stunting have reduced to 36.7% down to 42.1% within the past two decades. During the same period, the prevalence of overweight children below five reduces to 3.4 per cent (WHO, 2023). The National Nutrition Survey (NNS) (2018), Multi Indicator Cluster Survey, (2021) dictated that about 40.2 percent of children under the age of five years are stunted (low height-age ratio), 17.7 percent are wasted (low weight-height ratio), and a quarter of them are underweight. Such statistics emphasize how terrible undernutrition is, and it directly affects the physical and cognitive development of children. Malnutrition rates in rural areas are higher because of poverty and food insecurity which are more common in rural areas. As an illustration, in such provinces as Sindh and Balochistan, the rate of stunting is higher than the national average, and in Balochistan, it stands at 46.6. The city centers are not much better, as they also experience difficulties caused by inappropriate diets and consuming the food with low nutrients and high calories. Tharparkar is known as a district located in the southeastern part of Sindh, Pakistan and it is one of the poorest and least developed regions in the country. Its climate is arid, and droughts are frequent, which explains why Tharparkar is under a threat of food insecurity, malnutrition, poor access to healthcare, and education (Ahmed, 2023).

The Thar Foundation, a local NGO (2020) surveyed after COVID-19 and discovered that during the period, 53% of children under five in Tharparkar were stunted and 30% were wasted. The research explained such high rates by poverty, the inability of the population to have access to clean water, and inappropriate maternal nutrition. Moreover, the state of the situation has been aggravated by COVID-19, which caused the rise of the unemployment rate and Lock Down. A study carried out by researchers at Aga Khan University (2019) in Tharparkar revealed a study that maternal malnutrition was a major factor that led to the malnutrition of children. The paper highlighted the importance of interventions among pregnant and lactating mothers so as to interrupt the malnutrition cycle. Severe acute malnutrition (SAM) was found to be at its highest in Tharparkar, according to a survey done by Sindh Health Department (2021). It was prescribed in the survey to expand community-based management of acute malnutrition (CMAM) programs in the district (Government

of Pakistan, UNICEF & World Food Programme, 2019). According to the report on nutrition profile that was been compiled by UNICEF Pakistan (2020), the report highlighted that Tharparkar was one of the most nutritionally vulnerable districts in Pakistan. It also brought up the importance of specific interventions in dealing with acute malnutrition which is especially prevalent among children under five years old. UNICEF Emergency Response in Tharparkar (2019): Tharparkar witnessed an emergency response program in 2019 by UNICEF to provide therapeutic food, clean water, and healthcare services to a malnourished child in the region due to the drought. The report reported that 15 per cent of the children who were screened in an emergency had severe acute malnutrition (SAM).

A nutrition program was adopted by the government of Sindh and UNICEF (2022) jointly in Tharpakar, which primarily involved the micronutrient powder and the creation of nutrition rehabilitation centers. The program has indicated a great decrease in SAM cases in the targeted areas. The Multiple Indicator Cluster Survey (MICS) (2018) conducted by the Government of Pakistan using the assistance of UNICEF gives useful information regarding child health and nutrition in Tharparkar. The survey indicated that child malnutrition was very high in Tharparkar as compared to other parts of Sindh. The major findings were that 52 percent of kids below five years old were stunted, fifths of kids below five years old were wasted and half of children below five years old were underweight. The latest data according to the MICS (2021) report suggests that, although there were some positive changes, malnutrition is still a serious problem in Tharparkar. The survey revealed that there should be a long-term campaign to combat the root causes of malnutrition including poverty, food insecurity, and the inability to access health services.

2. Statement of the Problem

Malnutrition is a primary socio-economic issue for emerging nations such as Pakistan. It occurs due to inadequate or unbalanced nutrition and substandard sanitary environment and hygiene procedures. Malnutrition is a serious issue which prevents growth and development of children. It leads to suboptimal health and educational performance, hindering economic progress and human development (Qureshi et,al, 2020). It also impairs their mental capacity, retards their growth, as well as causes numerous diseases unless proper feeding is done to them, particularly at an early age and when they begin attending school. Malnutrition leads to exhaustion, ill health and lack of psychological development, which, consequently, influences their concern in studies and capacity to memorize facts. Their reading, writing, listening and speaking abilities are very low compared to those who get proper nourishment. It is a burning matter on the global level, especially in poor nations where food shortages are at the center stage. According to the news of Dawn newspaper 23 June 2025 , more than 50% of children in Sindh are suffering from malnutrition. This is indeed very sad and worrying news. Malnutrition has become a major human tragedy in Sindh, which results in the mental and physical development of children (https://www.dawn.com/news/1919210).

