

Outcomes of Cataract Surgery and Predictors of Poor Outcome in Lions Regional Ophthalmic Unit

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by

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List of Abbreviations

WHO	World Health Organization
ARMD	Age-related macular degeneration
BMI	Body Mass Index
PEX	Pseudoexfoliative Syndrome
ICCE	Intra Capsular Cataract Extraction
ECCE	Extra Capsular Cataract Extraction
SICS	Small Incision Cataract Surgery
RACSS	Rapid Assessment of Cataract Surgical Services
ROU	Regional Ophthalmic Unit
IAPB	International Agency for Prevention of Blindness
CSC	Cataract Surgical Coverage
WHO PBD	World Health Organization Prevention of Blindness and Deafness
VA	Visual Acuity
ALC	Ararat-1 Lions Club
LCIF	Lions Club International Foundation
LAICO	Lions Aravind Institute of Community Ophthalmology
AIC	Akaike's Information Criteria

ABSTRACT

Introduction: Cataract is the first leading cause of blindness worldwide. It is not preventable and surgery is required to restore vision. World Health Organization classifies outcomes of cataract surgery into three categories based on Visual Acuity (VA): Good Outcome (VA= 6/6-6/18, VA Best Corrected>85%), Borderline Outcome (VA<6/18-6/60, VA Best Corrected< 15%) and Poor Outcome (VA<6/60, VA Best Corrected< 5%).

Aims: 1) to assess the outcomes of cataract surgery in Lions Regional Ophthalmic Unit (ROU) in patients aged 50 years and over operated from January 2008 to April 2009, 2) to identify the reasons for borderline and poor outcome in this study group, 3) to give recommendations for decreasing the rates of borderline and poor outcomes, and 4) to compare the results of this study with the study conducted in Kanaker - Zeytoon Medical Union in 2006.

Methods: The study utilized a cross-sectional study design. People with missing contact information, mental and severe hearing impairments were excluded from the study. The main outcome variable was Best Corrected Postoperative VA. The study collected data using an interviewer - administered questionnaire adapted from a previous study in Armenia.

Results: The proportion of good outcomes in Lions ROU was 78.3%, borderline - 15.5% and poor - 6.2%. The proportion of good outcomes was statistically significantly lower than the WHO recommendation of >85%. Simple Linear Regression showed that age, ophthalmic comorbidity and level of education were significantly associated with VA. All these variables were included in the Multiple Linear Regression, where only age and ophthalmic comorbidity showed significant association. Independent Sample t-test showed that mean VA in the ROU was significantly higher than in Kanaker - Zeytoon Medical Union.

Conclusions: The study results showed that age and ophthalmic comorbidity were negatively associated with the VA and were predictors of poor outcome in this study group.

Early detection and treatment of ophthalmic comorbidities may improve outcomes of surgery in Lions ROU.

1. INTRODUCTION

1.1. Adult vision impairment worldwide

Visual impairment involves various visual functions such as visual acuity, contrast sensitivity, glare sensitivity, stereopsis, and visual field [1- 3]. According to the World Health Organization (WHO) classification, “low vision is defined as visual acuity of less than 6/18, but equal to or better than 3/60, or a corresponding visual field loss to less than 20 degrees in the better eye with best possible correction” [4-6]. Blindness is defined as “visual acuity of less than 3/60, or a corresponding visual field loss to less than 10 degrees in the better eye with the best possible correction” [4-6].

WHO assessed that in 2002, more than 161 million people had various visual impairments (excluding refractive errors), 124 million of those people had low vision and 37 million were totally blind [4-6]. In addition to these data, the number of blind people worldwide is increasing by at least 1–2 million per year [6].

Blindness decreases quality of life and has great impact on socio-economic development of individuals and society [4]. It was estimated that half of children blindness and 75.0% of total blindness in the world are avoidable (preventable and/or treatable) [5, 6]. Prevention of avoidable blindness brings to savings in health care and is considered to be one of the priority issues in public health ophthalmology [5].

The burden of blindness is not distributed equally throughout the world: the least developed countries carry the largest portion of avoidable blindness [1, 5]. More than 90.0% of the visually impaired people in the world live in developing countries, particularly in rural areas of those countries [5].

The top five causes of blindness are [1, 5]:

- Cataract - responsible for 47.0% of total blindness in the world

- Different types of glaucoma - 12.0% of world's blindness
- Age-related macular degeneration (ARMD) - 9.0% of world's blindness
- Corneal opacities - 9.0% of world's blindness
- Diabetic Retinopathy - 5% of world's blindness

In developing countries the main reasons of blindness are cataract and refractive errors, while in developed countries blindness is mostly due to ARMD [1, 5]. It is also estimated that in the majority of countries cataract is the main cause of low vision and blindness [1, 4-7]. Of 37 million blind people worldwide, 18 million are bilaterally blind due to cataract [4, 5].

Risk factors for developing cataract are: age, gender, systemic diseases, metabolic disorders, environmental factors, genetic disorders, cigarette smoking, alcohol consumption, Vitamin A deficiency and high BMI [7- 16].

Age: Several studies revealed strong association between ageing and development of cataract. The prevalence of cataract significantly increases after the age of 50 and about 82% of all blind people are aged 50 years or older [7, 8, 10].

Gender: Women of all ages are more likely to be visually impaired than men, and the prevalence of cataract among women is significantly higher compared to men [1, 15]. The main reasons for this inequality are longer life expectancy of women and lower access to health care services due to financial dependence on men [15].

Systemic diseases: Cataract is a common clinical manifestation of Bekhchet disorder¹ [8, 16]. Different studies reveal that people with systemic hypertension have higher risk for developing cataract compared with people without hypertension [8, 10].

¹ Bekhchet Disorder - ophthlmo-stomato-genital syndrome with cataract and/or uveitis as an ophthalmic manifestation of the disease

Metabolic disorders: Metabolic changes being present in case of diabetes and Pseudoexfoliative Syndrome (PEX)¹ are facilitating development of opacity in the lens [8, 10, 16]. The results of several studies showed that Diabetes Mellitus is significantly associated with posterior sub capsular cataract [9, 16].

Environmental factors: Literature shows that high levels of sunlight, particularly ultraviolet (UV) - B exposure fasten cataract formation and UV exposure is significantly associated with cortical cataract [8-10].

Genetic Disorders are responsible for different types of congenital cataract, which are often accompanied by other symptoms and/or involvement of other organs [16].

Other Risk Factors: Smoking, Alcohol consumption, Vitamin A deficiency and High Body Mass Index (BMI) are also considered as risk factors for cataract development [8 - 14]. There is controversial information related to the association between cigarette smoking and cataract formation. Some studies suggest that smoking is significantly associated with cataract, while others suggest that smokeless tobacco use was strongly associated with particular type of cataract - nuclear cataract [12-14]. Alcohol consumption was also found to be associated with cataract formation [11, 12]. People with Vitamin A deficiency and high BMI have higher risk of developing cataract than those with normal levels of Vitamin A and normal BMI [8- 10].

