

# **NR-1000F Auto Refractometer Application in Children Refractive Errors Evaluation**

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**Introduction.** Worldwide, more than 150 million people are estimated to be visually impaired because of uncorrected refractive error (RE), of which 8 million are functionally blind [1]. By the year 2020, it is estimated that 2.5 billion people – one third of the world's population – will be affected by myopia alone [2]. Childhood visual impairment due to RE is one of the most common problems among school-age children and is the second leading cause for treatable blindness [3]. Vision is important in child development because it allows children to interact with their environment [4]. Pediatric uncorrected RE is associated with increased morbidity and has extensive social and economic impacts, limiting educational opportunities and affecting subsequent quality of life in the adult population [5, 6]. More than 12 million children aged 5 - 15 years old worldwide are visually impaired due to uncorrected RE [7], and it is the leading cause of visual impairment worldwide [8]. The available data indicate that the incidence of RE is most frequent at 8 - 10 years of age [9]. Vision screening is a method for identifying children with visual impairment or with eye conditions that are likely to lead to visual impairment so that a referral can be made to an appropriate eye care professional for further evaluation and treatment. The simplest method for refractive errors evaluation is autorefractometry.

The aim of our research was to determine the frequency of refractive errors in individuals aged 7 to 18 years using the Nikon Auto Refractometer NR-1000F.

**Methods.** Having obtained permission from the Kaunas Regional Biomedical Research Ethics Committee, the study was conducted in the Department of Ophthalmology at Lithuanian University of Health Sciences. One thousand (2000 eyes) of 7 - 18 year-old children were investigated at the momentary research. Children were divided into three age groups: I group from age 7 to 9 years, II group from age 10 to 13 years and III group from age 14 to 18 years. We used the following subject inclusion criteria: (i) patients of both genders; (ii) age 7 to 18 years; (iii) participation consent. Subject exclusion criteria: (i) children until 7 years old age; (ii) children older 18 years old.

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. Refractometry was used for measurement of the refractive error of an eye. Auto Refractometer (AR) infrared rays are directed at the patient's fundus and the reflected light is detected by this instrument. A built-in microcomputer deduces the objective refraction in terms of sphere, cylinder, and axis, and then automatically displays this information, corrected for a 12 mm vertex distance. The AR also has the optional facility of automatic printout of the refractive data obtained, and is capable of recording a confidence value for each result to quantify numerically the reliability of the measurement. It completes each objective measurement in a total of 1-5 seconds, with the final measurement in only 0-5 seconds. The time taken for automatic fogging is 0.5 to 1 second with the patient seeing the fixation target, while the patient's accommodation is purportedly thoroughly relaxed by the inbuilt automatic fogging system. The machine can measure up to  $\pm 15D$  sphere and  $\pm 6D$  cylinder. The operator manipulates the dioptre adjusting ring till the cross reticule at the centre of the viewfinder appears sharply in focus. The patient is seated comfortably, and the eye to be refracted is aligned to the correct level with the measuring head. The green cross targets are aligned and centred by the operator with the peripheral red arrows moved out of the field of view to ensure precise positioning of the measuring head. The start button is depressed to activate the in-built automatic fogging system, and the refractive data are available within 1 - 5 seconds on the digital display panel together with their confidence value [10].

Statistical analysis was performed using the computer program SPSS / W 22.0 (Social sciences statistical package program for Windows, Inc., Chicago, Illinois, USA).  $\chi^2$  test was used for comparing frequencies of qualitative variables. Statistically significant difference was considered if  $p < 0.05$ .

**Results.** A total of 1000 children (2000 eyes) were examined; 451 (45.1%) were boys and 549 (54.9%) were girls. In the I age group was 312 (31.2%) children, 154 (49.4%) boys and 158 (50.6%) girls; II group was 354 (35.4%) children, 155 (43.8%) boys and 199 (56.2%) girls and in the III age group was 334 (33.4%) children, 142 (42.5%) boys and 192 (57.2%) girls ( $p > 0.05$ ) (Table 1.).

Prevalence of emetropia was overall 3.5% in the 7 - 18 years olds children. In the I age group was 13 (1.9%) children; II group was 29 (4.1%) children and in the III age group was 26 (3.9%) children ( $P < 0.001$ ) (Table 2).

