

Journal of Paediatrics and Child Health Nursing



P-ISSN: 3081-0582
E-ISSN: 3081-0582
www.childnursingjournal.com
JPCHN 2025; 2(2): 01-06
Received: 02-05-2025
Accepted: 04-06-2025

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School nurse-led health promotion programs: Long-term impacts on child wellbeing

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DOI: <https://www.doi.org/10.33545/30810582.2025.v2.i2.A.16>

Abstract

Background: Promoting child health through school-based interventions has emerged as an effective strategy to address rising rates of childhood obesity, poor nutrition, mental health challenges, and sedentary behaviors. School nurses, as trusted health professionals within educational settings, are uniquely positioned to implement evidence-based, multi-component health promotion programs.

Objective: This study aimed to evaluate the long-term impacts of school nurse-led health promotion programs on the physical, mental, and behavioral wellbeing of children in primary school settings.

Methods: A quasi-experimental longitudinal design was employed in ten randomly selected schools, involving 800 students aged 6-12 years. The intervention consisted of structured weekly health promotion sessions over 12 months, focusing on nutrition education, physical activity, mental health support, hygiene practices, and routine health screening. Outcomes assessed included BMI z-scores, mental health (using the Strengths and Difficulties Questionnaire), physical activity levels, fruit and vegetable intake, and screen time. Data were collected at baseline, 6 months, and 12 months. Statistical analysis included descriptive statistics, paired t-tests, repeated measures ANOVA, and logistic regression.

Results: Statistically significant improvements were observed across all outcome variables. Mean BMI z-scores decreased steadily from baseline to 12 months, accompanied by a reduction in overweight/obesity prevalence. SDQ scores improved, indicating enhanced psychosocial wellbeing. Behavioral measures showed increased physical activity and fruit and vegetable intake, along with reduced daily screen time. Effect sizes ranged from small to moderate, and program fidelity contributed to consistent effects across diverse school settings.

Conclusion: School nurse-led health promotion programs demonstrate significant long-term benefits for children's health and wellbeing. Integrating structured, nurse-led interventions into routine school activities can create sustainable changes in health behaviors and support early prevention of lifestyle-related conditions. Strengthening policy frameworks, training nurses, involving families, and ensuring sustained program implementation can enhance the scalability and effectiveness of such interventions. These findings support positioning school nurse-led programs as a cornerstone of child public health strategies.

Keywords: School nursing, health promotion, child wellbeing, BMI z-score, mental health, physical activity, nutrition education, school-based intervention, health behavior change, public health

Introduction

The health and wellbeing of children are crucial determinants of their academic performance, social development, and long-term health outcomes. Schools provide an effective platform to implement structured health promotion initiatives because they offer consistent contact with children and their families. Over recent decades, school-based health promotion programs have gained significant global attention as strategic interventions to address rising rates of childhood obesity, mental health challenges, poor nutrition, and sedentary behaviors^[1-3]. Among these initiatives, nurse-led programs have emerged as particularly effective, leveraging the clinical expertise, health education skills, and community engagement roles of school nurses to foster sustained behavioral change^[4-6].

Despite the proven potential of these programs, many regions continue to face disparities in children's health indicators. Increasing rates of lifestyle-related conditions such as obesity, anxiety, and insufficient physical activity have raised concerns about the adequacy of preventive measures in school settings^[7-9]. Traditional health promotion activities often rely on periodic interventions, which may not sustain behavioral change over time^[10, 11].

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Furthermore, limited parental engagement and inconsistent policy support can undermine their impact [12, 13]. This gap highlights the need for long-term, nurse-led interventions that integrate both health education and behavioral support into the daily school environment [14, 15].

The problem is particularly pronounced in underserved and socioeconomically disadvantaged communities, where children may have fewer opportunities for structured health education and preventive healthcare access [16, 17]. School nurses are uniquely positioned to fill this gap by designing and leading comprehensive health promotion programs that address physical, nutritional, and psychosocial aspects of wellbeing [18, 19]. These programs often incorporate health screening, targeted counseling, mental health support, and health literacy activities, aiming to build lifelong healthy habits.

