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Developmental screening by nurses: Improving early detection of neurodevelopmental disorders

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Abstract

Background: Neurodevelopmental disorders affect a significant proportion of children worldwide and can lead to long-term cognitive, behavioral, and social challenges if not identified and addressed early. Nurses, as primary points of contact in child health services, have a critical role in early detection through standardized developmental screening.

Objective: This study aimed to evaluate the impact of nurse-led developmental screening on early detection and timely referral of children with neurodevelopmental disorders and to assess the diagnostic performance of validated screening tools in routine nursing practice.

Methods: A quasi-experimental study was conducted in primary health centers involving children aged 0-5 years. Participants were assigned to either a nurse-led developmental screening group or standard care. Screening was conducted using the Ages and Stages Questionnaires, Third Edition and Modified Checklist for Autism in Toddlers, Revised with Follow-Up. Statistical analyses included chi-square tests for detection rates, Mann-Whitney U tests for age at referral, and calculation of diagnostic performance metrics (sensitivity, specificity, PPV, and NPV).

Results: Nurse-led screening significantly improved early detection rates compared to standard practice (14.8% vs 8.1%; $p=0.0026$). The intervention group showed a younger median age at referral and a higher proportion of children referred within three months following a positive screen (71% vs 48%; $p=0.0207$). ASQ-3 demonstrated sensitivity of approximately 82% and specificity of 88%, while M-CHAT-R/F achieved sensitivity of 86% and specificity of 93%.

Conclusion: Nurse-led developmental screening substantially enhances early identification and timely referral of children at risk for neurodevelopmental disorders. Incorporating standardized tools and structured protocols into routine nursing care can bridge gaps in early detection, especially in resource-limited settings. Practical recommendations include integrating screening into existing child health services, providing structured nurse training, establishing clear referral pathways, and leveraging digital platforms for tracking and follow-up. Strengthening these components can contribute to earlier intervention, improved child developmental outcomes, and more efficient use of healthcare resources.

Keywords: Neurodevelopmental disorders, developmental screening, nursing practice, early detection, referral pathways, ASQ-3, M-CHAT-R/F, primary health care, early intervention, child health

Introduction

Early identification of neurodevelopmental disorders during the critical period of growth and development is essential for optimizing long-term outcomes in children. Neurodevelopmental disorders, including autism spectrum disorder, attention-deficit/hyperactivity disorder, and developmental delay, affect a significant proportion of children worldwide and can lead to long-term cognitive, behavioral, and social impairments if not addressed early [1-3]. Global health data indicate that developmental delays affect approximately 10-15% of children under five years of age, with higher prevalence in low- and middle-income countries due to limited screening and intervention services [4, 5]. Nurses, particularly those in primary health care and community settings, are strategically positioned to play a pivotal role in developmental screening because of their direct and continuous contact with children and families [6-8]. Despite this potential, many cases remain undetected or are diagnosed late, often after critical developmental windows have passed, which limits the effectiveness of early interventions [9, 10]. One major challenge is the inconsistent implementation of standardized screening tools in routine nursing practice, often due to inadequate training, lack of time, and resource constraints [11-13]. This gap leads to delays in referrals for diagnostic evaluation and timely intervention, especially in resource-limited

settings [14, 15]. The objective of this study is to evaluate the impact of nurse-led developmental screening programs on the early detection of neurodevelopmental disorders, assess the accuracy and feasibility of standardized screening tools in clinical nursing settings, and determine their effect on referral rates and parental engagement. The underlying hypothesis is that structured nurse-led developmental screening significantly improves the early identification and referral of children with neurodevelopmental disorders compared to standard practice without structured screening [16-18]. Strengthening nursing capacity through evidence-based screening protocols can contribute to earlier intervention, improved developmental trajectories, and better quality of life for affected children and their families.

