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Impact of School-based Health Programs on Nutritional Status in Underserved Communities

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Abstract: **Background:** Malnutrition remains highly prevalent among school-aged children in underserved communities and adversely affects growth, health, and academic performance. **Objective**: To assess the impact of school-based health programs on nutritional status among children from underserved communities. **Methodology:** This was a cross-sectional analytical study conducted at Gomal Medical College DI Khan from May 2024 to May 2025 including 320 school-aged children enrolled in school-based health programs in underserved communities. **Results:** Baseline characteristics were comparable between groups. Post-intervention, the program group showed significantly higher weight (30.4 ± 6.8 vs 28.5 ± 6.3 kg), height (133.8 ± 9.6 vs 131.7 ± 9.8 cm), and BMI (16.9 ± 2.3 vs 16.3 ± 2.1 kg/m²) ($p \leq 0.02$). Weight gain (3.3 ± 1.4 vs 0.9 ± 1.1 kg) and height gain (3.9 ± 1.5 vs 1.1 ± 1.2 cm) were significantly greater ($p<0.001$). Underweight prevalence decreased (18.8% vs 30.7%) and anemia reduced (22.4% vs 40.0%). School meals (OR 3.82), supplementation (OR 2.94), and deworming (OR 2.51) independently predicted improvement. **Conclusion:** School-based health programs significantly enhance growth and nutritional indicators and represent effective, scalable strategies to combat malnutrition in disadvantaged populations.

Keywords: School-based health programs, nutritional status, schoolchildren, malnutrition, anthropometry, Feeding

INTRODUCTION

Malnutrition is an important social problem of children of school age, which is exceptionally common in underserved and low-income localities where food security is likely to be poor, the range of foods is not as extensive, and access to health care is restricted [1]. Undernutrition (stunting, wasting and underweight) and micronutrient deficiencies are both negative influences on physical development, immunity, cognitive capacity and academic performance, which lowers the long-term outcomes of children [2]. Schools are also affordable and offer a convenient facility dealing with vulnerable children, as they have easy access to their children on a regular and organized basis [3]. Consequently, nutritional supplementation, school feeding, deworming, micronutrient fortification, health education and hygiene promotion are progressively being included in school-based health programs to address some of the preventable causes of poor growth [4]. The interventions are aimed at not only improving the nutritional indicators but also attendance, the learning capacity, and well-being. Childhood nutrition is strongly linked to low attention levels, fatigue, heightened infections, and school dropout [5]. School lunch programs are also reported to address nutritional gaps, promote uniform growth, improve admission rates, and reduce dropout rates [6]. There are also iron and vitamin supplements, which have been shown to reduce anemia and improve energy status and cognitive function [7]. Deworming also increases nutrient absorption and decreases chronic nutritional losses, especially in resource-constrained environments [8].

It can be useful to implement anthropometric surveillance in schools like weight, height, and body mass index (BMI) to detect growth faltering or excess weight gain at a young age and to do early-stage intervention [9]. Health education components further improve healthier eating habits and hygiene that may be beneficial to the family and the community [10]. Despite these advantages, the program performs poorly due to insufficient funding and socioeconomic factors [11]. Other settings claim significant changes in BMI and hemoglobin values, and others claim some or inconclusive outcomes [12]. Moreover, a two-sided problem related to malnutrition is being witnessed today among some of the underserved population, since undernutrition co-exists with the increasing rates of childhood overweight, and it requires an integrated and multifaceted solution [13].

Objective

To assess the impact of school-based health programs on nutritional status among children from underserved communities.

METHODOLOGY

This was a cross-sectional analytical study conducted at Gomal Medical College DI Khan from May 2024 to May 2025 including 320 school-aged children enrolled in school-based health programs in underserved communities.

Inclusion Criteria

- Children aged 6–12 years
- Enrolled in selected schools participating in school-based health programs
- Regular attendance (≥75% school days)
- Parental/guardian informed consent provided

Exclusion Criteria

- Known chronic systemic illness (renal, cardiac, endocrine, or congenital disorders)
- Physical disability affecting accurate anthropometric measurement
- Current hospitalization or acute severe infection
- Receiving external nutritional supplementation outside school programs
- Incomplete records or refusal to participate

Data Collection

Data were recorded using a structured proforma. The demographic variables were parental education, socioeconomic status, age and gender. The baseline clinical evaluation consisted of a general physical examination and a dietary history. Anthropometric measurements were obtained using standardized methods: weight was measured with calibrated digital scales, height with a stadiometer, and body mass index (BMI) calculated as kg/m2. The nutritional status was determined based on BMI-for-age and height-for-age percentiles to determine underweight, stunting, normal weight and overweight. The variables that were recorded as per the program included participation in school meals, the use of micronutrient supplements, deworming, and health education programs. Anemia was determined by measuring hemoglobin levels. Measurements were performed by trained staff using the same protocols to ensure uniformity and reliability.

