Medical University
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"VISUAL REHABILITATION FOR LOW-VISION PEOPLE WITH SOCIALLY SIGNIFICANT EYE DISEASES"

EXECUTIVE SUMMARY

of a dissertation for obtaining

an educational and scientific degree "Doctor of Philosophy "

Scientific speciality "Ophthalmology and Visual Sciences"

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The dissertation contains 152 pages and is illustraited with 42 tables and 51 figures.The bibliography inclides 166 literature sourses, in 35 Cyrillic and 131 in Latin. The presentation is formatted in Times New Roman 12, line spacing-1.15. There are 13 chapters, corresponding to the purpose and tasks of the thesis.

The dissertation is discussed and proposed for defense by the Department Council of the Department of Health Care at Medical University "Prof. Dr. Paraskev Stoyanov"-Varna on 5rd of December 2022.

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The official defense of the dissertation will be held at an open meeting of the Scientific Jury. The materials on the defense are available in the Scientific Department of Medical University and are published on the web-site of Medical University of Varna.

N.B! The numbers of the figures and the tables in the executive summary do not correspond to the numbers in the dissertation.

NB! The team and the principal investigator declare that they have no financial interest or affiliation with any of the mentioned trademarks of the products used in the study, devices or sites cited.

CONTENTS

Abbreviations used:

LV - Low vision
LVD - Low Vision Devices
LVE - Low Vision Evaluation
RDT - Random Dot E Stereo Vision test
ROP - Retinopathy of prematurity
BCVA - Best Corrected Visual Acuity
ETDRS - Eye Charts from Precision Vision
ARMD - Age-related macular degeneration
IAPB - International Agency for the Prevention of Blindness
MLEC - medical-labour expert commission, in Bulgaria “TELK”
SSI - Severe sight impairment, blindness
SI - Sight impairment
WHO - World Health Organization
DR - Diabetic retinopathy
DD – Differential diagnosis
ZO - Visual acuity
AMD - Age-related macular degeneration
TPS - Technical aids
PDR - Proliferative diabetic retinopathy
TELK - Territorial expert medical committee
FRS - Foundation "Rehabilitation of the blind
HNV - Choroidal neovascularization
PER - Retinal pigment epithelium
SSB - Union of the Blind in Bulgaria
SOLB - Union of Ophthalmologists in Bulgaria
BDO - Bulgarian Society of Ophthalmologists
BSO - Bulgarian Union of Optometrists
VSD - Highly specialized activity
NHIF - National Health Insurance Fund
NCRS - National Center for Rehabilitation of the Blind
NABOO - Association of Bulgarian Optometrists and Opticians
MTSP-Ministry of Labor and Social Policy
USSR - Law on people with disabilities

“The only thing worse than being blind
is having sight but no vision!”
Helen Keller

Introduction

Quality of life includes all emotional, social and physical aspects of a person's life. Quality of life in the health care context is an assessment of a patient's well-being, or lack of it. Well-being is affected over time by a particular illness, disability or impairment of physical abilities (1). The severe visual impairment or blindness is a serious challenge for both the patient and the ophthalmologist. Blindness causes hard disability, and reduced vision is a serious social problem. Unlike total blindness, most people with severe visual impairment have useful residual vision. Depending on the nature and type of visual impairment, the visually impaired persons have serious difficulties in everyday life. With the help of special reading techniques and training, assistive devices and other advances in technology, they use the most of their residual vision. The vision therapist deals with the challenges posed by visual impairments in order to optimally improve the quality of life.

The visually impaired are trained in special reading techniques and in the use of different optical and technical aids. The first practical knowledge of image magnification, as is known, belongs to the ancient Greeks and Romans. There is historical evidence that Neron had hypermetropia, which he corrected with a special optical device. In 1908 Lippershey proposes a project for the first telescopic glasses. The modern telescope for the visually impaired was created by Moritz Von Ruhr. In 1924 Gredl and Stein are preparing a report on magnifiers for the visually impaired for the American Medical Association. That same year, Helen Keller's teacher, Anne Sullivan presented a report to the American Foundation for the Blind on the use of optical aids in the classroom. Sloan later offered the first self-illuminated reading magnifier.

The eye is one of the main sensory organs, that receipts a dynamic information about the world around us. Visual acuity is a measure of the ability of the visual sensory system to distinguish the smallest details of visual objects. It is accepted that visual acuity and visual field are the two criteria by which visually impaired groups are classified. (Popova, 2003) According to the best visual acuity with correction of the better-seeing eye, two main types of visual deficiency are distinguished - blindness and low vision.

II. Purpose and tasks

Purpose: To study and analyze the modern possibilities for visual rehabilitation of the visually impaired and to develop a behavior algorithm and a model for integrated care for these patients.

To achieve this goal, a set of tasks should be completed:

1. To make a literature review on the topic of blindness, low vision and the possibilities of visual rehabilitation, as well as to study innovative technologies for compensating and improving visual deficits.

2. To study the awareness of the population, as well as the opinion of medical specialists on the topic of blindness and low vision.

3. To study the adaptation of low-vision patients with socially significant eye diseases - ARMD, DR and glaucoma to their prescribed devices to support vision and satisfaction with their use.

4. To analyze the means for visual rehabilitation and the results of their use in children-students with impaired vision.

5. To develop an algorithm for the selection and prescription of the optimal visual aid by ophthalmologists - specialized for working with the visually impaired.

6. To create a model of an integrated approach for patients with impaired vision and different degrees of blindness.

III. Materials and methods

The subject of the study are visually impaired patients meeting the criteria for low vision, including patients with socially significant eye diseases and visual acuity equal to or less than 0.3. The study participants were divided into four groups: 1-st group with ARMD, 2-nd group with Glaucoma, 3-rd group with Diabetic Retinopathy and 4th heterogeneous group, called "other" for convenience. The first three groups are eye diseases of serious social importance.

Coverage of the study - 80 visually impaired patients/160 eyes were clinically treated, 23 children with impaired vision were retrospectively analyzed, data from a total of 195 (150+45 medical specialist) respondents on the problems of impaired vision and blindness were processed.

Place of the study - it was conducted in the Eye Clinic "St. Nikolay Chudotvorets" - Varna, using all the available facilities and equipment, as well as the one specially provided for the course of the research - a portable set of Zeiss telescopic glasses and the high-tech "talking glasses" OrCam My Eye. The patients who are included were mainly from the city of Varna and North-Eastern Bulgaria, with very few exceptions (two from the city of Plovdiv).

Time frame of the study - it was done for a period of 3 years 04.2019 - 04.2022, a time largely coinciding with the severe pandemic situation from Covid-19.
Ethical framework - it was launched after approval by the Research Ethics Committee at MU-Varna, KENI protocol dated 27.06.2019. Participation in the study is voluntary. All patients signed an informed consent after detailed explanation of the procedure (Appendix 9). It was carried out in accordance with the requirements of the Declaration of Helsinki on the rights of research patient. None of the patients were put at risk.

The materials and methods are separated into different groups according to the tasks.

To carry out the literature review (task 1) we referred to:
- **Historical method** - research, systematization, review and analysis of information from the literary sources - Bulgarian and foreign scientific publications, articles, books and textbooks regarding low vision, blindness and socially significant diseases, as well as means of visual assistance. The online database of the platforms Pubmed, Scopus, Oxford University Press, Mendeley, Elsevier, etc. is also used
- **Documentary method** - use and citation of relevant legal provisions and normative documents, current for Bulgaria and the world, regarding the classification of the problem, disability, social integration and medical rehabilitation.

To study the awareness of the population and the opinion of medical specialists (task 2) are used:

- **Sociological method** through a survey card using the direct survey method. It was conducted under standard conditions. Two groups of respondents were interviewed and two questionnaires were developed respectively (given in the appendix).

Questionnaire 1 is for the first group of random respondents, including 16 questions formulated with the aim of obtaining a clear and objective assessment based on the most common answers and prevailing opinion on the topic sought.

Questionnaire 2 is for a second group – medical specialists: ophthalmologists, GPs, opticians, laboratory assistants, nurses, optometrists, trainees and students, including 20 questions, some of them strictly professional, but most overlapping with the first survey.
Almost all questions are closed with two types of answers. One type is yes or no questions. The second type has more than one possible answer. Survey 2 has only one open question. The obtained results were processed with the software products of Microsoft Excel 2013. In addition to the correct formulation of the questions in a survey, it is important to pay attention to the types of questions and their design. The sequence of questions is also important in obtaining accurate data, which is the basis for qualitative analysis. Due to its nature, data obtained from

open-ended questions are not convenient to process. In survey 2 there is one such question - purposefully asked. The analysis, conclusions and recommendations from the survey are derived after a summary presentation of the results in a form illustrated with the relevant figures.
To carry out visual rehabilitation for visually impaired patients with socially significant eye diseases - ARMD, DR and glaucoma (task 3) we referred to clinical research methods - by introducing a strict work algorithm and using a special eye examination form/blank (Appendix 3).
The clinical research methods are summarized in the following sequence, which is the basis of the created algorithm of work in low vision patients:
A special form/blank was created for the eye examination of the visually impaired, containing several main groups of indicators, organized into 6 parts.

- Demographic characteristics – age, gender, place of residence are placed in the 1st passport part, as well as names and telephone.

- A detailed medical history - family history - yes or not, history of the problem such as years, progression - fast or slow, surgical interventions - which and how many eyes, intraocular applications - how many, diagnoses, TELK - yes or not, HUI-3 vision,

The eye exam is included in part 2:
2. Eye exam:Visual acuity of each eye separately

First visit

Without correction	With correction (BCVA)	With magnifier
VOD =		
VOS =		
Near reading: O. D. 20/		
Near reading: O. S. 20/		
Reading speed (words/minute)		

Notes: **HUI-3 vision –**
Previous Magnifier Experience - .....
Accompanying diseases - .....

date: **Second visit**

Without correction	With correction (BCVA)	With magnifier
VOD =		
VOS =		
Near reading: O. D. 20/		
Near reading: O. S. 20/		
Reading speed (words/minute)		

- Examination of uncorrected visual acuity for near and far. Distance vision was tested using a Huvitz CCP 3100 standard test projector in each eye separately, near vision was also tested in each eye separately using a Rosenbaum Pocket Vision Screener.

- Determination of vision with optimal optical correction (glasses) of each eye separately, after performing auto-refractokeratometry with Canon RK-F2 (as well as tonometry/pachymetry with Canon TX-20P),

- Improving vision with a magnifying device - what kind and what magnification is recommended are explored in part 3 of the form. At the beginning of the study, a set of different optical devices was determined, covering a wide range of different needs of patients with different diagnoses. A wide variety of aids were used, given in Fig. 1.:

• three types of magnifiers: 4X, 6X and 8X by Optelec with LED lighting (2 AA batteries),
Max TV and Max Detail by Eschenbah - lightweight glasses with a modern design for TV and reading, but with a small magnification (explaned in the literature review),
• the Zeiss Head on head magnifier - technical characteristics: 1.4X, 140 mm working distance, 72x75 mm field of view - D6. Head-worn loupes ensure that the patient's hands are free. They have a small magnification, but allow to be combined with other vision correction - lenses, glasses.
• OrCam My Eye-"talking glasses" presented in fig. 2 (given in the literature review).

Fig. 1. Optelec, Max TV and Head on magnifiers (photos by the author)

Fig.2. OrCam My Eye (photo by the author)

telescopic glasses – Zeiss portable diagnostic set

The Zeiss portable kit contains: two trial frames of different sizes, 4 types of telescopic magnifiers - G 1.8, G 2.2, K 4 and K 4 vario, various clip-on attachments for near binoculars, as well as a low vision test for 1 -2 meters, near test and polarized binocular English reading test in Fig.3.

Fig.3. Zeiss portable telescope eyepiece set (photo by author)

• electronic magnifier - 5 Inch Portable Digital Video Magnifier/Germany in fig.31.

The technical characteristics of the electronic magnifier are (fig. 4):

 Screen size: 5.0-inch (12.7-cm) HD full-color LCD screen (with a resolution of 800×480 pixels)
 Magnification: 4X to 32X smooth zoom
 Camera: 1.2 megapixels (for distant objects), 0.3 megapixels (for close objects)
 15 high contrast color modes
 It is suitable for viewing near and distant objects
 In "Close objects" mode, lighting is automatically turned on
 Freeze-frame function
 "Electronic Curtain" feature allowing comfortable line-by-line reading
 TV Output: AV and HDMI (resolution 1080×600)
 Sound signals when turning on and off the magnifier and when taking a snapshot
 Foldable handle for convenience when reading and viewing objects
 Protective case
 Working time with fully charged battery: 4 hours
 Battery: 2500mAh high-capacity rechargeable lithium-ion battery
 Dimensions: 150 millimeters (length) by 84 millimeters (width) by 30 millimeters (height)
 Weight: 245 grams (with battery)

Fig.4. Electronic magnifier-5 Inch Portable Digital Video Magnifier (photo by author)

- Determination of reading speed - the number of words/minute is examined binocularly without correction and after adapting a magnifying device on the first examination - for convenience called "before" and the same - number of words/minute binocularly without correction and after adapting a magnifying device on the second review after 3 months called "after". When reading, the text is unknown to the patient and the wrong words are excluded from the count - only the number of correctly read words in 1 min is included.

- Biomicroscopy of an anterior segment of the eye was performed in view of inclusion and exclusion criteria, as well as accompanying diagnoses or available surgeries.

- Ophthalmoscopy of the posterior segment of the eye was also performed in view of the inclusion and exclusion criteria, and if necessary, additional imaging and apparatus tests were also assigned: OCT and/or FAG,
- Assessment of functional vision is done in part 4 - near and far vision skills questionnaire. They are assessed subjectively by the investigator and anamnestically by the patient or his personal assistant or companion. They are based on the many checklists that are mainly used by typhlopedagogues in visual assessment.

4. Assessment of functional vision - test of both eyes together		
NEAR VISION SKILLS		
-a/ good eye-hand coordination	yes	no
-b/ full use of two hands/10 fingers	yes	no
-c/ holds the optical device correctly	yes	no
d/ keeps the focal length constant	yes	no
DISTANCE VISION ACTIVITIES		
-a/ reading from the blackboard (for students)	yes	no
-b/ seeing the bus number (for adults)	yes	no
-c/ going down/upstairs	yes	no
-d/ reading street names	yes	no

- Evaluation of motivation, adaptation, satisfaction with the rehabilitation and rejection of it is carried out in part 5. These indicators are analyzed at the second visit after 3 months of use of the recommended and purchased optical device. They aim to justify the acceptance or refusal of visual rehabilitation, the difficulties in its implementation and refer to the personal judgment of the patient.

5. Adaptation to the device - second visit:		
a/ is motivated to study	yes	no
b/ good adaptation - developed skills	yes	no
c/ needs additional training	yes	no
d/ rarely uses the optical device	yes	no
e/ completely rejects the aid	yes	no

- Part 6 is included at the end - by whom the visual rehabilitation is carried out, with the idea of checking whether there is inter-disciplinarity on the researched issue or whether the research is conducted only by the main researcher. It is possible to choose between an ophthalmologist, an optician, an optometrist, a vision therapist or a social worker, or a combination of them.

Inclusion and exclusion criteria
Referring to the data in the literature on low vision rehabilitation we determined:

Inclusion criteria:

1. Patients with MDSV, glaucoma and DR and a group of "other diseases" - including heterogeneous diagnoses, which we use for comparison.

2. Visual acuity of patients: PPLC up to 0.3 according to the classification and definition of low vision.

3. Children-students from the School for the visually impaired in the city of Varna, regardless of the diagnosis and visual acuity (vision is generally low - because it is a criterion for admission to the specialized school).

Exclusion criteria:

1. Active ARMD-wet form, CNV proven by imaging studies.
2. Proliferative DR, proven by imaging studies.
3. Patients with higher than the specified visual acuity.
4. Patients with lower than the specified visual acuity - complete binocular blindness.

The follow-up includes, in addition to the initial examination, a follow-up examination after 3 months, which follows the same algorithm and compares and analyses the data obtained.
To analyze the results of the use of special optical devices in visually impaired children-students (**task 4**), a checklist was used and analyzed. It contains an eye screening card at the first examination and a checklist for functional vision at the second examination. It is a simplified version of the eye examination form for low vision adult patients (Appendix 6). The assessment of functional vision for the studied period refers to the experience of typhlo-pedagogues= vision therapist. In it, near vision skills are assessed by analyzing eye-hand and eye-foot coordination, face recognition, whether he holds the optical device correctly and how he maintains a constant focal length. Distant vision skills are assessed by analyzing the results of whether they can read the blackboard, see the bus number, go up and down stairs and read street names.

When developing an algorithm for selecting a visual aid and creating a model of an integrated approach for low-vision patients (tasks 5 and 6), we referred to literary sources - educational material, reported studies, lectures given at international scientific forums, as well as dissertations of Bulgarian authors and translated literature. Attended practical courses and webinars on the subject.
In the analysis of all results, **statistical methods** were used for data processing with the IBM SPSS (Statistical Package for Social Sciences) software product, descriptive indicators for quantitative and qualitative variables were used, and the results were presented in tabular and graphical form.

The main statistical methods used are:

1. **Empirical analysis** of research units - count, arithmetic mean, mode, mean standard deviation, coefficient of asymmetry, coefficient of excess.

2. **Descriptive analysis** – quantitative variables with a normal distribution are examined and presented using mean value and standard deviation (mean±SD). Variables with a different from normal distribution are given with median and qualitative variables with relative proportions (%).

3. **Hypothesis testing** – t test is used:

- the null hypothesis H0 is defined, which states that there is no statistically significant difference, and the alternative hypothesis H1 states that there is a statistically significant difference

- perceived level of significance α=0.05 (5% risk of error) with guarantee probability p=95%

-compare the assumed level of significance α=0.05 (5% risk of error) at a guarantee probability p=95% and the estimated cut-off level of significance Sig

4. **Correlation analysis** is used to study dependencies. The purpose is to identify the degree of association between two parameters. If the correlation coefficient is a positive number, then the correlation is positive.

5. Analysis of the statistical significance of the relationships between the individual components - a non-parametric coefficient of contingency is calculated given the fact that the two variables (factor and outcome) between which a relationship is sought are categorical, located on a nominal scale. A correlation coefficient with values between 0 and 0.3 is defined as weak; between 0.3 and 0.5 – moderate; between 0.5 and 0.7 – significant. Statistical significance defines a result as significant at values less than (<) or equal to (=) 0.05.

Graphical methods represented by tables, figures and graphs were used in order to better illustrate and make accessible the statistical data obtained from the processed results.

IV. Results

The results are analyzed in the chronological order in which the tasks were placed.

Task 1 is fulfilled at the very beginning of the thesis with a detailed literature review on the subject, referring to the world and Bulgarian clinical and theoretical experience.

Task 2 It assumes the working hypothesis that the awareness and knowledge of the target groups of the study on the research issue - the visually impaired and their visual rehabilitation, is low.

Structure of the participants in the survey - the survey was mainly carried out in the eye clinic "St. N. Chudotvorets" - Varna. The majority of respondents were casual patients of the medical center or their relatives and companions, forming the first group of respondents. The other part of the respondents are fewer and are medical personnel and form the second group of respondents. A small number of fellow doctors completed the survey by e-mail.

Results Task 2 - Survey 1

The first group of respondents includes 150 respondents. Questionnaire 1 was conducted with them, which contains 16 closed questions and is given in Appendix 1.

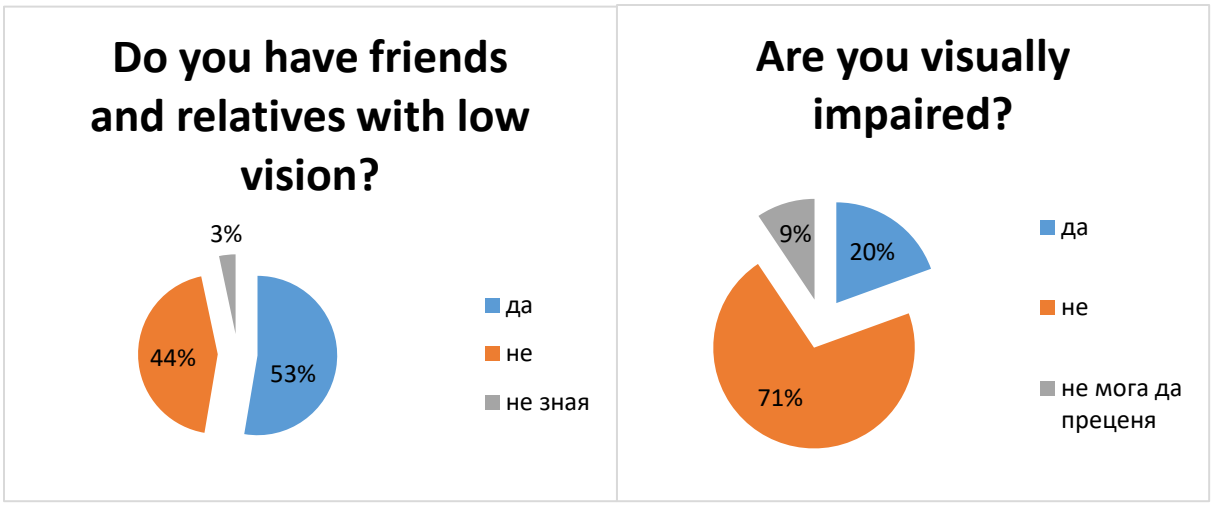


Fig. 5 – Answer to question 1 and 2

The first question is an introduction and shows 53% awareness of the issue about low vision. If the patients themselves have to decide whether they are - only 20% confirm this (fig. 5).