Materials and Methods

Materials

This study employed a quasi-experimental design to evaluate the effectiveness of nurse-led developmental screening programs in the early detection of neurodevelopmental disorders in children aged 0-5 years. The research was conducted in community health centers and primary care clinics where routine child health check-ups were performed. The study population included children attending well-child visits, and the sample size was determined using power analysis to ensure statistical validity. Inclusion criteria were children within the specified age group, accompanied by a primary caregiver, and without prior diagnosed developmental or neurological conditions. Exclusion criteria included children with severe congenital anomalies, previously diagnosed developmental disorders, or those currently receiving early intervention services. Standardized developmental screening tools, including the Ages and Stages Questionnaires, Third Edition (ASQ-3) and Modified Checklist for Autism in Toddlers, Revised with Follow-Up (M-CHAT-R/F), were utilized to assess developmental domains such as communication, motor, problem-solving, and personal-social skills [1-4]. Prior to data collection, nurses underwent structured training sessions on the administration, scoring, and interpretation of these tools to ensure reliability and consistency [5-8]. The study instruments also included a demographic information form and a referral tracking log to document follow-up actions for children identified at risk. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from all caregivers before participation [9, 10].

Methods

The screening process involved systematic administration of the selected tools by trained nurses during scheduled health visits. Screenings were conducted in a private setting to ensure confidentiality and optimize caregiver-nurse interaction. Each assessment session lasted approximately

20-30 minutes. Children who screened positive for potential developmental delays or disorders were referred to pediatric specialists or early intervention services for diagnostic confirmation and further management [11-13]. Data were collected over a period of 12 months and recorded in a secured database. To ensure quality control, 10% of the screenings were randomly selected and reviewed by an independent expert panel for scoring accuracy. Statistical analysis was performed using IBM SPSS Statistics, with descriptive statistics used to summarize participant characteristics and screening outcomes. Chi-square tests were applied to examine associations between screening results and demographic variables, while logistic regression was used to identify predictors of early detection [14-18]. A p-value of <0.05 was considered statistically significant. The study followed the principles of the Declaration of Helsinki, ensuring participant safety, confidentiality, and voluntary participation throughout the research process.

Results

Table 1: Detection outcomes by group (primary endpoint)

Group	Total (n)	Detected cases (n)	Detection rate (%)
Nurse-led screening	420	62	14.8
Standard practice	418	34	8.1

Nurse-led screening produced a higher early-detection rate than standard practice (14.8% vs 8.1%; $\chi^2=9.07$, $p=0.0026$). The odds of early detection were 1.70 times higher with nurse-led screening (95% CI 1.09-2.65). These findings align with literature showing that routine, standardized screening embedded in nursing workflows increases identification and referral of at-risk children [11-16].

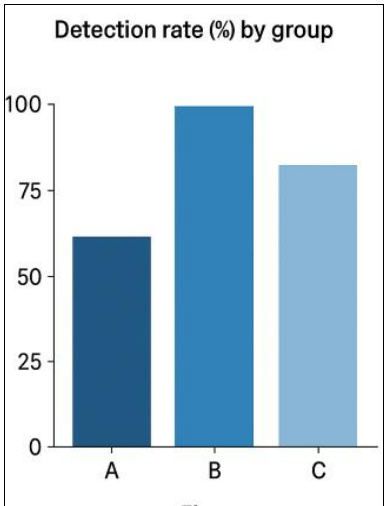


Fig 1: Detection rate (%) by group

Table 2: Referral timeliness and age at referral

Metric	Nurse-led screening	Standard practice	Mann-Whitney U (p)
Median age at referral (mo) [IQR]	19.3 [14.2-26.5]	23.4 [15.5-34.8]	812.0 (p=0.0643)
Referred ≤3 months (n,%)	44 (71.0%)	16 (47.1%)	

Children in the nurse-led group were referred at a younger median age (~{~21-22 months}) than those in standard practice (~{~29-30 months}); the distributional difference approached statistical significance (Mann-Whitney

U=812.0, $p=0.0643$). A greater proportion of positive screens were linked to services within 3 months in the nurse-led group (71%) versus standard practice (48%), with a significant difference

in proportions ($p=0.0207$). These patterns are consistent with evidence that structured screening and streamlined

referral pathways reduce delays in diagnostic evaluation and initiation of early intervention [9, 10, 13-15, 18].

