

**UNIVERSITI TEKNOLOGI MARA**

**THE IMPACT OF GLAUCOMATOUS  
VISUAL FIELD DEFECTS ON  
READING SPEED AND EYE  
MOVEMENT ANALYSIS**

**SHAUQIAH BINTI MUHAMAD  
JUFRI**

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## ABSTRACT

Visual field plays an important role on information retrieval for mobility and navigation in daily activities. Reading is one of the activities to retrieve information for knowledge acquisition in native and non-native language, which affect differently. The first part of our study was to develop a standardised reading passage as a tool to evaluate reading in the Malay language. The development of the reading passages encompassed three stages: exploratory, confirmatory and prototyping. In the exploratory stage, 300 sentences extracted from standard school textbooks endorsed by the Malaysian Ministry of Education based on two deciding factors. A total of 56 passages constructed with equal readability, based on a "5 continuous sentence structure of 50 words" combination. In the confirmatory stage, the 56 passages verified by twenty-five normal sighted native Malay speakers. The reading time measured using a stopwatch, while the errors marked in recording sheet. Reading speed quantified in words per minute (wpm). Three passages eliminated from the confirmatory testing based on the outliers present in the boxplot graph. Eleven passages further eliminated based on the 10 % highest error and best 5 % at the two extreme ends of the reading speed range. In the prototyping stage, 42 reliable, qualified reading passages randomly compiled into 3 sets with 13 passages each of SAH reading passage compendium (SAHRPC). This newly developed SAHRPC used in the main study investigating the effect of glaucomatous VFD on reading speed and eye movement analysis. Sixteen participants recruited using convenient sampling. Eight patients who diagnosed with glaucoma from a tertiary ophthalmology clinic grouped under the experimental category. Eight normal-sighted participants placed under the control group. Inclusion criteria was best-corrected visual acuity of 0.8 LogMAR or better. Visual field tested using the Humphrey Matrix 24-2 threshold protocol for all participants. Participants asked to read randomly selected reading passages monocularly. The duration to complete the passages measured using a stopwatch and errors made marked onto the recording sheets. Reading speed calculated in wpm. Eye movements measured indirectly during reading of the passages with Three-D video-oculograph (3D VOG). The eye movements recorded in total counts of fixation, saccadic, regression and return swept. Fixation ( $t=-2.59$ ;  $p<0.05$ ) and reading speed ( $t=3.12$ ;  $p<0.05$ ) significantly different between the glaucoma and control groups. Reading speed significantly correlated with total defect area ( $r(16)=+0.625$ ,  $p<0.05$ ) but was not apparent in eye movement [fixation  $r(16)=+0.048$ ,  $p>0.05$ ; saccadic  $r(16)=-0.165$ ,  $p>0.05$ ; regression  $r(16)=-0.109$ ,  $p>0.05$ ; return swept  $r(16)=+0.292$ ,  $p>0.05$ ]. Reading speed varied significantly between different types of glaucomatous field defects (one-way ANOVA:  $F(2,1985)=4.901$ ,  $p<0.05$ ), and fixation (one-way ANOVA: Welch's  $F(3,5.965)=4.5.32$ ,  $p<0.05$ ), but not saccades, regressions and return swept (one-way ANOVA: saccades  $F(3,61.55)=0.598$ ,  $p>0.05$ ; regressions  $F(3,17.05)=0.284$ ,  $p>0.05$  and return swept  $F(3, 0.33)=2.026$ ,  $p>0.05$ ). Arcuate defect had the highest incidence (62.5%), followed by pre-perimetric and nasal step (12.5%). In conclusion, reading speed reduced, and fixation counts increased in glaucoma patients. Our significant finding for fixation, together with an insignificant association with saccades, suggests that the disengaged and engaged mechanisms of visual attention might be affected differently by visual field defects. The association of defect area with faster reading speed, but the lack of significant correlation in eye movement might suggest a different coping strategy between eye movement adjustment and reading adaptation in response to visual field defects.

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