Although cataract cannot be prevented, its surgical treatment is one of the most cost-effective interventions in health care, preventing people from blindness [1, 5]. There are four main techniques of cataract extraction [1, 17-19]:

- Intra Capsular Cataract Extraction (ICCE) - the oldest method of cataract surgery and currently in majority of countries has only historical meaning

¹ Pseudoexfoliative Syndrome (PEX) - age-related dystrophic process in anterior chamber, with amyloid deposits on lens capsule and trabecular system

- Extra Capsular Cataract Extraction (ECCE) with Intraocular Lens implantation (IOL)
- mainly performed in developing countries
- Small Incision Cataract Surgery (SICS) - a modification of usual (ECCE) with low cost and better results, which is widely used in developing countries
- Phaco emulsification - main type of cataract surgery performed in developed countries, which enables ophthalmic surgeons to extract the lens at non mature and primary stages of cataract and achieve good post surgical results [19].

1.2. Situation in Armenia

The prevalence of cataract and resulting blindness in Armenia is also high [20]. In 2003, Garo Meghrigian Institute for Preventive Ophthalmology (Meghrigian Institute) conducted a Rapid Assessment of Cataract Surgical Services (RACSS) in Gegharkunik Marz of Armenia [20]. The results of RACSS survey indicated that the prevalence of blindness in this region was 3.7% and in 67.0% of cases the main cause of blindness was cataract [20]. In the population aged 50 years and over, the prevalence of cataract was 15.6% [20]. In the majority of the cases, people mentioned that they could not afford cataract surgery and/or it was not available in their region [20]. Unfortunately, similar data on cataract prevalence are not available for other marzes of Armenia.

In Armenia, there is an unequal distribution of ophthalmic services throughout the country [1, 20, 21]. Regional ophthalmic services were assessed in 1999, showing the following results: of 291 ophthalmologists practicing in Armenia in that year, 82.0% (n=238) worked in Yerevan and 18.0% (n=53) in rural areas [21]. In 1999, there were 64 ophthalmic surgeons per million population in the capital city, and only 4 per million population in rural settings [1, 20, 21].

Main reasons for lack of ophthalmologists in rural areas in 2003 included [20]:

- Poor planning of ophthalmic services

- Poor financing of ophthalmic care
- Poor equipment and poor working conditions.

Eye care services in Armenia are provided at three levels: primary, secondary and tertiary. Primary eye care is provided in primary health care facilities by ophthalmologists and family doctors [1].

The following facilities provide secondary eye care in Armenia [1]:

- Five Regional Ophthalmic Units (ROUs) in Vagharshapat, Vanadzor, Kapan, Goris and Gumri
- Lions Regional Ophthalmic Unit (ROU) in Sevan
- Private Eye Clinic “Gabex” in Yerevan
- Manook Manookyan's “Lousatsin” Ophthalmologic Clinic in Yerevan
- “Hovakimyans’ Eye Clinic” in Artashat
- Mobile Eye Clinic of the Armenian Eye Care Project.

Three eye clinics located in Yerevan provide tertiary eye care in Armenia [1]:

- Ophthalmologic Center after S.V. Malayan
- Eye Department of Kanaker - Zeytoon Medical Union
- Ophthalmic Clinical Hospital of Yerevan State Medical University

Unequal distribution of ophthalmic services and ophthalmologists throughout Armenia leads to high prevalence of eye diseases and resulting blindness in the marzes [20, 21].

1.3. Quality and outcomes of cataract surgery

Global Initiative “Vision 2020: The Right to Sight,” resulting from the partnership of WHO and the International Agency for Prevention of Blindness (IAPB), declared two main aims: “to eliminate avoidable blindness and to prevent doubling of avoidable visual

impairments by year 2020” [1, 5]. This action plan pays special attention to prevention of cataract blindness. In order to eliminate cataract blindness, the rates of cataract surgery (number of cataract surgeries per million population per year) should increase according to cataract prevalence in local populations [5]. As a benchmark for cataract surgical coverage (CSC) the minimal rate of 85.0% was chosen for all countries in the world [5]. In addition to increasing CSC, this initiative pays special attention to the quality of cataract surgery [5]. As an indicator of high quality, at least 85.0% of operated eyes should have VA \geq 6/18 postoperatively [5].

Considering data from different countries and using Visual Acuity as an indicator, World Health Organization Prevention of Blindness and Deafness (WHO PBD) developed standards for cataract surgery outcomes [1, 5]:

- Good Outcome: VA= 6/6-6/18, VA Best Corrected $>$ 85.0%
- Borderline Outcome: VA $<$ 6/18-6/60, VA Best Corrected $<$ 15.0%
- Poor outcome: VA $<$ 6/60, VA Best Corrected $<$ 5.0%.

Several clinical trials conducted worldwide suggested the possibility of achieving best corrected visual acuity of 6/18 or better in 90.0% of cases after cataract surgery [1, 22, 23]. Required qualifications of an ophthalmic surgeon, proper type of cataract surgery and proper care after that make it possible to achieve good results.

Outcomes of cataract surgery depend on the following surgery- and patient-related factors [1, 17-19, 24-29]:

1. Surgery-related factors

- surgeon (training, experience)
- surgical technique (ICCE, ECCE, SICS, Phaco-emulsification)
- surgical facilities (hospital vs. mobile eye clinic)
- surgical supplies (microscope, loupe, operating knives)

- quality and volume of pre surgical examinations
2. Patient-related factors
- socio-demographic characteristics (age, gender, others)
 - comorbidities (ophthalmic and general health-related)
 - level of education
 - socio-economic status
 - quality of home care after surgery (hygiene and medication use).

Several studies conducted worldwide indicated that currently used techniques of cataract surgery vary by their outcomes including postoperative VA and the rate of surgical complications [18, 19, 24, 26]. Phaco emulsification and SICS are the most effective techniques of cataract surgery enabling to avoid some complications, such as post surgical astigmatism and assure good postoperative VA [19, 28]. ECCE is on the third place considering the outcomes of cataract surgery, leaving behind the ICCE as the least effective technique of cataract surgery nowadays [18, 19, 24-26, 28, 29].

There might be a difference in outcomes of cataract surgery depending on characteristics of the facility, including different sterilization norms, lighting, ventilation and surgical supplies [30, 31]. In addition, the volume of pre surgical examination and early detection of concomitant diseases might influence outcomes of cataract surgery.

Several studies showed that age and gender of patients are significantly associated with the outcome of cataract surgery [3, 7, 15]. Older people and women have worse visual outcome compared with younger people and men [3, 7, 15]. Older people are more likely to have co-morbidities both general health and eye-related which could result in higher rates of borderline and poor outcomes, and women could have lower access to health care services because of financial dependence on men [3, 7, 15].

Some health-related comorbidities such as diabetes mellitus and hypertension also can influence outcome of cataract surgery [32]. From ophthalmic comorbidities, the most common predictors of poor outcome after cataract surgery are ARMD, glaucoma, diabetic retinopathy and optic nerve pathology [27, 32]. In case of ophthalmic comorbidity, even the best performed surgery may result in poor post surgical outcome.

Many studies investigated the role of education and socio-economic status on outcomes of cataract surgery and identified that low education and low socio-economic status were significantly associated with poor outcomes of cataract surgery [25, 27, 29]. People who are less educated and/or have lower socio - economic status may not follow physicians' recommendations related to post surgical treatment and care, which may lead to some post surgical complications such as bacterial conjunctivitis, uveitis, endophthalmitis and finally to reduction of VA [25, 27, 29]. Similarly, poor quality of in-home care and poor hygiene may result in bacterial conjunctivitis and/or other inflammations leading to poor outcomes of cataract surgery [30, 31].