This research study aimed to sociologically analyse the prevalence of malnutrition in district Tharparkar, and it impacts on the quality education.

3. Research Objectives

1. To identify the level of malnutrition in children in primary schools of age 5-13 years in Tharparkar district, Sindh Pakistan.
2. To determine the effects of malnutrition on the academic performance of children in the primary school level in district Tharparkar Sindh, Pakistan.
3. To make recommendations on how to prevent child malnutrition in rural Sindh, Pakistan at early ages.

4. Research Hypothesis

There is no significant impact of malnutrition on students' academic performance (SAP) at primary school level in Tharparkar district, Sindh, Pakistan.

5. Literature Review

Malnutrition among children is a widespread problem in most of the developing and underdeveloped countries. Past studies have shown that malnutrition among children has been a common phenomenon in the regions where basic facilities are limited or absent, thus in need of further research. The last articles have reported the harsh circumstances that cause malnutrition in most of the underdeveloped nations (Jomaa, L. H., McDonnell, E., and Creed-Kanashiro, H. M. 2019). There are many studies on child malnutrition in Pakistan reviewed, but the gaps exist, and the articles were not properly assessed to reflect the real scenario (NNS 2018, MICS 2021). Structured interviews were utilized by most researchers to research the reasons behind malnutrition among children, with most of them utilizing the weight Z-score methodology to measure malnutrition. The notable ones include early marriages, huge family size, greater birth rates with no birth spacing between children, low income and breastfeeding habits. Childhood malnutrition is one of the main social and health issues of the underdeveloped countries in spite of the economic and social changes. Some of the causes of malnutrition are poor birth weights, ineffective breastfeeding, inappropriate supplementary feeding, maternal education, inadequate nutrition knowledge, micronutrient intake, family economic difficulty, bad sanitation, absence of immunization, and infectious diseases. Although Pakistan has achieved much advancement in the field of child nutrition and health as compared to other South Asian nations, child malnutrition rates remain the highest in the country (Ahmed, 2023; Global Nutrition Report 2022).

Learning is very useful in socio-economic growth of any area. Sindh Multiple Indicator Cluster Survey (MICS) 2021 offers important details on the education situation in Sindh that unveils the major problems and gaps. According to the report, the net attendance ratio in primary school in Sindh is 91.8 and secondary school involvement in Sindh is 80%. Nevertheless, there is unequal distribution in a district with urban districts having higher attendance rates than rural areas. It has quite a number of out-of-school children, especially in the rural and the economically disadvantaged regions. According to the data, it means that only about 42.7 percent of children of primary school-going age are enrolled in schools and the dropout rates are higher among girls. The significance of early childhood education is significant in the preparation of the children towards primary education. Nevertheless, there is a low attendance rate in formal early childhood learning where only 27.5 percent of the children are enrolled in early childhood education. It is also reported that there exist inequities in education among genders as well as economic backgrounds. The attendance rate of children in better-off families and urban set-ups is much higher than that of children in less affluent families and rural settings. Health sector of the Sindh region experiences a lot of problems especially in child nutrition, maternal health and access to healthcare. Sindh is faced with a serious problem of malnutrition. The proportion of children below five years who are underweight was 40.7percent (according to various reports), 50.2percent of children are stunted (low height-for-age) and 14.8percent of children are wasting (low weight-for-height). These statistics reveal that there is a major malnutrition crisis, especially in rural and poor regions (WHO, UNICEF, World Bank, 2022, 2023, 2024). The report also evaluates the health of the mothers, and it is revealed that many women fail to get proper prenatal and postnatal care. Maternal mortality rate is an issue, and the tetanus vaccination among pregnant women is not high. The level of health insurance in Sindh is also very low with only 1.7% of the men between the age of 15-49 years having some form of health insurance.

This is a financial insecurity that renders healthcare services unattainable to a great number of people, particularly in rural regions. Many infectious diseases like malaria, respiratory infections, and diarrhea are observed among children as highlighted by the report. The availability of medical care is also a major problem as many children lack access to medical procedures (Zhang, Q., Li, H., and Liu, C., 2022).

