Assessing accuracy of non–eye care professionals as trainee vision screeners for children

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ABSTRACT • RÉSUMÉ

Objective: To determine the level of agreement between non–eye care trainees and a trainer (ophthalmologist) in a vision screening program.

Design: Prospective, observational study carried out in 3 phases (Phase I–III).

Participants: Study population included 1228 children, aged 6–14 years, at 5 elementary schools in the city of Hamilton.

Methods: In Phase I, 1228 children were screened by the trainee screeners, of which 273 children failed the vision testing. Of these 273 children, 170 consented to enrolment into Phase II and were examined by an ophthalmologist, who confirmed that 105 of these children were true positives. On retesting (Phase III), the ophthalmologist passed 158 of the 163 randomly selected children who passed in Phase I.

Results: Overall, trainee screeners had a sample sensitivity of 95.5% and sample specificity of 70.8% in detecting children who should fail vision screening. When we used the positive and negative prediction values obtained, 198 of the 1228 children had vision impairment—providing an estimated prevalence of 16.1%, or 161 children per 1000 population.

Conclusions: Non–eye care professionals can be trained to an acceptable degree of accuracy to perform certain vision screening tests on children. Such screening methods may be a useful approach to address existing gaps in provision of eye care for many Canadian children, thereby ensuring that all children receive timely vision screening.

Objectif : Déterminer le niveau d'accord entre des non-professionnels de la vue en formation et un formateur (ophtalmologiste) dans un programme de dépistage des troubles de la vue.

Nature : Étude observationnelle prospective en trois phases (phase I-III).

Participants : 1228 enfants de 6 à 14 ans de cinq écoles élémentaires de Hamilton.

Méthodes : À la phase I, 1 228 enfants ont été évalués par des dépisteurs en formation. De ce nombre, 273 enfants n'ont pas réussi le test de vision. 170 de ces 273 enfants ont accepté de participer à la phase II et ont été examinés par un ophtalmologiste, qui a confirmé le diagnostic de 105 enfants. À la suite d'un nouvel examen réalisé par l'ophtalmologiste (phase III), 158 élèves ont réussi le test sur 163 choisis au hasard parmi ceux qui l'avaient réussi à la phase I.

Résultats : Les dépisteurs en formation ont affiché une sensibilité de 95,5 % et une spécificité de 70,8 % pour la détection d'enfants qui auraient dû échouer au test de vision. En utilisant les valeurs de prédiction positives et négatives obtenues, on a déterminé que 198 des 1228 enfants avaient un trouble de la vision, soit une prévalence estimée de 16,1 % ou de 161 enfants par tranche de 1000 personnes.

Conclusions : Il est possible de former des non-professionnels de la vue pour qu'ils atteignent un niveau de précision acceptable en réalisant divers tests de dépistage de troubles de la vue chez des enfants. De telles méthodes de dépistage peuvent être utiles pour pallier des lacunes dans les régions mal desservies du Canada, et ainsi offrir à tous les enfants canadiens un dépistage rapide des troubles de la vue.

Over 80% of a child's learning is based on vision, and good eyesight is a key requirement for the development of a child, both physically and emotionally.[1] Among children, the prevalence of myopia can range from 3.4% to 43.6%, astigmatism from 1% to 11%, and hyperopia from 1.2% to 10.6%, depending on ethnicity and associated risk factors,[2–6] whereas strabismus affects 3%–4% of the population.[7,8] Childhood vision screening recommendations begin as early as infancy and continue every 12–24 months throughout childhood.[9,10] Despite the importance of identifying children with vision disorders, 6 Canadian provinces, including Ontario, have no preschool vision screening programs in place.[11] To mitigate this, the Ontario Association of Optometrists has established the Eye See … Eye Learn program, which offers vision testing to junior kindergarten pupils via participating optometrists in certain school regions.[12] Although this is an important step in bridging this gap, Eye See … Eye Learn relies on parents to bring their children to the optometrist. Despite these efforts, less than 14% of children in Canada under the age of 6 years have had an eye examination.[13]

Aim of the Study

The aim of this study was to assess the feasibility and accuracy of a new vision screening program for elementary school children in a Canadian urban setting.

