

Research Article

Impact of Integrated School Health Interventions on Dental Caries, Nutritional Status, and Communicable Disease Morbidity in Children: A Quasi-Experimental Study

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Abstract

School health interventions play a critical role in improving child health outcomes, particularly in low- and middle-income settings where malnutrition, poor oral hygiene, and infectious diseases remain highly prevalent. The present quasi-experimental study aimed to evaluate the impact of an integrated school health intervention program on dental caries prevalence, nutritional status, and communicable disease morbidity among school-aged children. A total of 240 children aged 6–12 years were enrolled and allocated into intervention and control groups. The intervention included structured oral hygiene education, supervised tooth brushing,

biannual deworming, nutritional supplementation awareness sessions, and hand hygiene training over a 6-month period. Post-intervention findings demonstrated a statistically significant reduction in mean dmft/DMFT scores in the intervention group compared to baseline and control group ($p < 0.001$). Nutritional assessment revealed significant improvement in BMI-for-age z scores and reduction in underweight prevalence ($p < 0.01$). Additionally, incidence of respiratory and gastrointestinal infections decreased significantly in the intervention group ($p < 0.05$). The integrated approach showed synergistic benefits across oral, nutritional, and infectious disease outcomes, indicating that school-based preventive

strategies can effectively reduce multi-domain child morbidity. The study concludes that comprehensive school health programs provide a cost-effective and scalable model for improving pediatric health indicators and reducing preventable disease burden in resource-limited settings.

Keywords: School health, dental caries, nutrition, communicable diseases

Introduction

Childhood health remains a fundamental determinant of lifelong wellbeing, educational attainment, and productivity. In many developing regions, school-aged children are exposed to a dual burden of disease characterized by undernutrition and high prevalence of infectious diseases alongside increasing rates of oral health problems. Dental caries, malnutrition, and communicable infections collectively contribute to absenteeism, poor academic performance, and reduced quality of life. Despite global health initiatives, these conditions remain inadequately addressed due to fragmented healthcare delivery systems and limited preventive strategies [1–3].

Schools represent a unique and efficient platform for delivering preventive health services to large pediatric populations. School-based health interventions have the advantage of accessibility, cost-effectiveness, and sustainability. They provide an opportunity to integrate multiple health services such as oral hygiene education, nutritional supplementation, deworming programs, and hygiene promotion into a single coordinated framework. Evidence suggests that integrated approaches are more effective than isolated

interventions in reducing disease burden and improving health outcomes in children [4–6]. Dental caries is one of the most prevalent chronic diseases in children worldwide and is strongly associated with poor oral hygiene practices, high sugar intake, and limited access to dental care. If left untreated, it can lead to pain, infection, malnutrition, and impaired growth. Simultaneously, malnutrition remains a major public health challenge affecting physical and cognitive development. Deficiencies in macro- and micronutrients weaken immune response, increasing susceptibility to infections. Communicable diseases such as respiratory tract infections, diarrhea, and parasitic infestations remain highly prevalent in school environments due to overcrowding and inadequate hygiene practices [7–9].

The interrelationship between oral health, nutritional status, and infectious diseases is increasingly recognized in pediatric health research. Poor nutrition can exacerbate dental caries risk, while oral infections can impair nutritional intake. Similarly, recurrent infections can worsen nutritional deficiencies, creating a vicious cycle of poor health outcomes. Breaking this cycle requires integrated preventive strategies rather than disease-specific interventions. Recent studies have emphasized the importance of school-based health promotion programs targeting multiple risk factors simultaneously [10–12]. Integrated school health interventions typically include structured oral hygiene instruction, supervised brushing programs, periodic deworming, handwashing education, and nutritional awareness campaigns. These interventions aim to modify health behaviors, improve hygiene

practices, and reduce exposure to infectious agents. Behavioral change at an early age has long-term benefits, as children are more likely to adopt lifelong healthy habits. Moreover, school-based programs can also influence families and communities through knowledge transfer [13–15].

Despite the theoretical advantages of integrated school health programs, evidence regarding their combined effect on oral health, nutrition, and communicable disease outcomes remains limited. Most existing studies focus on single-component interventions, such as deworming or oral hygiene education alone, without evaluating their combined impact. Additionally, there is a lack of quasi-experimental studies assessing real-world implementation of integrated health models in school settings. This gap highlights the need for comprehensive evaluations that reflect practical public health conditions [16–18].

Therefore, the present study was designed to assess the effectiveness of an integrated school health intervention on dental caries prevalence, nutritional status, and communicable disease morbidity among children aged 6–12 years. The study further aims to evaluate whether a multidimensional intervention approach can produce synergistic improvements across different health domains. Findings from this study may provide valuable evidence for policymakers and public health planners to develop scalable school health programs that address multiple pediatric health challenges simultaneously [19–20].

Methodology

The present quasi-experimental study was conducted among 240 school children aged

6–12 years selected from two comparable public schools at CMH Kharian Cantt Medical College, Kharian. One school was assigned as the intervention group (n=120), while the other served as the control group (n=120). Selection was based on similarity in socioeconomic background, infrastructure, and baseline health indicators to minimize selection bias. The study duration was 6 months, including baseline assessment and post-intervention evaluation.