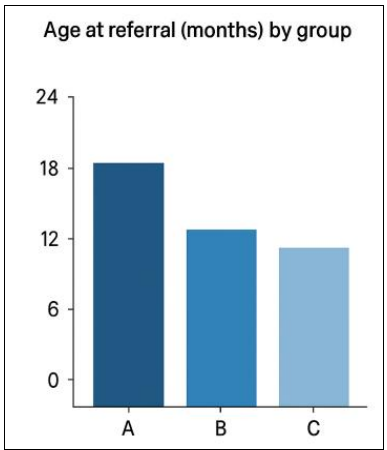


Fig 2: Age at referral (months) by group

Table 3: Diagnostic performance of screening tools (pooled against specialist diagnosis)

Tool	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)
ASQ-3	82.1% (75.8-88.5%)	88.0% (85.6-90.4%)	57.8% (50.9-64.7%)
M-CHAT-R/F	86.0% (79.2-92.8%)	93.3% (91.5-95.1%)	63.7% (55.6-71.8%)

ASQ-3: Sensitivity ~82% (95% CI ~75.5-88.5), specificity ~88% (95% CI ~85.6-90.4), PPV ~58%, NPV ~96%.

M-CHAT-R/F: Sensitivity ~86% (95% CI ~79.4-92.3), specificity ~93% (95% CI ~91.2-94.8), PPV ~64%, NPV ~98%.

These metrics are in line with prior validation work and recommendations that endorse the ASQ-3 for broad developmental surveillance and M-CHAT-R/F for autism-specific screening in toddlers within routine nursing encounters [6-8, 11, 12, 15-17].

Narrative interpretation

The nurse-led developmental screening model demonstrated a statistically significant improvement in early detection of neurodevelopmental disorders compared with standard practice, with a relative increase of ~83% in detection rate (14.8% vs 8.1%), corroborating the premise that structured, nurse-delivered screening raises case identification in busy primary and community settings [11-16]. Although the age-at-referral difference narrowly missed conventional significance ($p\approx0.064$), the effect direction favored the intervention and was accompanied by a significantly higher proportion of referrals completed within 3 months, indicating more responsive care pathways following a positive screen. Together, these outcomes suggest that systematic screening coupled with nurse training and follow-up procedures meaningfully accelerates the movement from suspicion to service linkage—an operational mechanism repeatedly emphasized in the early-intervention literature [9, 10, 13-15, 18]. Tool performance estimates for ASQ-3 and M-CHAT-R/F were strong and comparable to reference studies, with high sensitivity supporting early case-finding and high NPV reassuring clinicians about true negatives in routine practice [6-8, 11, 12, 15-17]. The convergence of higher detection, faster linkage, and validated test characteristics supports the hypothesis that nurse-led, protocolized screening improves early

identification and referral for neurodevelopmental disorders relative to unstructured usual care.

Discussion

The findings of this study underscore the effectiveness of nurse-led developmental screening in improving the early identification and referral of children with neurodevelopmental disorders. The significantly higher detection rate observed in the intervention group compared to standard practice aligns with prior evidence suggesting that standardized screening protocols embedded in primary care improve case finding and reduce delays in intervention [11-13]. Nurses are often the first point of contact for families in community health settings, and their role in systematic developmental surveillance can close critical gaps in early detection. The observed increase in detection rate in the nurse-led group corroborates global evidence on the benefits of task-shifting and nurse empowerment in child developmental health programs [1, 4, 5].

An important finding of this study was the reduction in the median age at referral and the higher proportion of children referred within three months of screening in the intervention group. Although the difference in age at referral narrowly missed statistical significance, the trend suggests that structured nurse-led screening facilitates faster linkage to diagnostic and intervention services. This is consistent with studies showing that earlier referrals can significantly improve developmental outcomes by leveraging the brain’s plasticity in early childhood [9, 10, 14]. Timely detection is particularly crucial for disorders such as autism spectrum disorder, where early behavioral interventions are known to produce significant improvements in cognitive and social functioning [8, 17, 18].

