



# Efficacy Of A Novel Vision Screening Tool In Identifying Vision Disorders In Children From Birth To Three Years of Age



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## Introduction

- The prevalence of amblyopia in children is about 2%<sup>1,2</sup> and of amblyogenic risk factors is about 15-20%.<sup>3-5</sup> Strabismus and amblyopia have been associated with reduced quality of life in children and adults and an increased risk of vision loss in the fellow eye. In the United States, vision screening in children are done to identify refractive errors, amblyopia and its risk factors. Several studies have evaluated the effectiveness of pre-school vision screening and the accuracy of screening tests over the last decade.<sup>6-9</sup>
- Few studies have shown that there are benefits to vision screening in children from birth to 24/37 months of age in the detection of amblyopia.<sup>10,11</sup> However, evidence on accuracy and efficacy of vision screening tests in this population is limited. The United States Preventive Services Task Force (USPSTF) currently offers no recommendation for vision screening in children under 3 years of age based on insufficient evidence.<sup>12</sup> Current approaches to vision screening in children under three years consists of behavioral vision screening (red reflex test, pupils, eye movements) and instrument based screening. Behavioral screening requires training and expertise to minimize over-referrals and instrument based screening can be expensive. Visual developmental assessment could be a viable tool for vision screening in early education and care centers (Early Head Start) and in pediatrician's offices. The former are under mandatory regulations to perform early vision screening annually.

### Visual Developmental Assessment:

- A novel approach to obtaining visual information from the infant or toddler is to enquire about the child's visual behavior in the form of a questionnaire from parents or primary caregivers.
- Infants with normal visual development are expected to perform age-appropriate activities based on the visual information they receive. For example, an 8-week-old infant is expected to make eye contact with his/her parents to communicate.
- Delay or absence of this behavior could potentially be due to high or unequal refractive errors causing reduced vision in one or both eyes. It is also important to note that abnormal visual development can impact normal motor, social and emotional development, which in turn can cause emotional and financial burden to the families if not identified and treated early.

### Purpose:

The aim of this study was to compare the efficacy of the novel visual developmental assessment to gold standard comprehensive eye exam in children under three years of age.

## Methods

- 225 children under three years of age were recruited from early education and care centers in Boston and Springfield, MA from July 2015-June 2016. Informed consent was obtained.
- Age appropriate visual developmental survey were developed by a multidisciplinary team of pediatricians, developmental psychologists, optometrists and ophthalmologists in 6 month intervals from birth to 36 months of age. Each survey had two sets of questions: Q1-5: Visual developmental assessment, Q6-10: Risk assessment

Child's name: \_\_\_\_\_ Date of Birth \_\_\_\_/\_\_\_\_/\_\_\_\_ Early education center location \_\_\_\_\_

These questions are about your child's vision development. Please read them carefully and answer the questions by placing a checkmark in the column that is most appropriate. Be sure to try each activity with your baby before answering the question. Make sure your baby is fed and well rested. Please return this questionnaire by \_\_\_\_\_

Birth - 6 months of age:	OFTEN	SOMETIMES	NOT YET
1. When you smile at your baby, does your baby immediately smile back?	_____	_____	_____
2. Does your baby look at his/her hands?	_____	_____	_____
3. When you show a toy while the baby is lying on its back, does he/she reach for the toy with their arm?	_____	_____	_____
4. When in front of a mirror, does your baby smile or recognize him/herself?	_____	_____	_____
5. Does your baby notice you approaching from 4-5 feet distance?	_____	_____	_____
	YES	NO	UNSURE
6. Does anyone in the family/your child's family have crossed-eyes or one eye that turns in a different direction?	_____	_____	_____
7. Was anyone in the family/your child's family told to wear glasses at 4 years or younger?	_____	_____	_____
8. When your child was born, did he/she have to stay in the hospital for more than 5 days?	_____	_____	_____
9. During pregnancy, did the mother smoke more than 5 packs of cigarettes per month?	_____	_____	_____
10. Was your child at least 8 weeks premature or born with low birth weight (3.5 lbs or less)?	_____	_____	_____

- The primary caregiver was asked to complete an age appropriate survey for the child and return them to the educator at the early education and care center. Eye exams were provided with 4 weeks of completion of the survey.
- The children were examined by masked licensed pediatric optometrists for a gold standard comprehensive examination with cycloplegia on the New England Eye Mobile Clinic. Comprehensive eye exam consisted of qualitative vision assessment (Fix and Follow), cover test, ocular motility, pupillary examination, ocular health assessment and cycloplegic retinoscopy using 1% cyclopentolate.
- Criteria for in the gold standard eye exam was adopted from Vision in Preschoolers study. Results of the survey was compared to the results of the gold standard eye exam.