Sample size was calculated using Epi Info software assuming a 20% expected reduction in dental caries prevalence after intervention, with 95% confidence interval, 80% power, and 5% margin of error. The minimum required sample size was calculated as 210; however, 240 participants were enrolled to account for potential attrition.

Inclusion criteria included children aged 6–12 years enrolled in selected schools with parental consent and regular school attendance. Exclusion criteria included children with chronic systemic diseases, congenital oral anomalies, long-term antibiotic therapy, or severe malnutrition requiring hospitalization.

Verbal and written informed consent was obtained from parents or guardians. Ethical approval was secured from the institutional review committee prior to study initiation. Confidentiality and anonymity of participants were strictly maintained throughout the study.

Baseline assessment included dental examination using dmft/DMFT index, anthropometric measurements (weight, height, BMI-for-age z score), and health records documenting episodes of respiratory and gastrointestinal infections over the past 3

months. Standard WHO protocols were used for all measurements.

The intervention program included supervised tooth brushing sessions using fluoride toothpaste conducted thrice weekly, oral hygiene education sessions once monthly, handwashing training using WHO-recommended techniques, biannual deworming using albendazole, and nutritional awareness sessions involving teachers and students. Health education

materials were reinforced through posters and interactive demonstrations.

The control group continued routine school activities without structured health interventions. Both groups were reassessed after 6 months using identical measurement tools. Data were analyzed using SPSS version 25. Paired t-tests, independent t-tests, and chi-square tests were applied. A p-value <0.05 was considered statistically significant

Results

Table 1: Baseline characteristics of study population

Variable	Intervention (n=120)	Control (n=120)	p-value
Age (years)	9.1 ± 1.8	9.3 ± 1.7	0.42
Male (%)	52.5%	50.8%	0.78
BMI-for-age z score	-1.12 ± 0.62	-1.08 ± 0.65	0.61
dmft/DMFT score	3.8 ± 1.4	3.7 ± 1.3	0.74
Infection episodes/year	4.2 ± 1.1	4.1 ± 1.0	0.69

Table 2: Pre- and post-intervention comparison

Outcome	Intervention Baseline	Intervention 6 months	Control Baseline	Control 6 months	p-value
dmft/DMFT	3.8 ± 1.4	2.1 ± 1.0	3.7 ± 1.3	3.5 ± 1.2	<0.001
BMI z-score	-1.12 ± 0.62	-0.72 ± 0.58	-1.08 ± 0.65	-1.05 ± 0.63	0.002
Infection episodes	4.2 ± 1.1	2.6 ± 0.9	4.1 ± 1.0	3.9 ± 1.0	<0.01

Table 3: Disease prevalence changes

Condition	Intervention (%)	Control (%)	p-value
Dental caries prevalence	68% → 42%	67% → 64%	<0.001
Underweight prevalence	36% → 21%	35% → 33%	0.01

Condition	Intervention (%)	Control (%)	p-value
Diarrheal disease episodes	41% → 22%	40% → 38%	0.02
Respiratory infections	52% → 30%	51% → 49%	0.03

Tables demonstrate significant improvement in oral health, nutritional status, and infection reduction in the intervention group compared to control, confirming effectiveness of integrated school-based interventions.

Discussion

The findings of the present quasi-experimental study demonstrate that integrated school health interventions significantly improve oral health outcomes, nutritional status, and communicable disease morbidity among school-aged children [11–13]. The marked reduction in dmft/DMFT scores in the intervention group indicates that structured oral hygiene education and supervised brushing effectively reduce bacterial load and prevent caries progression. The improvement in nutritional indicators such as BMI-for-age z scores highlights the indirect benefits of health education and infection control on nutritional absorption and dietary behaviors. Reduced infection frequency likely contributed to improved nutrient utilization and growth parameters, supporting the interconnected nature of pediatric health domains [14–15].

A significant reduction in communicable disease incidence, particularly gastrointestinal and respiratory infections, underscores the importance of hygiene-based interventions. Handwashing education and deworming strategies likely played a crucial role in reducing exposure to pathogens,

thereby decreasing morbidity rates across the intervention group [16].

The integrated nature of the intervention appears to produce synergistic effects rather than isolated improvements. This supports the concept that addressing multiple risk factors simultaneously yields greater health benefits than single-component interventions. The findings align with recent evidence suggesting that school-based comprehensive programs enhance overall child health outcomes more effectively [17]. Behavioral modification is a key mechanism underlying observed improvements. Children exposed to repeated health education sessions are more likely to adopt long-term hygiene practices, which extend beyond the school environment and influence household behaviors. This ripple effect enhances the sustainability of such interventions [18].

From a public health perspective, the study highlights the feasibility of implementing integrated health programs within existing school infrastructure without requiring major resource expansion. This makes the approach particularly relevant for resource-limited settings where healthcare access is restricted [19].

Overall, the study supports the hypothesis that integrated school health interventions can significantly reduce the burden of preventable diseases in children. The evidence reinforces the need for policy-level

adoption of multidimensional school health programs as part of national child health strategies [20].

Conclusion

Integrated school health interventions significantly reduce dental caries, improve nutritional status, and decrease communicable disease morbidity. A multidimensional approach demonstrates superior effectiveness compared to routine school health practices. Findings support scaling of integrated school-based programs for long-term pediatric health improvement.

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