ABSTRACT

Title: Development of a protocol for screening visual impairment in children aged 3 to 6 years.

Background: The optimum protocol for Preschool vision screenings (PVS) remains ambiguous worldwide. Research indicated that early screening and treatment led to enhanced visual outcomes. There are concerns regarding dearth of protocols for PVS and ongoing debate on the screening batteries.

Aim: To develop and validate a protocol for screening visual impairment in children aged 3 to 6 years

Methods: The permission for conducting the study was obtained from Institutional Ethics Committee, Kasturba Hospital, Manipal and subsequently from the Head of the department of Ophthalmology. An extensive literature review was conducted for the development of vision screening protocol. All manuscripts relevant to the area was reviewed for protocol development. Informed consent was obtained from the parents and verbal assent from the participants before commencing the study. It was a cross sectional study. Purposive sampling was used. The vision screening protocol was validated with the screened participants. The visual acuity measurements were recorded using Lea, HOTV and E charts. Frisby, Titmus and Randot preschool stereo tests were used for stereo acuity measurements. The order of the presentation of the charts were generated using a random number table. Plusoptix A09 was used to screen refractive errors. All the children underwent dry refraction, squint assessment, anterior segment examination, cycloplegic refraction and retinal evaluation following the screening tests. Diagnosis and management of each eye was recorded. The presenting visual acuity
<20/40 or 0.3 log Mar in the study eye was considered to be a visual impaired eye. E chart was used for categorizing visual impairment.

**Results:** A protocol for screening visual impairment in children aged 3 to 6 years was developed and validated. A total of 254 eyes were analyzed. 128 eyes had normal visual acuity and 126 were visually impaired. Mean age of the participants were 63.4±12.5 months. In the current study, sensitivity, specificity, PPV and NPV of Lea chart were 88.1%, 96.9%, 96.5% and 89.2% and HOTV chart were 87.3%, 97.7%, 97.3% and 88.1% for screening visual impairment. 66.7% sensitivity, 63.6% specificity, 60% PPV and 70% NPV was observed for Frisby stereo test. Titmus stereo fly test exhibited 88.5%, 40.0%, 54.1% and 81.2% while Randot preschool stereo test displayed 74.1%, 56.1%, 58% and 72.5% sensitivity, specificity, PPV and NPV for identifying visual impairment. Plusoptix recorded a sensitivity, specificity, NPV and PPV of 56%, 52.3%, 54.8% and 53.5% for spherical and 62.6%, 64%, 64.8% and 61.8% for cylindrical values in detecting visual impairment. There was very good Intra class Correlation Coefficient (ICC =0.990) between the visual acuity charts. Poor correlation was observed between stereo acuity charts (ICC = 0.198) and refractive techniques (ICC= 0.074). Bland Altman analysis showed good agreement between Lea and HOTV, Lea and E and HOTV and E visual acuity charts. The main causes of visual impairment in the study subjects were amblyopia (42.1%) and refractive errors(41.3%). Kappa statistics between different combinations of vision charts, stereo charts and Plusoptix A09 revealed that the visual acuity chart combinations had good agreement (κ= 0.850) over the other test combinations for screening visual impairment. No association was observed between age (χ²=2.0, p=0.571) and gender (χ²=2.12, p=0.345) with visual impairment. Chi square test showed no statistical significant differences between rural and urban subjects for the visual acuity charts employed viz. Lea
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(χ²=1.09, p=0.296), HOTV(χ²=0.287, p=0.59), E(χ²=0.204, p=0.65) and Randot preschool stereo test (χ² = 0.699, p=0.403).

Conclusion:

An algorithm was developed for screening visual impairment in children aged 3 to 6 years. The visual acuity charts demonstrated very high sensitivity and specificity for screening visual impairment in 3 to 6 year old children compared to stereo tests and Plusoptix A09. ICC values between visual acuity charts were good. Bland Altman analysis showed good agreement between Lea and HOTV, Lea and E and HOTV and E visual acuity charts. There was no association between age and gender with visual impairment screening. No statistical significant differences were observed in using Lea, HOTV, E vision charts and Randot preschool stereo test for children residing in rural and urban locality for screening visual impairment.

Keywords: vision screening, preschool, visual disorders, amblyopia, refractive errors, charts, vision, depth perception