Prevalence of myopia was overall 37.9 % in the 7 - 18 years olds children. I- st degree was 445 (16.7%), II- nd degree was 238 (44.6%) and III- rd degree was 75 (50.8%). In the I age group was 102 (16.7%) children, Ist degree was 87 (84.4%); II degree was 11 (10.7%) and III degree was 5 (4.9%). In the II age group was 316 (44.6%) children, Ist degree was 176 (55.7%); II degree was 122 (38.6%) and III degree was 18 (45.7%).

In the III age group was 339 (50.8%) children, Ist degree was 182 (53.7%); II degree was 105 (31.0%) and III degree was 52 (15.3%). The prevalence of myopia increased from 16.7% in the 7- 9 years old children to 50.8% in the 14-18 years olds ( $P < 0.001$ ). I degree of myopia was prevail in all age groups ( $P < 0.001$ ) (Table 3).

**Table 1.** Sex prevalence in age groups

Sex	Total, n (%)	7-9 years, n (%)	10-13 years, n (%)	14-18 years, n (%)	P value
	1000 (100%)	312 (31.2%)	354 (35.4%)	334 (33.4%)	$p > 0.05$
Boys	451 (45.1%)	154 (49,4%)	155 (43,8%)	142 (42,5%)	$p > 0.05$
Girls	549 (54,9%)	158 (50,6%)	199 (56,2%)	192 (57,2%)	$p > 0.05$

**Table 2.** Prevalence of emetropia

	Total, n (%)	7-9 years, n (%)	10-13 years, n (%)	14-18 years, n (%)	P value
Emetropia	70 (3.5%)	13 (1,9%)	29 (4,1%)	26 (3,9%)	$P < 0.001$

**Table 3.** Prevalence of myopia

	Total, n (%)	7-9 years, n (%)	10-13 years, n (%)*	14-18 years, n (%)*	P value
Myopia	758 (37.9%)	102 (16.7%)	316 (44.6%)	339 (50.8%)	$P < 0.001$
I degree (up to -3D)	445 (16.7%)	87 (84.4%)	176 (55.7%)	182 (53.7%)	$P < 0.001$
II degree (-3 to -6D)	238 (44.6%)	11 (10.7%)	122 (38.6%)	105 (31.0%)	$P < 0.001$
III degree (> -6 D)	75 (50.8%)	5 (4.9%)	18 (5.7%)	52 (15.3%)	$P < 0.001$

\*There is no evidence of relationship between II-nd and III-rd age group ( $p > 0.05$ ).

Hypermetropia was found in 1172 (58.6%) the 7 - 18 years olds children. I- st degree was 779 (16.7%), II- nd degree was 238 (44.6%) and III- rd degree was 155 (50.8%). In the I age group was 508 (81.2%) children, Ist degree was 299 (59.0%); II degree was 141 (27.8%) and III degree was 67 (13.2%). In the II age group was 363 (51.3%) children, Ist degree was 218 (60.0%); II degree was 91 (25.0%) and III degree was 54 (15.0%). In the III age group was 303 (45.3%) children, Ist degree was 171 (56.6%); II degree was 97 (32.2%) and III degree was 34 (11.2%). The prevalence of hypermetropia decreased from 81.2% in the 7 - 9 years olds to 45.3% in the 14-18 years olds ( $P < 0.001$ ). I degree of hypermetropia was mostly accepted in all age groups ( $P > 0.05$ ) (Table4).

**Table 4.** Prevalence of hypermetropia

	<b>Total, n (%)</b>	<b>7-9 years, n (%)</b>	<b>10-13 years, n (%)</b>	<b>14-18years, n (%)</b>	<b>P value</b>
Hypermetropia	1172 (58.6%)	508 (81.2%)	363 (51.3%)	303 (45.3%)	P<0.001
I degree (up to +2 D)	779 (16.7%)	299 (59.0%)	218 (60.0%)	171 (56.6%)	P>0.05
II degree (+2 to +5 D)	238 (44.6%)	141 (27.8%)	91 (25.0%)	97 (32.2%)	P>0.05
III degree (> +5 D)	155 (50.8%)	67 (13.2%)	54 (15.0%)	34 (11.2%)	P>0.05