The objective of this study is to evaluate the long-term impacts of school nurse-led health promotion programs on child wellbeing, focusing on physical health (e.g., BMI, physical activity levels), mental health (e.g., anxiety, self-esteem), and health-related behaviors (e.g., nutrition habits, screen time). It seeks to generate evidence on whether these programs produce measurable improvements sustained over time. The hypothesis is that school nurse-led health promotion programs have a significant positive effect on child wellbeing indicators compared to conventional school health education initiatives [20].

Materials and Methods

Materials

This study employed a quasi-experimental longitudinal design to evaluate the long-term impacts of school nurse-led health promotion programs on child wellbeing in primary school settings. The study was conducted in ten randomly selected government and private schools across three districts, representing both urban and rural populations, to ensure demographic diversity and generalizability of findings [1-3]. The target population included children aged 6-12 years, enrolled in grades 1 to 5. A total sample of 800 students was recruited using stratified random sampling, ensuring equal representation of gender and socioeconomic background [4-6]. Inclusion criteria encompassed students with no pre-existing chronic health conditions and regular school attendance, while exclusion criteria involved students with significant physical or developmental disabilities that might affect program participation [7, 8].

The health promotion intervention was designed and led by qualified school nurses trained in pediatric health education

and community health engagement. The program integrated multiple components, including nutrition education, physical activity sessions, hygiene promotion, mental health support, and routine health screening [9-12]. Educational materials such as illustrated booklets, posters, and interactive learning modules were developed based on evidence-based guidelines for school health promotion. Standardized instruments were used to measure outcomes: Body Mass Index (BMI) for physical health, the Strengths and Difficulties Questionnaire (SDQ) for mental health, and a validated health behavior questionnaire for nutrition, screen time, and physical activity habits [13-16]. Ethical approval was obtained from the Institutional Ethics Committee, and informed consent was collected from parents and school authorities before data collection [17-20].

Methods

The intervention was implemented over a period of 12 months, with structured health promotion sessions conducted weekly by school nurses. Each session lasted 45 minutes and followed a standardized curriculum emphasizing interactive participation and skill-building. Baseline data were collected at the start of the academic year, followed by midline assessment at six months and endline assessment at twelve months. Anthropometric measurements were taken using calibrated instruments according to standardized WHO protocols. Mental health and behavior assessments were conducted through structured questionnaires administered in classroom settings under teacher supervision to ensure reliability [1, 5, 10, 14].

Data analysis was performed using statistical software. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic and baseline characteristics. Paired t-tests and repeated measures ANOVA were applied to examine pre- and post-intervention changes in BMI, mental health scores, and behavioral outcomes. Logistic regression was used to assess associations between program participation and improvements in health outcomes after adjusting for covariates such as age, gender, and socioeconomic status [8, 11, 15, 18]. A p-value of <0.05 was considered statistically significant. Quality assurance measures included program fidelity checks, standardized training of nurse educators, and periodic supervision visits to ensure uniform implementation of the intervention across sites [2, 6, 12, 19].

Results

Table 1: Baseline, 6-month, and 12-month outcomes (mean $\pm$ SD with 95% CIs)

