Farnsworth–Munsell 100 Hue Test Evaluation in Healthy Children

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Introduction. The Farnsworth–Munsell (F-M) 100 hue test is widely used for measuring chromatic discrimination by clinicians and vision scientists [1]. Some studies suggest that demographic factors such as age, sex and even ethnicity should also be considered in explaining the communication values of various colours [2, 3]. Studies by Guilford et al. have indicated that people prefer colours in the following order: blue, red, green, violet, orange, and yellow but gender differentiation is minor, with men slightly tending to prefer blue to red, and women yellow to orange, although neither preference is sufficient to offset the above order for the general population. Indeed, this order is consistent even across age and national lines [4]. Many studies show that the performance on F-M 100 hue test varies as a U-shape function of age [5 - 8].

Therefore, to perform detailed visual examination, various functions, such as cognitive perception, colour contrast sensitivity, health of the visual system and the central processing function are tested. Studies have shown that the assessment of the visual acuity testing by the typical Snellen chart using the Landolt rings (C optotypes) alone is insufficient for the visual function testing because it provides limited information about the central vision, thus it is necessary to determine not only the visual acuity, but also the contrast sensitivity [9]. To determine colour perception established by the Farnsworth–Munsell 100 hue (F-M 100) in healthy children, and compare color contrast sensitivity in girls and boys, and in younger and older age groups.

Methods. A total number of 60 (120 eyes) children were enrolled in further analysis according to the subject inclusion and exclusion criteria. Having obtained permission from the Kaunas Regional Biomedical Research Ethics Committee, the study was conducted in the Department of Ophthalmology at Kaunas University of Medicine. The inclusion criteria for healthy children were as follows: 1) children of both genders, who did not have other eye disorders found on detailed ophthalmologic examination; 2) participation consent.

The exclusion criteria were as follows: 1) related eye disorders; 2) systemic illness; 3) congenital colour vision deficiencies were excluded by history.

In this research, visual acuity as well as the transparency of the cornea and lens, and the fundus were investigated in the patients. Biomicroscopy was
performed in order to assess the corneal and lenticular transparency. Non-
corrected and the best-corrected visual acuity (measured in decimals from 0.1 to
1.0) was evaluated using Landolt’s rings (C optotypes) by Snellen test types at a
5 meter distance from the chart.

The Farnsworth-Munsell 100 hue test was used for colour contrast
sensitivity [10]. The test was carried out under artificial daylight illumination;
care was taken to use the same instructions in all testing sessions. The light was
at about an angle of 90° from the patient’s side, the angle of viewing was about
60°, at about 45° to the plate surface and the monitor was free from glare. The F-
M 100 hue test requires arrangement of colour samples by hue. Four trays
containing 85 plastic colour samples were provided. Two colour samples in each
tray were repeated and used as supportive colours, between which other colour
samples had to be arranged so that a consistent transition of hue between the two
supportive colours was achieved. The colour samples were chosen in such
manner as to cover the entire range of hues. The samples differed in tone but
their hues were of approximately the same brightness and intensity. Two minutes
were given for each tray, though the speed of accomplishment of the test was not
highly accentuated, but the total time to complete the test was recorded.

A sequence number was assigned to each colour sample. The result was
evaluated as the total differences between the number of colour sample chosen by
a subject and the sequence number of the colour sample actually belonging to
that position. The degree of distinction of colours is assessed. The sensitivity of
colours may be very high, i.e. the number of mistakes is up to 20; or normal
average, i.e. the number of mistakes from 21 to 100; or disturbed, i.e. the number
of mistakes is more than 101.

Statistical analysis was performed using the computer program SPSS / W
13.0 (Social sciences statistical package program for Windows, Inc., Chicago,
Illinois, USA). The data are presented as real numbers (percent), the average
values and standard deviations (SD). T test and the Mann-Whitney U test were
used for the comparison of the two groups. A statistically significant difference
was considered if p < 0.05.

Results. A total number of 60 (120 eyes) ophthalmologically healthy
children were enrolled in further analysis. The mean of the age was 10.6 ± 3.4
(age ranged from 4 years to 17 years old). The results of TES colour contrast
sensitivity was 189 ± 81 (min – 52, max – 356, median – 182). (Fig. 1)
The TES of the Farnsworth–Munsell 100 hue test in healthy boys and girls was statistically insignificant: $191.88 \pm 77.69$ vs. $185.36 \pm 85.92$, $p = 0.8$. Colour contrast sensitivity was also analyzed in patients age group, younger than 10 years old, and 10 years and older. The results revealed that colour contrast sensitivity was better in older children`s group: $213.98 \pm 80.67$ vs. $156.46 \pm 69.53$, $p = 0.002$. (Fig. 2)
Discussion. The aim of our research was determine colour perception established by the Farnsworth–Munsell 100 hue in healthy children, and compare color contrast sensitivity in girls and boys, and in younger and older age groups. Our results of F-M 100 hue test revealed that TES was 189±81 in healthy children (min – 52, max – 356). Also we revealed that colour contrast sensitivity was better in older children’s group compared to younger children’s group: 213.98 ± 80.67 vs. 156.46 ± 69.53, p = 0.002. Our study is in agreement with the study done by Kinnear PR. and Sahraie A [1]. This scientists group also established that younger children make significantly more errors leading to higher TES than older children [1]. The results of this scientist group established that children at the age 7 years the TES was 240, at the age 8 years - 200, at the 9 the TES was 150, at the age 10 - 125, and at 11 TES - 108 [1]. The results of TES are better at the age - 19 years, and the TES are 43, and in the age 70 - 79 years results begins to decreas, and TES are 150 [1].

Women are believed to be more discriminating in the use of colour names than men and this is often taken to imply superior colour vision. Differences between men and women in red-green colour discrimination have been reported as not being significant [11]. In our study boys and girls colour contrast sensitivity was similar, the TES in boys was - 191±77, and in girls a little bit better 185±85, but significance was indifferent. So the age is one of the most important factor’s in the error scores, but it also depends on illness, and health of visual system.

Other scientis group also evaluated Farnsworth-Munsell 100-hue color vision test to 232 normal subjects between 10 and 80 years of age [12]. One half the subjects underwent binocular testing followed by monocular testing. In the other half monocular testing preceded binocular testing, and established that performance was better with both eyes than with either eye alone [12]. The worst performance occurred on monocular tests in subjects without previous experience with the task (that is, those for whom this was the first test). The well-known age trend was apparent (children and elderly have the worst color vision) [12].

Conclusions. Colour contrast sensitivity is very similar in boys and girls. Colour contrast sensitivity was better in older children’s group.

References


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**Purpose.** To determine colour perception established by the Farnsworth–Munsell 100 hue (F-M 100) in healthy children.

**Methods.** Our study comprised 60 healthy children. The computerised F-M 100 program was used for colour discrimination. Children were divided into two age groups: < 10 years and 10 older.

**Results.** The total error scores (TES) of the F-M 100 was 189 ± 81. The TES was very similar in boys and girls (191 ± 77 vs. 185 ± 85, p = 0.8). The results revealed that TES was better in older children group compared to younger children (213.98 ± 80.67 vs. 156.46 ± 69.53, p = 0.002).

**Conclusion.** The TES is very similar in boys and girls. Colour contrast sensitivity was better in older children’s group.

**Key words:** children, gender, age, colour vision.