Does High and Low contrast visual acuity change with aging?

A cross sectional study in healthy population.

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BERLIN2016

Purpose

- To evaluate the range of High Contrast Visual Acuity (HCVA) and Low Contrast Visual Acuity (LCVA) with an LCD Optotype in a normal population.
- To evaluate if aging in healthy people causes a decline in the HCVA and LCVA

Method

HCVA (93% Weber contrast) and LCVA (12.5% Weber contrast; -0.9 logC) were measured monocularly with the best subjective refraction arranged in a trial frame with trial lenses.
A 5 Sloan letter row was presented in descending logarithmic progression of 0.10 logMAR. A forced choice procedure and a letter by letter (0.02 logMAR) scoring criteria were used to assess the threshold (Bailey & Lovie, 1976).
Every single 5-letters row were randomly generated among 28 different sets of balanced readability (Ferris et al, 1982) with a LCD system (CSO, Florence, Italy) (Fig.1) and presented isolated. The luminance of the display was 62 cd/m^2.

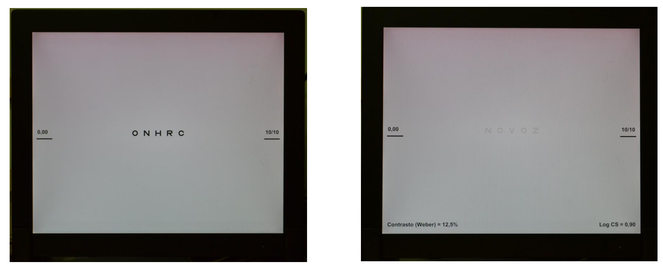

Fig.1: HC and LC letters arranged on LCD system.

Results

Participant Demographics and visual information	
Age (years)	38.4 ± 20.5 range 6.0-87.7
Gender n (%)	208 (55.3%) females 168 (44.7%) males
Refraction	OD SER -0.23 ± 1.45 D range +3.75/-4.50 OS SER -0.23 ± 1.45 D range +4.50/-4.50
Eye Dominance (Sighting)	244 right (64.9%) 132 left (35.1%)

Table 1: Participant Characteristics (n=376).

All the distributions of VA (HCVA and LCVA for both eyes) were found to be statistically different from normality (p<0.05).
Table 2 summarises all the descriptive statistics of VA at high and low contrast for both right and left eyes and for dominant and non dominant eyes.
HCVA resulted significantly correlated to LCVA in right eye and left eye (both r Spearman=0.75; p<0.00) (Fig.2).
The relationship between Mean Spherical Equivalent (MSE) and VA showed statistical significance both in right eyes, with Spearman correlation of 0.12 (p=0.03) and 0.17 (p<0.00) for HCVA and LCVA respectively, and left eyes with Spearman correlation of 0.15 (p<0.01) and 0.19 (p<0.00) for HCVA and LCVA respectively (Fig.3).

	Median	Mean	Min	Max	IQ range	SD
HCVA OD	-0.12	-0.12	0.10	-0.30	0.10	0.07
HCVA OS	-0.12	-0.12	0.12	-0.30	0.08	0.07
LCVA OD	0.12	0.12	0.48	-0.08	0.12	0.08
LCVA OS	0.12	0.13	0.46	-0.06	0.10	0.08
HCVA Dominant Eye	-0.14	-0.13	0.10	-0.30	0.10	0.07
HCVA Non Dominant Eye	-0.12	-0.11	0.12	-0.30	0.10	0.07
LCVA Dominant Eye	0.12	0.12	0.48	-0.08	0.10	0.08
LCVA Non Dominant Eye	0.14	0.14	0.46	-0.06	0.12	0.08

Table 2: Descriptive statistics of VAs. Dominant eye resulted statistically better than non dominant eye both for HCVA and LCVA (Wilcoxon; ps<0.00).

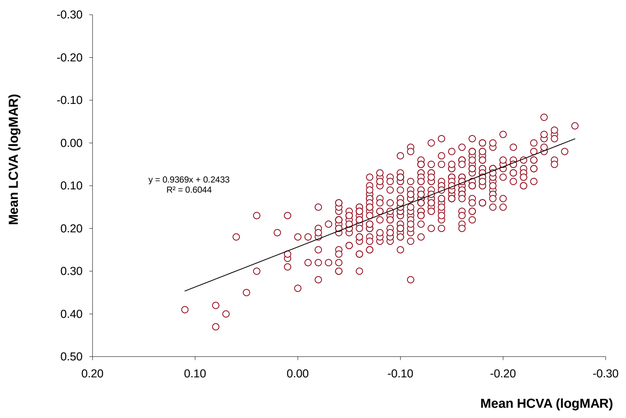

Figure 2: Scatterplot between mean of HCVA in both eye and mean of LCVA in both eye. for all participants. (Spearman correlation=0.75; p<0.00).

Age was significantly correlated with a difference between HCVA and LCVA both in right eyes (Spearman coefficient=0.21, p<0.00) and left eyes (Spearman coefficient=0.24, p<0.00) (Fig.4).
The relationship between age and VA showed statistical significance both in right eyes, with Spearman correlation coefficient of 0.18 (p=0.001) and 0.23 (p<0.00) for HCVA and LCVA respectively, and left eyes with Spearman correlation of 0.16 (p=0.002) and 0.28 (p<0.000) for HCVA and LCVA respectively (Fig.5).
The distribution of VAs (HCVA for right eye, left eyes and both eyes; LCVA for right eye, left eyes and both eyes) was not the same across different age groups (Kruskal-Wallis test, all ps<0.00) (Fig.6). However if paired comparisons are calculated between groups then statistical differences can be found only between 35-50 years and 50-65 years and between 35-50 years and 65+ years (Mann-Whitney, p<0.00). Whilst for the former comparison the clinical difference is quite small, for the latter it is more significant.