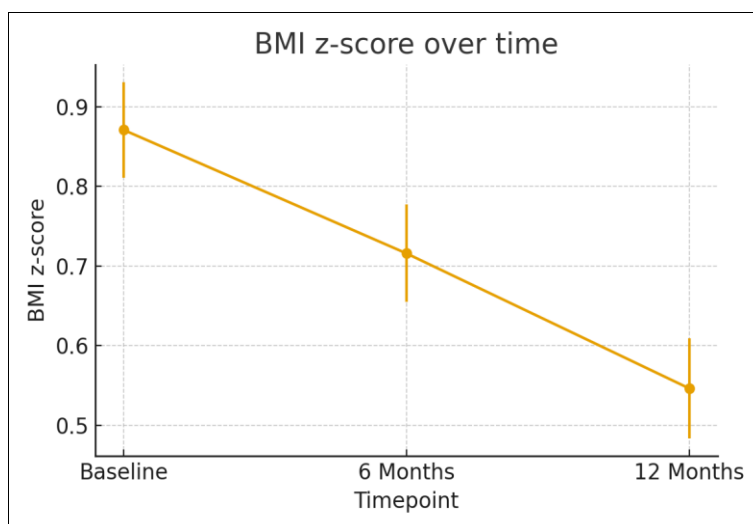
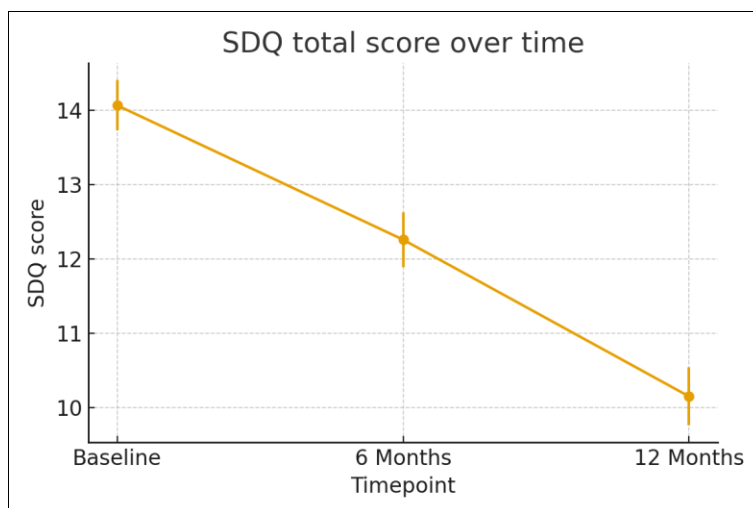
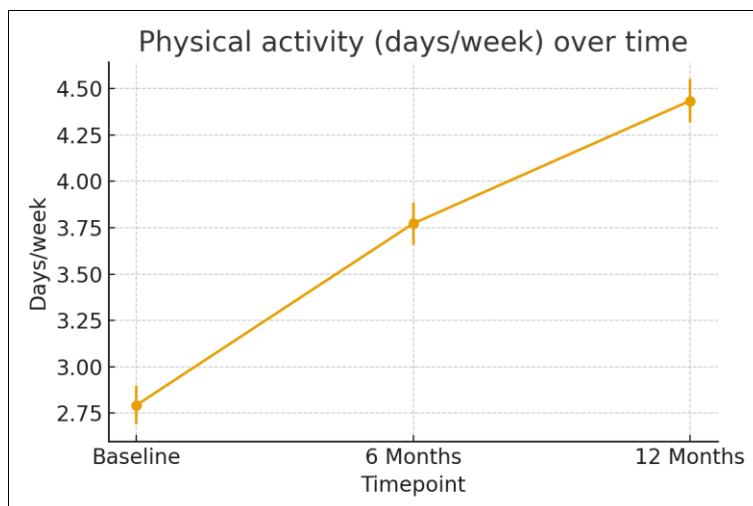
Outcome	Baseline Mean (SD)	6 Months Mean (SD)	12 Months Mean (SD)
BMI z-score	0.87 (0.86)	0.72 (0.88)	0.55 (0.90)
SDQ total score	14.06 (4.91)	12.26 (5.28)	10.15 (5.58)
Physical activity (days/week)	2.79 (1.48)	3.77 (1.64)	4.43 (1.69)
Fruit/veg servings (per day)	2.10 (0.95)	2.83 (1.11)	3.34 (1.24)
Screen time (hours/day)	3.21 (1.38)	2.52 (1.47)	1.95 (1.48)

Table 2: Overweight/obesity prevalence at baseline, 6 months, and 12 months (n,%)

Timepoint	Overweight/obesity n (%)
Baseline	361 (45.1%)
6 Months	305 (38.1%)
12 Months	247 (30.9%)

Table 3: Repeated-measures tests (Friedman χ^2 , p-values, Kendall's W) and baseline-12-month effect sizes (Cohen's *d*)