1.4. Quality and outcomes of cataract surgery in Armenia

In 2003, the results of RACSS survey revealed that in Armenia only 57.0% of operated people achieved good postoperative VA ($VA > 6/18$), which is significantly below the 85.0% benchmark suggested by WHO. In addition, the proportion of cases of borderline VA was 20.0% (WHO standard $< 15.0\%$) and poor outcome was 22.9% (WHO standard $< 5.0\%$) [20].

In 2006, the study conducted in Kanaker - Zeytoon Medical Union Eye Clinic on the quality of ophthalmic services in this center showed the following results: good outcome was achieved in 69.9% of cases, borderline outcome - 24.5% of cases and poor outcome - 5.6% of cases. The outcomes of cataract surgery in Kanaker - Zeytoon Medical Union 2006 did not satisfy the WHO requirements.

Strengthening Regional Ophthalmic Services in Gegharkunik Marz of Armenia

Taking into account the results of the RACSS survey in Armenia and following the WHO recommendations for eliminating cataract blindness (increasing the rates of cataract surgeries up to the level of cataract incidence rate), Meghriyan Institute in collaboration with Ararat-1 Lions Club (ALC) Charitable Foundation and support from Lions Club International Foundation (LCIF) implemented a five year project aimed at strengthening ophthalmic services in Gegharkunik Marz of Armenia [20]. Within the scope of this program a number of ophthalmologists and nurses passed special training in the field of clinical ophthalmology. The project organized the training following the requirements of the Ministry of Health (MOH) of Armenia. In addition to the educational program, Lions Regional Ophthalmic Unit (ROU) was established in Sevan. The ROU was built according to the MOH standards and equipped by high quality ophthalmic equipment from the WHO standard list (surgical microscope, slit lamp, A-scan, YAG-laser and other supplies). Two ophthalmic nurses of ROU passed the training “Clinical and Supervisory Skills Development of the Ophthalmic Paramedical Personnel” and the surgeon passed the special training “Short Term Courses in IOL Microsurgery and Small Incision Cataract Surgery” at Lions Aravind Institute of Community Ophthalmology (LAICO), Madurai, India [32].

Sevan ROU is unique in the whole region and provides high quality ophthalmic services to residents of Gegharkunik Marz and neighboring regions. Periodically, Meghriyan Institute has been organizing outreach visits to Gegharkunik and Tavush Marzes of Armenia for population screenings. Those who needed thorough eye examination and/or treatment were referred to the ROU for further diagnosis and/or treatment.

The current study was the first attempt to evaluate outcomes and quality of surgical care among cataract patients of the ROU, where the main surgical technique is SICS, with low cost and good results.

The study hypothesized, that the outcomes of cataract surgery in Lions ROU should satisfy the WHO requirements.

1.5. Aims

The aims of the study were:

1. To assess the outcomes of cataract surgery in Lions ROU
2. To identify factors associated with borderline and poor outcomes of cataract surgery in Lions ROU
3. To give recommendations for decreasing the rates of borderline and poor visual outcomes of cataract surgery in Lions ROU
4. To compare the results of this study with the similar study conducted in Kanaker - Zeytoon Medical Union Eye Clinic in 2006

2. METHODS

2.1. Study setting and Population

The study was conducted in Lions ROU of Sevan, Gegharkunik Marz of Armenia. The clinic started to perform cataract surgeries since January 2008.

The target population of the study was people with age-related cataract aged 50 years old and over. The study population was all cataract patients aged 50 years and older, admitted to Lions ROU for cataract surgery in the period from January 2008 to April 2009.

People with the following characteristics were excluded from the study:

- People with missing contact information
- Patients with congenital and traumatic cataract

- People with severe hearing and mental impairments were excluded from the study

Data collection lasted from March 30 to May 15, 2009.

2.2. Study design

A cross-sectional study addressed two research hypotheses.

Research Hypothesis 1: At least 85.0% of cataract patients of Lions ROU operated in the period January 2008 - April 2009 and aged 50 years and over achieved good VA postoperatively ($VA \geq 6/18$).

Study Design 1: “Pre - experimental” One shot Design was chosen to assess the outcome of cataract surgeries in Lions ROU [33]:

X O

X – Intervention (cataract surgery)

O – Follow-up measurement (observation starting from 2 weeks after surgery)

Research Hypothesis 2: Mean VA in patients of ROU aged 50 years and over with ≤ 21 weeks time to follow up will be statistically significantly different from patients of Kanaker - Zeytoon Medical Union of the same age and time to follow up favoring to the ROU.

Study design2: “Pre - experimental Design” with Non - Equivalent Control Group was chosen to compare the results of this study with another one [34]:

Intervention group **X₁ O₁**

Comparison group **X₂ O₂**

X₁ and **X₂** –Cataract surgery in intervention and comparison groups (Lions ROU and Kanaker - Zeytoon Medical Union, Eye Clinic respectively)

O₁ and **O₂** – follow-up measurements (starting from 2 weeks after surgery) in intervention and comparison groups

2.3. Study Variables

Independent variables of the first research hypothesis were the following: age, gender, education, employment status, alcohol consumption, hand washing habits, post surgery complications, use of medication, visits to the clinic, hypertension, type of surgery, presence of ophthalmic comorbidity and general health related comorbidities (see Table 1). Main modifiable risk factor of this study was presence of ophthalmic comorbidity. The main independent variable for the second research hypothesis was the clinic where the surgery took place.

The main outcome variable of this study was Visual Acuity after cataract surgery measured at the follow up starting from at least 2 weeks after the surgery. The majority of the studies evaluating outcomes of cataract surgery are measuring VA 4-12 weeks after surgery [1, 23]. This is the minimum time frame for complete recovery when surgery related changes in eye tissues disappear (aedema) and sutures are removed [1, 23].

2.3. Instrument

The study instrument was adapted from the study conducted in Kanaker - Zeytoon Medical Union in 2006 [1]. Only minimal changes were made in the instrument; some questions were deleted from the instrument, since they did not reflect the study objectives.

The adapted version of the study instrument consisted of several parts: Socio-Demographic Information and Behavior, Detailed Eye Screening Form and WHO Visual Function Questionnaire (WHO VF-20) [1, 35].

Socio-Demographic Characteristics and Behavior section included questions about:

- Date of birth, gender, ethnicity, refugee status, monthly income, education, previous and current occupation, living conditions, family structure.
- Smoking status and alcohol use of respondents.

- Self-reported health assessment, previous hospitalizations/reasons, patients' hygiene and measurement of blood pressure.

Detailed eye screening form included questions about:

- Visual acuity (unaided and best corrected), eye position, eye movement, external part of eye, anterior segment (conjunctiva, sclera, cornea, anterior chamber, iris), lens, pupil, posterior segment (vitreous, retina) and IOP measurement.
- Post surgery complications/causes, visits to the hospital after surgery/reasons, daily activities after surgery/duration, use of medications after surgery.

WHO visual function questionnaire (WHO VF-20) included questions about:

- Patients' perspective on quality of life after cataract surgery.
- Difficulties in seeing on short and long distances.
- Perception of their visual status and possible changes in the future.

2.4. Sample Size

The study used the following formula for sample size calculation for proportions [36]:

$$N = z^2 * pq / d^2$$

N- Sample size

z- Statistics for 95% confidence interval

p- Expected frequency of good outcome (p=85.0%)

q- Expected frequency of borderline and poor outcomes combined (q=1-p=15.0%)

d- Level of precision (5.0%)

$$N = (1.96)^2 * 0.85 * 0.15 / (0.05)^2 = 196$$

2.5. Data Collection

The study team selected participants from the ROU admission list who were operated in the period from January 2008 to April 2009. Study team first contacted patients operated 2-12 weeks before the interview, and then patients operated earlier than that time frame.