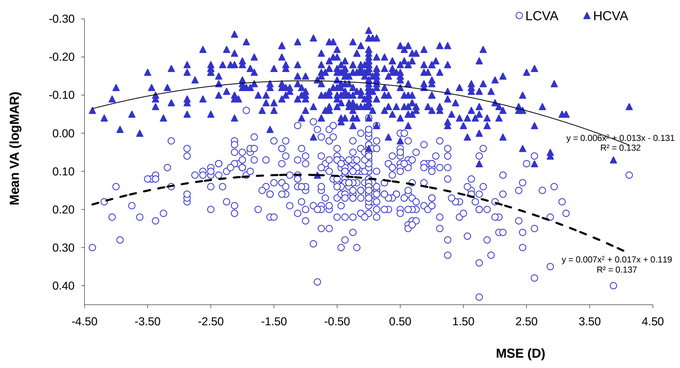

Figure 3: Relationship between mean monocular MSE and mean HCVA and LCVA. Spearman correlation is 0.14 (p<0.01) and 0.19 (p<0.00) for HCVA and LCVA respectively. The best curve fit is represented in the graph.

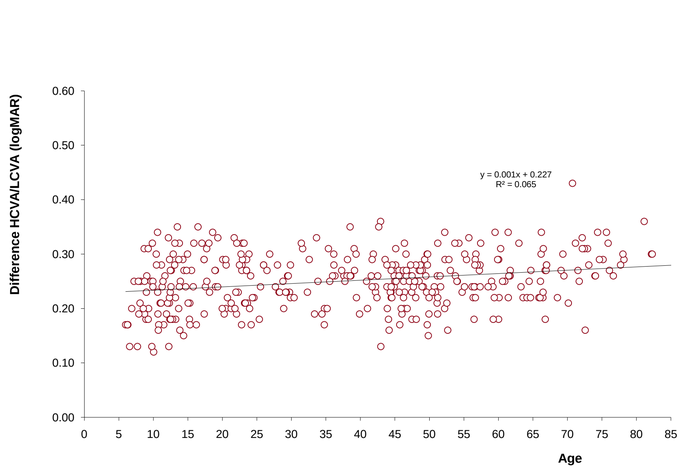

Figure 4: : Relationship between age and the mean monocular difference of HCVA and LCVA (Spearman correlation of 0.23 (p<0.00).

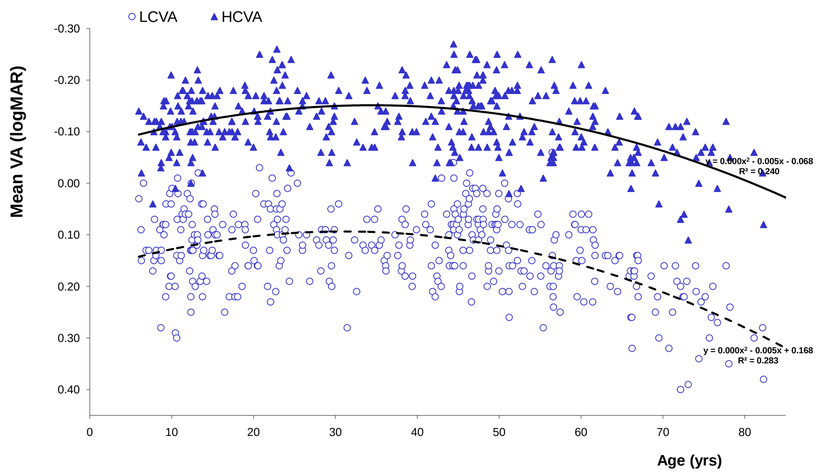

Figure 5: : Relationship between age and mean monocular HCVA and LCVA. Spearman correlations are 0.18 (p<0.00) and 0.30 (p<0.00) for HCVA and LCVA respectively. The best curve fit (polynomial regression) is represented in the graph.

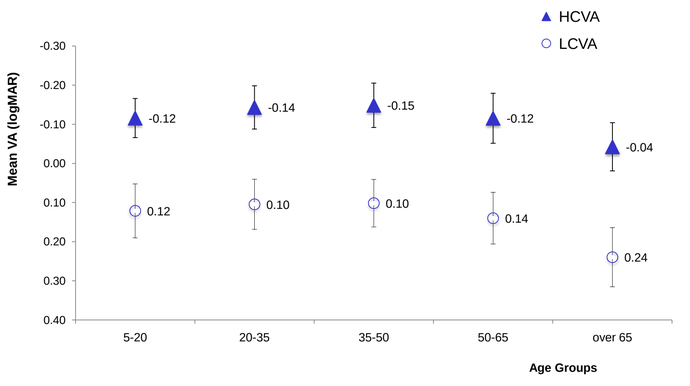

Figure 6: Mean monocular HCVA and LCVA ± SD have been plotted for 5 age groups.

Discussion

Aging did not affect the measures of HCVA and LCVA, which remained clinically stable up to 65 years. The study showed a steady high HCVA up to 60 years of age with a following decline that has previously been described using chart optotypes (Pitts, 1982). Over this age both HCVA and LCVA showed a signficant drop, with a level of 0.24±0.08 and -0.04±0.06 logMAR respectively. The VA in healthy subjects dropped of a value of about 0.25 logMAR if the contrast generated with a LCD system is decreased to 12.5%.

In conclusion both HCVA and LCVA threshold, as well as their difference, represent an important measure when visual functionality of patients is investigated because they provides noteworthy information about functional vision and allows a better understanding of subtle vision loss potentially due to optical or neurophysiological problems (Elliott, 1998). Data found in the study can represent a reference for a normal range of measurements collected by LCD devices.

References

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