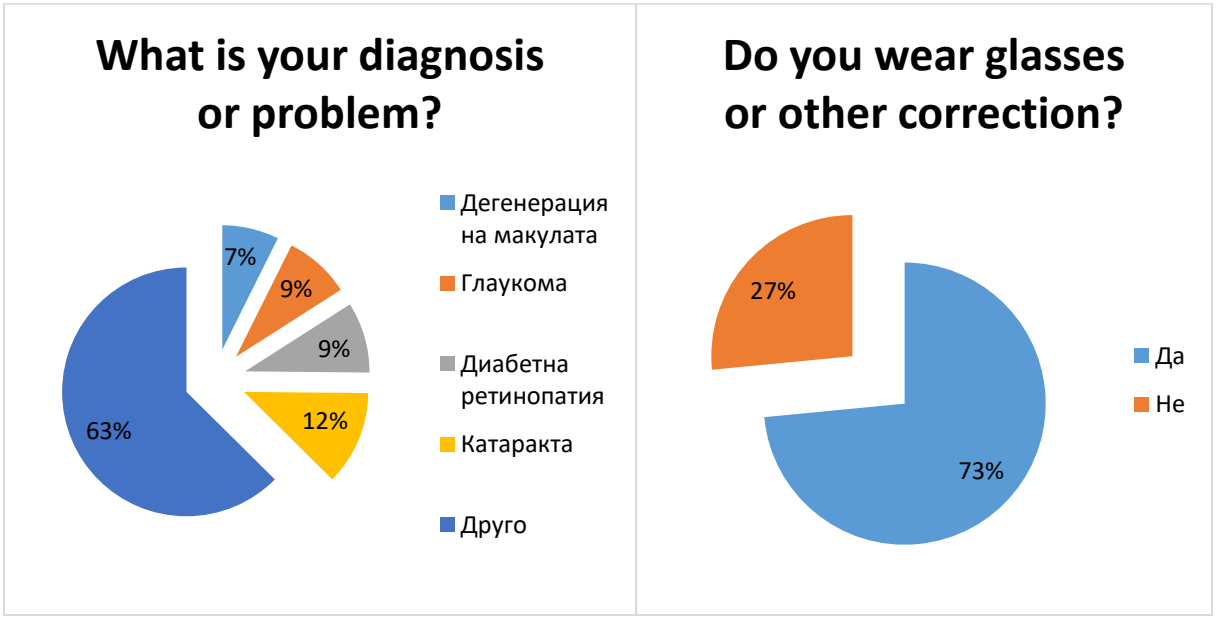


Fig. 6 – Answer to question 3 and 4

Regarding the question of diagnosis/problem they have 37% have the specifically listed socially significant diseases, which are also the most common causes of low vision. Under "other" in question 3, a large percentage of 63% of respondents meant refractive deviations - diagnoses such as astigmatism, myopia and presbyopia, mainly corrected with glasses (Fig. 6).
In the next question, 73% of respondents confirm that they wear optical correction. This percentage is very close to the answer "other" - 63% of the previous 3rd question, which we consider a control question.

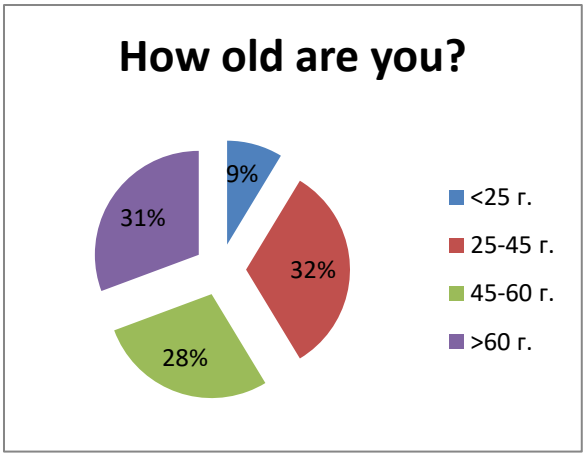


Fig. 7 – Answer to question 5

Question 5 about the age is basic (Fig. 7). The smallest percentage are the respondents under 25, but the active part of the population between 25 and 60 are 60%.
On the 6th question about education, 49% answered " secondary education" and "higher education" - 44%. This suggests a total of 93% intelligent people with knowledge of many topics, including low vision.

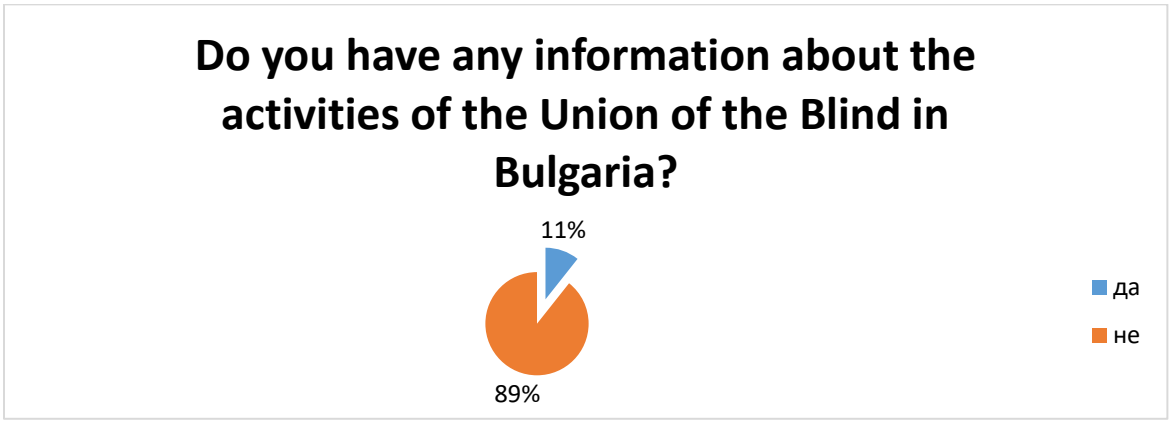


Fig. 8 - Answer to question 7

To the question about the Union of the Blind in Bulgaria, the majority of respondents answered negatively (89%) (Fig. 8). This question is fundamental and proves lack of information about the subject, regardless of age and education. The answer to the next question is the same - are they familiar with the activities of the School for the visually impaired in Varna - 89% do not know about its existence and activities.

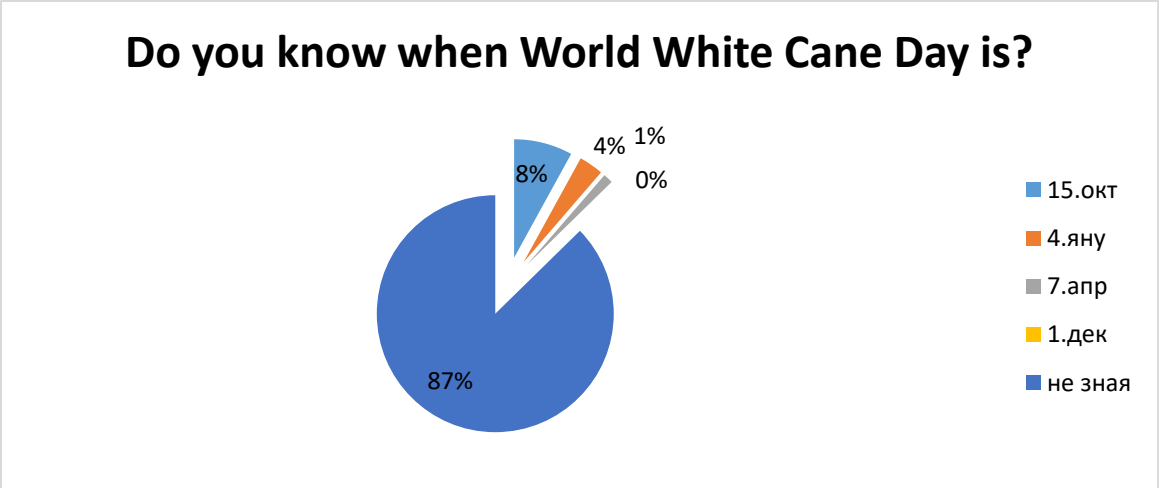


Fig. 9. - Answer to question 9

Respondents, who do not know when is the day of white walking stick for blind are 87%. It is very close to the answers of the respondents who have no information about the activities of the Union of the Blind (89%) as well as those who do not know about the activities of the School for the visually impaired - 89%. This shows a persistent trend of lack of information on the subject (Fig. 9). The correct answer to question 9 is listed among others known dates - world health day-7.04 and 1.12-day to AIDS, and unknown - 1.12- international day of the disabled and 4.01- Braille' day.

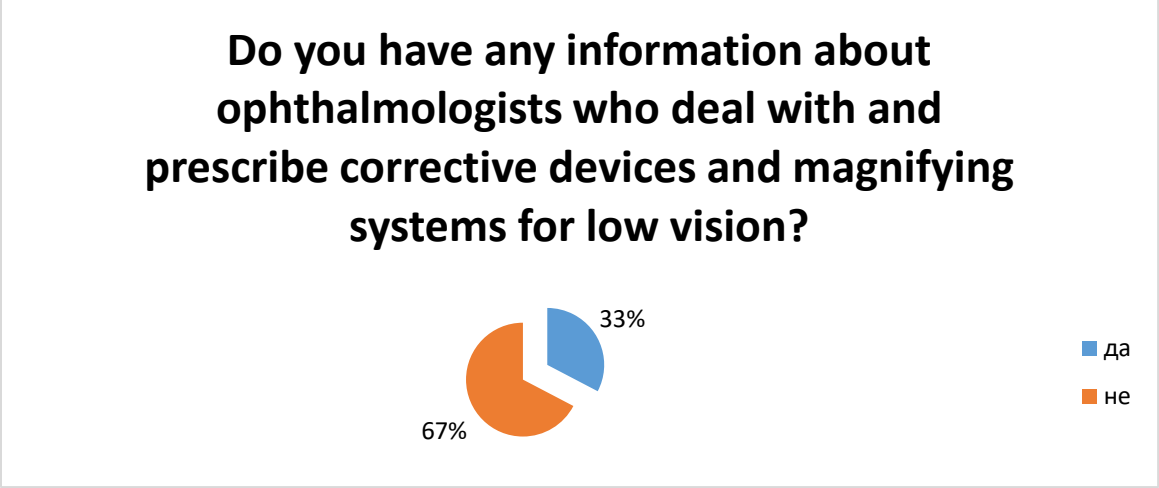


Fig. 10. – Answer to question 10

The answer to question 10 is negative - 67% do not know about eye specialists who prescribe optical devices and magnifying systems (fig.10). We expected worse result more than 80%. The probable explanation is that a large part of the participants in the survey are our patients. They and their relatives are familiar with the fact that in the eye clinic "St. N. Chudtoverets" we purposefully consult the visually impaired.

Question 11 has definitive answer - 95% of the respondents do not know what kind of social benefits for optical correction the visually impaired can bye.

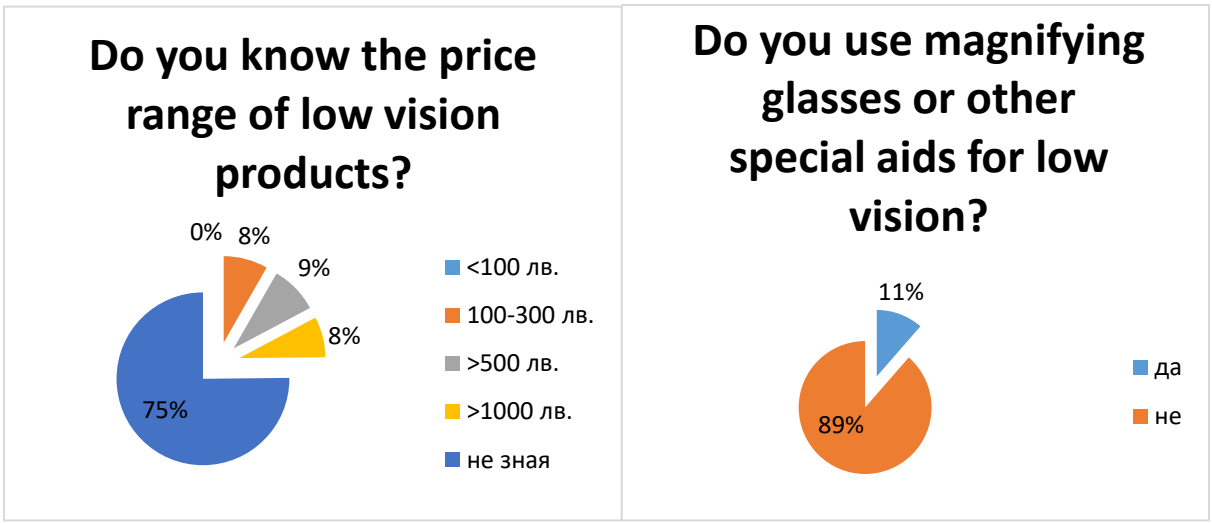


Fig. 11 – Answer to question 12 and 13

Patients do not know the price range of low vision products in 75%, but despite this there isn't a price below BGN 100 lv. This shows that they assume a high price for optical devices. The answer to the 13th question is again negative in 89%, like previous questions (95% do not know about social benefits and 67% do not know which specialist can consult them) (fig. 11).
There is heterogeneity in the answers to the 14th question about the financial possibility of the respondents. Only 20% of the respondents give answer yes. The overall negative answer - "no, I don't know and maybe" is 79%.

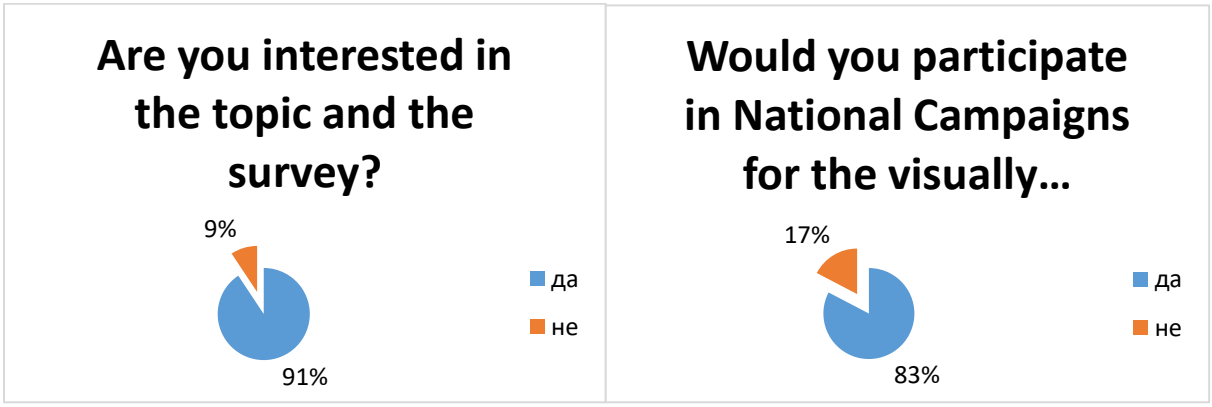


Fig. 12 – Answer to question 15 and 16

Definitely last two questions are positive, they would take place in National program for low vision and blind people. The positivism of the respondents is encouraging (Fig. 12).

Results Task 2 - Survey 2

Survey 2 was conducted among 45 respondents, whose opinion and attitude on the subject were investigated. The participants are medical specialists with different professional specializations. The survey has a variety of question types, including an open-ended one. Application 2

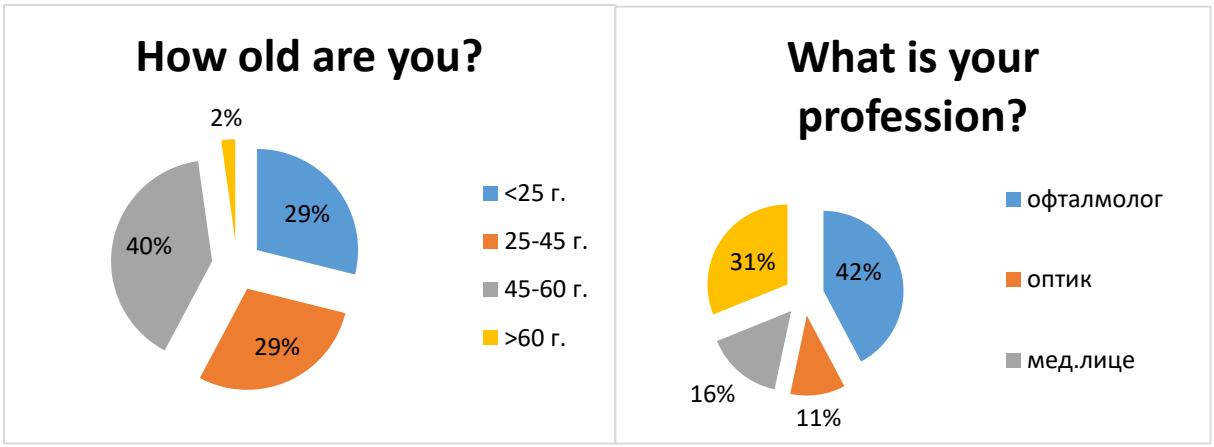


Fig. 13 – Answer to question 1 and 2, survey 2

Participants of 45-60 years old are 40%. Respondents under 25 age are students and specialists in optics, optometry and ophthalmology. The ophthalmologists are 19 specialists, followed by students - 14, medical workers of different classes - 7 and opticians - 5 (Fig. 13).
Question 3 is difficult because it contains major information, that only ophthalmologists can answer. One of the subpoints is slightly misleading and can be considered a control, because patients with visual acuity above 0.3 (in this case > 0.5) are not low-vison.
All ophthalmologists who answered the 4th question have blind patients with one or two eyes. But how many of them have TELK document - in 31% the answer is "I don't know". We consider this information important, and we refer this question to the main ones.
Question 7 has a definitive answer, 89% of respondents have no experience in prescribing special optical products.

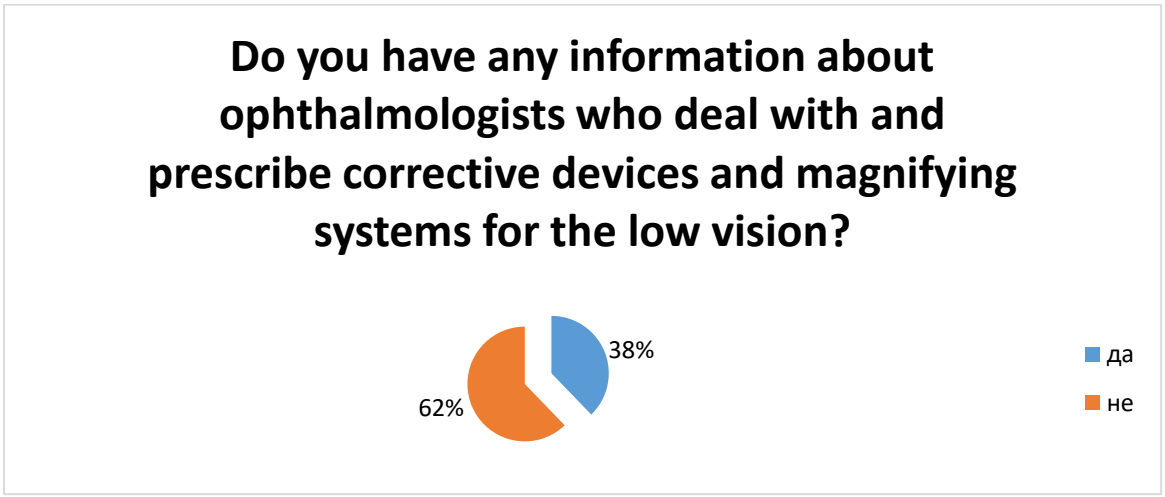


Fig. 14 – Answer to question 8, survey 2

Only 38% of the participants in the second survey have information to whom they can direct their patients with low vision (Fig. 14).