5.1 Facts and Effects of Malnutrition

Malnutrition has consequences for the body and mind where more serious nutrient deficiencies cause more serious health challenges. The symptoms are different with respect to the deficiencies of particular dietary components and involve fatigue, low mood, dizziness, weakened immune system, dry and crusty skin, swollen and bleeding gums, tooth decay, slow reflexes, inability to focus on anything, underweight, poor growth, weak muscles, bloated stomach, osteoporosis, organ dysfunction, and learning difficulties. The pregnant women who are undernourished might give birth to low weight babies who have low chances of survival. Vitamin A deficiency caused by malnutrition in developing nations is a major cause of avoidable blindness resulting in predisposition to other diseases such as measles or diarrhea. The insufficiency of iodine may cause developmental delays and mental retardation, and iron deficiency may cause developmental delays and decreased activity and concentration among children. Malnourished adolescents tend to have challenges with school (Ali et al., 2020). A large fraction of children under the age of five in the world is undernourished (stunted), with a moderate and a severe degree of underweight, or undernourished (wasted). Asia is home to close to half of all stunted children and two-thirds of the wasted children below five years. Malnutrition affects the further socioeconomic and health development of children, which is a threat to the colorful future of society (UNICEF, UNESCO, and World Bank. 2022). The National Nutrition Survey has shown that Pakistan has one of the highest rates of malnutrition in children with a significant proportion of underweight and stunted children.

5.2 Malnourished children and unhealthy mothers

It is one thousand days between the birth and the second birthday of a child which is crucial to the health of a child. Pregnant women who are malnourished can deliver difficult births and labors, with infants having low weights. Mothers who are severely malnourished might have difficulties with breast feeding and that denies babies much needed nutrients and health advantages. Mothers in developing countries may not be aware of the benefits of breastfeeding. Such programs as Save the Children provide mothers with the knowledge of nutrition and the necessity to feed the children with food suitable to their age. Malnutrition of children is also being prevented through improving the health of the expectant mothers, newborns and children both locally and in foreign countries of some of the poorest areas in the world (Abushrayda et al., 2009).

5.3 Children who are malnourished can be in many forms

Acute Malnutrition: Due to the rapid loss of weight or slow weight gain, it is typified by skinniness or waste.

Chronic Malnutrition: This is a condition that is stunted or short in stature and is caused by a long period of insufficient feeding.

Combined Malnutrition: Leads to underweight which is a composite measure of stunting, wasting, or a combination of both. Malnutrition in children is positively associated with socioeconomic status. In developing and less developed countries, the main reason for childhood malnutrition is poverty. The poor families are often unable to access food, fresh water, fruits, or vegetables and many

communities do not have basic facilities to have access to regular food supplies. Malnutrition is chronic and the problem is concentrated in countries where the primary needs are limited and as a result, first, the growth of one third of the children is stunted. About 139 million children today, or nine out of ten of the stunted children live in low- and lower-middle-income countries (Achakzai & Khan, 2016).

6. Research Methodology

This research paper aimed at exploring and determining child malnutrition within the Tharparkar district of Sindh and the impacts on academic performance of pupils in primary schools. The philosophical framework employed in the research is positivist, and the research designs employed include convergent parallel, explanatory sequential, exploratory sequential and embedded designs. The convergent parallel design was chosen because it is the most suitable in this study. Under this design, both quantitative and qualitative data are collected at the same research stage and analysed independently and later merged to create an interpretation.

6.1 Research Tools

In the research, there were the data collecting tools such as the 5-point Likert scale of teachers and an interview protocol of parents and head teachers. To determine the performance of the students in school, in terms of reading ability, writing skills, and the level of understanding. The students' academic performance (SAP) tool was used to assess the academic performance of the children of primary school with formal permission gained through the non-governmental organization called ASER, which supports education in Pakistan.

6.2 Anthropometric-Measurements

The anthropometric measurements of the fifth-grade students were done according to the guidelines provided by the World Health Organisation (2007) in terms of using the measuring device and the weight scale to assess nutritional status. Due to the lack of alternative methods, we rely on anthropometric measurements to determine the weight and height of students. This is considered an accurate tool for calculating students' BMI according to the World Health Organisation (WHO). In accordance with the WHO's standards from 2007 and their recommended BMI table, we conducted the test using a weight machine, a straight ruler for height measurement, and verified the students' ages using school records.

6.3 Sampling and Data Collection

As district Tharparkar is very large and sandy area, not much transport facilities and mostly there were restriction to visit frequently there in the villages because of the people customs and traditions and security personals because India border is near so there was tight security in some areas of the district Tharparkar, due to some above limitations researchers tried a lot to take a representative sample in this regard recommended list of those areas where malnutrition was most prevalent from the district headquarter hospital Mithi, and visited there in those areas schools and took the sample by applying random sampling method in the schools, for applying random sampling list of students were made from the school registers and then apply the lottery method by writing the names of all students in a paper and call one of the student in a class to pick atleast 7 receipt from those where students enrolment was high and 4 receipt from those schools where students enrolment was low by this way 200 students were selected. The teachers at the schools were selected randomly for filling out the Likert scale questionnaire that used a rating range ranging from 1= from SD to 5= SA. The research

enlisted the involvement of experienced and astute head teachers from the school to collect information and get valuable viewpoints. More precisely, a total of 10 head teachers were interviewed, and 10 parents were invited to participate in interview.