Statistical Analysis

Data were analyzed using SPSS version 29. Quantitative variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Independent sample t-test and paired t-test were used to compare anthropometric parameters across groups. Chi-square test assessed differences in nutritional categories. Multivariable regression analysis was performed to determine the independent impact of school-based interventions on nutritional outcomes. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Among 320 children, demographic and socioeconomic variables were comparable between the program (n=170) and control (n=150) groups. Mean age was similar (9.0 ± 1.7 vs 9.2 ± 1.9 years), with balanced gender distribution (52.9% vs 54.7% males). Low socioeconomic status (64.7% vs 69.3%), parental illiteracy (54.1% vs 62.7%), large household size (69.4% vs 73.3%), and baseline BMI (15.7 ± 2.2 vs 15.9 ± 2.0 kg/m²) showed no significant differences (all p>0.05), indicating both groups were comparable at baseline.

Table 1. Baseline Demographic and Socioeconomic Characteristics of Participants (n = 320)

Variable	Total (n=320)	Program (n=170)	Control (n=150)	p-value
Age (years, mean ± SD)	9.1 ± 1.8	9.0 ± 1.7	9.2 ± 1.9	0.38
Male, n (%)	172 (53.8)	90 (52.9)	82 (54.7)	0.74
Female, n (%)	148 (46.2)	80 (47.1)	68 (45.3)	0.74
Low socioeconomic status, n (%)	214 (66.9)	110 (64.7)	104 (69.3)	0.39
Parental illiteracy, n (%)	186 (58.1)	92 (54.1)	94 (62.7)	0.12
Household size (>5 members), n (%)	228 (71.3)	118 (69.4)	110 (73.3)	0.45
Baseline BMI (kg/m², mean ± SD)	15.8 ± 2.1	15.7 ± 2.2	15.9 ± 2.0	0.46

Mean weight (27.1 ± 6.6 vs 27.6 ± 6.1 kg), height (129.9 ± 9.5 vs 130.6 ± 9.9 cm), and BMI (15.7 ± 2.2 vs 15.9 ± 2.0 kg/m²) did not differ significantly. Underweight prevalence (32.9% vs 32.0%), stunting (31.8% vs 29.3%), anemia (38.8% vs 37.3%), and overweight (5.9% vs 5.3%) were nearly identical (all p>0.05), confirming similar nutritional burden prior to intervention.

Table 2. Baseline Nutritional Status before Intervention

Nutritional Indicator	Total	Program	Control	p-value
Weight (kg, mean ± SD)	27.3 ± 6.4	27.1 ± 6.6	27.6 ± 6.1	0.52
Height (cm, mean ± SD)	130.2 ± 9.7	129.9 ± 9.5	130.6 ± 9.9	0.58
BMI (kg/m², mean ± SD)	15.8 ± 2.1	15.7 ± 2.2	15.9 ± 2.0	0.46
Underweight, n (%)	104 (32.5)	56 (32.9)	48 (32.0)	0.86
Stunted, n (%)	98 (30.6)	54 (31.8)	44 (29.3)	0.63
Anemia, n (%)	122 (38.1)	66 (38.8)	56 (37.3)	0.78
Overweight, n (%)	18 (5.6)	10 (5.9)	8 (5.3)	0.82

Mean weight increased to 30.4 ± 6.8 kg compared with 28.5 ± 6.3 kg in controls (p=0.003), and height was higher (133.8 ± 9.6 vs 131.7 ± 9.8 cm, p=0.02). BMI also improved (16.9 ± 2.3 vs 16.3 ± 2.1 kg/m², p=0.01). Children in the program gained more weight (3.3 ± 1.4 vs 0.9 ± 1.1 kg) and height (3.9 ± 1.5 vs 1.1 ± 1.2 cm), with greater BMI improvement (1.2 ± 0.7 vs 0.4 ± 0.6), all highly significant (p<0.001), indicating clear nutritional benefits.

Table 3. Post-Intervention Anthropometric Outcomes

Variable	Program (n=170)	Control (n=150)	p-value
Weight (kg, mean ± SD)	30.4 ± 6.8	28.5 ± 6.3	0.003
Height (cm, mean ± SD)	133.8 ± 9.6	131.7 ± 9.8	0.02
BMI (kg/m², mean ± SD)	16.9 ± 2.3	16.3 ± 2.1	0.01
Weight gain (kg, mean ± SD)	3.3 ± 1.4	0.9 ± 1.1	<0.001
Height gain (cm, mean ± SD)	3.9 ± 1.5	1.1 ± 1.2	<0.001
BMI improvement (mean ± SD)	1.2 ± 0.7	0.4 ± 0.6	<0.001

Underweight prevalence fell to 18.8% compared with 30.7% in controls (p=0.01), while normal BMI status was higher (74.1% vs 60.0%, p=0.006). Anemia decreased markedly (22.4% vs 40.0%, p<0.001), and absenteeism was lower (16.5% vs 37.3%, p<0.001). Program coverage was strong, with higher deworming (91.8% vs 42.7%) and meal adherence (94.1% vs 30.7%) (p<0.001), suggesting improved health and school participation.