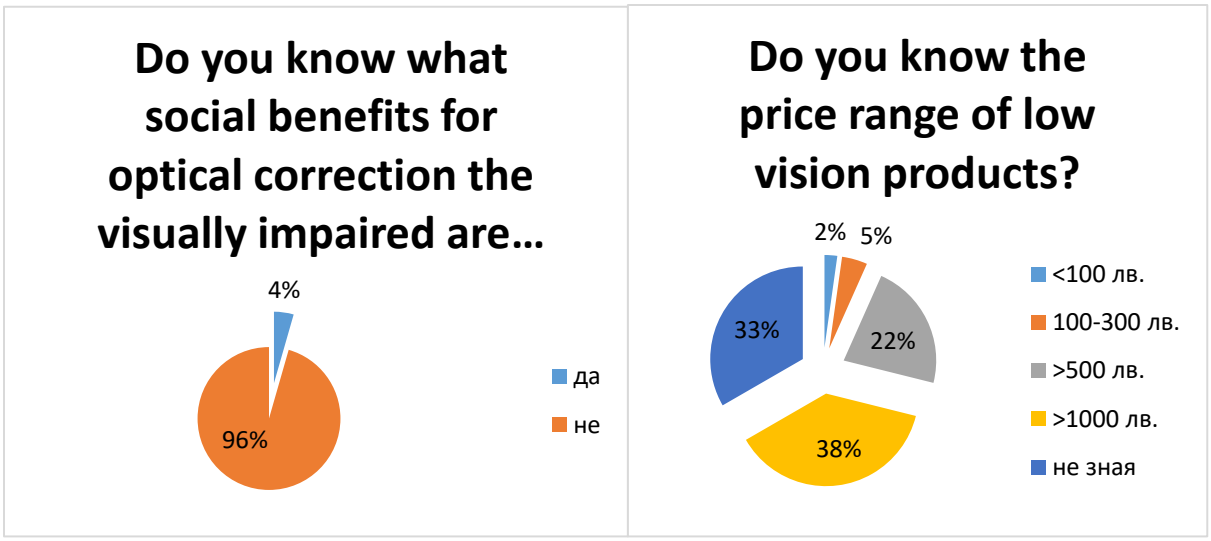


Fig. 15 – Answer to question 9 and 10, survey 2

Question 9 is highly specific. The answer is similar to the first survey - all participants/respondents have no information on the topic. Question 10 is also main and the results are given in fig.15. Only 22% gave a relatively exact price of the special optical devices. As well as in the survey 1, only 20% of the respondents gave a positive answer of the question 11. Following the answer to question 10 that the majority of respondents do not know the price range, it is logical that 61% would guess "may be". In the first survey, this percentage was 79%. Question 12 - "Do you know when World Day of white walking sticks is?", 20% of participants responded positively, compared to 9% positive responses to the same question in the first survey. Medical professionals are expected to have more knowledge on the problem, which is confirmed.

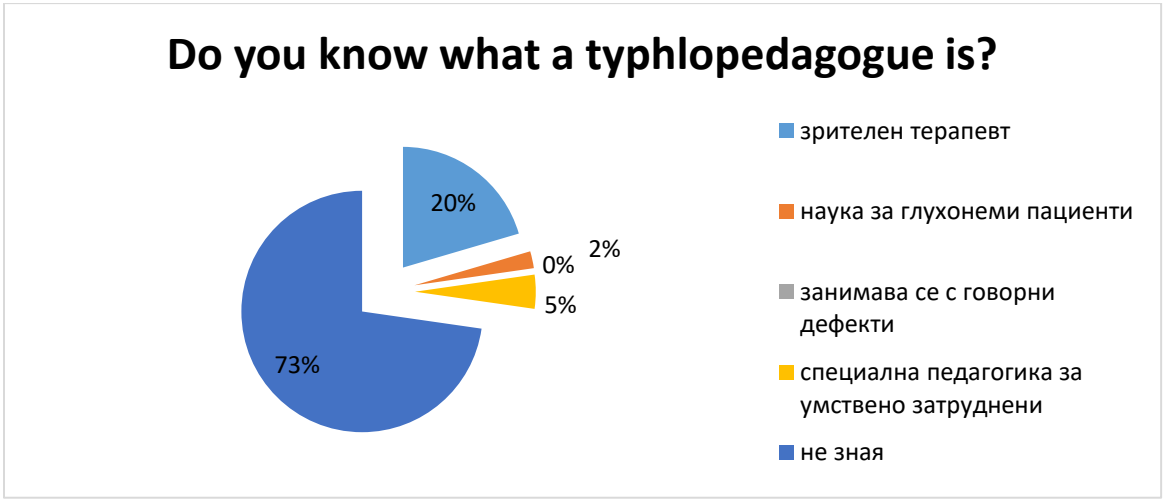


Fig. 16 – Answer to question 13, survey 2

Question 13 on fig.16 is strictly specific and has a control function. Answer "I don't know" is 73%. The result is very close to the 71% "don't know" of the previous question 12.
The following questions again expect similar results. Respondents who are not familiar with the main institutions, such as the Union of the Blind, for example, are 87%.

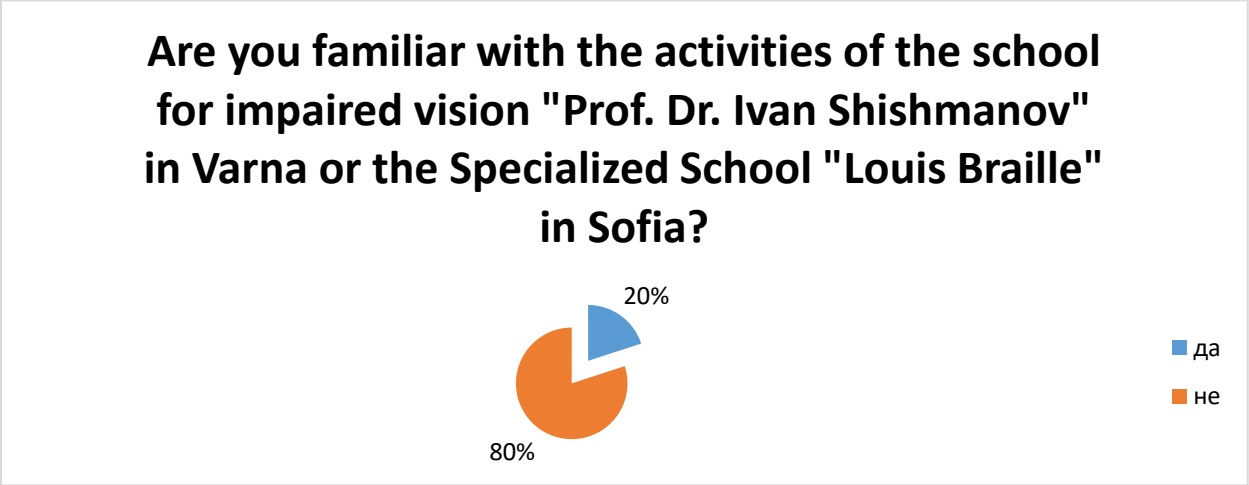


Fig. 17 – Answer to question 15, survey 2

Question 15 - whether they are familiar with the activities of the specialized School for the visually impaired only 20% give a positive answer, compared to the answer to question 14 - whether they know about the activities of the Union of the Blind - only 13%. The explanation, perhaps, is that the School for impaired vision "Prof. Dr. Ivan Shishmanov" is located in Varna and a large number of doctors have information about children from it (fig. 17).

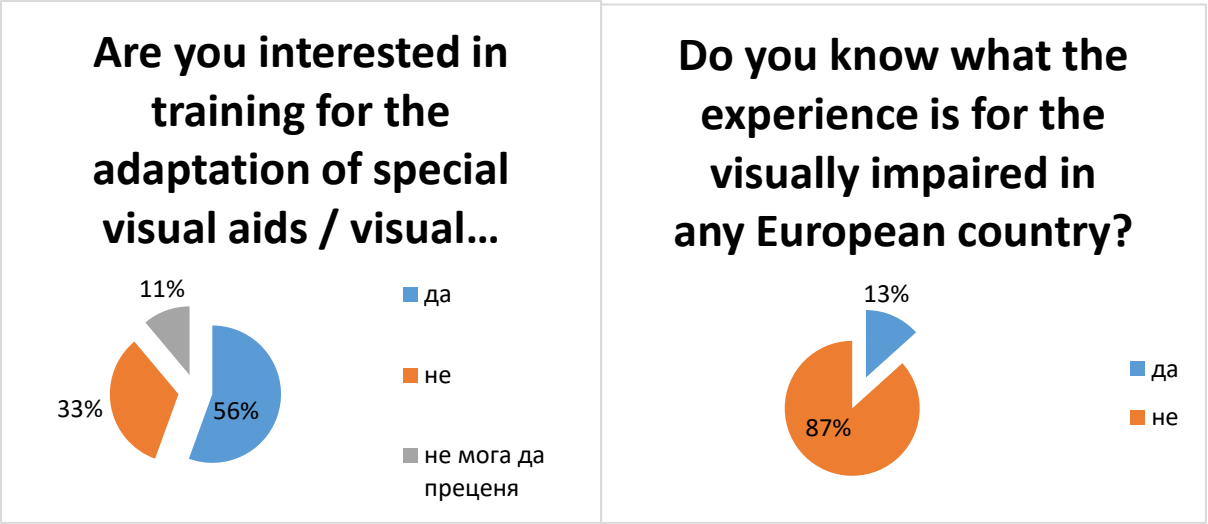


Fig. 18 – Answer to question 16 and 17, survey 2

The answer to the 16th question is unexpected. If we calculate the percentages of ophthalmologists - 42%, opticians - 11% and students - 31%, they are a total of 84%. It was assumed that all of them would like a training in low vision rehabilitation, but in fact only 56% showed interest (fig.18). A lot of participants - 87% do not have information about the experience in Europe on this problem. This response approaches 81% answer in the next 18th question. This is a control question that confirms the negative answers to questions 14 and 15. Question 18 - "What ideas and suggestions do you have about visual rehabilitation?" is open ended, which unfortunately is largely incomplete. Only four respondents - 9.0% give an idea on this topic.

Positive answer to question 19 was given by the respondents in both surveys, respectively 91% and 96%. On the last question - whether they would participate in National Campaigns, a total of 87% of the respondents have an interest and would participate in activities on this socially significant problem - blindness.
The survey gives an exact picture of the lack of knowledge on the visually impaired and visual rehabilitation. The results strongly confirm the working hypothesis.

Results Task 3

3.1. Demographic characteristics - the present study was carried out in the eye clinic "St. N. Chudotvorets" - Varna for the period: 05.2019 -05.2022 (Appendix 3). There were examined 80 patients/160 eyes, 25 (31.25%) were men and 55 (68.75%) were women. The average age of the examined is 72 years old, the youngest patient is 19 years old and the oldest 93 years old. The most common manifestation of age (mode) – the most common age is 70 years. According to the age there are 3 groups: up to 30 years, from 30-60 years and over 60 years which predominate. We have a right distribution curve on histogram by age. For the purpose of the study, we divide all 80 patients into 4 groups, which will be analyzed and compared according to the leading diagnosis. First group with macular degeneration (ARMD), second with glaucoma, third group with diabetic retinopathy (DR) and the fourth group includes heterogeneous diagnoses and is called "other". Retinal degenerative diseases - 5 and atrophy of the nerve in 3 low vision patients are most common diagnoses (Table 1).

Table 1.Diagnoses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ARMD	49	61,3	61,3	61,3
	Glaucoma	9	11,3	11,3	72,5
	DR	6	7,5	7,5	80,0
	Друго	16	20,0	20,0	100,0
	Total	**80**	**100,0**	**100,0**	

Table 2 shows all the heterogeneous diagnoses forming the last group, which is represented by 10 female and 6 male.

Table 2. Distribution by diagnoses in group "other"		
Diagnosis	male	female
1. Amblyopia+esotropia		1
2. Panuveitis	1	
3. Retinitis pigmentosa and Stargardt's b-st	1	4
4. Retinal detachment	2	
5. Retinopathy of prematurity (ROP)	1	
6. Atrophy of the optic nerve (due to Tu and MS)	1	2
7. Keratopathy		2
8. Corneal dystrophy		1
TOTAL	**6**	**10**

In all four observed groups, the relative part of female is greater. In the case of glaucoma patients, all female were followed. Table 3 shows distribution in absolute number and in percentages by gender and by diagnosis. For example, 32 women with MDS were 58.2% of all women in the study and 65.3% of all diagnosed with ARMD, as well as 40% of all participants. In the same way, from the table, male and female can be traced in all groups of diagnoses.

Table 3. Distribution by gender and leading diagnosis

GENDER		diagnosis				
		ARMD	Glaucoma	DR	Other	total
Female	**Total count**	**32**	**9**	**4**	**10**	**55**
	% Gender	58,2%	16,4%	7,3%	18,2%	100,0%
	% Leading diagnosis	65,3%	100,0%	66,7%	62,5%	68,8%
	% of total	40,0%	11,3%	5,0%	12,5%	68,8%
Male	**Total count**	**17**	**0**	**2**	**6**	**25**
	% Gender	68,0%	,0%	8,0%	24,0%	100,0%
	% Leading diagnosis	34,7%	,0%	33,3%	37,5%	31,3%
	% of total	21,3%	,0%	2,5%	7,5%	31,3%
total		**49**	**9**	**6**	**16**	**80**

3.2. Medical history data - results

In order to study in details the visual rehabilitation of the visually impaired, it's necessary to know also MLEC ("TELK"), HUI-3 or surgical procedures. The main indicator showing the invalidation of patients in Bulgaria is the TELK decision. Study patients validated the answers to this question with the relevant available document. The overall ratio is 63.75% having MLEC ("TELK") to 36.25% who are uncertified. Table 4 shows distribution in absolute number and percentage by TELK and by diagnosis. For example, 28 patients with ARMD were 54.9% of

all with MLEC (“TELK”) and 57.1% of all with ARMD, as well as 35% of all participants. The distribution by diagnoses of the visually impaired with MLEC (“TELK”) shows that patients with macular degeneration have the highest relative share of disability, 35.0%. While 77.8% of the group of glaucoma patients have MLEC (“TELK”), the result is similar in the "other" group - 75%. These data also correlate with the HUI-3 and vision results discussed below.

Table.4. Distribution: diagnoses and MLEC, in percentage and absolute number

MLEC (“TELK”)			**Leading diagnosis**				
			ARMD	Glaucoma	DR	Other	total
Disability	**Yes**	**count**	**28**	**7**	**4**	**12**	**51**
		% Disability	54,9%	13,7%	7,8%	23,5%	100,0%
		% Leading diagnosis	57,1%	77,8%	66,7%	75,0%	63,8%
		% TELK of total	35,0%	8,8%	5,0%	15,0%	63,8%
	No	**count**	**21**	**2**	**2**	**4**	**29**
		% Disability	72,4%	6,9%	6,9%	13,8%	100,0%
		% Leading diagnosis	42,9%	22,2%	33,3%	25,0%	36,3%
		% TELK of total	26,3%	2,5%	2,5%	5,0%	36,3%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

The HUI questionnaires are designed to classify the health status of patients (Appendix 4). Different HUI-2 and HUI-3 questionnaire were developed. The HUI-3 consists of 8 indicators – vision, hearing, speech, movement, dexterity/skills, emotion, cognition and pain – each with 5 or 6 degrees of severity. The vision section assesses the quality of vision, with grades from 1 to 6 indicating progressive deterioration. For instance: degree 4 - Able to recognize a friend on the other side of the street with or without glasses but unable to read ordinary newsprint, even with glasses, 5 - Unable to read ordinary newsprint and unable to recognize a friend on the other side of the street, even with glasses, 6 - Unable to see at all. The investigated HUI-3 index in our study is mainly distributed between severity grades 5 and 6, with only one patient from the "other" group being grade 3. The most common index is 5, and the data are listed in Table 5.

Table 5. HUI-3 grades, N and % ratio

HUI-3		count	%
degrees	1	0	0
	2	0	0
	3	1	1.3
	4	18	22,5
	5	35	43,8
	6	26	32,5
	total	**80**	**100,0**

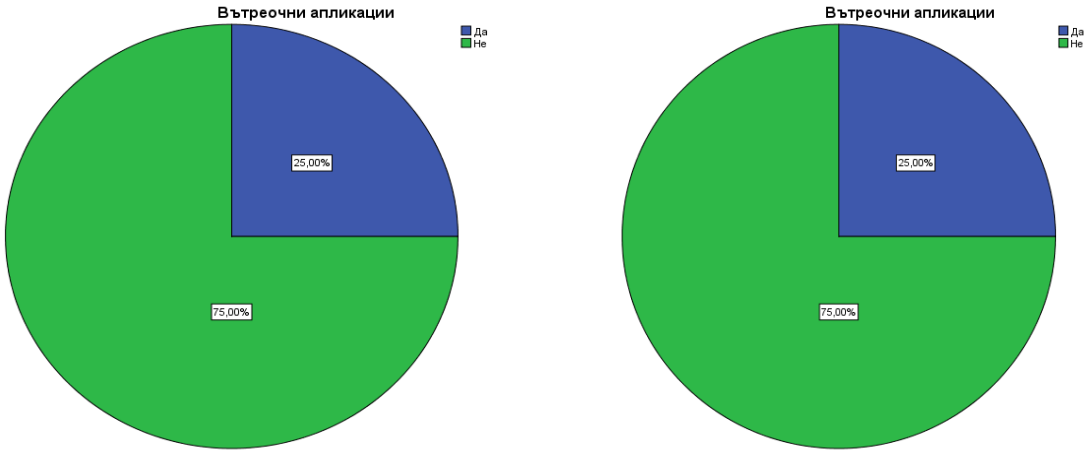


Fig. 19. Surgical interventions and intraocular applications

Based on the medical history in addition to surgical procedures, we additionally searched for intraocular anti-VEGF applications that patients had received prior to inclusion in the study. A total of 20 patients, 19 of whom were diagnosed with ARMD and only one with DR or 25% of all 80 patients had anti-VEGF therapy (Fig. 19). Statistical significance analysis was performed on this indicator. The calculated odds ratio of 0.380 indicates a moderate direct association between intraocular applications and the leading diagnosis of ARMD. The coefficient can be accepted as statistically reliable (Sig=0.004<α=0.05).

3.3. Clinical characteristics - distance vision, near vision, reading speed and type of magnifier/magnification - results

3.3.1. Vision

The main indicator in ophthalmology is, of course, visual acuity. The distant and near vision of each eye was examined in detail and without correction, corrected mainly with glasses and with a magnifying device. Table 6 shows that only 1.8% have vision 0.3 = 3 eyes.

Table 6. Uncorrected visual acuity for distance at 1-st exam

Group	Visual acuity	Total eyes: 160	%
1.	Ø - PPLC	26	16.25%
2.	0.01-0.05	89	55.62%
3.	> 0.05 ≤ 0.1	30	18.75%
4.	> 0.1 ≤ 0.2	12	7.5%
5.	> 0.2 ≤ 0.3	3	1.8%

Vision absolute 0 is present in 6 eyes-3.75%, with the other eye having better vision, but meeting the inclusion criteria. The detailed analysis showed that 55.62% of distance visual acuity was in the 0.01-0.05 range. It is too low, which predetermines the reluctance of optical correction for distance.

A series of tables (Appendix 7 and 8) presents the results showing the distribution of visual acuity by diagnosis and age range. Appendix 7 gives the distance vision data by diagnoses - 4 "before" tables and 4 more "after" tables at 3 months. Appendix 8 shows near visual acuity in a synthesized table for the four groups of diagnoses "before" and "after", as well as without correction and with correction. From the compared data in the left and right half of the tables, it is evident that the lowest visual acuity - from PPLC to 0.05 - was basically unchanged in all 4 studied groups. With the applied correction, we have an improvement in vision with an increase in the relative share of vision by 0.3 in all four diagnosis groups. The distribution by diagnosis and age shows that patients in the age range up to 30 years. there is only in the "other" group. They are 6 eyes, which is 3.75% of all 160. In the range 31-60 years. we also have very few patients and again in the "other" group - 19 eyes and only 2 eyes in the ARMD group. All other patients are concentrated in the age group over 61, which is also confirmed by the demographic analysis - elderly patients dominate. Out of all 80 patients examined, only one was prescribed and bought a magnifying device for distance - telescopic glasses. All others were **NOT** interested in a zoom correction for far. That is why such a column in the table is not present, unlike the analysis of near vision tables.

Near visual acuity is presented (for clarity due to the large amount of data) in four tables by groups of diagnoses, respectively without correction, with best correction and with a magnifying device at the first examination ("before") and at 3 months ("after'). The appendix contains all 8 tables - 4 for the first examination and 4 for the second for each diagnosis, giving information about near vision. The pooled analysis showed that in all four groups there was an expected rightward shift (increasing direction of vision) on the post-correction and post-augmentation visual acuity tables. For instance the vision improvement is above 20/50. For example, baseline vision of 20/800 usually does not change after correction and magnification, but vision between 20/400 and 20/70 after magnification improves to 20/50 even to 20/25. There were only four eyes in all 4 groups that achieved 20/20 visual acuity after using a magnifying device. In all four diagnosis groups, this improvement in vision was significant.

3.3.2. Reading speed

Reading speed was examined in all patients at the first examination ("before") and at the second examination after 3 months ("after"). The summarized data as well as a detailed analysis of the reading speed was made according to diagnoses, gender and age, compared with MLEC (“TELK”), HUI-3 (Table 7).