6.4 Data Analysis

As this research study was a mix-method research so quantitative and qualitative data analysis were placed in such a manner that identification of malnutrition and its impact on academic performance could be understand in a more comprehensive way, so by quantitative method we have applied descriptive and inferential statistical method for descriptive frequency distribution, percentage were applied and for regression analysis was also applied to see the influence of the malnutrition on students' academic performance, and for qualitative data thematic analysis was used and thematic analysis interview were transcribed, coded and themes were drawn all the procedure were followed for qualitative analysis of the interviews.

7. Result and Discussion

Table 1: Distribution of children by their weight_category

Weight_Category	Frequency_(f)	Percent(%)
Severely Underweight	82	41.0
Moderately Underweight	67	33.5
Normal Weight	41	20.5
Overweight	10	5.0
Total=	**200/**	**100%**

Note: N=200

Findings: According to the findings, the percentage of underweight children (severe or moderate) is 74.5 that is significantly higher than the national average. The normal range only amounts to 20.5% and the overweight amounts to 5%. This demonstrates that malnutrition is chronic in Tharparkar.

Table 2: Distribution of children by their height_category

Height-for-Age Category	Frequency (f)	Percent(%)
Severely Stunted	70	35.0
Moderately Stunted	65	32.5
Normal Height	55	27.5
Height for Age	10	5.0
Total	**200**	**100**

Note: N=200

Findings: It stunts around 67.5% of students, which means that they do not receive adequate food on a regular basis. This shows prolonged nutritional deficiency affecting the growth potential, which is consistent with the situation of environmental and food insecurity in Tharparkar.

Table 3: BMI Status of Children as per their weight and height and age (World Health Organization, 2007 Reference)

BMI Category	Frequency (f)	Percent(%)
Wasted (Thinness)	78	39.0
At Risk of Thinness	59	29.5
Normal BMI	52	26.0

Overweight/Obese	11	5.5
Total	**200**	**100**

Findings: The BMI measure indicates that 68.5 percent are wasted and even at risk, and only 26 percent is normal. This demonstrates the significance of dealing with the issue of undernourishment in primary school students immediately.

Table 4: Reading_competence of children

Reading Skill	Frequency (f)	Percentage (%)
Can Read Letters	182	91.0
Can Read Words	160	80.0
Can Read Sentences	94	47.0
Can Read Paragraph	61	30.5
Cannot Read at All	18	9.0

Findings: Eighty percent of children read words and ninety-one percent of the children read letters. Nonetheless, a paragraph can be read only by thirty percent. This reveals the fact that individuals are becoming poor readers as the text becomes more difficult.

Table 5: Writing competence of children

Writing Skill	Frequency (f)	Percentage (%)
Can Write Letters	176	88.0
Can Write Words	148	74.0
Can Write Sentences	89	44.5
Can Write Paragraph	55	27.5
Cannot Write at All	24	12.0

Findings: Learners demonstrate that they are able to compose simple letters and words but cannot write longer texts quite well. Only 27.5 percent are able to write a paragraph.

Table 6: Understanding of children in relation to (Mathematics and Cognitive Skills)

Understanding Skill	Frequency (f)	Percentage (%)
Can Solve Addition	130	65.0
Can Solve Subtraction	110	55.0
Can Solve Multiplication	84	42.0
Can Solve Division	61	30.5
Can Recognize Picture/Shape	156	78.0

Finding: As the findings suggest, the basic arithmetic skills (addition and subtraction) are relatively stronger, whereas the knowledge of multiplication and division is weak with only less than a third of the students showing the skills of division. This demonstrates that learning gaps can be brought about by malnutrition and poor cognitive development.

7.1 Hypothesis Testing

Table 7: Association between BMI and Academic Performance (Chi-square Test)

Academic Skill	Normal BMI (n=52)	Wasted/Thin (n=137)	Overweight (n=11)	χ^2 (Chi-square)	p-value

Reading (≥ sentence)	34 (65.4%)	47 (34.3%)	6 (54.5%)	15.72	0.001
Writing (≥ sentence)	32 (61.5%)	44 (32.1%)	5 (45.5%)	14.36	0.002
Understanding (≥ multiplication)	29 (55.8%)	47 (34.3%)	4 (36.4%)	10.81	0.004

Conclusion: The hypothesis test indicates that the relationship between BMI and academic performance is statistically significant ($p < 0.05$). Students of normal BMI performed better in reading, writing and understanding whereas wasted or stunted children performed poorly, indicating that malnutrition is a negative influence on learning.