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METHODOLOGY

Study design and participants

This was a prospective, observational study carried out in 3 phases in children aged 6–14 years who were currently enrolled in full-time education at 5 elementary schools in Hamilton, Ontario. These schools serve an urban population that, based on census data, has one of the lowest living standards in Canada.[14,15] All 3 phases required informed consent and assent forms. The study team obtained research ethics board approval from Hamilton Integrated Research Ethics Board (REB No. 12-426) and from the Evidence-Based Education and Services Team at Hamilton Wentworth District School Board.

Phase I: in-school vision screening. Two bachelor of health science students were trained in vision screening at McMaster Children's Hospital. These Two trainee screeners then conducted on-site vision screening of children aged 6–14 years at 5 local schools. Two M&S smart systems were used as the vision screening tools in this study, with presenting acuity recorded by line and the fellow eye occluded with an adhesive Ortopad orthoptic eye patch (Master-Aid Pietrasanta Pharma S.p. A Viareggio, Lucca, Italy). Each child's acuity was measured at a distance of 20 feet with Snellen crowded letters. Regarding stopping criteria, an eye's best visual acuity (VA) was recorded as the lowest line of which the child was able to correctly identify half or more of presented optotypes.

Phase II: ophthalmic examination for children who failed screening in the first phase. Previously published criteria[16] were used to define which children failed the vision screening tests carried out in the first phase:

1. presenting distance VA of 20/40 or worse in one or both eyes, and/or
2. difference of 2 or more lines in presenting distance VA measurement between 2 eyes

Children who failed vision screening in Phase I were enrolled in the second phase of the study, in which their visual acuities were re-measured under the same conditions as in Phase I, this time by the pediatric ophthalmologist. The ophthalmologist in Phase II was masked to the children's VA measurements from Phase I. All children in Phase II had a follow-up with a pediatric ophthalmologist within 2 weeks of Phase I.

Phase III: assessing false-negative rate. In Phase III, a randomly selected sample of children who passed vision screening in Phase I was re-tested on site in schools by the pediatric ophthalmologist. All children who failed vision testing by the trainee screeners or the pediatric ophthalmologist in any phase were invited for a full ophthalmological examination at McMaster Children's Hospital by the pediatric ophthalmologist, which included a cycloplegic refraction. Importantly, the same devices and protocol were used for VA measurements in Phases I, II, and III and in any follow-up visits for consistency. Those results are not discussed as they were not the focus of this study.

Statistical analysis

Screening test accuracy was measured by calculating and reporting sample sensitivity, sample specificity, positive and negative predictive values, and likelihood ratios with their corresponding 95% CIs. StatsDirect (www.statsdirect.com) statistical software was used for the analyses.

RESULTS

Phase I

Overall, 1228 children (age range 6.8–14.8 years, mean 10.6 years, median 10.6 years) from 5 schools were enrolled into the first phase. Of these children, 273 (22%) failed the vision screening based on the previously mentioned criteria.

Phase II

All 273 children who failed Phase I were invited to enrol in Phase II, of which 170 (69.9%) attended and were examined by the pediatric ophthalmologist. On retesting, the ophthalmologist passed 65 and failed 105 of the children in Phase II.

Phase III

In Phase III, 163 randomly selected children who passed screening in Phase I were reassessed by the pediatric ophthalmologist, who passed 158 of these children a second time.

Accuracy of trainees as vision screeners. Table 1 shows the screening test properties of the trainee screeners compared with the pediatric ophthalmologist. The trainee screeners

Table 1—Accuracy of trainee screeners compared with eye care professionals

Phase	Children Failed by Pediatric Ophthalmologist	Children Passed by Pediatric Ophthalmologist	Total
II			
Children failed by trainee screeners in Phase I	105	65	170
III			
Children passed by trainee screeners in Phase I	5	158	163
Total	110	223	333

Sample sensitivity (105/110) = 95.5% (95% CI: 89.7%–98.5%).
Sample specificity (158/223) = 70.8% (95% CI: 64.4%–76.7%).
Sample accuracy [(105 + 158)/333] = 79.0% (95% CI: 74.3%–83.0%).
Likelihood ratio of a positive test (sensitivity/[1 − specificity]) = 3.27 (95% CI: 2.68–4.10).
Likelihood ratio of a negative test ([1 − sensitivity]/specificity) = 0.06 (95% CI: 0.02–0.14).