Table 7. Comparative indicators – age, gender, MLEC, HUI-3 and reading speed

Diagnosis N / % of total 80	gender	N	Average age years	MLEC		HUI-3				Average reading speed "before" without magnify.	Average reading speed "before" with magnify..	Average reading speed "after" without magnify..	Average reading speed "before" with magnify.
				Yes	No	3	4	5	6				
ARMD	**male**	**17**	**79,88**	**12**	**5**	**0**	**3**	**8**	**6**	**9,29**	**25,71**	**9,71**	**26,76**
49 / 61,3%	female	32	77,91	16	16	0	7	18	7	12,72	36,06	12,19	38,56
Glaucoma	**male**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
9 / 11,3%	female	9	79,67	7	2	0	2	3	4	8,11	28,56	7,33	27,56
DR	**male**	**2**	**69,00**	**1**	**1**	**0**	**1**	**1**	**0**	**15,50**	**40,00**	**17,00**	**44,50**
6 / 7,5%	female	4	71,00	3	1	0	2	1	1	12	45,75	14,50	49,50
"other"	**male**	**6**	**50,17**	**5**	**1**	**0**	**0**	**0**	**6**	**1**	**3,66**	**1**	**3,83**
16 / 20%	female	10	46,90	7	3	1	3	4	2	19,90	56,70	19,30	56,60

Results of the statistical parameters of the first review:

N Valid – number of study units – 80 patients

Mean - the arithmetic mean - the average reading speed of the 80 patients without augmentation "before" was 11.53, approx. 12 words/min

Mode-mode-most common manifestation of the units in a given feature-most common reading speed without increase before is 10.5, approx. 11 words/min

Std. deviation-root mean squared standard deviation-measures differences between units on a given trait-patients differ on a trait reading speed with no "before" increase on average during 7.91 words/min, approximately 8 words/min

Skewness-coefficient of asymmetry-relevant when distributing the units 0.519 as a value speaks of moderate asymmetry with a left drawn distribution curve /shown in the histogram above/

Kurtosis - coefficient of excess - is related to the peak draw of the distribution curve -0.523 speaks of moderate clustering of researched patients.

Table.8.Reading speed by diagnosis, without and with magnification,"before" and "after"

diagnosis	Reading speed	"Before" reading speed without magnification	"Before" reading speed with magnification	"After" reading speed without magnification	"After" reading speed with magnification
ARMD	Average speed	**11,53**	**32,46**	**11,33**	**34,47**
	Max. speed	27,00	68,00	26	70
Glaucoma	Average speed	**8,11**	**28,55**	**7,33**	**27,56**
	Max. speed	16,00	72,00	15	75
DR	Average speed	**13,16**	**43,83**	**15,33**	**47,83**
	Max. speed	21,00	62,00	24	60
"Other"	Average speed	**12,81**	**36,81**	**12,44**	**36,81**
	Max. speed	30,00	89,00	30	91

Conclusion:

Sig=0.000< α=0.05 shows that there is a statistically significant difference in the reading speed "before" without and with an increase in the 80 patients (Table 8).

At the second examination after 3 months. the main indicator that can be tracked, apart from visual acuity, where there is no particular dynamic, is again the reading speed. The obtained data from Table 15 show that there is again a statistically significant difference in the reading speed "without" and "with increase" in the second examination as well.

Table 9. Reading speed at 1-st review and at 3-rd month

"Before"	Average Speed	"After"	Average Speed
"Before" reading speed without magnification	11,5250	"After" reading speed without magnification	11.40
"Before" reading speed with magnification	33,7500	"After" reading speed with magnification	35.16

It was interesting to compare the reading speed "without magnification" on the first and second examination, as well as the reading speed "with magnification" again on the first and second exam. A result of Sig=0.594>α=0.05 indicates that there is no statistically significant difference in reading speed without increase "before" and "after" in the observed patients. The result Sig=0.057>α=0.05 again shows that there is no statistically significant difference in the reading speed with an increase at the 1-st examination and at the 3-rd month in the studied patients. The data are given in Table 9.

3.3.3. Magnifying device / magnification

The results for the recommended magnifier are given in Table 10.

Table 10. Types of optical devices–relative number and percentage representation

Type of magnifying device	count	%
Magnifying glass	47	58,8
Electronic magnifier	24	30,0
Max detail	3	3,8
“head on”	2	2,5
Telescopic glasses	1	1,3
"talking glasses" OrCam	3	3,8
Total	**80**	**100**

The Cross-tabulation showed the relationships between the different types of magnification and the groups of diagnoses. For example, 35 magnifying glass were recommended to patients with ARMD, which is 74.5% of all magnifying glass recommended and 71.4% of devices to all with ARMD. The data are given in table 11 and the relative share for each type of devices can be determined for which socially significant diseases are recommended. It is noteworthy that magnifiers are the preferred aids of correction of low vision, followed by electronic magnifiers by 30%. "Talking glasses" - OrCam My Eye has only 3 recommendations in the heterogeneous group "other". The estimated contingency coefficient of 0.539 indicates a moderate direct

relationship between the leading diagnosis and the type of magnifying device. The coefficient can be accepted as statistically reliable.

Table 11. Type of magnifying device and groups of diagnoses

Type of magnifying device		Diagnosis				
		ARMD	Glaucoma	DR	other	total
Magnifying glass	**count**	**35**	**4**	**4**	**4**	**47**
	% Type of magnification	74,5%	8,5%	8,5%	8,5%	100,0%
	%of diagnosis	71,4%	44,4%	66,7%	25,0%	58,8%
	% of total	43,8%	5,0%	5,0%	5,0%	58,8%
Electronic magnifier	**count**	**11**	**4**	**2**	**7**	**24**
	% Type of magnification	45,8%	16,7%	8,3%	29,2%	100,0%
	% of diagnosis	22,4%	44,4%	33,3%	43,8%	30,0%
	% of total	13,8%	5,0%	2,5%	8,8%	30,0%
max detail	**count**	**1**	**0**	**0**	**2**	**3**
	% Type of magnification	33,3%	,0%	,0%	66,7%	100,0%
	% of diagnosis	2,0%	,0%	,0%	12,5%	3,8%
	% of total	1,3%	,0%	,0%	2,5%	3,8%
head on	**count**	**2**	**0**	**0**	**0**	**2**
	% Type of magnification	100,0%	,0%	,0%	,0%	100,0%
	% of diagnosis	4,1%	,0%	,0%	,0%	2,5%
	%. of total	2,5%	,0%	,0%	,0%	2,5%
Telescopic glass	**count**	**0**	**1**	**0**	**0**	**1**
	% Type of magnification	,0%	100,0%	,0%	,0%	100,0%
	% of diagnosis	,0%	11,1%	,0%	,0%	1,3%
	% of total	,0%	1,3%	,0%	,0%	1,3%
OrCam My Eye	**count**	**0**	**0**	**0**	**3**	**3**
	% Type of magnification	,0%	,0%	,0%	100,0%	100,0%
	% of diagnosis	,0%	,0%	,0%	18,8%	3,8%
	% of total	,0%	,0%	,0%	3,8%	3,8%
Total	**count**	**49**	**9**	**6**	**16**	**80**
	% of total	61,3%	11,3%	7,5%	20,0%	100,0%

Sixteen patients - 20% reported previous experience of using a magnifying aid. In all of them - 100% it was a magnifying glass (fig. 20).

Fig. 20. Previous experience with a magnifying device

The distribution by diagnoses of those who have already used a magnifying glass is given in table 12. Those with MDSV dominate - 9 have experience. The calculated odds ratio of 0.186 indicates a weak linear relationship between the leading diagnosis and previous experience with a magnifying device. The coefficient can't be accepted as statistically reliable (Sig=0.411>α=0.05).

Табл.12.Previous experience with a magnifying device correlate with diagnosis

leading diagnosis		Previous experience with a magnifying device		
		Yes	No	total
	ARMD	9	40	49
	Glaucoma	2	7	9
	DR	0	6	6
	Other	5	11	16
total		16	64	80

An important indicator is the purchase of an optical device, because without it, visual rehabilitation practically can't be carried out. Table 13 gives the percentage ratio by diagnosis of all those who didn't purchase a magnifying device. Again, patients with macular degeneration prevail - in 50% they didn't buy, which is equal to 16.3% of the total number who didn't buy any optical device.

Table 13. Satisfaction with the recommended optical device, ratio bought/don't bought

Satisfaction		diagnosis				total
		ARMD	Glaucoma	DR	Other	
Bought a magnifying device	**count**	**36**	**5**	**5**	**8**	**54**
	% satisfaction	66,7%	9,3%	9,3%	14,8%	100,0%
	% diagnosis	73,5%	55,6%	83,%	50,0%	67,5%
	% Bought of total	45,0%	6,3%	6,3%	10,0%	67,5%
Don't Bought a magnifying device	**count**	**13**	**4**	**1**	**8**	**26**
	% satisfaction	50,0%	15,4%	3,8%	30,8%	100,0%
	% diagnosis	26,5%	44,4%	16,%	50,0%	32,5%
	%don't Bought of total	16,3%	5,0%	1,3%	10,0%	32,5%
total	**count**	**49**	**9**	**6**	**16**	**80**
	% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

3.4. Assessment of functional vision - results of the first examination

All subsequent 11 tables from 14 to 24 provide detailed information in absolute value and percentages of the investigated indicators distributed in the four groups by leading diagnosis. A cross-tabulation was used, which gives the correlations in percentages in great detail.

Table.14. Use of two hands - 10 fingers

Use of two hands - 10 fingers			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**48**	**9**	**5**	**15**	**77**
		% use of two hands - 10 fingers	62,3%	11,7%	6,5%	19,5%	100,0%
		% diagnosis	98,0%	100,0%	83,3%	93,8%	96,3%
		% total use 10 finger	60,0%	11,3%	6,3%	18,8%	96,3%
	No	**count**	**1**	**0**	**1**	**1**	**3**
		% use of two hands - 10 fingers	33,3%	,0%	33,3%	33,3%	100,0%
		% diagnosis	2,0%	,0%	16,7%	6,3%	3,8%
		% total don't use 10 finger	1,3%	,0%	1,3%	1,3%	3,8%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

The first three indicators - in tables 14, 15 and 16, analyze the possibility of the low vision patient to deal with the optical devices. With all three the results are good. There is no problem with eye-hand coordination, they handle their 10 fingers and hold the magnifying glass correctly (Table 14 and Table 15). The positive percentage of answers decreases - only 45%, when we analyze whether the focal length is kept constant in table 16. The best result according to this indicator is found in patients with macular degeneration - 58.3% of them do well, but they are only 26.3% of all examined patients.

Table 15. Hold the optical device correctly

Hold the optical device correctly			leading diagnosis				
			ARMD	Glaucoma	DR	Other	Total
	Yes	**count**	**34**	**7**	**5**	**8**	**54**
		% holds the optical device correctly	63,0%	13,0%	9,3%	14,8%	100,0%
		% leading diagnosis	69,4%	77,8%	83,3%	50,0%	67,5%
		% of total holding device	42,5%	8,8%	6,3%	10,0%	67,5%
	No	**count**	**15**	**2**	**1**	**8**	**26**
		% holds the optical device correctly	57,7%	7,7%	3,8%	30,8%	100,0%
		% leading diagnosis	30,6%	22,2%	16,7%	50,0%	32,5%
		% of total not holding device	18,8%	2,5%	1,3%	10,0%	32,5%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

Table 16. Maintain a constant focal length

Maintain a constant focal length			leading diagnosis				
			ARMD	Glaucoma	DR	Other	total
	Yes	**count**	**21**	**5**	**3**	**7**	**36**
		% maintains a constant focal length	**58,3%**	13,9%	8,3%	19,4%	100,0%
		% leading diagnosis	42,9%	55,6%	50,0%	43,8%	45,0%
		% of total maintaining	**26,3%**	6,3%	3,8%	8,8%	**45,0%**
	No	**count**	**28**	**4**	**3**	**9**	**44**
		% maintains a constant focal length	63,6%	9,1%	6,8%	20,5%	100,0%
		% leading diagnosis	57,1%	44,4%	50,0%	56,3%	55,0%
		% of total not maintaining	35,0%	5,0%	3,8%	11,3%	55,0%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

The next three distance vision activities (three tables) correlate with distance visual acuity and age of the low vision patient. Reading from the blackboard was not studied because it concerns school age. The results given in tables 17, 18 and 19 are unsatisfactory in a high percentage in all groups. Especially in the first one with ARMD - 67.2% can't see the bus number, 50% can't go up and down stairs and 63.9% of them can't read the names of the streets.

Table 17. View bus number

View bus number			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**8**	**3**	**3**	**5**	**19**
		% View bus number	42,1%	15,8%	15,8%	26,3%	100,0%
		% leading diagnosis	16,3%	33,3%	50,0%	31,3%	23,8%
		% patient of total	10,0%	3,8%	3,8%	6,3%	23,8%
	No	**count**	**41**	**6**	**3**	**11**	**61**
		% View bus number	**67,2%**	9,8%	4,9%	18,0%	100,0%
		% leading diagnosis	83,7%	**66,7%**	50,0%	**68,8%**	76,3%
		% patient of total	51,3%	7,5%	3,8%	13,8%	76,3%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

From the cross-tabulation tables, it can be seen that the DR group performed best in the last 3 indicators. For example, only 4.9% can't see the bus number, 4.2% can't go up and down stairs, and 5.6% of them can't read street names.

Table 18. Going up and down the stairs

Going up/down stairs			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**37**	**7**	**5**	**7**	**56**
		% going up/down stairs	66,1%	12,5%	8,9%	12,5%	100,0%
		% leading diagnosis	75,5%	77,8%	83,3%	43,8%	70,0%
		% of total going stairs	46,3%	8,8%	6,3%	8,8%	70,0%
	No	**count**	**12**	**2**	**1**	**9**	**24**
		% going up/down stairs	**50,0%**	8,3%	4,2%	37,5%	100,0%
		% leading diagnosis	24,5%	22,2%	16,7%	56,3%	30,0%
		% of total don't going stairs	15,0%	2,5%	1,3%	11,3%	30,0%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

From the detailed data presented in the tables, percentage conclusions can be drawn for all the studied indicators by groups of diagnoses. Glaucoma patients in 100% and those from the fourth group in 81.3% did not cope with reading street names at all. The same two groups have a very poor performance - they do not see the bus number, respectively in 66.7% and 68.8%. It is noteworthy that in both groups of diagnoses (including glaucoma and mainly hereditary retinal

degenerations and atrophy of the nerve) the studied activities are related to specificity in the reading technique.

Табл.19. Reading name's street

reading name's street			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**3**	**0**	**2**	**3**	**8**
		% reading name's street	37,5%	,0%	25,0%	37,5%	100,0%
		% leading diagnosis	6,1%	,0%	33,3%	18,8%	10,0%
		% of total reading	3,8%	,0%	2,5%	3,8%	10,0%
	No	**count**	**46**	**9**	**4**	**13**	**72**
		% reading name's street	63,9%	12,5%	5,6%	18,1%	100,0%
		% leading diagnosis	93,9%	**100,0%**	66,7%	**81,3%**	90,0%
		% of total don't reading	57,5%	11,3%	5,0%	16,3%	90,0%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

Analyzing the presence of motivation for visual rehabilitation and good adaptation skills at the first examination, we see extremely positive results, respectively in 90% and in 66.25% (fig. 21).

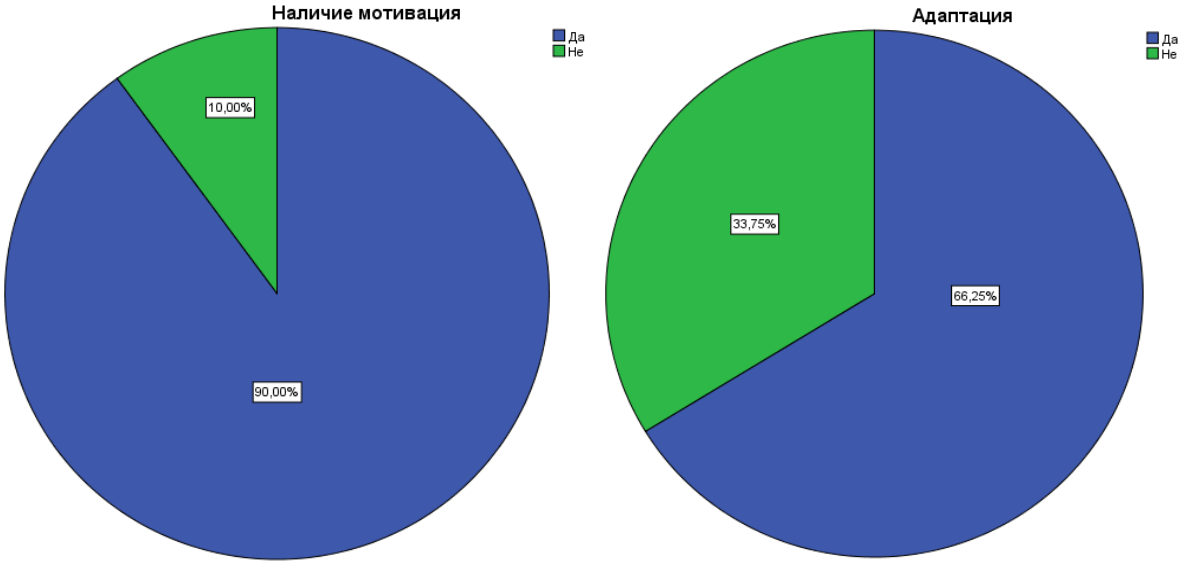


Fig. 21. Motivation and adaptation - percentage ratio

The last examined indicators related to the four groups of diagnoses are given in the attached tables - from table 20 to table 24 inclusive. The interrelationships are shown by cross-tabulation.

Table 20. Availability of motivation

Availability of motivation			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**46**	**9**	**6**	**11**	**72**
		% availability of motivation	**63,9%**	12,5%	8,3%	15,3%	100,0%
		% leading diagnosis	93,9%	100,0%	100,0%	68,8%	90,0%
		% of total with motivation	57,5%	11,3%	7,5%	13,8%	90,0%
	No	**count**	**3**	**0**	**0**	**5**	**8**
		% availability of motivation	37,5%	,0%	,0%	62,5%	100,0%
		% leading diagnosis	6,1%	,0%	,0%	31,3%	10,0%
		%of total without motivation	3,8%	,0%	,0%	6,3%	10,0%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

Table 21. Good adaptation

Good adaptation			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**36**	**6**	**4**	**7**	**53**
		% adaptation	**67,9%**	11,3%	7,5%	13,2%	100,0%
		% leading diagnosis	73,5%	66,7%	66,7%	43,8%	66,3%
		% of total with adaptation	45,0%	7,5%	5,0%	8,8%	66,3%
	No	**count**	**13**	**3**	**2**	**9**	**27**
		% adaptation	48,1%	11,1%	7,4%	33,3%	100,0%
		% leading diagnosis	26,5%	33,3%	33,3%	56,3%	33,8%
		% of total without adaptation	16,3%	3,8%	2,5%	11,3%	33,8%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

Table 22. Need for additional training

Need for additional training			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**26**	**5**	**2**	**9**	**42**
		% need for additional training	61,9%	11,9%	4,8%	21,4%	100,0%
		% leading diagnosis	53,1%	55,6%	33,3%	**56,3%**	52,5%
		% of total with training	32,5%	6,3%	2,5%	11,3%	52,5%
	No	**count**	**23**	**4**	**4**	**7**	**38**
		% need for additional training	60,5%	10,5%	10,5%	18,4%	100,0%
		% leading diagnosis	46,9%	44,4%	66,7%	43,8%	47,5%
		% of total without training	28,8%	5,0%	5,0%	8,8%	47,5%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

The best motivation - 63.9% and adaptation - 67.9% demonstrated the group with ARMD. Patients from the group with heterogeneous and more severe diagnoses did it the hardest (table 20 and table 21). They have 56.3% need for additional training (Table 22).