2.6. Study Protocol

The student investigator contacted all people with valid contact information starting from patients operated 2-12 weeks before the interview. If there was no response or day of follow up was not convenient to the patient, second attempt was made after 1 week. The student investigator made up to three calls with 1 week interval between them and if after the third call the patient did not visit the ROU for follow up, he/she was considered as a refusal.

After giving written consent to participate, the head nurse of ROU measured the blood pressure of the participants. Then, the student investigator conducted an interview using interviewer - administered questionnaire, during which respondents answered to the questions related to their socio-economic characteristics, behavior and their visual function.

After completing interview, the student investigator measured VA and conducted ophthalmic examination. VA was measured from 5 meters using Golovin - Sivtcev's chart for measuring VA. This chart allows to measure VA in decimals, where the first line corresponds to the VA=0.01 and the tenth line to the VA=1.0 [16]. In the case, of VA less than 0.01, VA was measured from closer distance and then converted into decimals. If the patient could read the first line (or count fingers) from less than 5 meters, VA was calculated by the following formula [16]:

$$VA=d/D$$

d- Distance from which patient reads the first line of the chart (or count fingers)

D- Distance from which people with 100% VA should read the first line (standard=50 m)

Ophthalmic examination was conducted using ROU equipment including slit lamp and ophthalmoscope. If required, the student investigator prescribed glasses for far and close distances and gave verbal or written recommendations.

2.7. Data Management and Analysis

The student investigator entered collected data into SPSS 11.0 software, then checked it for missing values and in case of having that, went back to the medical records, checked the information and entered it into SPSS. The research team used STATA 10 analytical package to perform data analysis. Descriptive statistics (mean, proportions, and frequency distributions) was performed to describe the study population by all variables. Linear Regression (Simple and Multiple) allowed checking associations between independent and dependent variables. For analyzing second research question, the student investigator separated a sub-sample of patients with time to follow up ≤ 21 weeks in order to have a sample comparable to the study population from Kanaker - Zeytoon Medical Union. Independent sample t-test compared mean VA in two study groups.

2.8. Ethical Considerations

Departmental IRB of the American University of Armenia reviewed the proposal and gave approval for conducting this study. All ethical norms, including confidentiality and voluntary based participation were assured throughout the project. All participants received an identification number (ID) and their names did not appear on the examination charts. The results of the study remained confidential and were used for research purposes only. The participants signed the written consent form before the interview, after reading and agreeing with it. In case if the respondent was totally blind, the interviewer read the consent form after which the respondent gave either written or verbal agreement. All study documents are kept

in the archive of the Meghriyan Institute, where only members of the research team have access. The Meghriyan Institute will keep the records for 5 years and then destroy them.

3. RESULTS

Overall, 357 cataract patients operated in ROU from January 2008 to April 2009 met the eligibility criteria. Contact information was missing in 48 cases and in 51 cases the provided contact information was wrong, which led to low contact and response rates. Totally, 213 people were contacted throughout the study, of which 131 people agreed to participate and completed interview and physical examination. Of those participants, 6 people met the exclusion criteria and were excluded from further analysis. Cataract surgery on both eyes was performed in 4 cases. Since, an operated eye was chosen as a unit of analysis, 129 cases were used for the final analysis ($131-6+4=129$).

3.1. Response Rate

The contact, response and refusal rates of the study were the following:

- Contact rate = $168/353*100\%=47.6\%$.
- Response rate = $125/353*100\%=35.4\%$.
- Refusal rate = $41/168*100\%=24.4\%$.

Reasons for non contact included deaths, being out of the country, and missing or wrong phone numbers.

Reasons for refusal included financial problems, poor health status, nobody to accompany, taking care of other family member, bad weather or did not mention the reason.

3.2. Descriptive Statistics

Descriptive statistics was performed for all variables to describe the study population. The mean age of participants was 70.24. About 48.8% were males and 51.2% were females. Only 3.9% of participants were employed at the time of the interview, the rest were

pensioners or unemployed. About 22.5% of people were currently smoking and the rest were either previous or non smokers. The majority of participants mentioned rare use of alcohol. About 19.4% of participants had various ophthalmic comorbidities, the most common of which were age-related macular degeneration (ARMD), diabetic angioretinopathy, hypertonic angiopathy and glaucoma. From general health related comorbidities the most common were hypertension and diabetes. Measurements of blood pressure showed that before the interview 69.8% of participants had elevated blood pressure. Two ophthalmic surgeons using different surgical techniques performed cataract surgeries in the ROU. From all cataract surgeries performed in the ROU in the specified time frame SICS was performed in 93.8% and ECCE in 6.2% of cases. There were no complications of surgery in this study group regardless the type of surgery (see Table 2).

Descriptive statistics was performed to determine the proportions of outcomes by WHO classification. The proportion of good outcome in the ROU was 78.3%, borderline outcome - 15.5% and poor outcome - 6.2% (see Table 3). Statistical analysis showed that there was a statistically significant difference between good outcomes in the ROU and the WHO standard ($P=0.03$)¹.

3.3. Simple Linear Regression

Simple Linear Regression checked the associations between all independent and outcome variables. Main independent variable of this study was the presence of ophthalmic comorbidity. After running Simple Linear Regression, age, ophthalmic comorbidity and level of education were significantly associated with the outcome variable (postoperative VA). Age was negatively associated with the postoperative VA and showed that for one year increase in age, VA decreased by 0.014. Education status was positively associated with the

¹ $Z = \frac{(\text{Phat} - P_0)}{\sqrt{\text{Phat} * \text{qhat} / n}}$

postoperative VA with borderline significance showing that for 1 step increase in the educational level postoperative VA increased by 0.051. Presence of ophthalmic comorbidity was negatively associated with the outcome variable, showing that in the presence of ophthalmic comorbidity, postoperative VA decreased approximately by 0.3. All other variables were not significantly associated with the postoperative VA, and the Table 4 summarizes the results.

Confounding analysis did not identify any confounders for the association between independent and dependent variables.

3.4. Multiple Linear Regression

All variables that showed significant association with postoperative VA in the Simple Linear Regression, including the main independent variable - ophthalmic comorbidity, were analyzed in the Multiple Linear Regression. After adding age into the model, the coefficient for ophthalmic comorbidity changed only slightly (less than 15%) and the p-value was less than 0.05, which showed that ophthalmic comorbidity was still significantly associated with the postoperative VA. After adding the level of education into the model the coefficient for ophthalmic comorbidity and age did not change significantly and the p-value was <0.05 , which revealed statistically significant association of these variables with outcome variable. In this model the level of education did not show significant association with postoperative VA. For determining the “best” model, the research team calculated the AIC (Akaike’s Information Criteria), where the lower values of AIC indicate a better model. Based on this hypothesis, the model including ophthalmic comorbidity and age was identified as the best.

3.5. Comparison between Outcomes in Lions ROU and Kanaker - Zeytoon Medical Union

The second research hypothesis of this study was to compare the results of this study with the study conducted in Kanaker - Zeytoon Medical Union. For that reason, the student

investigator separated a sub-sample of participants with time to follow up ≤ 21 weeks in order to have a comparable sample.