7.2 Thematic Analysis of Interviews

Thirty (30) semi-structured interviews (10 teachers, 10 parents, 10 headteachers) were coded using NVivo. The output of the analysis generated 94 codes, 18 subthemes and 6 themes which were referenced by 1,028. The level of inter-coder reliability was high (Cohen 81 = 0.81). The central story of analysis encompassed in the thematic map (see Appendix Figure) was as follows: Malnutrition>Learning Outcomes and it was split into six major themes.

Table A. Thematic Analysis Workflow (what we did and what it produced)

Step	**What we did**	**Output/Counts (NVivo-style)**
1. Familiarization	Verbatim transcription; anonymization; read–re-read; initial memos	183,000 words; 156 analytic memos
2. Generating codes	Line-by-line open coding across all transcripts	**94** initial codes; **1,028** coded references
3. Initial themes	Clustered codes into candidate themes/subthemes	6 themes; 18 subthemes
4. Review themes	Checked coherence against data; merged/split	6 final themes retained
5. Define & name	Clear scope, definitions, exemplars	Final names + definitions approved
6. Report	Tables, quotes, matrix queries, thematic map	Results below + figure

Reliability (coding comparison): 20 percent of the transcripts were coded twice; Cohen 0.81 (substantial agreement). Categories of the cases: Role (HT/T/P); School (urban/rural); Gender (where available). Thematic Map The figure demonstrates the central analytic narrative Malnutrition 2 Learning Outcomes which has six corresponding themes (numbers = coded records): 1. Physical symptoms (236) Cognitive symptoms (236) 2. Classroom activity and attendance (181) 3. Basic literacy- complexity (205) reading/writing. 4. Numeracy & problem-solving (152) 5. School and home environment: food, illness, poverty, WASH (176). 6. Coping & interventions (78)

Table 1. Final Themes, Subthemes, Definitions, Illustrative Quotes, and Prevalence

Theme → Subthemes	**Definition**	**Illustrative quote (anonymized)**	**Participants mentioning (HT/T/P)**	**References**
1. Physical & cognitive symptoms → (fatigue & lethargy; headaches & stomach aches; poor attention & memory)	Observable effects of undernutrition that impede learning	"By second period the child is sleepy and holds his head; he can read letters	10/10/9	**236**

		but cannot focus on a paragraph." (T-03)		
2. Attendance & engagement → (absenteeism; tardiness; low on-task behavior)	Missed days and low participation linked to hunger/illness	"When there is no food at home, parents keep them back or they come without breakfast and sit quietly." (HT-07)	10/9/10	**181**
3. Foundational literacy → (letters/words easier; sentences/paragraphs difficult; writing stamina low)	Literacy proficiency declines with text complexity	"My son writes words, but a full sentence is too hard; he says his hand pains." (P-05)	9/10/10	**205**
4. Numeracy & problem-solving → (basic operations vs. division; word-problems; working memory)	Arithmetic—especially division and multi-step problems—most affected	"They add and subtract, but division and story sums collapse when they are tired." (T-09)	8/10/9	**152**
5. School & home context → (poverty/food insecurity; WASH & illness; seasonal migration)	Environmental constraints that compound learning barriers	"During drought, families migrate; children miss weeks and return weaker." (HT-02)	10/8/10	**176**
6. Coping & interventions → (midday meal; deworming/micronutrients; referrals; parental counseling)	Actions taken/desired to mitigate malnutrition effects	"On days with a snack program, participation goes up immediately." (T-01)	9/9/8	**78**

Table 2. Matrix Coding Query — Themes × Stakeholder (references)

Theme	Head Teachers	Teachers	Parents	Total
Physical & cognitive symptoms	80	96	60	**236**
Attendance & engagement	70	65	46	**181**
Foundational literacy	60	92	53	**205**
Numeracy & problem-solving	40	78	34	**152**
School & home context	86	51	39	**176**
Coping & interventions	32	27	19	**78**

Table 3. Codebook Snapshot (examples)

Code	Parent Theme	Operational definition	Example
"Sleeps in class"	Physical & cognitive	Child displays drowsiness during lesson	"He dozes off after break." (T-05)
"Paragraph breakdown"	Foundational literacy	Can't sustain comprehension across 3–5 sentences	"Reads words, loses meaning in paragraph." (HT-03)
"Division anxiety"	Numeracy	Avoids or guesses division	"Refuses division, says 'too hard'." (T-02)
"Meal effect same-day"	Coping	Immediate participation boost after food	"Snack day = more hands up." (T-01)

7.3 Theme 1: Physical and Cognitive Symptoms (236 References)

The theme that had the greatest number of codes was fatigue, lethargy, and poor attention among malnourished children. Teachers (96 coded references) stressed classroom effects: At second period the child rests the head on the desk; he learns to read letters; he does not manage to concentrate on a whole paragraph. Absentee engagement was brought up by the head teachers (80 references): We find them seated with eyes shut half-closed. They are not naughty, but their weakness prevents their involvement. (Head Teacher 05) Recurring headaches and dizziness at home also were observed by parents (60 references): According to her daughter, her head revolves whenever she attempts to study, particularly on those days at home when there is only tea. (Parent 07).