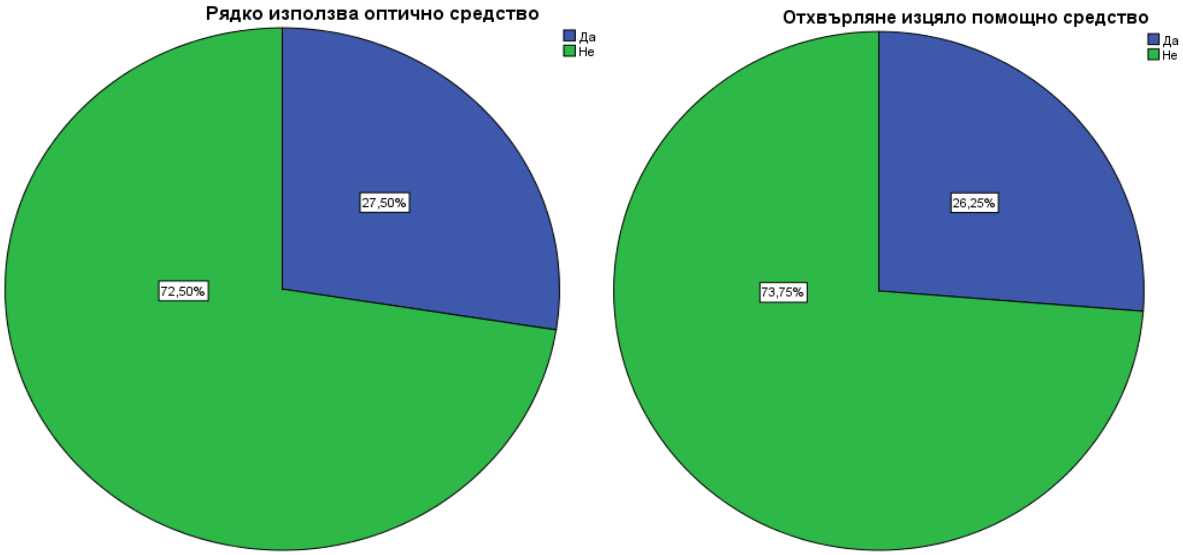


Fig. 22. Rarely uses or rejects the optical device

Analyzing whether they rarely use the optical device or completely reject it, we see that there are almost 100% overlap of the two results. The data are given in figure 22 - in 27.5% and 26.25%, respectively, rare use and rejection of the magnifying device is observed. The percentages are not high. The patients with ARMD rarely use the recommended device or rejecting it completely, as a relative number are 11 and 10 patients, respectively. The group with glaucoma in 44.4% don't use or reject the visual rehabilitation - 4 out of 9 patients (table 23 and table 24). The explanation is in the specificity of loss of the visual field in glaucoma patients.

Table 23. Rarely uses optical device

Rarely uses optical device			leading diagnosis				
			ARMD	Glaucoma	DR	Other	total
	Yes	**count**	**11**	**4**	**1**	**6**	**22**
		% rarely uses optical device	50,0%	18,2%	4,5%	27,3%	100,0%
		% leading diagnosis	22,4%	44,4%	16,7%	37,5%	27,5%
		% of total rarely uses	13,8%	5,0%	1,3%	7,5%	27,5%
	No	**count**	**38**	**5**	**5**	**10**	**58**
		% rarely uses optical device	65,5%	8,6%	8,6%	17,2%	100,0%
		% leading diagnosis	77,6%	55,6%	83,3%	62,5%	72,5%
		% of total not rarely uses	47,5%	6,3%	6,3%	12,5%	72,5%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

Table 24. Reject the device entirely

reject the device entirely			leading diagnosis				total
			ARMD	Glaucoma	DR	Other	
	Yes	**count**	**10**	**4**	**1**	**6**	**21**
		% reject the device	47,6%	19,0%	4,8%	28,6%	100,0%
		% leading diagnosis	20,4%	44,4%	16,7%	37,5%	26,3%
		% of total rejecting	12,5%	5,0%	1,3%	7,5%	26,3%
	No	**count**	**39**	**5**	**5**	**10**	**59**
		% reject the device	66,1%	8,5%	8,5%	16,9%	100,0%
		% leading diagnosis	79,6%	55,6%	83,3%	62,5%	73,8%
		% of total not rejecting	48,8%	6,3%	6,3%	12,5%	73,8%
total		**count**	**49**	**9**	**6**	**16**	**80**
		% patient of total	61,3%	11,3%	7,5%	20,0%	100,0%

3.5. Visual rehabilitation - results after 3 months

Motivation and adaptation to the device/visual rehabilitation were assessed for all who attended the second examination at 3 months. They comment on the need for additional training, whether they rarely use or completely reject the aid. Of all 80 patients who passed the first examination, 5 low vision patients did not appear at the second follow-up examination after 3 months. The advanced age of the patients and the severe pandemic situation didn't make contact with these patients. Out of all 80 examined patients, 21 did not purchase any means for optical correction, which is 26.25%. In the analysis (for convenience) we collectively take these 5 and 21 patients as a total of 26 or 32.5% who "not bought" the recommended device. They actually, for one reason or another, didn't undergo visual rehabilitation. The evaluation of these parameters is given in table 25.

Table 25. Adaptation to the device - Results on a second visit

3-rd month - motivation	Count -80	Percent %
not bought optical device	26	32.5 %
Yes	53	66.25 %
No	1	1,25 %
3-rd month - need for additional training		
not bought optical device	26	32.5 %
Yes	3	3,75 %
No	51	63.75 %
3-rd month - rarely use an optical device		
not bought optical device	26	32.5 %
Yes	2	2,5 %
No	52	65 %
3-rd month - completely rejects the device		
not bought optical device	26	32,5 %
Yes	1	1,25 %
No	53	66,25 %

The difference between the first and second review is a slight percentage drop in motivation and adaptation at the second review, from 90% and 66.5% to 66.25% for both indicators at the 3-rd month, respectively. The enthusiasm with which the visually impaired come to a consultation for visual rehabilitation decreases due to awareness of all the difficulty and length of the process of its implementation. However, patients who rarely use or completely reject an optical device decrease sharply at the second examination, from 27.5% and 26.3%, respectively at 2.5% and 1.25%. The drop is significant, but it is reported only to those who have purchased an optical device. Let's not forget that at the second examination, a total of 26 (5+21) visually impaired people didn't undergo visual rehabilitation at all.

On the examination form, in the last 6th part, to the question of who supports visual rehabilitation, the answer is 100% - ophthalmologist. There is no involvement of any other specialist from the proposed interdisciplinary model, excluding the moment of purchase of the devise from the optician. Starting the study, the research team had expectations that other specialists would be involved in the follow-up process of visual rehabilitation. These expectations were not met.

Results by diagnostic groups:

Group 1 with AMD had: the highest proportion 61.25% in the study, they had the highest 35% MLEC (medical-labour expert commission) decision and their were 19 of all 20 patients with anti-VEGF. They preferred a magnifier for correction, and 9 of the 16 low vision patients with previous experience of magnification were again from this group. They had high percentages of all functional vision indicators, in 51.3% of all they could not see the bus number and in 57.5% they could not read street names, but there was very high motivation in 93.9% and adaptation in 73.5%. These data represent motivation in 57.5% and adaptation in 45% of all 80 followed up.

For group 2 with glaucoma we can summarize - a small group of 9 visually impaired people, all female only and almost all of them 77.8% (7 out of 9) have MLEC decision. They show the lowest reading speed with the least improvement. Only this group has purchased an optical aid for distance correction-telescopic glasses and have no preference-they equally use a magnifier and an electronic magnifier. The 66.7% (6 of 9) do not see the bus number and 100% of them do not read street names, but like the first group all have high motivation and adaptation.

The third group with DR in 66.7% were women and in the same percentage had MLEC decision. Only one patient among them had anti-VEGF therapy. They improved reading speed from 11.16 words/min to 43.83 words/min at first examination and from 15.33 words/min to 47.83 words/min at the second one. They had no previous experience, but in 66.7% preferred the magnifier as a rehabilitation tool, and in the highest percentage 83.3% purchased the recommended optical correction. They scored very well on all near activities when assessed for functional status, were good at going up and down stairs, could see bus numbers, but 66.7% not good at being able to read street names. They often use the purchased optical aid and do not need further training - only 5% of all tracked needed it.

The heterogeneous fourth group - called **"others**" - represents 20% and has the youngest patients, e.g. 19 years, and here also women predominate. The group has 75% patients with

MLEC decision, their reading rate at both visits is consistent with the average found. The interesting thing here is that due to the different included diagnoses, the recommended visual rehabilitation aids are heterogeneous - magnifier in 25%, e-magnifier in 43.8%, max detail in 12.5% and talking glasses in 18.8%. In 31.25% had previous experience, that is why 50%- highest of all groups, did not purchase their recommended aid. They did not have good functional results in either near or far activities. They also had the worst motivation and adaptation scores, at 68.8% and 43.8% respectively, while in the other groups they went from about seventy percent to 100%. They need further training as in the other three groups. They rarely use or completely reject visual rehabilitation in 7.5% of all those followed up, while in diabetics, for example, these data are 1.3%.

Task results - 4

The children from the specialized school for blind „Prof. Dr. Ivan Shishmanov" – Varna have been studied in 2009 and 2018. During the initial study 23 children were examined and in 2018 the children were 16. Seven did not appear because they have changed or graduated school. The visual acuity and the objective state of the eye were examined at the first visit, and the results were recorded on a specially developed check-list for low vision. In the period between the first and the second visit, the students were systematically trained by a visual therapist. At the second visit the visual acuity and functional vision and social skills of the students were studied. Visual rehabilitation was provided by auxiliary magnification devices. A wide variety of magnifiers with a large magnification - from 3x to 12x and an electronic magnifier (CCTV) were used. Based on the LV Prasad (LVPFVQ) (11) self-assessment questionnaire we developed an adapted version that we used during the second visit. It included several areas of research: near vision, distant vision, adaptation to a magnifying aid, visual rehabilitation and who is involved in it.

At the first visit in 2009 a total of 23 children were studied from 1-3 grade, 17 were male an 6 - female. Their average age was 10 years (between 7 and 13). Low vision of one eye has been observed in 5 children - from them with vision of the poor eye <0.1 were three children and with vision > 0.1 ≤ 0.3 - two children. Low vision in both eyes was found in 18 children – vision of the better eye < 0.1 was observed in 14 children and visual acuity > 0.1 ≤ 0.3 of better eye – in 4 children. The groups were 4, according to the visial acuity, following the WHO classification for visual impairment in childhood. Visual acuity and diagnosis are given in Table 26 and Table 27, respectively.

Table 26. Distribution according to the visual acuity of the better eye at the first visit

Vision	Number - %
Ø, PPLC ≤ 0.1	14 - 60.8
>0.1 ≤ 0.3	4 - 17.4
>0.3 ≤ 0.5	3 - 13.0
> 0.5	2 - 8.6

Table 27. Distribution of the children according to the diagnosis

Leading Diagnosis	Number
1. ROP	6
2. Atrophia n. optici	4
3. Retinitis pigmentosa	1
4. Albinismus	1
5. Ablatio retinae	2
6. Phtysis bulbi	1
7. Cat. congenita	2
8. Peters syndrome	1
9. Pseudophakia	2
10.Glaucoma congenita	1
11.Trauma (enucleatio)	1
12. Microphthalmus	1

All children had more than one ocular pathology. It is noticeable from the distribution by diagnosis that nystagmus, exotropia, esotropia and retinopathy are accompanying diseases. There were 8 students with disturbed color sensation and 15 had normal color vision. Only 4 students had Braille literacy, the remaining 19 were also taught in a flatbed font. Two children had a mild to moderate degree of mental retardation, and one had child cerebral palsy as an accompanying diagnosis. During the initial review in 2009, 10 children were recommended for visual rehabilitation by magnifying glasses, 6 were recommended for correction with dioptric glasses, 4 used Braille and 3 of them received no specific recommendation, they did well according to the visual therapist. On the second visit in 2018, 16 students were examined, 13 were male, 3 were female. The average age was 19.5 years (between 17 and 22). Only one of them had a significant worsening in vision - from 0.1 to 0.02, while in the others the slight change in vision did not shift the distribution of the groups of vision. Following the recommendations 9 years later, it was found that a total of 11 children used a magnifying glasses, 7 of them using a magnifying glass and an electronic magnifier, only one child used dioptric glasses in combination with a magnifying glass, and the other three children used only a magnifying glass. Having in mind the social character of buying dioptric glasses, this recommendation is not considered fulfilled (Table 28). Three students learned only by means of Braille and two did not need special optical devices because they had good visual acuity and did well. The most preferred magnification of the magnifiers used was 5x - in 6 children (37.5%) with visual acuity > 0.1 < 0.5, two with visual acuity 0.3 used - 7x, and two students with vision 0.1 - 12x. One child with vision 0.5 of the better eye occasionally used a 3x magnifier in the learning process.

Table 28. Distribution of the recommendation and the visual rehabilitation for a 9-year period

Reco recommendationdation-	**N - CNhildren**	**visual rehabilitation18**	**N - NChildren**
Magnifying glasses	10	Magnifying glasses	3
Dioptric glasses	6	Magnifying and dioptric glasses	1
Magnifying glasses and el. magnifier	7		
Braille	4	Electronic magnifier	3
Without device	3	Without device	2
Total:	**23**	**Total:**	**16**

Functional vision assessment at the second visit in 2018 was based on the results of the adapted questionnaire (table 29). All near vision skills were positively developed for the observed period - students kept the optical device correctly in 93.75% of the cases, recognized a face in 81.25%, had good coordination in 75%, and maintained a focal length in 68.95%. The evaluation of the activities for distant vision had a success rate of 100% when climbing stairs. This result was expected because of the adapted school environment for these children. The remaining activities in this category were represented in 50%. This is consistent with poor vision at distance as well as that none of the children used telescopic glasses for distance, as well as with acquiring additional knowledge of mobility and orientation. The high motivation to improve ability in 81.25% of students coincided with their good adaptation and developed skills - also at 81.25%. In 50%, additional training with the optical devices was still required, and only in 12.5% their use was rejected altogether, may be due to the accompanying diagnoses.

Table 29. Results of the adapted functional vision assessment questionnaire at the second visit

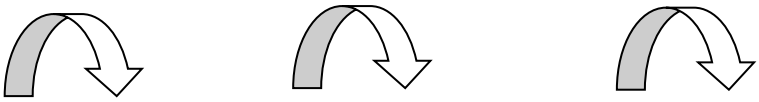
SKILLS FOR NEAR VISION			
a/ good coordination eye-hand eye-leg	yes	no	75%
b/ face recognition	yes	no	81.25%
c/ keeps the optical device correctly	yes	no	93.75%
d/ keeps the focal length constantly	yes	no	68.75%
ACTIVITIES FOR DISTANT VISION			
a/ reading from the blackboard (for students)	yes	no	50%
b/ see the bus number	yes	no	50%
c/ climbing stairs	yes	no	100%
d/ read street names	yes	no	50%
2. Visual aid:	**yes %**		
a/ magnification			
b/ type of magnifying device			
c/ use flatbed font	yes	no	62.5%
d/ Braille literacy	yes	no	100%
3. Adaptation - Comment:	**yes %**		
a/ has a learning motivation	yes	no	81.25%
b/ good adaptation and developed skills	yes	no	81.25%
c/ need additional training	yes	no	50%
d/ rarely uses the optical device	yes	no	43.75%
e/ rejects entirely the optical device	yes	no	12.5%
4. Visual rehabilitation is assisted by:	**yes %**		
a/ ophthalmologist	yes	no	100% visual therapist
b/ optometrist	yes	no	
c/ optician	yes	no	
d/ visual therapist	yes	no	
e/ psychologist	yes	no	
f/ social worker	yes	no	

The data of the survey of visually impaired children shows that a total of 23 children of grades 1st-3rd were covered at the first visit, of which 17 were male, 6 were female, and the average age was 10 years (7-13 years). On the second visit only 16 students were examined. In 2009, monocular vision impairment was found in 5 children and binocular vision impairment in 18. 10 children were recommended for visual aids using magnifiers, 6 were referred for correction with dioptric spectacles, in 4 only Braille preparation was possible and in 3 - no recommendation, they were doing well. Nine years later, a total of 11 children were found to be using magnifiers, 7 of them using both magnifiers and an electronic magnifier, only one child using spectacles and magnifiers, and the remaining three children using magnifiers only. The most preferred magnification of magnifiers used was 5x - in 6 children (37.5%). Three students were trained on Braille only. Functional vision assessment showed positively developed near vision skills - students held the optical aid correctly in 93.75% and recognised a face in 81.25%. The assessment for far activities shows 100% coping with stairs. In 50%,

further training with the magnifying aid is still required and in only 12.5% the aid is rejected entirely.

Results tasks – 5 and 6

Referring to historical, procedural-documentary and clinical research methods, we combined the results of task 5 and 6. We analyzed the possibilities of access to visual rehabilitation and the barriers to its implementation in our country. We have done a complete working model, including an algorithm and an integrated approach to follow-up of the low vision patient.
About 75% to 95% of the visually impaired can be visually rehabilitated by optical means. Ophthalmologists with an interest in visual rehabilitation have to do highly specialized training. Determining the necessary magnification of the optical device should be a basic skill of these professionals. Following the algorithm of examination of the visually impaired patient, after determining the exact magnification of the optical device, the specific type of magnifying glass, telescopic glasses, electronic device or other should be recommended and adapted according to the relevant needs to improve the patient's vision. The steps in the low vision specialist's work algorithm proposed by us are the following:
1. Passport part - names, years, gender, city, correctly filled data for ICD - leading and accompanying eye diagnosis.
2. A detailed medical history – family data and duration of the problem, progression, surgical interventions, intraocular applications, disability, accompanying diseases,
3. Examination of uncorrected near and far visual acuity. Distance vision is tested using a standard test projector, near vision using a special viewing table for low vision,
4. Determination of vision with optimal optical correction (glasses) for each eye separately,
5. Vision improvement with a magnifying device for each eye separately – what kind and magnification are they. The needs of the patient - type of magnifying device - only for near or also for far, motivation, previous experience, diagnosis, age, etc...
6. Determination of reading speed - number of words/minute after correction with glasses and after adaptation of a magnifying device, HUI-3,
7. Biomicroscopy of the anterior segment of the eye and ophthalmoscopy of the posterior segment of the eye - if necessary, to perform machine imaging tests: OCT and FAG, angio-OCT, computer perimetry, Amsler's test,
8. Assessment of functional vision - questionnaire with near and far vision skills,
9. Training and adaptation of the patient, as well as late follow-up - but not earlier than 3 months, in view of his socialization and the possible progression of the main disease.
First, it is necessary to determine the visual acuity, then the correct magnification of the correction device. There are many tables for determining visual acuity, as well as many formulas for calculating magnification. Often used are the synthesized tables for direct recalculation, which are common used by low vision specialists. The main practical goal of ophthalmologists is to improve vision, according to which magnification formula it is recalculated. The following diagram gives a synthesized view of this practical algorithm:



VISION – DIOPTER - MAGNIFICATION – FOCAL LENGTH

First we determine the vision, then the necessary diopters, recalculate the necessary magnification and finally calculate the focal length.
The easiest and most affordable ways to determine the magnification are:

Magn. = V_{BEST} / V_{TARGET} or **Magn.= DIOPTER**

(magnification for far) (magnification for near) **4**

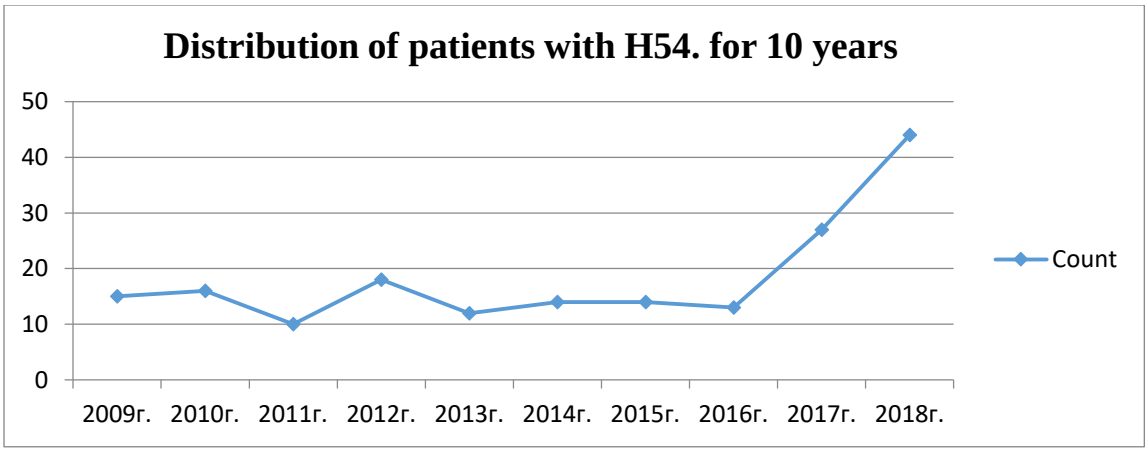
Magnifier power is calculated from LogMAR visual acuity.
For example, if the best corrected acuity is 6/75 (20/250) or 0.08 and the desired magnification result is 6/12 (20/40) or 0.5, a **6x** magnifier must be adapted. This is obtained by the decimal equivalents 0.08/0.5 = 6.25. Most low vision devices (LVD) are difficult to use due to the limited field of view. Training is necessary for both children and adults. It is important that they understand how to use the prescribed device and overcome difficulties.
Difficulties and limitations in the implementation of visual rehabilitation in Bulgaria are of a different nature. Using literature sources and sharing our approximately 10 years of experience with visually impaired patients, we obtained the following results:

- There is a lack of ophthalmologists specialized in working with the visually impaired
- Lack of specially equipped clinic with auxiliary magnifying devices, with sets of magnifying glasses and telescopic glasses, as well as electronic devices
- Access to magnifiers is difficult, as they are not reimbursed by the NHIF. Their price range varies from a hundred and more BGN (eg BGN 150 for a 6X magnifying glass) to several thousand - in particular, 4,500 euros for the "talking glasses", which is unaffordable for a large part of these patients.
- There is a lack of information aimed at low vision patients in need. The visual rehabilitation is present in the definition of the specialty in the eye disease standard as one of the ophthalmologist's activities, but nowhere does it mention it as an additional specialization, qualification or highly specialized activity. It is accepted that the ophthalmologist has basic care for eye health and rehabilitation. However, it turns out that the reality is completely different. Practice shows that the eye doctors who have knowledge of visual rehabilitation of the visually impaired in Bulgaria are insufficient. The main reasons for this are:

1. lack of a doctor's office equipped with tests and visual aids, which is an expensive investment,
2. lack of subspecialization in the field of visual rehabilitation,
3. lack of motivation for this activity on the part of ophthalmologists, since
4. the consultation-examination is very slow and hard work, due to the nature of the pathology – blind or partially sighted, usually elderly patients,
5. difficult psycho-emotional working environment with many disabled patients and their relatives.