The study compared main characteristics of the participants in both groups using chi-square and Fisher's exact test, and Table 6 presents the results. The two study groups were significantly different by the presence of ophthalmic comorbidities, post surgery complications, type of surgery, and other variables (see Table 6). The study population of Lions ROU had higher rate of ophthalmic comorbidities compared to the Kanaker – Zeytoon Medical Union, which might decrease the proportion of good outcome in this study group. The type of surgery in the sub-sample from the ROU was SICS, while in Kanaker – Zeytoon Medical Union – SICS and ECCE. Finally, there were no surgical complications in the ROU, while there were some complications of surgery in Kanaker – Zeytoon Medical Union. Outcomes of cataract surgery in this sub-sample were: good outcome in 79.3% of cases, borderline outcome - 17.2% and poor outcome in 3.5% of cases (see Table 7).

Independent sample t-test compared mean VA in two follow-up categories (≤ 21 weeks and >21 weeks) of the ROU patients, the results of which showed that there was no significant difference in mean VA in the two groups with different times to follow up (see Table 8). The proportion of good outcome in the ROU was about 10.0% higher than in Kanaker - Zeytoon Medical Union (see Table 9).

Independent sample t-test allowed to compare mean VA in the ROU and Kanaker - Zeytoon Medical Union and showed marginally significant difference between the two means favoring the ROU, proving the second research hypothesis of the study.

4. DISCUSSION

4.1. Study Limitations

All cataract patients with valid contact information were contacted to participate in this study. Many patients did not have home or cell phones and did not provide contact information; therefore research team could not contact them. There is a possibility, that these were very poor people whose characteristics might be different from those who participated in the study. In addition, the refusal rate was high and the research team did not have any information about surgical outcomes of those people. Some people died in the period from cataract surgery to follow up and it was possible that surgical outcomes in these people were different from those who participated in the study. These limitations resulted in a selection bias.

There was a possibility that some participants did not remember the information related to income, previous hospitalizations, personal hygiene and use of medication after the surgery and gave wrong answers to these questions, leading to potential reporting bias.

Another limitation of this study was measurement bias. VA was measured using Golovin- Sivtcev's chart which allows measuring VA in decimals. Different countries are using different types of VA measurement charts and in most cases VA is measured in fractions. WHO also defined VA categories in fractions and as a result, the measurements taken in the ROU might not completely correspond to WHO measurements. In addition, VA was measured only by one person (the student investigator) and interviewer bias was a possibility.

Blood pressure was measured only once and the mean systolic and diastolic pressures were not calculated, which could be another source of measurement bias.

High refusal rate did not allow generalizing the results of this study to all patients operated in the ROU. Also, the majority of participants were from Sevan and neighboring

villages, which means that results could not be generalized to the entire Gegharkunik Marz. All these limitations affect generalizability of the study findings.

4.2. Conclusions

This cross-sectional study evaluated the outcomes of cataract surgery in patients aged 50 years and over operated in the period from January 2008 to April 2009 in Lions ROU. The quality of cataract services was assessed using WHO indicators of good, borderline and poor outcomes. The results of this study showed that the proportion of good outcome in the ROU was 78.3%, statistically significantly below the WHO standards for good quality of cataract surgery.

This study identified age and ophthalmic comorbidities as potential predictors of poor/borderline outcomes

The study results also demonstrated that the ROU reached better results than the Kanaker - Zeytoon Medical Union; however, the ROU had room for improvement to reach the WHO recommendations.

4.3. Recommendations

This study was the first one conducted in the Lions ROU after its establishment and the second in Armenia evaluating outcomes of cataract surgery. Considering the fact that the outcomes of cataract surgeries in Lions ROU did not satisfy the WHO requirements, the research team gave the following recommendations for continuous quality improvement of ophthalmic services of the ROU and other eye clinics in Armenia:

1. Organize ophthalmology seminars among health professionals of Gegharkunik Marz of Armenia to assure early detection and referral of patients to the ROU
2. Organize population screenings for early detection and treatment of cataract and ophthalmic comorbidities

3. Consider changing type of surgery performed in Lions ROU from SICS to Phaco emulsification
4. Disseminate the results of this study and encourage other ophthalmic clinics to conduct quality assessment of ophthalmic services and outcomes.

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TABLES

Table 1 Study variables

Variables	Type	Measure
Dependent:		
Best corrected Visual Acuity	Continuous	Numbers
		1- (VA=6/6-6/18)
		2- (VA<6/18-6/60)
Best corrected Visual Acuity	Categorical	3- (VA<6/60)
Independent:		
Age	Continuous	Numbers
		1- (50 -59)
		2- (60 -69)
		3- (70 -79)
Age	Nominal	4- (80 -89)
Gender	Binary	0-Male 1-Female
Family Income	Ordinal	1-(Less or equal to 25,000 AMD) 2-(26,000-50,000 AMD) 3-(51,000-100,000 AMD) 4- (More than 100,000 AMD)
Level of education	Ordinal	1- (8 years of school or less) 2- (Secondary school education) 3- (College/secondary professional) 4- (Bachelors +)
Employment Status	Binary	1- Unemployed or Pensioners 2- Employed
Smoking status	Nominal	0-Non-smoker 1-Previous smoker 2-Current smoker
Alcohol Consumption	Ordinal	1-Every Day 2- Every other day 3- Once a month 4-On special Occasions 5-Never
Ophthalmic Comorbidity	Binary	0-No ophthalmic comorbidity 1- Ophthalmic comorbidity
General Health Co-morbidities	Binary	0-No general health Comorbidity 1- General Health Comorbidity
Hand washing habits	Numeric	1-Never 2-After toilette 3-Before taking medicine 4-Before preparing/eating meal 5-Other
		1- SICS

Variables	Type	Measure
Type of surgery	Numeric	2- ECCE
Post surgery complications	Nominal	0-No Complications 1- Complications
Use of medication	Binary	0-No 1-Yes
Visits to the Clinic	Binary	0-No 1-Yes
Reasons of visits to the clinic	Numeric	1-Pain 2-Infection 3-Trauma 4-Discomfort 5-VA decrease 6-Other
Blood Pressure	Continuous	Numbers
Blood Pressure	Nominal	0-(sbp<140, dbp<90) 1- (sbp>=140, dbp>=90)
Hypertension	Binary	0-No Hypertension 1-Hypertension

