



Validation of a modified ETDRS chart for European-wide use in a population using the Cyrillic alphabet.

P Tsoka¹, S Plainis¹, T Giannakopoulou¹, V Tsapaki², P Nikolitsa¹, J Moschandrea³, MK Tsilimbaris²

¹Institute of Vision & Optics (IVO), University of Crete ²Dept of Ophthalmology, University Hospital, Heraklion, Crete

³Dept of Social Medicine, University of Crete

1. INTRODUCTION

The development of the visual acuity charts for the Early Treatment Diabetic Retinopathy Study (ETDRS), offered to the ophthalmologic / optometric community a rigorous test design, which has been widely adopted in basic and clinical vision research (Ferris III et al., 1982, 1993). However, ETDRS charts contain a set of Sloan letters which are not used in Greek, Cyrillic and Central European alphabet. More recently, the UoC visual acuity chart (Plainis et al., 2007), a modified ETDRS chart was developed for European-wide use.

The purpose of the study is to evaluate the test-retest variability and the validity of the charts in a population using the Cyrillic alphabet.

2. METHODS

The UoC chart contains a set of letters recognisable by European citizens using the Latin, the Greek and the Cyrillic alphabets: the Roman letters C, D, R, V, S and Z (contained in the standard ETDRS chart) are substituted with E, P, B, M, A and T, respectively. The charts were validated in a cohort of 310 english-speaking school children (620 eyes), with a mean age of 12.5 (SD 1.4) yrs, in a Bulgarian city (Stara Zagora).

Visual acuity of both eyes was assessed with the habitual refractive correction, once using the standard ETDRS charts and twice using the UoC charts (chart 1 for RE and chart 2 for LE, see figure 1). A back-illuminated slim stand (Sussex Vision Ltd., UK), at 4m distance, held the acuity charts. The four charts were viewed in random order to limit any learning effects. All subjects were asked to identify each letter one by one in each line starting from the upper left-hand letter, and to proceed by row until they had four or five (all letters) mistakes on a line. The experimenter scored correct responses on specially designed data forms. A visual acuity score was derived from the calculation of missed letters up to the last readable line.

The intra-class correlation coefficient (ICC) was used to assess the test-retest reliability of the UOC chart. Limits of agreement were calculated for differences in visual acuity scores (test-retest variability) between measurement occasions for the UoC chart. Standard method comparison measures (Bland-Altman analysis) were used to assess agreement between the two charts.

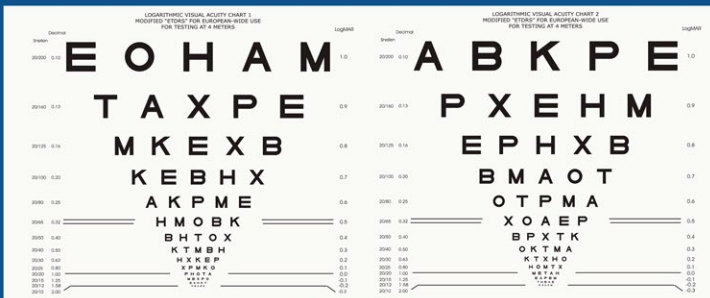


Figure 1: The UoC charts for RE and LE

3. RESULTS - TEST-RETEST VARIABILITY (TRV)

The intra-class correlation coefficient (ICC) was estimated to be 0.968 (95% CI from 0.958 to 0.975) for the RE and 0.961 (95% CI from 0.950 to 0.970) for the LE.

To further illustrate the differences across the two sets of charts, Bland-Altman analysis (95% range, ± 1.96 SD) was performed. Figure 2 shows that 96.2% of the values for the RE and 95.0% for the LE lie between the limits of agreement. The test-retest variability (TRV) of the UoC chart were found to be ± 0.10 for both RE and LE.

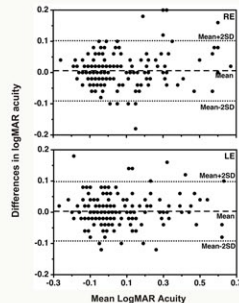


Figure 2: Plot of the difference in logMAR acuity between the measurements with the UoC charts against their average (Bland-Altman analysis) for the right (upper graph) and left (lower graph) eyes. The dashed line represents the mean difference, whereas the dotted lines the mean ± 1.96 SD.

4. RESULTS - VALIDITY OF THE CHART

The agreement between the two sets of charts was evaluated by Bland and Altman analysis, making the assumption that the differences are normally distributed. The assumption of normality itself was evaluated by inspection of quantile-quantile normal plots.

The UoC charts produced on average slightly higher logMAR acuity scores (0.015 for RE, 0.019 for LE) compared to the standard ETDRS charts, which corresponds to less than one letter difference. However, Bland-Altman scatter plots (figure 3) revealed that 97.1% of the values for the RE and 97.4% for the LE lie between the limits of agreement.

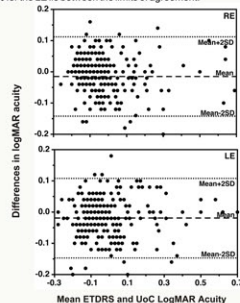


Figure 3: Plot of the difference in logMAR acuity between the UoC and the standard ETDRS charts (UoC minus standard ETDRS) against their average acuity for the right (upper graph) and left (lower graph) eyes. The dashed line represents the mean difference, whereas the dotted lines the mean ± 1.96 SD.

5. CONCLUSIONS

The UoC chart was found to have excellent test-retest reliability and offers an acceptable level of test-retest variability (± 0.10) when compared to the published estimates of the gold standard ETDRS chart (± 0.07 to ± 0.11). Moreover, it produced significant agreement in VA scores with the standard ETDRS chart, replicating measurements on a Greek population (Plainis et al., 2007).

The UoC forms a valid alternative to the ETDRS chart, offering the advantage of containing letters recognisable by all European citizens.

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