We find the evidence in another ours retrospective study. In it, we tracked the distribution and ratio of the diagnoses entered in the outpatient examinations: H54.- blindness, H36.0 - diabetic retinopathy (DR) and H35.3 - macular degeneration (ARMD) over a period of 10 years. Our hypothesis is that the diagnosis of blindness H54 is not adequately classified and reflected in outpatient examinations in all its seven subcodes. The data from all ophthalmologists working under the NHSOC from the program product MEDEX in the eye medical center "St. N. Chudotvorets"–Varna for the period: September 1, 2008–September 1, 2018. . For the ten-year follow-up period, all reported outpatient examinations of a total of 13 ophthalmologists working under the National Health Service are 155,843 examinations. Of these, the ratio of diagnoses is as follows: H36.0 - a total of 4020, H35.3 a total of 4878, and H54. – only 170 patients (114). Many patients with socially significant eye diseases have passed, but there are few patients with blindness reflected in outpatient examinations. Therefore, very few patients are given the option of visual rehabilitation because it is not actively offered.

Table 30. Number of patients with blindness by year



In the follow-up of our patients, the sharp rise in the reflection of blindness in the outpatient lists after 2016. coincides with the increased work and interest of the team in the visual rehabilitation of the visually impaired in the eye center (table 30). Data from the present study confirm this. For a period of 3 years 2019-2022. through medical center are passed 279 patients with the diagnosis of blindness H54.0 - H54.7. Due to the follow-up of the visually impaired in recent years, all of them have consultation with a visual rehabilitation. For the researched period, only 80 of the referred visually impaired people had such a specialized examination. Of these patients, 25 were male and 55 were female, and the predominant diagnosis was ARMD. Only 59 visually impaired patient purchased their recommended optical device. The most commonly prescribed and purchased magnifying device turns out to be the magnifying glass. The difficulties in carrying out the visual rehabilitation reflect on the percentage ratio of those examined, rehabilitated, purchased a magnifying device and satisfied with it. The results are presented in table 31.

Табл.31. Относителен дял на прегледани, рехабилитирани, закупили увеличително средство и доволни от него

number of outpatients with a diagnosis of blindness H.54 - **279**
number of patient with specialized consultation for visual rehabilitation - **80 = 28.67%**
number of patients did not show up for a second examination after 3 months – **5 = 6.25%**
number of patients who bought a magnifying device - **59 = 73.75%**
number of patients satisfied/regularly using the aid - **40 = 50%**
number of patients dissatisfied/irregularly using the aid - **19 = 23.75%**
number of patients with difficult adaptation and returned optical device-**13 = 16.25%**
number of patients with retraining for the aid - **45 = 56.25%**

Based on all the vision rehabilitation data and models in the literature, our recommended integrated working model is as follows. Here you can see a collaboration of many specialists:

1. Ophthalmologist - trained to work with low vision. Its main role is precise diagnosis related to an expected prognosis of visual acuity and subsequent visual rehabilitation. Determining the most appropriate optical device, after exhausting all conservative and surgical options for improving vision individually for each patient with impaired vision.

2. Optometrist and/or optician. These specialists interact with the ophthalmologist, supplementing his work - they can carry out the training and monitor the adaptation to the aid already assigned. The role of the optician is the technical support of the purchased devices, and the optometrist also monitors complaints and deterioration of vision by referring the patient for a follow-up examination. Borrowing the experience of other countries, the optometrist can regularly follow up the patient every 6 months, and the ophthalmologist can thoroughly examine him once a year.

3. Visual therapist - teacher of visual rehabilitation (typhlopedagogue). These specialists are valued and used mainly for impaired vision in childhood. However, this should change and they should also be used by the late blind, especially with hereditary eye diseases where visual problems are known and expected.

4. Psychologist. It is also a mandatory element of the multidisciplinary team, because numerous studies show concomitant depressive states and even suicidal attitudes. A psychologist is needed not only for the very elderly, but also for the suddenly blind, as well as for children, especially those with multiple disabilities. The families of these patients have social isolation and they also need professional counseling.

5. Social worker. He is a link between all the specialist. In recent years, mediators have also played a rather active role, which would also contribute to social integration, especially in some risky areas.

Following this interdisciplinary model would overcome most of the difficulties already shared.

V. Discussion

The main keywords in this dissertation are - visual rehabilitation, socially significant eye diseases, blind, low vision, reading speed, integrated approach and optical devices. All of them

are connected with the tasks, the results of which indisputably prove the urgent need to conduct the present study.

The literature review shows that in Bulgaria the topic of the visually impaired is poorly researched, as we cite and refer mainly to foreign sources and experience (task 1). From inquiries made in Bulgarian publications, there are publications on the subject by Angel Sotirov from the National Center for the Rehabilitation of the Blind in Plovdiv, who states (quote): "...despite their high professionalism, ophthalmologists don‘t have special knowledge on the rehabilitation of the blind. In our survey conducted this year with 26 ophthalmologists, it turned out that for the most part they don‘t have an adequate idea of the main functions of the Center, of what rehabilitation services it offers, and some even of them, unfortunately, didn‘t know about his existence…". The quoted text was published in 1991, and 30 years later the level of awareness of the public and of the ophthalmologists is no different. Proof of this is the results of the survey conducted by us (task 2). After summarizing the obtained results, we should note that it proves the low awareness of the society on the issues of blindness and the visually impaired. Analyzing the opinion of the respondents, we come to the conclusion that knowledge on the issue of visual rehabilitation of patients with low vision is extremely low. The trend is persistent, regardless of the age, education and profession of the respondents. It remains so even among medical professionals. The knowledge and experience of optometrists and specialist ophthalmologists in this field is the connecting link in the care of the visually impaired. In Bulgaria, both types of visual rehabilitation specialists are very few in number. Countries in the Western European region generally follow the following model: the main ophthalmic care is carried out by ophthalmologists who deal with eye diseases and provide eye surgery, and partly some activities are carried out by optometrists and opticians. There are separate sectors in which ophthalmologists work, especially for the rehabilitation of the visually impaired. Conditions are different in the countries of the Eastern European region, where a large percentage of ophthalmologists are surgically inactive, providing first-line diagnostic services and medical treatment in their offices. Due to the rather dense coverage of populated areas in Eastern Europe by ophthalmologists, the number of optometrists is significantly lower or their services are almost non-existent. The situation with specialists dealing with the visually impaired is similar in Bulgaria. Optometrist is a specialist class with code - 2267 6002 according to the National Classification of Professions and Duties. In 2018 graduated the first graduating class of 9 masters in optometry at the MU "Prof. Dr. Paraskev Stoyanov" - city of Varna. In Bulgaria, optometrists graduate also at the Sofia University "St. Kliment Ohridski" from 2011. The training course is 4 years and includes building competencies in several areas. The WHO includes optometrists in the group of health professionals, but not medical professionals, and defines it as a priority for development.

Conducting national campaigns on the low vision problems is reasonable. The holding of post-graduate training courses in visual rehabilitation of the visually impaired for ophthalmologists, optometrists and specialists, opticians and health care professionals is justified. We don't have such at this stage. Legal changes are also needed, which we will consider in the discussion on tasks 5 and 6. Initiatives (campaigns) are sporadically carried out for the prevention, screening or follow-up of eye diseases. The most significant of them are: "Right to Vision Vision 20/20" Program, the National Screening Campaign "Vision is Everything! Check yourself!", Municipal programs for the protection of children's vision, a long-standing initiative for IOP screening in

the World Glaucoma Week, prevention of diabetes and diabetic retinopathy, SBOBAL-Varna "Your vision is important to us", etc. All of them cover the main children or cataract patients. None of them are specifically directed at low vision or blind patients.

Innovative technologies for improving and compensating the visual deficit are also not widely used in Bulgaria. In the discussion of tasks 3 and 4, we will see that the main optical device that our patients can afford is the magnifying glass. If we have to note the technological achievements that are still available in our country, we can divide them into: 1.surgical, 2.optical, 3.medical-genetic and 4.software. In the literature review, we analyzed in detail the possibilities for surgical implantation of special magnifying lenses. In Bulgaria, upon request and precise calculation, mainly the lenses can be delivered: 1.Schariot Macula Lens - bifocal Add-On IOLs, focused on patients with advanced stage ARMD, but may also be useful for other diseases of the macula, e.g. myopic maculopathy, diabetic retinopathy or hereditary retinal diseases. 2. Eyemax mono - for monocular or binocular implantation in patients with AMD. It has Wavefront optimized and aspherical optics providing a good image in all areas up to 10 degrees from the fovea. In addition to intraocular lenses, other innovative optical magnifying devices are available but difficult to afford for patients. Such are the Zeiss and Eschenbach telescopic glasses, whose prices are in the range of BGN 2,500-4,000. Fortunately, we also have the possibility of delivery of OrCam MyEye - "talking glasses", but again at very high price of 4,500 euros. More accessible for our market are the electronic magnifiers of various brands, whose prices are from BGN 650-1200 and more.

In the range of innovations in the field of ophthalmology, we should also note the possibilities for making an accurate genetic diagnosis and the possibility of genetic counseling for rare eye diseases (usually concerning childhood). This is for the prevention of early blinded patients.

Medical-genetic consultation is an indispensable part of modern care for the visually impaired with hereditary retinal dystrophies. In Bulgaria, this is carried out in several genetic laboratories - the Laboratory of Genomic Diagnostics at the Center for Molecular Medicine, Medical University - Sofia and the Eye Clinic - "Alexandrovska" Hospital. Unfortunately, in our country, modern therapies using orphan drugs for rare diseases are not carried out , there are no optogenic therapy clinical trials, no stem cell work in retinal degenerative lesions, and we have no experience with the Argus II epiretinal prostheses, for example.

Medicine, and ophthalmology in particular, is a high-tech science. IT technologies are developing extremely dynamically. This enables software programs, specialized keyboards, speech synthesizers and other innovations used by low vision patients to improve quite quickly as well. They are many and varied, some of them are accessible and available in Bulgaria, mainly represented in the portfolio of the company Bg Assist (115).

To study the adaptation of low-vision patients to their prescribed vision devices and the satisfaction with their use is not an easy task (Task 3). This is directly dependent on the individual characteristics of the patient. The function of everyone's visual system is determined by physiological and functional capabilities. The first are anatomically determined - a fact determined by a number of diseases of the eye and visual pathways, regardless of whether they are congenital, acquired or hereditary. The physiological vision can be changed as a result of surgical interventions or therapy prescribed by the ophthalmologist. Functional vision is the patient's working vision - it is strictly individual, related to the effective use of physiological vision and can be improved through the methods of visual assistance and rehabilitation (Prof.

Radulov). That is why patients with the same vision, even with the same diagnosis and at similar ages, don‘t have the same functional vision.

Functional vision is the basis of this dissertation. In order to highlight its features, it is important to discuss the demographic and clinical characteristics of the patients. Demographic parameters of the study didn‘t differ from those published in the literature. For example, in a study by Gianni Virgili, Ruthie Acosta (116), the participants ranged in age from 9 to 97 years (average median age - 71 years). In our study, the average age of patients offered visual rehabilitation was also 72 years. In another study on Austria (117) Marlene Glatz et al. cite a mean age of 75.7 ± 18.0 years, median 82, range 0–103 years. Most of their patients (n = 3675, 83.4%) were of retirement age, and only 729 patients (16.6%) were beyond it. Women were significantly more 63.5% and older than men. Overall, the most common diagnoses in this study were macular degeneration, other retinal diseases and glaucoma in the elderly, and hereditary retinal diseases in working age and children. Our results are similar. One of the studies to establish the prevailing causes of blindness in Scotland in the early 1980s gave the most common causes of blindness in the region: senile macular degeneration-30%, glaucoma-15%, cataract-10%, diabetic retinopathy- 8% and myopic degeneration (118). ARMD is the overall leading cause of blindness in most European countries (119), particularly in the United Kingdom, including England and Wales and Scotland, as well as in Ireland and Italy.

Regarding DR, in our study the examined patients were few in number – only 6, which is 7.5%. Data in the literature also indicate a similar decreasing trend. For example, in the United Kingdom, the proportion of blindness in the working-age population caused by DR has declined, both due to improved diabetes control and a national screening program for DR (120) (Liew et al., 2014). In Wales (121), despite increasing numbers of individuals with diabetes, the incidence of visual impairment (SI) and severe visual impairment (SSI, blindness) per 100,000 population due to DR has almost halved over an 8-year period from 2007 to 2015. This indicates better screening and early diagnosis of complications affecting vision. Similar favorable data are also reported by Scanlon PH (122) in the National English Diabetic Retinopathy Screening Program 2003-2016. The program started in 2003 and covers the whole of England, with 2.59 million people with diabetes screened. The benefit of the program is that diabetic retinopathy is no longer the leading cause of working-age blindness in England. According to data of Nencheva B. and for our country for the period 2005-2012 the incidence of disability due to DR has significantly decreased, which is a significant achievement for the preventive programs implemented. In addition to these, new therapies such as intravitreal anti-VEGF injections and corticosteroids are showing results. DR has become a less common cause of blindness in working-age people in England as well as in Germany, Austria, and also in Ireland (117). In the DR group of our study, anti-VEGF therapy was administered in only one patient. All the remaining 19 applications were made to patients with ARMD. Better diabetes care is paying off. The general conclusion we can make about the DR group - a small number of patients with reduced vision, most women, with good visual acuity - but meeting the inclusion criteria, without many application of anti-VEGF injections, not all with TELK, have a good index HUI-3 as well as better reading speed without and with zoom.

The group of glaucoma patients is a very interesting group. It is also small in number - only 9, which is 11.5% and all of them are women. Their average age is 79 years - comparable to the patients with ARMD, and the TELK-77.8% and HUI-3 indicators are worse than the other

groups. In this group, accompanying diagnoses were equally cataract and pseudophakia. And of all 80 study participants, glaucoma was reported as an accompanying diagnosis in only 4 patients. In the literature, the data are similar. While 1999 Patricia Nelson, Peter Aspinall, and Colm O'Brien (123) found that while there is a paucity of useful information on the extent of visual impairment in glaucoma patients, there is a wealth of information to date. About 20 years later, the medical records of 118 glaucoma patients (58 men and 60 women) were followed up at Ain Shams University Hospitals (124). Sixty-seven patients (56.7%) were considered visually impaired, while seven patients (5.9%) were considered blind. Forty-one patients (34.7%) were considered blind in one eye. Another large multicenter study at 7 university centers examined 2402 patients with glaucoma in at least one eye. Reported blindness is about 20% (125), defined as visual acuity ≤0.05 and/or visual field loss to less than 10°. In a 1991 study by S. Blomdahl, B. M. Kalisendorf, B. Tengrot, and O. Wallin. all 1795 glaucoma patients in Stockholm were followed (126). They found that the majority of patients (68%) had visual acuity better than 0.1. The remaining 590 patients had visual acuity < or=0.1. Glaucoma is the cause of low visual acuity in 20%, glaucoma in combination with other eye diseases in 35%, and only other eye diseases in 44%. The reported results for Bulgaria are from the team of academician P. Vasileva for 1995. In these, glaucoma was also cited in 20% as a cause of blindness (127). Internationally, the prevalence of glaucomatous blindness varies from very low among patients in Sweden, for example, to more than 20% among glaucoma patients in South Africa (128).

In the last group of our patients ("other"), those with different diagnoses, but meeting the inclusion criteria, were collected. It is major that these patients are younger, about 50 years old, women are also more of them, 62.5%. Retinal hereditary diseases prevail - Retinitis pigmentosa and Stargard - a total of 5. A large part of them have TELK-75% and low vision, respectively 5 and 6 degrees of HUI-3. We find a comparable result in the study of Marlene Glatz (117). Patients with hereditary retinal diseases are significantly younger than those with macular degeneration or other retinal diseases, an average of 57 years. by 83 $p<0.001$.

After researching the literature, we chose a follow-up period of 3 months not by chance. This turns out to be an optimal time for adaptation to targeted rehabilitation with an assistive device. At the same time, the follow-up is not long enough to expect deterioration of visual functions, due to the same or new diseases. In a series of studies by the Gobeille M, Malkin A, Jamara R, Ross NC (129) team, it was confirmed that there was no significant difference in outcome at 3 months versus 1 year. Of the patients who completed the 1-year follow-up period, 59% reported a subjective worsening of vision.

In a study by SJ. Fröhlich for the period January 2003. and October 2004 a total of 2,500 patients were followed, with 1,198 patients (48%) with ARMD and 296 patients (12%) with DR. It found using a mean 4.0X magnification associated with reading in DR compared to 7.6X in ARMD patients. Magnifiers were prescribed in 94% of DR patients, while electronic devices were required in only 6%. In 14.8% of ARMD it was necessary to recommend electronic systems (130), and in our study 13.8%.

In a clinic in Tübingen, patients with impaired vision were followed for two periods 2007-2011. and 1999-2005. Their results were comparable: electronic loupes were most frequently prescribed in both groups, 43%, followed by standard loupes, 32% and 29.5%, respectively, and magnifying glasses, 17% and 18.8%, respectively (131).

In a study by Lamoureux E, Pallant J et al. 124 women and 68 men with an average age of 80 years. have undergone visual rehabilitation. The majority were with ARMD 62% (119), with 78% (149) of them having moderate to severe visual impairment <6/18. After rehabilitation, there were improvements in vision and reading, but not so much in mobility and independence (132).

In another study, the average need for magnification in 568 patients was 9.9 ± 7. Table-top video magnifiers (22%), filter glasses (15%), and electronic magnifiers (13%) were most commonly prescribed. Children and young people use smart phones and tablets significantly more often - 8% vs. 0.6% ($p < 0.01$) compared to older patients over 60 years old visually impaired. Electronic magnifying devices were more often prescribed in these elderly patients in 30% to 3%, ($p<0.01$). Visual rehabilitation showed significant differences between juvenile and older visually impaired patients. Children and youth need electronic magnifiers less often because they use mobile devices (133). Our data showed that only one young woman in group 4 with retinitis pigmentosa used a smart device freely and as a work tool. Modern iPad and iPhone technologies have a number of features for the visually impaired, including voice commands, zoom, background change, speech selection, and more. Joshua L. Robinson et al. (134) track the results of their use. Participants had a best-corrected visual acuity (BCVA) of 20/60 or worse or significant peripheral visual field defects. 33 visually impaired subjects with 18 different diagnoses, with an average age of 54.3 years, were analyzed. Analysis shows that despite these modern iPad and iPhone options, patients need and seek the services of a low vision specialist. Another study compared the Optelec Compact 5 HD portable video magnifier and the Apple iPad tablet using the SuperVision + Magnifier app. 60 semi-adults aged 19 to 97 were included. Mean visual acuity was low 20/136 (135). The preferences between the two devices are almost equal: 25 for the iPad, 33 for the Optelec Compact 5 HD and 2 cannot decide. Interestingly, in a study by the Australian College of Optometry (136), prescription of the more expensive electronic loupes was relatively low. A similar low rate of prescription of electronic loupes is also found in the UK model, where these devices are even provided free of charge. It was concluded that in Australia there is also a lack of awareness and difficulties in accessing services, as well as a lack of understanding of the benefits of visual rehabilitation. There is also a low prescription rate in Bulgaria, but the leading motive here is the high price.

It is interesting the research of Virgili G and Acosta R, who found in the 2017 database a total of 13 studies, of which conducted in the USA - 7 pcs., Great Britain - 5 pcs. and Canada-1 pc. In all of them, with a total of 715 patients, insufficient evidence was collected to support the use of a specific type of electronic or optical device for a specific diagnosis leading to low vision. A trend was found for electronic devices to improve reading speed more than optical devices (137). In his study, Jackson ML. (138) describe the AAO Smart Sight model and how it can be applied in a Canadian setting. Namely, that all patients with visual acuity below 20/40, scotoma, visual field loss or contrast sensitivity be provided with information about available visual rehabilitation. According to Robillard N , Overbury O there are approximately 8,000 requests in Quebec for aids to the visually impaired each year according to statistics obtained from the "Lagie Régie de l'assurance maladie du Québec" (76).