Table 2 Descriptive statistics by outcome variable

Characteristic	VA=6/6-6/18	VA<6/18-6/60	VA<6/60	Total
Age:				
Mean± SD	69.02± 7.55	75.01±8.37	73.71±5.42	70.24±7.88
Min, Max	(52.3; 82.91)	(56.9; 88.3)	(65.5; 81.6)	(52.3; 88.3)
Age Categories, n (%)				
50-59	15 (14.6)	2 (10.0)	0 (0.0)	17 (13.2)
60-69	27 (26.7)	1 (5.0)	2 (25.0)	30 (23.3)
70-79	52 (51.5)	12 (60.0)	4 (50.0)	68 (52.7)
80-89	7 (6.9)	5 (25.0)	2 (25.0)	14 (10.9)
Gender, n (%)				
Male	50 (49.5)	8 (40.0)	5 (62.5)	63 (48.8)
Female	51 (50.5)	12 (60.0)	3 (37.5)	66 (51.2)
Employment Status, n (%)				
Unemployed or Pensioners	97 (96.0)	19 (95.0)	8(100.0)	124 (96.1)
Employed	4 (4.0)	1 (5.0)	0 (0.0)	5 (3.9)
Family income, n (%)				
Less or equal to25,000AMD	18 (17.8)	2 (10.0)	3 (37.5)	23 (17.8)
26,000-50,000 AMD	45 (44.6)	10 (50.0)	1 (12.5)	56 (43.4)
51,000-100,000 AMD	29 (28.7)	6 (30.0)	2 (25.0)	37 (28.7)
More than 100,000 AMD	7 (6.9)	1 (5.0)	2 25.0)	10 (7.8)
Do not know	2 (2.0)	1 (5.0)	0 (0.0)	3 (2.3)
Education, n (%)				
8 years of school or less	42 (41.6)	12 (60.0)	5 (62.5)	59 (45.7)
Secondary school education	25 (24.6)	6 (30.0)	1 (12.5)	32 (24.8)
College/secondary professional	24 (23.8)	1 (5.0)	2 (25.0)	27 (21.0)
Bachelors +	10 (9.0)	1 (5.0)	0 (0.0)	11 (8.5)
Smoking Status, n (%)				
Non-smoker	53 (52.4)	13 (65.0)	2 (25.0)	68 (52.7)
Previous smoker	23 (22.8)	5 (25.0)	4 (50.0)	32 (24.8)
Current smoker	25 (24.8)	2 (10.0)	2 (25.0)	29 (22.5)
Alcohol Consumption, n (%)				
Every Day	2 (2.0)	0 (0.0)	0 (0.0)	2 (1.6)
Every Other Day	2 (2.0)	0 (0.0)	2 (25.0)	4 (3.1)
Once a month	4 (4.0)	0 (0.0)	0 (0.0)	4 (3.1)
On special Occasions	50 (50.5)	9 (45.0)	3 (37.5)	63 (48.8)
Never	42 (41.5)	11 (55.0)	3 (37.5)	56 (43.4)
Type of surgery, n (%)				
SICS	93 (92.1)	20(100.0)	8 (100.0)	121 (93.8)
ECCE	8 (7.9)	0 (0.0)	0 (0.0)	8 (6.2)
Post surgery complications, n (%)				
No complications	101(100.0)	20(100.0)	8 (100.0)	129(100.0)
Complications	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Use of medications, % (n)				
Yes	101 (100.0)	20 (100.0)	8 (100.0)	29 (100.0)
No	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Characteristic	VA=6/6-6/18	VA<6/18-6/60	VA<6/60	Total
Visits to the Clinic, n (%)				
Did not visit the clinic	5 (4.9)	0 (0.0)	0 (0.0)	5 (3.9)
Visited the clinic	96 (95.1)	20 (100.0)	8 (100.0)	124 (96.1)
Time to follow up, n (%)				
≤21 weeks	23 (22.8)	5 (25.0)	1 (12.5)	29 (22.5)
>21 weeks	78 (77.2)	15 (75.0)	7 (87.5)	100 (77.5)
Ophthalmic Comorbidity, n (%)				
No Ophthalmic Comorbidity	88 (87.1)	12 (60.0)	4 (50.0)	104 (80.6)
Ophthalmic Comorbidity	13 (12.9)	8 (40.0)	4 (50.0)	25 (19.4)
General Health Comorbidity, n (%)				
No General Comorbidity	22 (20.8)	4 (20.0)	4 (50.0)	30 (23.3)
General Comorbidity	79 (78.2)	16 (80.0)	4 (50.0)	99 (76.7)

Table 3 Visual outcomes of cataract surgery by WHO classification

Visual Acuity by WHO Classification			
Best corrected Visual	VA=6/6 - 6/18	VA<6/18 - 6/60	VA<6/60
Acuity, n (%)	101 (78.3%)	20 (15.5%)	8 (6.2%)
Total	129 (100.0%)		

Table 4 Simple linear regression

Characteristics	Regression Coefficient	P-value	95% Confidence Interval	
Age	-0.0144	0.000	-0.0211	-0.0078
Ophthalmic comorbidity	-0.2959	0.000	-0.4267	-0.1652
Level of Education	0.0513	0.058	-0.0018	0.1044
General Health related co - morbidity	-0.0005	0.823	-0.0051	0.0042
Gender	-0.0488	0.386	-0.1597	0.0622
Employment Status	-0.0680	0.641	-0.3559	0.2198
Family Income	0.0001	0.949	-0.0042	0.0044
Smoking Status	0.0835	0.214	-0.0489	0.2159
Alcohol Consumption	-0.0374	0.287	-0.1065	0.0317
Duration follow-up period	0.0127	0.725	-0.0587	0.0841
Type of surgery	0.1017	0.383	-0.1282	0.3316

Table 5 Multiple linear regression

	Characteristics	Regression Coefficient	P-value	95% Confidence Interval		AIC*
Model 1	Ophthalmic comorbidity	-0.2959	0.000	-0.4267	-0.1652	0.4229
Model 2	Ophthalmic comorbidity	-0.2654	0.000	-0.3898	-0.1410	0.3158
	Age	-0.0128	0.000	-0.0191	-0.0066	
Model 3	Ophthalmic comorbidity	-0.2642	0.000	-0.3887	-0.1396	
	Age	-0.0121	0.000	-0.0186	-0.0056	0.3254
	Level of education	0.0214	0.390	-0.0277	0.0705	

*AIC (Akaike's Information Criteria) = $-2(\log \text{likelihood}) + 2(\text{model df})$

Table 6 Descriptive characteristics of patients by facility

Characteristic	Lions ROU	Kanaker – Zeytoon Medical Union	P-value
Age:			
Mean± SD	68.17±8.49	69.66±9.55	0.422
Min, Max	(53.1; 81.9)	(30; 100)	
Age Categories, n (%)			
50-59	7 (24.1)	24 (9.3)	0.110
60-69	6 (20.7)	84 (32.5)	
70-79	14 (48.3)	125 (48.5)	
80-89	2 (6.9)	25 (9.7)	
Gender, n (%)			
Male	11 (37.9)	134 (49.8)	0.246
Female	18 (62.1)	135 (50.2)	
Employment Status, n (%)			
Unemployed or Pensioners	27 (93.1)	210 (78.5)	0.000
Employed	2 (6.9)	58 (21.5)	
Family income, n (%)			
Less or equal to 25,000 AMD	2 (6.9)	219 (82.0)	0.000
26,000-50,000 AMD	13 (44.9)	39 (14.6)	
51,000-100,000 AMD	8 (27.6)	8 (3.0)	
More than 100,000 AMD	3 (10.3)	0 (0.0)	
Do not know	3 (10.3)	1 (0.4)	
Education, n (%)			
8 years of school or less	14 (48.4)	105 (39.2)	0.671
Secondary school education	5 (17.2)	72 (26.9)	
College/secondary professional	5 (17.2)	45 (16.8)	
Bachelors +	5 (17.2)	46 (17.2)	
Smoking Status, n (%)			
Non-smoker	20 (68.9)	208 (77.3)	0.000
Previous smoker	4 (13.8)	11 (4.1)	
Current smoker	5 (17.3)	50 (18.6)	
Alcohol Consumption, n (%)			
Every Day	0 (0.0)	24 (8.9)	0.000
Every Other Day	1 (3.5)	12 (4.5)	
Once a month	1 (3.5)	3 (1.1)	
On special Occasions	7 (24.2)	177 (65.8)	
Never	20 (68.8)	53 (19.7)	
Type of surgery, n (%)			
SICS	29(100.0)	222 (82.5)	0.007
ECCE	0 (0.0)	47 (17.5)	
Post surgery complications, n (%)			
No complications	29(100.0)	202 (75.4)	0.001
Complications	0 (0.0)	66 (24.6)	
Visits to the Clinic, n (%)			
Did not visit the clinic	2 (6.9)	98 (36.7)	0.001
Visited the clinic	27 (93.1)	169 (63.3)	