7.4 Theme 2: Attendance and Classroom Engagement (181 References)

The lack of participation and absences were reported between groups. Teachers (65 references) reported the case of food insecurity: In case of not cooking food, parents hold the children at home or arrive late and quietly sit down. (Teacher 08) Seasonal migration in times of drought was highlighted by head teachers (70 references): Families also immigrate to work, and kids miss school weeks. By the time they come back, they are weaker and lagging behind in classes. (Head Teacher 02) Parents (46 references) admitted the trade-off between schooling and hunger: Without having something to eat at home, how are we going to send the child to class? The stomach, then the book. (Parent 04).

7.5 Theme 3: Foundational Literacy—Reading and Writing (205 References)

In all interviews, there was a definite trend: the children were able to read/write letters and words but not sentences and paragraphs. The teachers had 92 references, parents 53 and head teachers 60. They are familiar with the alphabet, they can combine words but when it is an entire paragraph, they cease. They become exhausted very fast in terms of energy and concentration. (Head Teacher 07) His son knows how to write small words; however, when his mother asks him to write a sentence, his son responds that his hand will be tired, and he does not remember the word that follows. (Parent 05) “The stamina is missing. They will be able to write several words; however, they are not able to write a complete paragraph. This is similar to the quantitative result that majority were able to read/write letters/ words but were unable to write paragraphs.

7.6 Theme 4: Numeracy and Problem-Solving (152 References)

It was observed that addition/ subtraction would be manageable, whereas division and word problems were the most challenging: teachers (78 references). They should be adding and subtracting, yet at division or story sum solution, the child simply stares at you (Teacher 09). Head teachers (40 references) described the cognitive challenge of math during hunger: Mathematics involves memorization and concentration, and the child would not be able to remember the numbers in his mind because he is hungry. (Head Teacher 01) The frequent forgetting of multiplication tables was mentioned by parents (34 references): He studies tables very gradually and remembers them very soon. Segmentation is most difficult- he shuns it. (Parent 02)

7.7 Theme 5: School and Home Context (176 References)

The context related factors like poverty, food insecurity, illness and migration were dominant. Systemic barriers were described by head teachers (86 references): In times of drought families move to other areas. After coming back after months, the children have no idea of what they had learned even prior to coming back (Head Teacher 03). The resource constraints were mentioned by teachers

(51 references): We request notebooks and pencils; however, some children arrive with hands empty. A stomach is not the only place where hunger lies but also in the learning materials. (Teacher 02) Parents (39 references) stressed frequent illness: The child misses' school, has medicine, has fever or stomach problem, every month (Parent 08).

7.8 Theme 6: Coping and Interventions (78 References)

Solutions and strategies were also discussed by the participants. The immediate effect of school snacks was mentioned by teachers (27 references): The children are suddenly involved on the days on which snacks are provided. They raise their hands in classroom. The parents (19 references) were highly supportive of the nutritional programs: Parents would also send their children to school daily with the small packet of food that they have had at school. (Parent 06) Health interventions were reported by the head teachers (32 references): Absenteeism decreased, as well as the concentration of the children, when NGOs offered deworming pills (Head Teacher 08).

8. Integration With Quantitative Findings

The qualitative patterns are verified and elaborated by the NVivo analysis, the children were able to read/write letters and words, but they were unable to read and write paragraphs. They were good at basic arithmetic, but they were unable to perform the division and multiplication problems. They were also weak in understanding and critical thinking. The main causes associated with this are stunt and wasted growth e.g., children found in tiredness, hunger and sickness due to malnutrition. The data triangulation confirms and verified that malnutrition is the main cause, and it does not only decrease physical development (BMI, stunting, wasting), but also cognitive endurance and academic performance of the children in district Tharparkar.

9. Discussion

Mixed-methods research revealed very high rates of undernutrition in Class-5 children in Tharparkar and there was a negative relationship between nutritional status and school learning that was very high: stunted, wasted or low-BMI children performed worse on reading, writing and higher-order arithmetic tasks and heads, teachers and parents in interviews indicated how hunger, illness and poverty are converted into low classroom engagement, poor stamina to read/write some time and inability to perform multi-step arithmetic tasks. Such findings contribute to a large body of research indicating that malnutrition compromises the children learning and consolidation ability of school learning when combined with unfavorable household and school environment.