Table 1: Significant refractive error defined by VIP

Type of Refractive Error	Significant Refractive Error
Hyperopia	>+3.25 D
Myopia	>-2.00D
Astigmatism	>1.00D difference between meridians
Anisometropia	>1.00D IOD hyperopia >3.00D IOD myopia >1.50 IOD astigmatism

IOD = intra-ocular difference

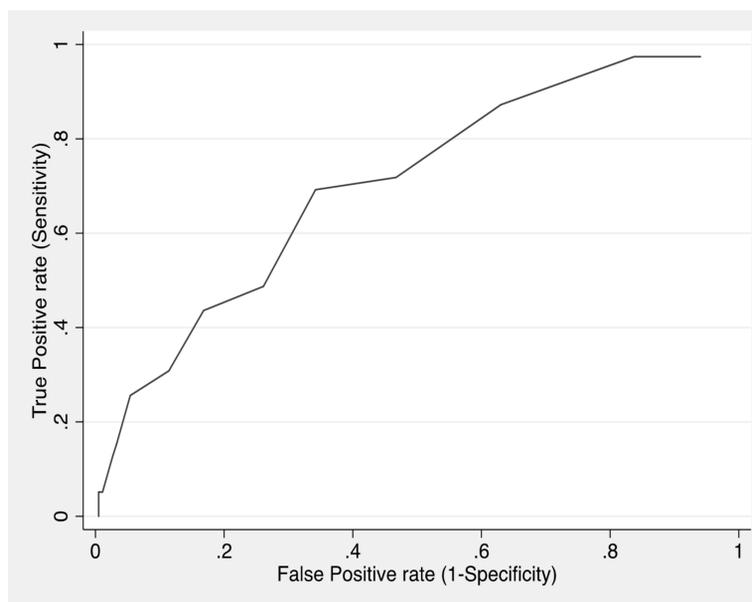
## Results

- Scoring criteria for Q1-5 a score of 1 for often, 0.5 for sometimes and 0 for not yet was used. For Q6-10 a score of 0 for yes, 0.5 for unsure and 1 for no was given.

Table 2: Sensitivity and specificity of two cut off scores for the survey to detect amblyogenic risk factors.

	GSE Pass	GSE Fail	Sensitivity (95% CI)	Specificity (95% CI)
<b>Survey Total with cutoff of 8</b>				
Pass	121	12	69.2	65.8
Refer	63	27	(52.4-83.0)	(58.4-72.6)
<b>Survey Total with cutoff of 7</b>				
Pass	153	22	43.6	83.2
Referral	31	17	(27.8-60.4)	(76.9-88.3)

ROC analysis of the survey:



A receiver operating characteristic (ROC) analysis plots the sensitivity vs 1-specificity (false positive rate) and each point represents a value from a different cut-off point. Area under the curve (AUC) analysis provides a summary of the accuracy of a screening test and ranges in value from 0.0 to 1.0. AUC > 0.9 (excellent), 0.8-0.9 (very good), 0.7-0.8 (good), 0.6-0.7 (average) and less than 0.6 (poor). The AUC for the survey was 0.703.

Table 3: Risk Factor for vision disorders in children from birth to 36 months of age

Risk factor	OR (95% CI)	P Value
Survey Score <7	3.81 (1.82-8.00)	0.000
Survey Score <8	4.32 (2.05-9.10)	0.000
Age*	1.01 (0.97-1.06)	0.606
Age**	1.01 (0.97-1.05)	0.660
Sex*	0.47 (0.21-1.05)	0.065
Sex**	0.45 (0.20-1.01)	0.053
* Adjusted with Survey Score <7		
** Adjusted with Survey Score <8		

- Survey scores of 7 and 8 showed increased odds of having amblyogenic risk factors.
- Both age and gender of the child were not risk factors for detection of amblyogenic risk factors.

## Summary

- Results of this pilot study show that the sensitivity and specificity of the survey in detection of amblyogenic risk factors is 69.2% and 65.8% respectively for cutoff score of 8.
- The AUC from ROC analysis for the survey was 0.703 indicating that the survey was a good predictor of vision problems in children under three years of age.
- Results of this pilot study also show that a survey score of <8 increases the risk of failing an eye exam and detection of amblyogenic risk factor increases about 4 times compared to scoring >8.
- To our knowledge this study is the first of its kind to use a visual developmental assessment as a vision screening tool for detection of vision problems in children under three years of age.
- A limitation of this pilot study was the small sample size. However, our findings suggest that visual developmental assessment combined with risk assessment might be a viable approach to screen for vision disorders in this cohort. Further research with a large sample size if necessary to evaluate the validity of this novel screening tool.

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