**Discussion.** Refractive error is defined as the inability of the eye to bring parallel rays of light into focus on the retina, resulting in nearsightedness, farsightedness or astigmatism. Uncorrected refractive error in children is associated with increased morbidity and reduced educational opportunities. Vision screening is a method for identifying children with visual impairment or eye conditions likely to lead to visual impairment. So the aim of our research was to determine the frequency of refractive errors in individuals aged 7 to 18 years using the Nikon Auto Refractometer NR- 1000F. The overall prevalence of emetropia was 3.5%. Prevalence of myopia was overall 37.9% and increased from 16.7% in the 7 - 9 years old children to 50.8% in the 14 - 18 years old. I degree of myopia was common refractive error in all age groups. In the study done by Wu JF et al. prevalence of myopia (overall:  $36.9 \pm 0.6\%$ ;  $95\%CI:36.0,38.0$ ) increased ( $P<0.001$ ) from  $1.7 \pm 1.2\%$  ( $95\%CI:0.0,4.0$ ) in the 4-years olds to  $84.6 \pm 3.2\%$  ( $95\%CI:78.0,91.0$ ) in 17 years old. This study group established that myopia was associated with older age (OR:1.56;  $95\%CI:1.52,1.60$ ;  $P<0.001$ ), female gender (OR:1.22; $95\%CI:1.08,1.39$ ;  $P=0.002$ ) (11). Prevalence of high myopia ( $2.0 \pm 0.2\%$ ) increased from  $0.7 \pm 0.3\%$  ( $95\%CI:0.1, 1.3$ ) in 10-years olds to  $13.9 \pm 3.0$  ( $95\%CI:7.8,19.9$ ) in 17 years olds [11]. These results agree with previous population-based and school-based investigations documenting a marked increased prevalence of myopia in the younger generation [12 - 14]. It is in contrast to other countries such as Scandinavian countries, Mexico, Poland, Brasil, Australia, Laos, Iran, South Africa, Morocco, Brazil and Poland and, in which either no increased prevalence of myopia or a considerably less marked increase in the prevalence of myopia has been reported [15 - 19]. The prevalence of low to medium myopia was markedly higher in the present Shandong Children Eye Study than in the previous study on adults in the neighboring region of Greater Beijing giving another example for the increased prevalence of myopia across the generations [20].

The overall prevalence of hypermetropia was 58.6% and decreased from 81.2% in the 7 - 9 years olds to 45.3% in the 14 - 18 years old in our study. I degree of hypermetropia was mostly accepted in all age groups. In the study done Wu JF et

al. the results are very similar, and the overall prevalence of mild hyperopia and medium to marked hyperopia was 42.8% and 5.8% respectively, and as a corollary to the prevalence of myopia, it decreased with older age [11]. Again as a corollary to the prevalence of myopia, the prevalence of hyperopia overall was associated with younger age [11]. In the other study done by Sewunet SA et al. out of 432 participants selected for the study, 420 (97.2%) were in the age group 7 - 15 years. The mean age was  $12 \pm 2.1$ SD. Overall prevalence of refractive error was 43 (10.2%). Myopia was found among the most dominant 5.47%, hyperopia 1.4% in both sexes [21]. Other study found that of those with refractive error, there were 35.8% with myopia, 29.5% with hypermetropia and 34.8% with astigmatism. Males had slightly more myopia and astigmatism, and female more hypermetropia though the difference was not statistically significant [22].

**Conclusions.** The prevalence of emetropia was 3.5%. Prevalence of myopia was overall 37.9% and prevalence of hypermetropia was 58.6%. Myopia was increasing and hypermetropia was decreasing with age. I degree myopia and hypermetropia was the most common refractive errors in all age groups.

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#### **NR-1000F Auto Refractometer application in children refractive errors evaluation**

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**The aim of this research** is to determine the frequency of refractive errors in individuals aged 7 to 18 years using the Nikon Auto Refractometer NR- 1000F.

**Methods.** We examined 1000 of 7-18 year-old children. Children were divided into three age groups: I group from age 7 to 9 years, II group from age 10 to 13 years and III group from age 14 to 18 years. The Nikon Auto Refractometer NR- 1000F was used to determine the refractive errors.

**Results.** Prevalence of emetropia was overall 3.5 % in the 7-18 years olds children. Prevalence of myopia was overall 37.9 % and increased from 16.7% in the I-st age group to 50.8% in the III-rd age group. I-st degree of myopia was prevail in all age groups.

Hypermetropia was found in 58.6% and decreased from 81.2% in the I-st age group to 45.3% in the III-rd age group. I-st degree of hypermetropia was the most common refractive error in all age groups.

**Conclusion.** The prevalence of emetropia was 3.5%, of myopia was 37.9 % and of hypermetropia was 58.6%. I-st degree myopia and I-st degree hypermetropia was the most common refractive errors in all age groups.