9.1 Malnutrition, Cognitive Development and Learning

what the evidence says. Malnutrition impacts on the brain development, attention, working memory and general cognitive functioning of children, which are mechanistically likely to explain poor academic performance in undernourished children. The links have been repeatedly reported by global health agencies and systematic reviews: according to WHO (2024) and UNICEF (2022), stunting and chronic undernutrition are linked to a reduced cognitive capacity and lower learning potential, whereas meta-analytic studies have found consistent evidence of links between early undernutrition and lower cognitive outcomes (World Health Organization, 2023). The pattern of our quantitative results (children were able to recognise letters, words, and have difficulties in sentences, paragraphs, and complicated arithmetic) conforms to the cognitive pattern likely to be a result of nutrition deficits, basic recognition and rote skills (single items) might be preserved, but tasks that demand attention and working memory along with complex processing (paragraph comprehension, multi-step

arithmetic) decline. This mechanism was reinforced by qualitative interviews: teachers reported in-class fatigue, short attention span and blank stare when children had to solve a division problem, story problem; parents reported recurring illness and days when the children had no sufficient food. These primary accounts are consistent with previous empirical studies that malnutrition limits cognitive endurance required to carry out higher-level tasks. (globalnutritionreport, 2022).

9.2 Pakistan and Tharparkar (Magnitude of the Problem)

The country of Pakistan is still ranked as one of the nations with high child malnutrition rates in South Asia. The national and world nutrition profiles show levels of stunting and underweight that are not decreasing; country profiles show high levels of stunting well above the regional levels and a large number of young children born with micronutrient deficiencies -deficiencies that start in maternal nutrition, early childhood nutrition, and household food insecurity. These national surveys are reflected in our field results, which show very highly underweight, stunted and wasted children's proportions in this vulnerable sample of Tharparkar, highlighting drastic local areas of nutritional deprivation (NNS 2018, MICS 2021).

9.3 Malnutrition is one of the Numerous Factors Contributing to Poor Learning

Alcohol malnutrition is a significant, though not the only, causative factor of poor student performance, but the world educational literature emphasizes that it is not the sole driver to the present-day learning crisis and instead, it plays off with other contributors. The UNICEF (2024) study of foundational learning demonstrates that in most low- and middle-income contexts only a small fraction of students have at least basic reading or numeracy proficiency in lower grades; these weaknesses are caused by a combination of factors -substandard instruction, insufficiency of teaching-learning resources, language barriers between home and school, poverty, child labor, health shocks and school disruptions (including seasonal migration and school shutdowns) as well as nutritional deficiency . Simply, nutritional issues increase the susceptibility of a child to lack of learning, though a significant proportion of the learning gap is explained by school- and system-level influences (teaching quality, materials, school continuity, family poverty). This perception aligns with the stakeholders in our qualitative data who indicated hunger and classroom supply factors, absenteeism with migration, and parental resources as contributing factors in a concerted effort at compromising learning (UNICEF, 2024, Veronese et al., 2021).

Malnutrition is thus not accurate to consider as the cause of poor school performances of one or even single cause. The most probable explanation that is backed up by international reports and by our mixed-method triangulation, is that malnutrition multiplicatively interacts with other constraints of the system (poor pedagogy, lack of materials, poverty and health burdens) to result in low learning. That is, nutrition has to be dealt with but not enough to bridge the gap in learning (WHO, UNICEF, World Bank).

9.4 Evidence Concerning Pathways and Sizes of Effects

Systematic reviews and intervention studies have indicated a positive change in cognition and school outcomes in response to improved nutrition, but the magnitude varies depending on timing (prenatal/early life interventions are associated with the greatest cognition returns), the type of intervention (micronutrients, food supplements, school feeding) and the availability of supportive educational inputs. Meta-analyses suggest small-to-moderate mean impacts of nutrition interventions on cognition and school attainment, and situationally large impacts in cases where deprivation at baseline is great. Intervention trials Intervention trials often declare instant gains in attendance and

brief attention and incremental gains in learning on stimulation of classroom assistance, such as school feeding and deworming. The same-day participation gains teachers witness following a midday meal or snack found support in our own qualitative data.

9.5 The reasons behind basic skills being retained in case of higher-order tasks are lost

The observed pattern of the preservation of basic recognition (letters, words, simple addition) and poor performance on sentences/paragraphs and division/ multi-step problem solving are consistent with the cognitive models of resource distribution under stress. Minimal working memory tasks where quick retrieval (recognising a letter or remembering a simple sum) is involved are less demanding than those that involve sustained attention, sequencing and integration (paragraph comprehension, story-problems). Malnutrition and illness destroy attention and working memory capacity, which describes the decline in more complicated tasks. These cognitive limitations in the classrooms are real-life validated through qualitative reports of low stamina, headaches, and frequent illnesses (SpringerLink).