"Looking eyes are a common thing. Eyes that see are rare." Oswald Sanders

With this sentence we will begin the discussion of the issue of reading speed. Only preserved vision is not enough for a good visual outcome. There are numerous tests for determining visual acuity - already discussed in detail. They all identify one letter/number/character from the test in the short review time. However, reading text is a much more demanding and difficult skill. Therefore, it is an important parameter for the analysis of rehabilitation results in visually impaired patients. Reading speed is usually measured using the MNREAD test, but here again there is a variety of many possible tests. The Bailey-Lowey Reading Chart and the Pepper Visual Reading Skills Test (VSRT) use a series of unrelated words. Kolenbrander maps, Radner's test, and the MNREAD acuity chart use a series of short sentences. The International Reading Speed Texts (IResT) use paragraphs of text of approximately 130 words. The set contains ten equivalent texts in each language. The IResT test is now available in 19 languages, but unfortunately not in Bulgarian. The English IReS T texts were translated into Greek and matched for length, content, and language difficulty. Greek IReSTs are presented at a distance of 40 cm and a size of 1 M to assess reading speed (139). A team from G.A. Hahn, D. Penka, C. Gehrlich, et al. have developed a set of standardized, homogeneous and comparable texts in four European languages English, Finnish, French, German (140). There are no adapted similar reading tests in Bulgarian.

Factors of the text that affect reading speed in normally sighted patients:

1. Font size - choose the smallest font that the patient can read binocularly
2. Difficulty of the subject - age-appropriate, not highly specialized text
3. Familiarity of the text - new material that is read only once so that there is no learning effect.
4. Contrast and type of font - Times New Roman is most often used

For the visually impaired, visual tests which are used are standardized. The smallest readable font size gives the power of magnification. It shows how many times the text must be magnified to be read from a distance of 25 cm. Misread words are subtracted from the total number of words in the text. The reading speed can be calculated using the formula:

number of words read correctly **Words per second x 60 = words per minute**
reading time (seconds)

We now have words per second, multiplying our answer by 60 will give us words per minute. Another easier way is to count only the words read correctly for a period of 1 min (words/minute). We use this model of investigation of our patients. In our study, the average reading speed of the 80 patients without magnification "before" was 11.53, approx. 12 words/min. After magnification of first review we have 33.75 words/min. Three months later, the reading speed without magnification was 11.40 words/min, and after magnification it was 35.16 words/min. We have the lowest reading speed in the group of glaucoma patients, and the 4th group, which has a higher visual acuity, because they are younger. The most significant increase in reading speed after a magnification in DR was 43.8 words/min at the first examination and 47.8 words/min at the second after 3 months. The weakest result was in the group with glaucoma. This is explained by the fact that only the temporal island of vision is preserved in the terminal stage of the disease, which explains the need for a specific reading technique with head adjustment.

From Almutairi's data it is clear, that a reading rate below 80 words/minute is considered slow reading, between 80 and 160 words/minute is functional reading, and above 160 words/minute is fluent reading. The average reading speed is 200 to 250 words per minute for adults reading non-specialized material. The Champion speed readers can read in the 1000-2000 words/minute range. Reading speed according to age is e.g. 1st class - less than 81 words/min, 2nd class 82 – 108 words/min, 5th class 148 – 161 words/min, 12th class 241 – 255 words/min. (141). There is limited research on reading speed for students with low vision in flat print and for Braille readers. For example, in the study by Gompel, van Bon, and Schreuder, 2004 the result was a 1.5- to 2-fold slower rate for students with low vision compared with sighted students (142). Braille readers performed one-third to one-half slower than the reading speed of their sighted peers (Ferrell, Mason, Yang, & Cooney, 2006).

In our study, we used the standard and most widely used Rosenbaum near visual acuity table, which has text at the end. It consists of 43 words, which when examining visually impaired patients turned out to be quite sufficient for the first reading. Only several patient had to repeat part of the text - single words at the beginning. We determined reading speed by accurately timing 1 minute and counting only correctly read words. The test was performed with the best near-binocular vision correction, as well as with the magnifying device with which the patient could see the text. We examined the reading speed at the 1st examination and after 3 months. The results are not unified, as there are no standardized visual acuity tables/tests for the visually impaired in Bulgaria. We compare the data with those in the literature:

Nguyen NX, Weismann M. Study of patients with severe visual impairment (visual acuity <0.1) showed significantly less improvement in reading speed compared to patients with visual acuity of 0.1 or better after rehabilitation ($p = 0.0001$). Again, this study (143) demonstrated that without appropriate optical aids, the reading speed of almost all patients was < 30 words/min, which did not represent reading ability. Using optical aids, patients improved their average reading speed to 72 ± 35 words/min. As shown in a previous study by the same authors, fluent reading requires > 70 words/min. While according to Whittaker & Lovie-Kitchin, a reading speed of 80 words/min is better for fluent reading, and 40 words/min is called “spot reading” (144).

In the study by Gianni Virgili, Acosta (145) on the problems of visual rehabilitation, 530 ARMD patients aged 82+/-8 years were studied. The mean magnification requirement was 7.4+/-6.3 times (range 2-25). Visual rehabilitation was achieved by optical devices in 58% of patients, with 42% of patients requiring electronic closed-circuit television systems. Mean reading speed was 20+/-33 words/min before and increased significantly to 72+/-35 ($p< 0.0001$) after the aids were provided. Patients with severe visual impairment (visual acuity <or= 0.1) showed a significantly lower improvement in reading speed than patients with visual acuity of 0.1 or better after rehabilitation (p </= 0, 0001). Before the provision of magnifying aids, only 16% of patients could read. Better reading was achieved in 94% of patients after magnification was provided. More importantly, there were significant differences ($p \leq 0.0001$) in reading speed before and after rehabilitation with visual aids in the group of patients with visual acuity < 0.1 (before/after: 0.4 ± 3.8/ 40 ± 13 words/min) compared to the group of patients with visual acuity 0.1 or better (before/after: 20 ± 28 / 84 ± 30 words/min).

In a study by Calabrèse A (146) involving 165 sighted and 43 visually impaired, the conclusions were that overall the data with the MNREAD test and the iPad application were very similar.

For the visually impaired, maximum reading speed and critical print size are equivalent on the iPad and MNREAD tests.
Altinbay D et al. examined (147) vision and reading with the Turkish version of the MNREAD test. This is a prospective study including 27 patients with ARMD. A reading speed between 0 and 103 words/min is established and it is proven that it is negatively related to increasing age. Assessment of adaptation to the recommended optical aid and satisfaction with its use is difficult, but it is one of the main parameters that excites researchers not only nowadays. In a retrospective study by Van Rens conducted way back in 1991, 261 patients were included - 181 women and 80 men (148). The average age of the patients was 73.5 years (range 16-95 years). The main causes of visual impairment were macular degeneration (38.9%), diabetic retinopathy (16.1%), glaucoma (8.4%) and cataract (7.4%). Optical aids were recommended to 208 persons (79.7%). Follow-up of an average of 12 months - from 3 months to 22 months, was carried out in 250 cases (96%). During this period, 24 patients (9%) died. At least 161 individuals (62%) used their assistive devices regularly, i.e. 77% of patients provided with rehabilitation. Citing this more than 30-year-old study, we confirm the design and main results of our study as well.
Rohrschneider K, Kiel R, Pavlovska V and Blankenagel A (149) analyzed the responses to 301 questionnaires (52%). Most patients (30%) with age-related macular degeneration are equipped with loupes. They report high satisfaction - 57% use their optical devices mostly for reading and writing (74% and 78%, respectively). However, 20 of the patients could no longer read due to a decrease in visual function.
In a study by Dougherty BE and Kehler KB (150), of 119 prescriptions for the visually impaired, 19% had not been used in the past 3 months. Device abandonment was not related to age ($p = 0.863$) or type of magnifying device ($p = 0.412$), and there was a significant relationship between loss of central vision and rejection of the magnifying device ($p = 0.046$).
According to another study by Gobeille MR and Malkin AG (151), withdrawal from already prescribed and started visual rehabilitation occurred most frequently in the telescopic spectacle group. According to the authors, electronic magnifiers and loupes are preferentially used, and the results do not differ significantly at 3 months and 1 year later. In the US, magnifying devices are not covered by major health insurances, including Medicare. However, the participants in this study received the boosters through a grant.
Numerous studies have been conducted on the quality of life of patients with impaired and reduced vision. For example, Lamoureux E et al. found significant improvements in overall quality of life and two specific domains: mobility and independence of daily living in the visually impaired. Further research is needed as the clinical significance of rehabilitation is still modest (152).

In Bulgaria, visual assistance for children has long-standing traditions (task 4). The work and more than 30 years of experience of Prof. Radulov is recognized worldwide. His theoretical and practical aids in this field illuminate the pedagogical aspect of the problem, but the medical one is not so studied. A system has been built that works well in the two specialized schools for children with special visual needs in Sofia and Varna, as well as in the National Rehabilitation Center in Plovdiv.
From the processing of our data, it is clear that the number of long-term followed students is not large. This trend has been observed in Bulgaria in recent years in studies of children with

special educational needs (153). This is due to the decreasing number of visually impaired students with only visual impairments or blindness, at the expense of children with multiple disabilities. In many of the foreign publications about visually impaired children, their number is also not large. In a study of 5 children by Patillo and Georgia, in 2004 (154), an increase in reading speed was demonstrated without an increase in errors or a decrease in the level of comprehension. Words per minute improvement ranged from 38% to 109%, (average 70%). In a very small group of students according to Toussaint (155) – only 4 trained in Braille, it was found that it was the teaching process that was effective in helping children who had residual vision. Not all visually impaired students use braille as their preferred method of reading. It is often used in combination with letterpress type, in addition to enlarged or magnified type by optical or electronic means. The selection is based on many surveys of the team of specialists who serve visually impaired students. This is also confirmed by the processing of the data collected by us. All students - 100% of the specialized school - know the Braille alphabet, but 62.5% also use the flat print font. In four of the children in 2009 it was found that due to extremely low vision they can only cope with the Braille alphabet, and in 2018 three of them (one child left) can now also use an electronic magnifier. Another Muranaka team (156), in 1985. investigates the ability to read picture books using an electronic magnifier - CCTV. It gives enough improvement and stimulates the interest of children to look at the image with increasing attention.

In the study by Swati Chavda et al. 2014 (157) in order to analyze the benefits of the rehabilitation of visually impaired children, a systematic search of the literature was made. By category - rehabilitation of the visually impaired, the following databases were studied: MEDLINE, Embase, Cochrane, CINAHL, Biosis, Web of Knowledge, Scopus, PsycINFO and ERIC. Out of a total of 2854, only 28 articles meet the criteria for keywords: children under 18 years of age, low vision, visual rehabilitation, quality of life, magnifying devices, reading skills, mobility, etc. All the studies have a small number of children - under 20, and the largest one has 56 participants. Reading skill is the only area that has been studied in several articles - 9 but few conclusions can be done due to some limitations all of these studies. For example, Farmer and Morse in 2007 (158) in their study of 16 children, reported an improved reading index in the magnifying group compared to the group used increased text size. Increased letter spacing results in increased reading speed. Letter spacing is of great importance for people with the lowest reading speed – this is also confirmed in the study by McLeish (159) et al. on 14 children in 2007 in England. After discussion with the vision therapist, reading speed was not examined in our study due to previously anticipated unsatisfactory results.

In a large-scale study of 52 students by Zammitt et al. in 1999 (160) demonstrates the effective need for magnification at as early an age as possible. A similar conclusion can be drawn from our results for the assessment of functional vision. A number of instruments exist to assess functional status in the visually impaired, but most of them are unsuitable for use in children. The development of such a questionnaire is valuable because, unlike adults, children with visual impairments often can't or don't express their problems. This is due to a number of reasons such as lack of awareness, assumption that all people have vision similar to theirs, fear of being examined by a doctor, etc. One such self-report questionnaire in visually impaired children is the LV Prasad (LVP-FVQ). Referring to it, our adapted questionnaire was also created. It covers issues of skills in using residual vision, how visual rehabilitation is done and adaptation to it,

and by whom. Through the questionnaire, the near vision skills, which are the basis for literacy, and the far vision skills - the basis for the social adaptation of visually impaired children, were analyzed. Thanks to the work of the visual therapist specifically, there is a favorable adaptation to the process of visual assistance.

The algorithm of behavior in the visually impaired (**task 5**) includes the algorithm of the clinical examination (visit) of the patient - history, diagnosis, DD, supplemented by an assessment of functional vision, as well as the algorithm of implementation of visual rehabilitation - vision, magnification, type of magnifier, training, adaptation and tracking. Visual impairment occurs when an eye disease affects the visual system and one or more of its functions. Visual impairment is primarily measured by distance visual acuity. Additionally, near vision, visual field, contrast sensitivity and color vision are examined. For the visually impaired, the behavior algorithm includes determining distance vision and near vision in each eye separately, both without correction and with correction with glasses and with a magnifying device.
Lester FK back in 1980 (87) states that in order to be able to perceive a visual stimulus there are 2 important conditions: 1. A functioning visual system – a healthy visual analyzer and 2. good lighting. It is clear that even the healthiest eye can't see in total darkness. That is why the term "reading triangle" was introduced, which includes: 1. good lighting, 2. good font quality, 3. good projection of the image on the retina. In order to fulfill the last condition, there are three ways: 1. bring the object closer to the eye - change in the working distance 2. increase the size of the object, the font 3. let the image pass through a system of lenses - magnification. First, the visual acuity needs to be investigate, then the correct magnification with the optical device. There are numerous tables for determining visual acuity discussed in the literature review.

The oldest known assessment of reading is the Jaeger test, which consists of several sentences that decrease geometrically in size (Rubin, 2013; Runge, 2000). Jaeger's test was originally printed in German, then translated into English and French.
However, due to font changes occurring in translations, the size progression is lost (Runge, 2000). The development of Bailey–Lovie maps solved this problem by reducing the standard print size of texts logarithmically (Bailey & Lovie, 1980). Bailey-Lovie charts are now commonly used by clinicians to assess magnification in patients with low vision (Times New Roman, 12 point font, Rubin, 2013). The modified ETDRS "European" charts contain a set of Latin letters that are common to the three European alphabets—Latin, Greek, and Cyrillic—and are therefore readable by European citizens (161). Detailed studies were done by the Greek team Glenni A, Kristakis E et al.
The Rosenbaum Pocket Vision Screener also assesses near visual acuity. In our patients, we used this test, since those with Latin letters are not applicable for Bulgarian, especially elderly patients. Corrective glasses must be worn to determine "best-corrected" visual acuity. WHO defines glasses and contact lenses as functional interventions, because they don't remove or cure the causes leading to refractive errors, but only compensate.
After we already have a correctly determined vision, it is necessary to calculate the magnification necessary for patients with low vision. It should be noted that magnification can compensate for reduced retinal resolution but not for the effect of scotoma (Rubin 2001, Whittaker & Lovie-Kitchin 1993, Legge et al. 1992).

There are many formulas for determining magnification based on visual acuity, e.g. of Kastenbaum, Lovie, Bailey of Lebenson, etc.

The required increase is the easiest to calculate using the formula:

Patient's actual visual acuity = X (magnification)
Desired visual acuity of patient

VA patient = X magnification
VA desired

For example, we have vision 20/200, and the desired vision is 20/50, then 200/50=4X magnification is needed.
The necessary magnification for near is most easily calculated by the formula:
If a patient reads a 10 cm 4M text, then:
400cm:10cm=40 Diopter 40D : 4=10X magnification for close
Magnification (M) = Dioptric power (D)
This formula works if the patient can maintain enough accommodation to hold the object at 25 cm. If magnification is used, the reading text is placed in the main focal plane of the lens.

Another way to calculate is Snellen's formula. It shows the relationship between letter size, viewing distance, and distance visual acuity.

$$V = \frac{m}{M}$$

(V = visual acuity, m = visual distance in meters and M = letter size in M-units)

A modified Snellen formula is convenient for analyzing near vision, as all components have direct clinical value:

$$\frac{1}{V} = \text{Magnification requirement,}$$

Viewing distance, measured in diopters D, is directly related to the required reading addition (or accommodation).

$$\frac{1}{V} = \frac{M}{m} \text{ and } \frac{D}{m} = \frac{1}{M}, \text{ substituting } D = \frac{V}{M} \text{ and finally } D : 4 = X \text{ magnification}$$

Precision Vision offers small test cards with a 40 cm cord attached. They don‘t require calculations, since the visual acuity values for use at 40 cm are given on the map. They are suitable for patients with normal vision. Precision Vision also offers larger reading cards for low vision patients. They can be used at any distance, recalculating according to the modified Snellen formula.

The combined charts for direct recalculation are widely used by low vision specialists. For example, that of the Lighthouse Chart given on the table. 32.

Table.32. Lighthouse Chart

Guide to Selecting Optical Aids
By the New York Lighthouse

Lighthouse Guide Vision	Lighthouse Guide NYL Code	IMRC/APH Extension Diopters	Magnification	Focal Length
20/40 – 20/60	A	3-6 D	Up to 1.5X	12-6 inches
20/70 – 20/100	B	7-10 D	1.75X – 2.50X	6-4 inches
20/100 – 20/200	C	10-20 D	2.5X – 4X	4-2.5 inches
20/200 – 20/400	D	20-40 D	5X – 8X	2.5-1 inch
Below 20/400	E	40-80 D	10X – 20X	0.5 inch or less

Each symbol used in its Code relates the visual acuity range to the number of Diopters needed to read average print. (8pt. to 12pt)

Available and most used in Bulgaria are the sets for low vision consultation of the companies Eschenbach and Zeiss. Therefore, their tables for the adaptation of a magnifying device are often applicable (Fig. 24). These are the charts included in the work algorithm that we also used in this study.

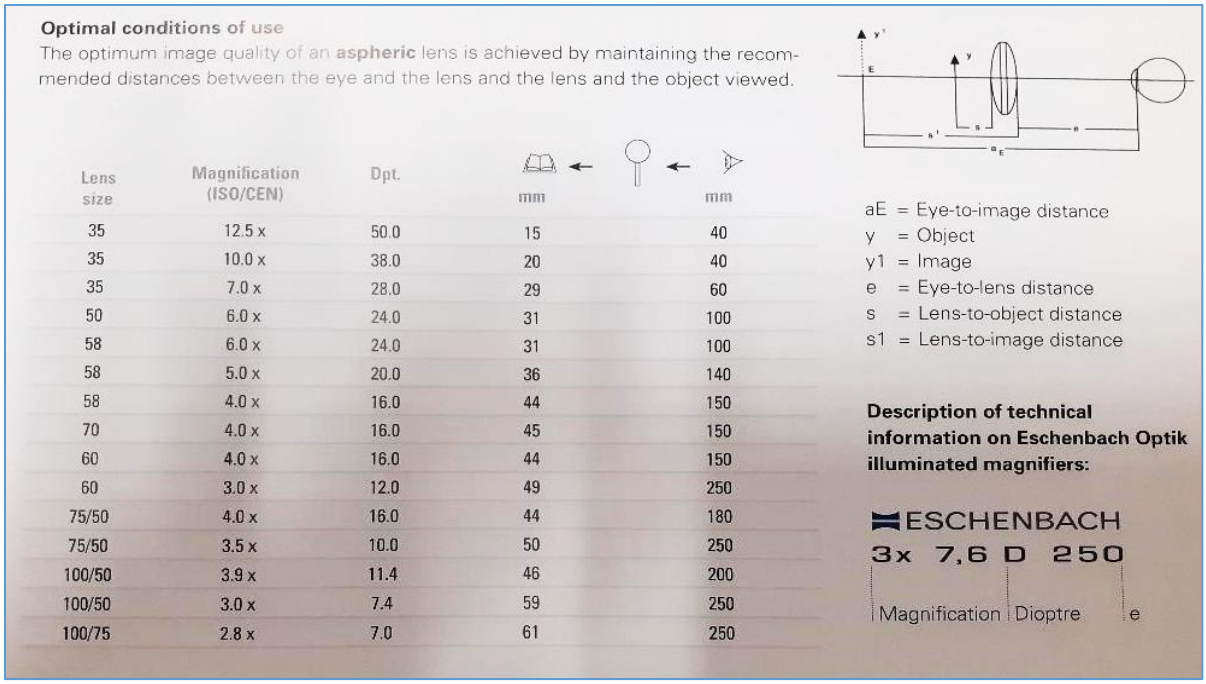


Fig. 24. Eschenbach chart

In order to create a model of an integrated approach to patients with impaired vision (**task 6**) and different degrees of blindness, it is necessary: 1. unification of a standard classification of

the degrees of impaired vision, 2. algorithm of work of the eye specialist, 3. multifunctional interdisciplinary team and 4. regulatory framework of new legal regulations.

In the literature review, we saw great variety of diversity in the classification of impaired vision and blindness. From the results in our study, we have shown the irregularity of using a diagnosis of blindness H54. in the medical documentation, which would subsequently serve as a basis for social benefits and disability. A similar result was found in a study by Glatz M et al. (162) of 2022, found that GPs considered other leading diseases more suitable for registration for social benefits. Such as impaired mobility and override the ophthalmic ICD-10 diagnosis, even if it is "legally" and ophthalmologically correct. Also, in some cases instead of specific blindness codes H54. general codes such as "other vision disorders"-H53.8 were selected.