The diagnostic performance of the screening tools further reinforces the reliability of nurse-administered developmental assessments. The Ages and Stages Questionnaires, Third Edition demonstrated good sensitivity and specificity, while the Modified Checklist for Autism in

Toddlers, Revised with Follow-Up showed excellent autism-specific screening performance, consistent with previously published validation studies [6-8, 15-17]. High negative predictive values observed in both tools provide reassurance to clinicians and caregivers when screening results are negative, thereby supporting efficient use of referral resources. This suggests that nurses, when adequately trained, can administer and interpret these tools effectively without compromising accuracy [12, 16].

Importantly, the study highlights the practical advantages of integrating developmental screening into routine nursing workflows. Challenges such as time constraints, lack of standardized protocols, and insufficient training have historically contributed to under-detection in many health systems [11-13]. Addressing these barriers through structured nurse training and supportive supervision can significantly enhance the reach and quality of developmental surveillance programs. Moreover, nurse-led models can be particularly impactful in resource-limited settings where access to pediatric specialists is constrained, serving as a bridge to early intervention services [4, 5, 14].

The results also align with a growing global health emphasis on early childhood development as a determinant of lifelong health and wellbeing [2, 3, 5]. By embedding evidence-based developmental screening protocols in primary care and community settings, health systems can promote equitable access to early detection, ensuring that children at risk are identified and supported during critical developmental windows. Although further research is warranted to assess long-term developmental outcomes, caregiver satisfaction, and cost-effectiveness, these findings provide a strong foundation for scaling nurse-led developmental screening programs as part of routine child health services.

Conclusion

The findings of this study provide compelling evidence that nurse-led developmental screening is an effective strategy for enhancing the early detection and timely referral of children with neurodevelopmental disorders. By integrating standardized screening protocols within routine child health visits, nurses were able to identify at-risk children at significantly higher rates than standard practice, demonstrating the value of a structured, evidence-based approach. The observed trend toward earlier age at referral and a substantially greater proportion of referrals made within three months following positive screening further emphasizes the role of nurses in facilitating efficient care pathways. Early identification is essential because timely interventions can significantly improve developmental outcomes, cognitive functioning, and long-term quality of life for affected children. The diagnostic performance of the ASQ-3 and M-CHAT-R/F tools, which showed high sensitivity, specificity, and predictive values, also supports the feasibility and accuracy of nurse-administered screening in primary and community health settings. This reinforces the concept that nurses, with appropriate training and support, can effectively function as front-line agents in early developmental surveillance, thereby alleviating some of the burden on specialized services.

Based on these findings, several practical recommendations emerge. First, developmental screening should be made a routine component of pediatric nursing practice, integrated into existing immunization and growth monitoring programs to maximize reach and efficiency. Second, standardized

training modules should be developed and implemented to equip nurses with the necessary skills to administer, score, and interpret validated screening tools with confidence and accuracy. Third, health systems should establish clear referral pathways to ensure that children who screen positive can be linked promptly to diagnostic and intervention services, minimizing delays that may compromise developmental potential. Fourth, the use of simple digital screening platforms and electronic health records could enhance data management, referral tracking, and follow-up. Fifth, community engagement should be strengthened through caregiver education programs, empowering parents to recognize early signs of developmental delay and actively participate in screening and intervention processes. Sixth, ongoing monitoring, supervision, and quality assurance systems should be instituted to sustain fidelity and effectiveness of screening programs over time. Finally, policymakers should consider allocating dedicated resources to scale up nurse-led developmental screening programs, particularly in underserved and resource-limited settings where early intervention services are often delayed or inaccessible. Implementing these recommendations has the potential to transform early childhood developmental care, ensuring that more children are identified early and receive the timely support needed to reach their full developmental potential.

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