Characteristic	Lions ROU	Kanaker – Zeytoon Medical Union	P-value
Ophthalmic Comorbidity, n (%)			
No Ophthalmic Comorbidity	23 (79.3)	250 (92.9)	0.024
Ophthalmic Comorbidity	6 (20.7)	19 (7.06)	
General Health Comorbidity, n (%)			
No General Comorbidity	9 (31.1)	73 (27.4)	0.091
General Comorbidity	20 (68.9)	193 (72.6)	

Table 7 Visual outcomes of cataract surgery by WHO classification in two follow up groups

Follow-up categories	Visual Acuity by WHO Classification			Total
	VA=6/6-6/18	VA<6/18 - 6/60	VA<6/60	
>= 21 weeks	23 (79.3%)	5 (17.2%)	1 (3.5%)	29 (100.0%)
> 21 weeks	78 (78.0%)	15 (15.0%)	7 (7.0%)	100 (100.0%)

Table 6 Independent sample T-test between different follow up groups

Follow up groups	Observations	Mean VA	SD	95% CI		P value
≤21 weeks	29	0.6586	0.3065	0.5420	0.7752	
>21 weeks	100	0.6534	0.3227	0.5894	0.7174	0.938

Table 7 Visual outcomes of cataract surgery by WHO classification by facility

Outcomes of cataract surgery	Lions ROU	Kanaker Zeytoon Medical Union
Good Outcome, n (%)	23 (79.3%)	188 (69.9%)
Bad Outcome*, n (%)	6 (20.7%)	81 (30.1%)
Total, n (%)	29 (100.0%)	269 (100.0%)

***Bad Outcome** category includes two categories: borderline and poor outcome

Table 8 Independent sample t-test for comparing mean VA between two facilities

Groups	Observations	Mean VA	SD	95% CI	P-value
Lions ROU	29	0.6586	0.3065	0.5420 0.7752	
Kanaker – Zeytoon Medical Union	269	0.5501	0.3044	0.5136 0.5866	
Difference		0.1085		-0.0087 0.2257	0.0694