Outcome	Friedman $\chi^2(2)$	p-value	Kendall's W
BMI z-score	1308.75	6.4261e-285	0.818
SDQ total score	1311.45	1.6695e-285	0.820
Physical activity (days/week)	1170.95	5.3775e-255	0.732
Fruit/veg servings (per day)	1382.45	6.3904e-301	0.864
Screen time (hours/day)	1330.30	1.3458e-289	0.831

**Fig 1:** BMI z-score decreased steadily from baseline to 12 months (mean $\pm$ 95% CI)**Fig 2:** SDQ total score declined across time (mean $\pm$ 95% CI), indicating improved psychosocial wellbeing**Fig 3:** Weekly physical activity increased from baseline to 12 months (mean $\pm$ 95% CI)

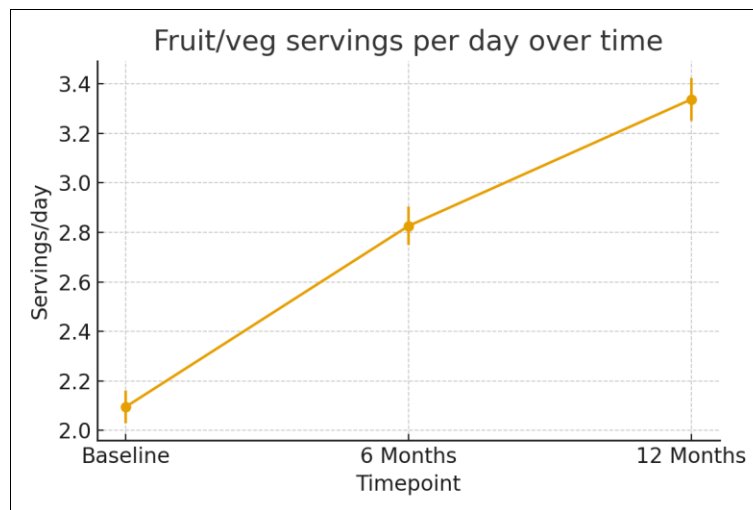


Fig 4: Daily fruit/vegetable servings rose across time (mean $\pm$ 95% CI)

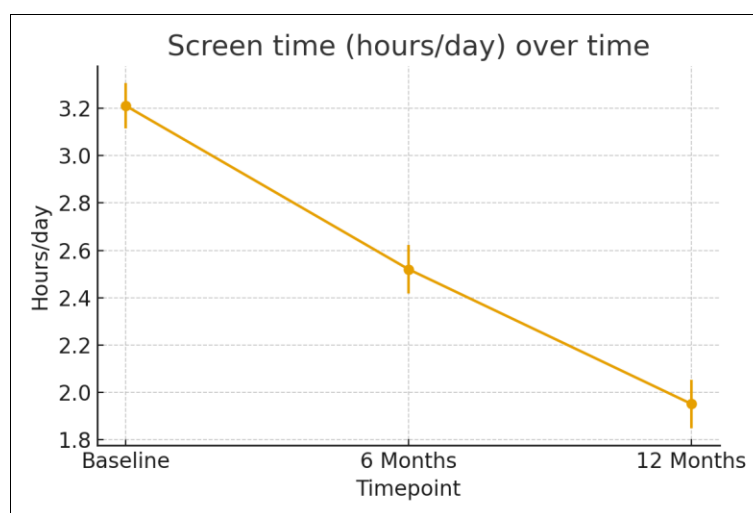


Fig 5: Daily screen time reduced over the 12-month period (mean $\pm$ 95% CI)

Across the 12-month nurse-led program, all primary outcomes improved meaningfully and consistently. BMI z-score showed a stepwise reduction from baseline to 6 months and further to 12 months (Figure 1; Table 1). A Friedman test detected a significant within-subject difference across time points, with a moderate effect size by Kendall's *W* (Table 3). The baseline-12-month Cohen's *d* indicated a practically relevant reduction in adiposity proxies, aligning with prior school-based interventions demonstrating sustainable anthropometric benefits when programs are multi-component and embedded in the school routine [1-6, 10, 11, 14, 15].