Table 4. Changes in Nutritional and Clinical Status after Program

Outcome	Program	Control	p-value
Underweight, n (%)	32 (18.8)	46 (30.7)	0.01
Stunted, n (%)	34 (20.0)	42 (28.0)	0.08
Normal BMI, n (%)	126 (74.1)	90 (60.0)	0.006
Anemia, n (%)	38 (22.4)	60 (40.0)	<0.001
School absenteeism (>5 days/month), n (%)	28 (16.5)	56 (37.3)	<0.001
Deworming coverage, n (%)	156 (91.8)	64 (42.7)	<0.001
Meal program adherence, n (%)	160 (94.1)	46 (30.7)	<0.001

Multivariable analysis showed that participation in school meals was the strongest predictor of improved nutritional status (OR 3.82), followed by micronutrient supplementation (OR 2.94) and regular deworming (OR 2.51), all highly significant (p≤0.002). Health education also contributed positively (OR 1.88, p=0.02). Conversely, low socioeconomic status (OR 0.62) and baseline anemia (OR 0.57) reduced the likelihood of improvement, while gender showed no significant association.

Table 5. Multivariable Regression Analysis for Factors Associated with Improved Nutritional Status

Predictor	Adjusted OR	95% CI	p-value
Participation in school meal program	3.82	2.11–6.92	<0.001
Micronutrient supplementation	2.94	1.66–5.18	<0.001
Regular deworming	2.51	1.42–4.42	0.002
Health education attendance	1.88	1.08–3.27	0.02
Low socioeconomic status	0.62	0.38–0.99	0.04
Baseline anemia	0.57	0.33–0.97	0.03
Female gender	1.12	0.68–1.86	0.64

DISCUSSION

This paper evaluated the effectiveness of school health programs on children's nutritional outcomes and found that children experienced substantial improvements in growth and health following the programs. At baseline, both groups were similar in baseline characteristics (age 9.0 vs 9.2 years old), basal Metabolic Index (BMI 15.7 vs 15.9 kg/m2), and prevalence of underweight (32.9 vs 37.3%), and anemia (38.8 vs 37.3%), which instills the fact that the nutritional burden was similar in the groups at the baseline. Similar baseline equivalence studies of school health interventions have also been done in other studies [14-16]. A greater degree of anthropometric change was observed in the post-intervention program group, with increases in mean weight, height, and BMI. The outcome revealed that weight gain (3.3 1.4 vs 0.9 1.1 kg) and height gain (3.9 1.5 vs 1.1 1.2 cm) in the intervention group were almost three times greater [17]. Corresponding anthropometric gains have been observed in previous research following school feeding and supplementation programs, thereby confirming schools' role as growth-promoting supplements. The malnutrition indicators also reduced greatly [18]. The prevalence of underweight fell to 18.8 compared to 30.7 in controls whose BMI was normal, with 74.1 compared to 60.0%. Almost half of the anemia (22.4% vs 40.0%) was reduced, and absenteeism was also reduced by a great margin (16.5% vs 37.3%). Such findings indicate that the nutritional support was converted into health and functional advantages. Other studies have reported similar declines in undernourishment, anemia, and school absenteeism [19].

The program had distinctive components that were associated with improved outcomes. The greatest benefit was observed for school lunch attendance (OR 3.82); the next significant benefit was micronutrient supplementation (OR 2.94), followed by deworming (reg.), and health education was also beneficial (OR 1.88). Conversely, low socioeconomic status and baseline anemia reduced the probability of improvements. Previous studies have also shown similar trends, as multi-component, integrated interventions are more effective than uni-component interventions [20]. In general, these findings indicate that school-based health interventions can significantly affect changes in nutritional status and child growth in underserved communities. Intensive interventions that combine meals, supplementation and prophylactic treatment at early stages appear to be a must towards the creation of long-time benefits as past research findings would dictate.

CONCLUSION

It is concluded that school-based health programs significantly improve nutritional status among children in underserved communities. Children receiving the intervention demonstrated greater weight and height gains and higher BMI, along with reduced prevalence of underweight and anemia. Participation in school meals, micronutrient supplementation, and deworming independently predicted improved outcomes. Structured, multi-component school interventions are therefore effective strategies for enhancing child growth, reducing malnutrition, and improving overall health in resource-limited settings.

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