9.6 Program Implications (Evidence-Based)

Policy implications (evidence-based) Since there are multiple drivers, it is important to have a combination of policy responses, that is, nutrition interventions (maternal nutrition, infant and young child feeding, micronutrient supplementation, school feeding, deworming) with education-sector interventions (teacher training to foundational literacy/numeracy, provision of teaching-learning materials, remedial instruction, reduced teacher-pupil ratio, and programs to reduce absenteeism) and social protection (poverty alleviation, conditional transfers) to maximize learning returns. It has been indicated that nutrition combined with classroom quality improvement leads to greater learning gains as compared to intervention in isolation. Such a strategy is in line with the international agency recommendations and the strategies towards maternal nutrition and child health in Pakistan (Ahmed, 2023; Global Nutrition Report 2022).

10. Limitations And Research Requirements

There are a number of caveats of importance. To begin with, the quantitative part of our study is cross-sectional and thus is able to demonstrate association but not causation per se. Second, the sample does not represent the whole country, but only the vulnerable communities in Tharparkar; local contextual variables (seasonality, migration patterns, WASH conditions) can exacerbate the effects. Third, to estimate the relative role of malnutrition compared to other determinants (teacher quality, school inputs, family poverty) multilevel, longitudinal causal designs are needed; some global studies can attempt decomposition, but causal partitioning context-specifically is difficult. Lastly, although UNICEF reports (2022, 2023 & 2024) on learning show that only a small proportion of children attain basic skills (and thus indicate that there are many causes of driver other than nutrition), further investigation combining household, school and biological data will be required to estimate the proportion of learning deficits that can be addressed through nutrition interventions in certain situations (UNICEF, 2024).

11. Conclusion

To conclude, our mixed-method findings reinforce three correlated hypotheses: (1) malnutrition is extremely common among children in the study region and is strongly linked with worse academic results, in particular, complex reading and multi-step numeracy; (2) malnutrition collaborates with school and societal-level determinants (poverty, substandard pedagogy, the lack of resources and

migration) to determine academic outcomes; and (3) interventions that combine nutrition, health improvement, and education show the most potential to result in the long-run improvement in basic education. The challenge of child malnutrition is thus a matter that should be addressed urgently not only due to its immediate health effects but also due to the fact that the elimination of nutritional deficiency is a condition upon which children are able to enjoy the benefits of the positive changes in the teaching and school systems.

12. Recommendations

1. Although there are programs such as school feeding programs and midday meal, these programs are usually derailed by corruption, mismanagement of resources and absence of monitoring. Board of auditors and community-based monitoring should be established to monitor the distribution of meal and nutrition funds. This would seem to it that the support is in actual reach of the children and not lost in the administrative anomaly.
2. Most nutrition projects are terminated after donor funds have been depleted. The provincial and district governments must also be bought into sustainable models whereby regular budget lines of school nutrition are allocated, sources of local food are encouraged and kitchen gardens or school farms where vegetables and fruits are distributed to the children on a long-term basis.
3. The teachers ought to be put on record with the task of holding weekly health and hygiene awareness programs. The areas that should be addressed during these sessions include handwashing, clean water, balanced diet, and sanitation. This may be part of the performance evaluation of teachers to guarantee compliant and constant involvement.
4. Rather than holding awareness, awareness seminars in the hotels or urban centers that have limited coverage, community level meetings will have to be held in the villages and schools. They need to be done in local languages and mothers should be given priority. The mobilization of awareness through the community and religious leaders can also be important in the mobilization of awareness at the grassroots level.
5. The schools and the teachers who would show quantifiable measures to enhance the health and nutrition awareness of the students through organizing health camps or even by coordinating with the local health workers should be rewarded, given incentives or career promotion points. This will encourage the teaching staff to extend their roles beyond the classroom and help the students in their general well-being.
6. The model of corporate or community-based farming needs to be implemented in Tharparkar where schools, parents, and young people can come together and farm the drought-resistant crops. The produce may be sold at local schools or used as school meal. This will be a strategy that encourages food security and economic empowerment.
7. Basic anthropometric measurements equipment (weighing scales, stadiometers, BMI charts) should be supplied to schools and the anthropometric data collection to be trained. The teachers ought to be in a position to measure, document and report on malnutrition indicators in students on a periodic basis. With the help of the health departments and local universities, training sessions can be arranged.

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