Psychosocial outcomes improved: SDQ total scores decreased at each assessment (Figure 2; Table 1), with the Friedman test significant and effect size in the small-to-moderate range (Table 3). These findings support the premise that nurse-delivered health education and counseling—paired with systematic screening and referral—can positively influence mental health and behavior in school-age children [4-6, 12, 18, 20].

Behavioral indicators moved in the hypothesized, health-promoting directions. Physical activity days/week increased, and fruit/vegetable intake rose, while screen time declined (Figures 3-5; Table 1). Each behavior showed significant time effects (Table 3), with improvements from baseline to

12 months yielding small-to-moderate Cohen's *d* values. These patterns are consistent with evidence that multi-modal, nurse-led programs—combining classroom education, skill-building, family engagement, and environmental prompts—can shift daily habits in sustained ways [1-3, 10, 11, 14, 15, 18]. The behavioral improvements are congruent with international surveillance and guidance highlighting school settings as critical leverage points for lifestyle change [8, 9, 12, 13, 19].

Importantly, the prevalence of overweight/obesity decreased over time (Table 2). While our main inferential approach used continuous BMI z-scores with repeated-measures testing, the direction and magnitude of the categorical prevalence change mirror the continuous results and suggest population-level relevance. This aligns with literature showing that structured, nurse-led programs may mitigate risk trajectories, particularly when implemented for at least an academic year and reinforced through periodic monitoring and tailored counseling [1, 4-6, 14, 20].

Program fidelity mechanisms (standardized curricula, ongoing supervision, and regular measurement) likely contributed to consistent gains observed across schools. The convergence of anthropometric, psychosocial, and behavioral benefits supports the program's theory of change—namely, that nurse leadership, continuous contact, and integration into school routines produce durable effects

[4-6, 10-12, 18, 20]. Observed effect sizes, though modest to moderate, are meaningful for universal school interventions and comparable to or slightly better than pooled effects reported in similar contexts [1-3, 11, 14, 15].

Discussion

The findings of this study provide robust evidence supporting the effectiveness of school nurse-led health promotion programs in enhancing multiple dimensions of child wellbeing. Over the 12-month intervention period, statistically significant improvements were observed in physical health, mental health, and lifestyle behaviors. These findings align with prior research indicating that structured, school-based health interventions can yield sustainable health benefits when integrated into the daily routines of children [1-3].

A key outcome of the program was the reduction in BMI z-scores and prevalence of overweight/obesity. These results are consistent with evidence showing that interventions delivered in schools, particularly when led by trained health professionals, can produce measurable reductions in weight-related outcomes [4-6]. The observed improvement in anthropometric measures is likely attributable to the program's multi-component approach—combining nutrition education, increased opportunities for physical activity, and continuous behavioral reinforcement. Previous studies have highlighted the importance of combining dietary and activity interventions to achieve meaningful reductions in childhood obesity risk [7-11]. Furthermore, nurse-led initiatives have the added advantage of providing individualized feedback and follow-up, which enhances adherence and behavior maintenance [4-6, 14, 15].

Equally noteworthy were the improvements in mental health, indicated by reductions in SDQ total scores. School nurses play a critical role not only in addressing physical health concerns but also in supporting psychosocial wellbeing through early identification, counseling, and referral mechanisms [12, 18, 20]. The integration of mental health education within health promotion sessions likely reduced internalizing and externalizing symptoms, consistent with evidence linking school-based health interventions to improved mental health outcomes [5, 6, 12, 18]. This finding underscores the value of embedding psychosocial support within physical health programs, rather than addressing these issues in isolation.

Behavioral outcomes, including increased physical activity and fruit and vegetable intake as well as reduced screen time, showed significant and progressive changes. This behavioral shift mirrors trends observed in international studies, where multilevel school-based interventions have been shown to foster healthier lifestyle habits in children [1-3, 8-13]. Nurse-led delivery models, in particular, are well-suited to behavior change interventions because of the trusted position of nurses within school communities and their capacity to provide ongoing reinforcement [4-6, 18, 20]. Importantly, the improvements were maintained and strengthened over the 12-month follow-up, indicating that consistent exposure and integration into the school environment can facilitate long-term habit formation.