Usher syndromes, for example, were coded as "deafblind" and some DR patients as "other retinal diseases" without further information. All this would compromise the accurate statistics of blind and partially sighted patients. For example, in Denmark (163), a visual acuity of less than or equal to 6/60 (< or = 6/60) was accepted as the standard for blindness. It was studied on the basis of 1585 application forms to the Danish Blind Society in 1993. Statistics on blindness are generally very sensitive to the definitions of blindness used. Changing the definition of blindness to a visual acuity of only less than 6/60 reduced the number of formally blind patients by 32%, and based on the WHO definition of visual acuity <3/60 only 562 individuals (35%) would were considered blind. In Bulgaria, the WHO classification for impaired vision is handled, but the main weight is given to the disability groups according to MLEC ("TELK"). And there is a difference in visual acuity between the two classifications. As we found in our study, the average age of the patients who were offered visual rehabilitation was 72 years, with the proportion of women being 68.75%, 28.67% have consulted, and 91.25% have purchased any device. Of those who recently purchased a magnifying device, 75% are satisfied with the rehabilitation of their vision and use it regularly. A collective of Coker MA, Huisingh CE, et al. (164) also examined referral rates for visual rehabilitation of adults with irreversible visual impairment. Of 143 patients with low vision in one or both eyes, the mean (SD) age was 55.4 (11.1) years, and 68 (47.6%) were women. As noted in the electronic health record, the referral rate for rehabilitation was 11.4% for patients with irreversible bilateral visual impairment (4 of 35 patients) and 1.9% for those with unilateral impairment (2 of 108). According to Jonathan Jackson of the Australian College of Optometry (136), although rehabilitation has been shown to be effective for the visually impaired, uptake is alarmingly low. Only 20% (compared with 28.67% here) of Australian patients with low vision receive such rehabilitation, although over 90% could benefit. In their study, Shah P. et al. show that even when visual rehabilitation is available, patients may not use it. All 702 patients with vision worse than 20/60 or visual field worse than 60° in the horizontal or vertical meridian underwent structured interviews. Among them, only 54% used vision rehabilitation, 33% of patients had never heard of vision rehabilitation or were never referred, and 13% knew but didn't use it. Highly educated patients are more likely to be aware of the need for one. As regarding vision rehabilitation worldwide, the lack of accessibility of the service, poor financing and low awareness have been highlighted. In the article by de Boer MR. and Langelaan M. (165) has a guideline of the Dutch Society of Ophthalmology, according to which consultation with an ophthalmologist is essential. It reveals the possibility of rehabilitation in the presence of visual acuity <0.5 and/or visual field <30 degrees in the better eye. Mild cases are handled by an optometrist, and severe cases by a

specialized center for work with the visually impaired. Visually impaired and blind patients are informed about the existence of patient organizations. All the necessary information is sent by letter to the family doctor. The study by Acton J. and Molik B. from 2016. (166) showed the effect of home visits on visual rehabilitation. Preliminary evidence suggests that home visit-based rehabilitation has a positive effect on vision-related functional outcomes.

The cited global experience provides the basic framework of the integrated model, to which we added specialists who gave the multidisciplinary look of the team we proposed. In addition to human resources, Bulgaria also needs a new regulatory framework. The legal provisions that regulate the possibilities of social assistance in visual rehabilitation were very outdated in nature, but promulgated without updating at the start of the 2019 study. The proposals we have made have been reported at several workshops and round tables on the problems of the visually impaired (Retina Association Bulgaria 2021 - round table "Vision for vision"). Namely in the part: *"...*for the provision of aids, devices, equipment and medical devices for which disabled people with an established need, according to the type of disability and the individual assessment of needs, use targeted assistance…"

According to the statutory requirements under the Health and Safety Act, in point 9 of Appendix 2 it is clearly visible what means would be allowed (marked in gray) - telescopic glasses, magnifying glasses, screen and binoculars, and for what diagnoses (marked in yellow) - if the disability is the result of a work accident, occupational disease, traumatic injury, a complication of a general illness, myopia and hypermetropia over 10 diopters. Socially significant eye diseases, such as ARMD, diabetic retinopathy, glaucoma, retinitis pigmentosa, etc. are not included in the regulatory framework. The listed diagnoses are socially significant and are the leading cause of blindness worldwide, as we have argued extensively above. In July 2022 a regulatory change is initiated, concerning only the activities of providing aids - to be financed and administered by the National Health Insurance Fund (NHIF). The ordinance remains outdated with a view to updating the indications and diagnoses for the use of targeted assistance by the visually impaired and the possibility of adequate visual rehabilitation. This social assistance was also extremely financially insignificant, and included glasses and equipment (marked in gray from the table), for the most part out of use. There was no unison with the modern low vision enhancement technologies we looked at. What's new to come:

In appendix No. 5 of the methodology in the project of a normative act for assessing the needs of high-tech devices for people with permanent disabilities, discussed immediately before the submission of this dissertation, modern aids for visual rehabilitation are published. The team of the present study hopes that this will be confirmed and become a promulgated normative act in force from 2023. It is clear from the public discussion that many organizations are actively participating and supporting the amendments, which is a moral recognition of our work and efforts.

Ophthalmologists usually diagnose and treat patients with eye problems, but when a diagnosis of blindness or reduced vision is made, the patient is referred to other institutions, e.g. TELK or the class organizations - Union of the Blind in Bulgaria, and the collaboration is interrupted. That is why the creation of a team of specialists is justified. Optometrists are a unit that is not widely represented in our country, they are still being trained. They should consult and advise patients about magnifying devices in collaboration with the ophthalmologist. Typhlopedagogists have recently been replaced by the term visual therapist. Typhlopedagogy

is a part of special pedagogy - defectology, which develops the issues of training, education and upbringing of blind and partially sighted people in view of the peculiarities of their cognitive capabilities. It is dealt with by the visual resource teacher. Such specialists are few in number and are mainly concentrated in schools for visually impaired children or resource centers. Psychologists are especially needed in cases of patients with sudden vision loss, which is a great stress for the patient and his family. They are also mandatory when working with visually impaired and blind children. It would also be necessary for the elderly patients with low vision, which a number of studies prove to be polymorbid and depressed. The place of the social worker is in the field of socio-economic assistance and integration of people with disabilities.

VI. Final conclusion

This dissertation deals with the issue of the visually impaired in a comprehensive way - from the most common socially significant diseases associated with it, through the social aspect of the problem to the visual rehabilitation and integration of these patients. The selection of these three diseases specifically - AMD, glaucoma and DR for follow-up in the study is determined not only by the high incidence of the diseases, the severity of complications leading to blindness, but also the specificity of the visual impairment - impaired central visual acuity. This sharply worsens functional vision due to central scotoma and requires specific reading techniques as well as special magnification aids. These socially significant eye diseases are the leading causes of reduced vision and blindness in the world, with an unfortunately upward trend in their future incidence.

Our results confirm the importance of low vision rehabilitation by adequately providing optical aids to improve reading ability, which significantly increases its speed.

In our study, it was found that most of the visually impaired children had residual useful vision. Depending on the nature and type of visual impairment, they often have difficulty performing their daily tasks. All of the students in the special school are proficient in Braille, but nearly two-thirds also use flat print. Half of them still need additional training with the aid. This confirms the need for visual rehabilitation at as early an age as possible.

The inadequate public awareness and knowledge of ophthalmologists on the problems of the visually impaired and visual rehabilitation was confirmed in a categorical manner by the survey conducted in both the variants. This unambiguously demonstrates both the need for change in public opinion and specialized training of medical professionals. Therefore, the need to introduce an algorithm for the work of the low vision specialist is justified. It should emphasize the types of visual rehabilitation aids- magnifiers, telescopic spectacles, electronic devices, and television systems-and specify the algorithm for determining the necessary magnification of the aid. All this expands the possibilities for visual rehabilitation and social integration of the visually impaired. The results of the questionnaire show the positive attitude towards the topic and the desire for mutual help towards the visually impaired.A complex national strategy is needed, because it is an intersection not only of health but also of social policy. This is where all the efforts of the participants in the interdisciplinary team in working with the visually impaired are directed. The role of the ophthalmologist, who specialises in visual rehabilitation, is paramount. The optometrist, the vision therapist (typhlopedagogue) and

the optometrist have a determining role. The specific work carried out by the social worker and the psychologist should not be overlooked. This is the model of an integrated approach - a strong link between the individual professionals, mutual assistance between institutions. Only in this way will there be a comprehensive provision of health care and social services, which will guarantee a dignified and independent life for people with visual impairment.

Visual rehabilitation does not have an instant effect. It is a process of diagnosis of the problem, training in the correct use of the optical aid, adaptation to the aid, combined with trust in the team of specialists - ophthalmologists, optometrists, typhlopedagogues, and sometimes a social worker and psychologist. It also involves a period of follow-up, assessment of the condition and motivation in continuing education, all combined with patience and professionalism. The results of the research in this paper confirm the need for both children and adults for visual assistance/rehabilitation, teamwork and continuous time to obtain optimal results in improving functional vision.

VII. Important conclusions

1. In Bulgaria, there has been no extensive analysis of the overall information on the long-term follow-up of the visually impaired and the possibilities for access to the high-tech achievements of optics and medicine for visual rehabilitation. There are also no studies on the degree of improvement and optimal use of functional vision when adapting to different types of aids. There is limited information on social support and integration opportunities for the visually impaired.

2. The level of awareness of patients as well as medical professionals about blindness and low vision is unsatisfactory. Many of them have no information about the activities of the Blindness Association or schools for the visually impaired, do not know the legal possibilities for prescribing optical aids, and are not interested in specialized training in visual rehabilitation. However, more than 90% of the respondents expressed a positive attitude towards participation in National campaigns to raise awareness and integration of visually impaired patients.

3. From the study of the low vision adult patients, it is clear that due to the fact that the visual acuity for distance in most of them is very low, between 0.01 and 0.05, they show no desire for optical correction for distance. The preferred means of correcting near visual deficit is magnifiers, followed by electronic magnifiers.

4. There is a statistically significant difference in reading speed "without" and "with magnification", in the second case it is about three times higher in all groups of patients studied. The same significance in reading speed "without" and "with magnification" was maintained at the 3rd month examination. However, there was no difference in the two groups of indicators between the first and second examination. The cited global experience provides the basic framework of the integrated model, to which we added specialists who shaped the multidisciplinary look of the team we proposed. In addition to human resources, Bulgaria also needs a new regulatory framework. The legal provisions that regulate the possibilities of social assistance in visual rehabilitation were very outdated in nature, but promulgated without updating at the start of the 2019 study. The proposals we have made have been reported at several workshops and round tables on the problems of the visually impaired (Retina Association Bulgaria 2021 - round table "Vision for vision"). Namely in the part:

Art. 68. (1) In the cases under Art. 73 of the Law on People with Disabilities, the medical conditions, operational terms and the necessary medical documents for the provision of aids, devices, equipment and medical devices for which disabled people with an established need, according to the type of disability and the individual assessment of needs, use the target aid, are specified in Annex No. 2 of the regulation.

5. Of all 80 patients who underwent primary examination, one-third did not undergo visual rehabilitation despite being recommended an appropriate aid. Assessment of functional vision in those who purchased such aids showed that patients with age-related macular degeneration had the best motivation to use and adapt to them, followed by those with glaucoma and DR. Group 4 patients with the more heterogeneous and more severe diagnoses had the most difficulty.

6. In the study of children with low vision, it was found that with the help of training, assistive magnification devices and other advances in technology, they could make the most of their residual vision. The most preferred magnifying aid for visually impaired students is the magnifying glass. Their high motivation to handle the magnifying aid coincides with their good adaptation and developed skills.

7. There are significant barriers and difficulties in access to visual rehabilitation of organizational and personnel nature - limited resources, lack of trained specialists, lack of integrated approach and formed multidisciplinary team. Overcoming them will contribute significantly to improving the visual assistance of the visually impaired and will ensure comprehensive care based on modern standards and competencies by all specialists involved in the integrated model: ophthalmologist, optometrist, optician, vision therapist/typhopedagogue, social worker and psychologist.

VIII. Contributions

1. Contributions of a cognitive nature

1.1. A detailed literature review was made, covering Bulgarian and world literature and accessible databases, dedicated to blindness and the visually impaired

1.2. A systematic theoretical review was carried out on the topic of visual support for children with impaired vision

1.3. An analysis of the visual rehabilitation of adult patients with socially significant eye diseases was carried out

2. Contributions of a scientific and original character at the national level

2.1. First-ever long-term follow-up of low-vision patients and an analysis of magnifiers used in children and adults for visual rehabilitation

2.2. For the first time in Bulgaria, the opinion of patients, healthy people and medical specialists on the subject of blindness and low vision has been studied, and the current regulations in the Republic of Bulgaria regarding visual rehabilitation have been analyzed

2.3. An algorithm for working with patients with impaired vision was developed and proposed by a multidisciplinary team of specialists specialized in applying the innovative achievements of optics and medicine to compensate reduced or missing vision in these patients

2.4. Barriers and difficulties in the implementation of visual rehabilitation were studied and defined, and a model of integrated care for patients with impaired vision was built.

3. Contributions of a confirmatory nature

3.1. The initial hypothesis that the awareness of the population and medical professionals is unsatisfactory on the issues of blindness and low vision was confirmed

3.2. The use of optical magnifiers for visual rehabilitation has been shown to improve residual functional vision

3.3. Weaknesses and shortcomings in integrated care for the visually impaired were identified and pointed out

IX. Publications and participation in scientific forums

Publications related to the dissertation work

1. How do we classify blindness - H54. According to ICD-10? I.Pitakova, East European Scientific Journal, 11(51)2019, 29-34

2. Low-vision magnifying devices for visually impaired - I.Pitakova, Z.Zlatarova, Journal Medinfo-3/2020, p.52-56, Year XX

3. Access to visual rehabilitation and difficulties in its implementation, I. Pitakova, Z. Zlatarova, Bulgarian Ophthalmological Review, 64 (2) 2020, p.39-45

4. Innovative technologies to improve low vision - I. Pitakova, Bulgarian Ophthalmological Review, 65 (2) 2021, p.35-42

Publications on the subject – visually impaired and visual rehabilitation

1. "Visual deficiency. Visual rehabilitation - part 1" Ophthalmology reference bulletin - 4/2008, pp. 25-29

2. "Visual deficiency. Visual rehabilitation-2nd part" Ophthalmology Reference Bulletin - 5/2008, pp. 17-19

3. "Study on public awareness of the problems of blindness and the visually impaired" - Varna Union of Scientists - 26.10.2018.

4. "Integrated approach for the visually impaired" - Journal of Varna Medical College,
VII Scientific Conference 5-6.10.2018

5. "Investigation of functional vision in visually impaired children after long-term visual rehabilitation" - Bulgarian Ophthalmological Review, 2018; 62(4):26-34

Participation in scientific forums on the subject

1. "Causes of low vision and blindness in North-Eastern Bulgaria-myths and facts" Grupcheva Hr., Pitakova I., Peeva St., Tabakova K., Chervenkova E., Grigorova A. Report of the 17th annual meeting of SOLB, Plovdiv 26-29.05.2004

2. "Integrated approach for the visually impaired" I. Pitakova, T. Kostadinova, Z. Zlatarova, 7th Scientific Conference of Varna Medical College 5-6.10.2018.
3. "Study on public awareness of the problems of blindness and the visually impaired". I. Pitakova, T. Kostadinova, Z. Zlatarova, Union of Scientists Varna 26.10.2018
4. "Review, approach and rehabilitation for the visually impaired" - I. Pitakova, poster participation BDO Congress, Borovets, 24-27.10.2019

Participation in projects on the subject

1. Participant in the competition "Innovations and good practices in the health sector", campaign of Capital, Project - "Visual rehabilitation of the visually impaired".
2. Advocacy and informational-educational campaign: "Vision for Sight" of the association Retina Bulgaria, Lector on the topic "Eye diseases - causes of vision loss and behavior in them"

X. Summary

Aim

The aim of this thesis is to study and analyse the modern possibilities for visual rehabilitation of the visually impaired and to develop an algorithm for work and a model for integrated care for these patients.

Methodology

The materials and methods of the thesis are separated into different groups, because of multi-layered scope and multi-directional tasks.
Using historical and documentary methods, significant tasks have been completed in of preparing a literature review, building an algorithm for the work of low vision specialists and summarizing an integrated approach including a multidisciplinary team.
This clinical trial screens and follows up visually impaired people with socially significant eye diseases. Patients diagnosed with H54 blindness, according to ICD-11, were studied. The follow-up period is three years - 2019-2022. Visual rehabilitation with optical devices was prescribed for patients with visual acuity ≤ 0.3 with correction of the better eye or both eyes. The included patients were divided into four groups - with macular degeneration, diabetic retinopathy and glaucoma, compared with another general group of low vision. The results were processed statistically with SPSS.
The data of examined children from the school for the visually impaired in Varna were retrospectively processed and analysed for period of 2009-2018. An adapted version of the questionnaire was developed, which we used in the second visit. It includes several areas of research: near vision skills, far vision skills, adaptation to magnifying devices and who provide visual assistance.
The results of a specially developed questionnaire in 2 versions were analysed. The studied groups of respondents are two - the first includes 150 patients, the second includes 45 medical specialists.

Results

The survey research gives an indicative picture of the lack of knowledge on visually impaired and their visual rehabilitation. Sixty percent of the respondents are between the ages of 25 and 60. A large part of them (89%) have no information about the activity of the Union of the Blind and schools for the visually impaired in Varna and Sofia. The share of respondents who are not interested in specialized training in visual rehabilitation is 33%. Many of the respondents -75%, lack information about the price of magnifying devices of the visually impaired. The results strongly confirm the working hypothesis that the awareness of the target group of the study on the researched issue is very unsatisfactorily.

The data from the study of visually impaired children shows: total of 23 children from school grades 1-3 were included in the first visit, of which 17 male, 6 female, theirs average age was 10 years (7-13). On the second visit only 16 students were examined. First visit in 2009, monocular reduced vision was found in 5 children, and binocular reduced vision – in 18. The results are - 10 children were recommended visual assistance through a magnifying glass, 6 were referred for correction with dioptric glasses, in 4 only Braille training was possible and at 3 - no recommendation, they are doing well. Nine years later, it was found that a total of 11 children use a magnifying glass, with 7 of them using both a magnifying glass and an electronic magnifier, only one child using glasses and a magnifying glass, and the remaining three children using only a magnifying glass. The most preferred magnification of the magnifiers used is 5x – in 6 children (37.5%). Three students become literate only in Braille. The assessment of functional vision shows positively developed. For instance: close vision skills - students hold the optical device correctly in 93.75% and recognize a face in 81.25%. The distance activity rating shows 100% success. In 50%, additional training with a magnifying device is still necessary, and only in 12.5% the aid is completely rejected.

Visual rehabilitation of the visually impaired adults takes place in Varna for the period of 05.2019 until 05.2022. All 80 patients/160 eyes were examined, of which 25 (31.25%) were men and 55 (68.75%) were women. In all four observed groups, the relative part of the women is greater. Only 1.8% have better vision 0.3, i.e. 3 patients, and vision absolute 0 is present in 6 eyes - 3.75%. The analysis shows that distance visual acuity is concentrated between 0.01-0.05. It is too low, which predetermines the lack of optical correction for distance. Only one patient was prescribed and purchased a magnifying device for distance - telescopic glasses. There were only four eyes of all 4 groups in which a maximum visual acuity of 20/20 was achieved after using a magnifier. The data about reading speed shows that there is a statistically significant difference in reading speed "without" and "with magnification" in both reviews. On the first review, the average speed was: 11.52 d/min without magnification and 33.7 d/min with magnification, and on the second, respectively: 11.40 d/min without magnification and 35.16 d/min with magnification. The magnifiers are the preferred correction of vision, followed by electronic magnifiers by 30%. Only 32.5% of all 80 patients who passed the first examination, did not do the visual rehabilitation - 26.25% did not purchase the recommended aid, and 5 did not appear for a second examination. The assessment of functional vision shows that the ARMD group demonstrated the best motivation - 63.9% and adaptation - 67.9%. Patients from 4-th group with more severe diagnoses had the hardest time to deal.

The integrated model for the visually impaired includes a multidisciplinary team of an ophthalmologist applying the detailed medical algorithm, an optometrist, an optician, a vision therapist, a social worker and a psychologist.

Conclusions

Visual rehabilitation does not have an immediate effect. It is a process of diagnosis of the problem, training in the correct use of the optical aid, adaptation to the aid, combined with work in the team of specialists - ophthalmologists, optometrists, a vision therapist, and sometimes a social worker and a psychologist. It also includes a period of follow-up, assessment of the condition and motivation in continuing education, all combined with patience and professionalism. The results of the research in this thesis confirm the need for visual rehabilitation, for teamwork and for a long period to obtain an optimal result in the improvement of functional vision.

Key words - visually impaired, visual rehabilitation, visually impaired students, reading speed, socially significant eye diseases, blindness.