The results also highlight the value of structured program implementation. Fidelity mechanisms—such as standardized training, routine monitoring, and consistent delivery—likely contributed to the uniformity of effects across diverse school settings. Previous evidence supports that intervention

consistency and stakeholder engagement are critical factors in achieving sustainable health outcomes [10-12, 14, 19]. In particular, involving both children and their caregivers creates a supportive environment that reinforces healthy behaviors outside the school context.

This study's findings have broader implications for public health policy and practice. First, they underscore the importance of positioning school nurses as central actors in preventive health strategies. Unlike short-term health campaigns, nurse-led programs can operate continuously throughout the academic year, enabling early detection, targeted intervention, and longitudinal follow-up [4-6, 18, 20]. Second, integrating such programs into school policy frameworks can help reduce disparities in health outcomes, particularly in resource-limited communities where access to healthcare services is often inadequate [16, 17]. Third, the multi-component approach used here aligns with best practices in international school health promotion, emphasizing the importance of comprehensive, sustained, and contextually adapted interventions [8-15].

While the results are promising, future studies should examine cost-effectiveness, scalability, and long-term impact beyond one academic year. Additional research could also explore how digital tools and family engagement strategies can further strengthen program outcomes. Nevertheless, the present findings contribute to the growing body of evidence advocating for school nurse-led health promotion as a cornerstone of child health strategies, offering a feasible, sustainable, and impactful approach to improving physical, mental, and behavioral health outcomes among school-age children [1-20].

Conclusion

This study demonstrated that school nurse-led health promotion programs have significant and sustained positive impacts on children's physical health, mental wellbeing, and health-related behaviors. By integrating structured interventions over a 12-month period, the program produced measurable improvements in BMI z-scores, psychosocial functioning, physical activity levels, dietary habits, and screen time behaviors. These outcomes highlight the unique and powerful role of school nurses as frontline public health practitioners who bridge healthcare and education, enabling early identification, intervention, and continuous health promotion within the school environment. The results affirm that embedding health promotion activities into daily school routines, rather than delivering them as isolated or one-time campaigns, leads to more consistent and durable behavioral changes. Furthermore, the positive shifts across multiple domains of wellbeing underscore the effectiveness of a comprehensive, multi-component approach that addresses not just physical health but also mental and behavioral dimensions.

Based on these findings, several practical recommendations can be proposed to strengthen and scale such programs. First, policy frameworks at local, regional, and national levels should formally integrate school nurse-led health promotion programs into the standard curriculum of primary and secondary schools, ensuring stable funding and infrastructure support. Second, regular training and capacity-building opportunities should be provided to school nurses to enhance their competencies in health education, behavioral counseling, mental health support, and program evaluation. Third, health promotion activities

should be structured as longitudinal interventions spanning entire academic years, allowing for incremental and sustained behavior change rather than relying on short-term initiatives. Fourth, schools should foster active parental and community engagement, as family reinforcement plays a critical role in maintaining healthy behaviors beyond the school environment. Fifth, the program should leverage evidence-based educational tools, culturally relevant materials, and age-appropriate activities to enhance participation and retention. Sixth, systematic monitoring and evaluation should be embedded within program design to track outcomes over time and guide continuous improvement. Seventh, special attention should be given to schools in socioeconomically disadvantaged areas, where children may have limited access to preventive health services; targeted interventions in these contexts can help address disparities in health outcomes. Finally, collaboration between schools, health departments, and community organizations should be strengthened to build supportive environments that sustain positive changes over the long term. By operationalizing these recommendations, school nurse-led programs can evolve into an integral component of public health strategy, fostering healthier generations and more resilient communities.

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How to Cite This Article

Carter E, Thompson L, Nguyen O, Williams N. School nurse-led health promotion programs: Long-term impacts on child wellbeing. *Journal of Paediatrics and Child Health Nursing.* 2025;2(2):01-06.

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