FIGURES

Figure 1 Mean age of participants by different VA categories

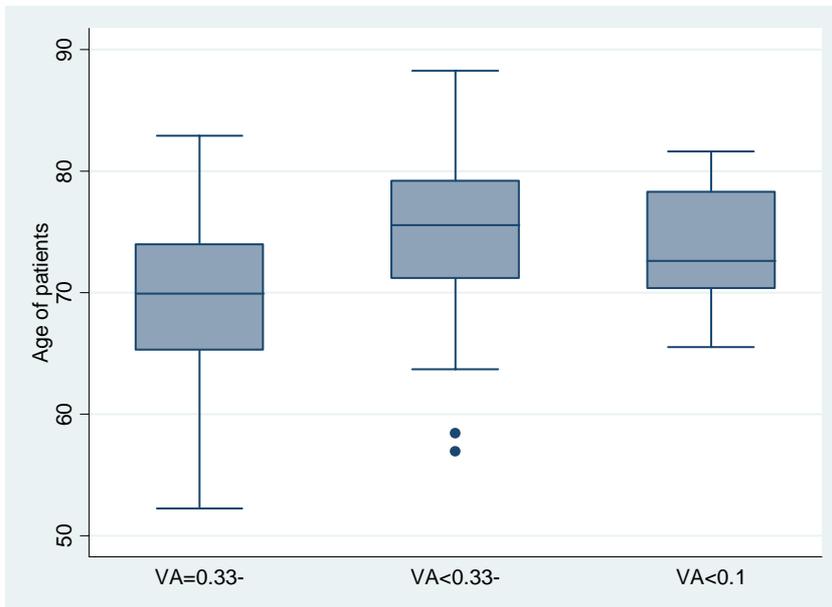


Figure 2 Age distribution of participants

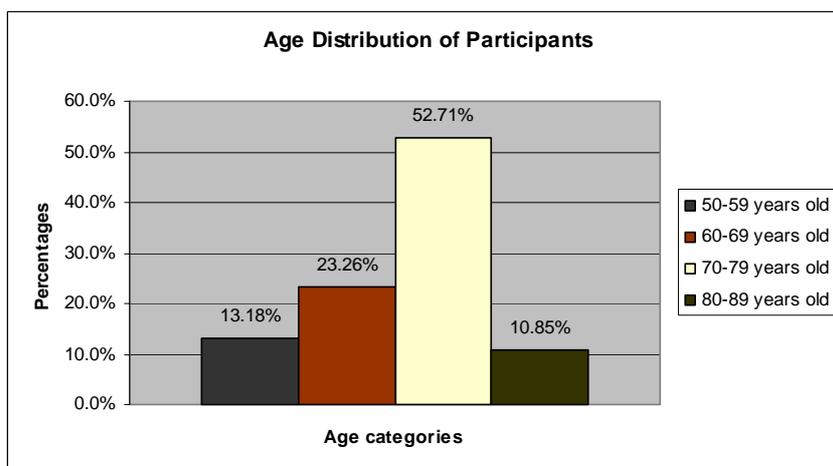


Figure 3 Gender distribution of participants

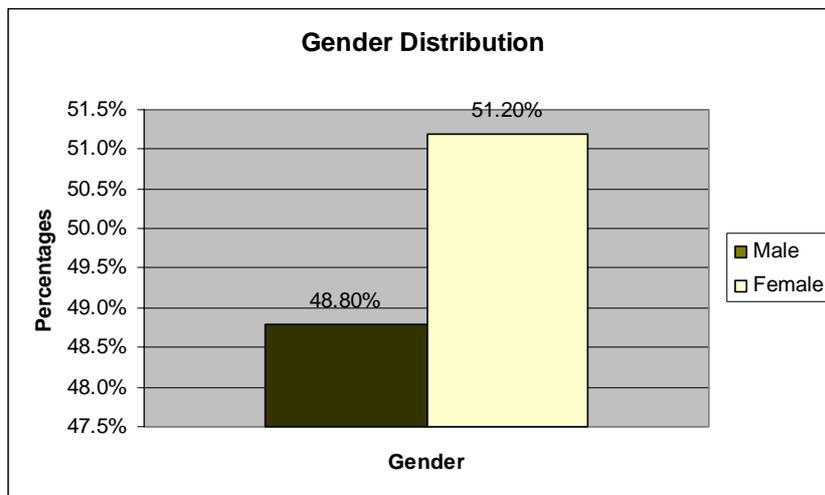


Figure 4 Smoking status of participants

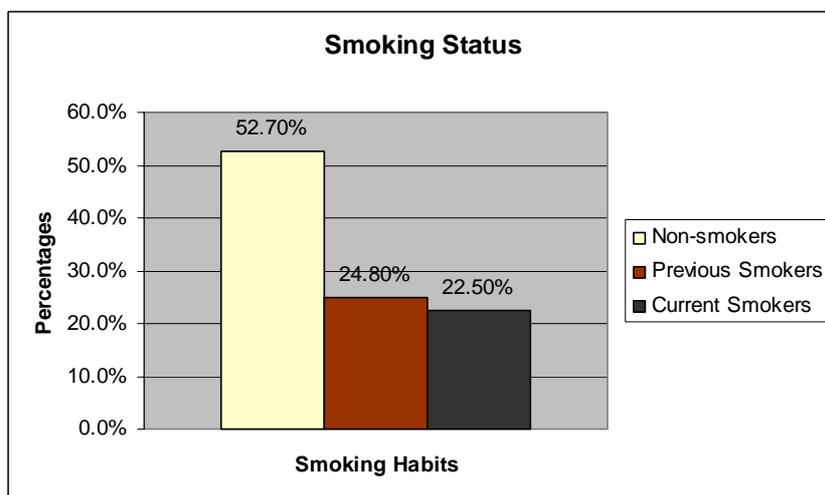


Figure 5 Employment status of participants

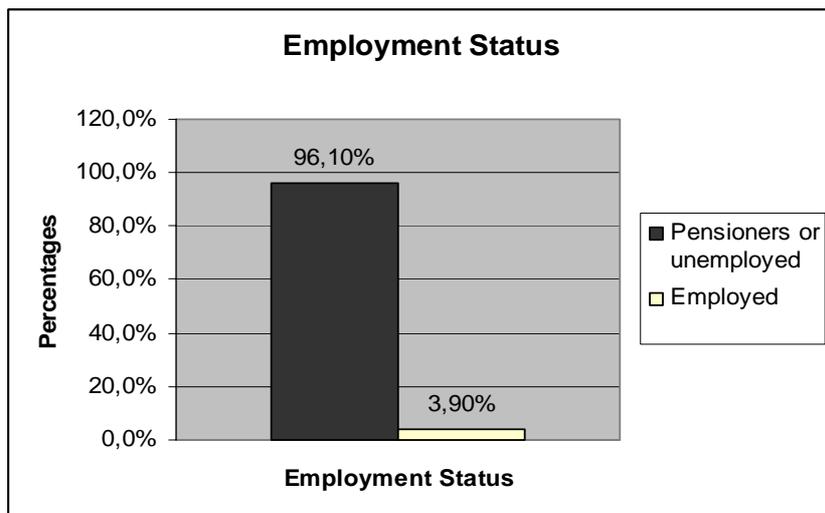


Figure 6 Drinking habits of participants

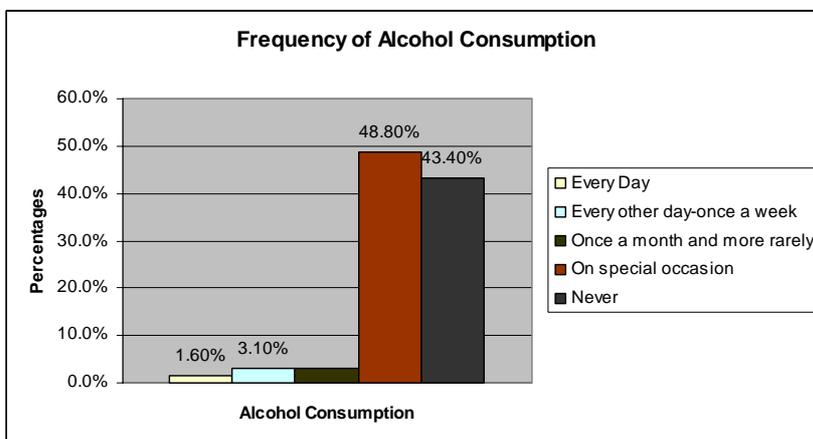
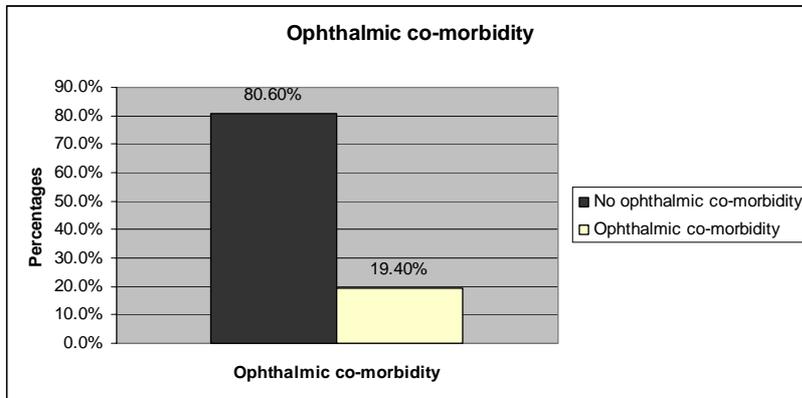


Figure 7 Presence of ophthalmic comorbidity



APPENDICES

Appendix 1

Consent Form

Meghrigian Institute for Preventive Ophthalmology

American University of Armenia

Outcomes of Cataract Surgery and Predictors of Poor Outcome in Sevan ROU

Good morning/afternoon...

My name is Marine Nalbandyan. I am an ophthalmologist and a second year student at the American University of Armenia, Master of Public Health Program.

Garo Meghrigian Institute for Preventive Ophthalmology, Center for Health Services Research and Development, American University of Armenia is conducting a research study among cataract patients of Sevan ROU.

The purpose of this study is to evaluate visual outcomes of cataract surgery in Sevan Regional Ophthalmic Unit, to determine the reasons of poor outcome, and to assess the quality of life after cataract surgery. In addition, results of this study will be compared with the results of similar study conducted in Kanaker-Zeytoon Medical Union in 2006, which will help to improve quality of health care services in Sevan ROU.

Your name was chosen from the admission list of Sevan ROU and you are asked to participate in this research study, because you received cataract surgery in Sevan ROU. Totally, about 100 people who received cataract surgery in Sevan ROU will participate in this study. Those who are illiterate in Armenian and/or have severe visual impairment will be excluded from the study. If you agree to participate in the study, we will ask you to answer some questions related to your job, living conditions, some habits and quality of life. In addition you will pass ophthalmic examination, including measurement of Visual Acuity, examination of external part and eye fundus. If it is required you will be prescribed glasses. The interview and ophthalmic examination will last for 30 minutes. You will pass ophthalmic examination and asked required questions only once, after which you will be not contacted regarding to this study.

Participation in the study will not carry any risk and will not affect your further treatment.

The only inconveniency will be the time spent on it.

As a benefit, all participants will receive free ophthalmic consultation by me and a frame donated by Meghrigian Institute. In addition, this study will investigate predictors of poor outcome of cataract surgery, which will enable researchers to make recommendations for continuous quality improvement and assuring high quality ophthalmic services in Sevan ROU. This will be long-term benefit of this study for residents of Gegharkunik Marz and neighboring regions.

Through this study you will be assigned a special Identification Number (ID) and your name will not appear on the examination chart. All results of the study will remain confidential and will be used for research purposes only. The examination charts will be kept in the locked room of Meghrigian Institute, where only members of the research team have access. Study records will be kept for 5 years and then will be destroyed.

Your participation in this study is voluntary. You can refuse to answer any question or withdraw from the study whenever you wish without any penalty and negative consequence for your future treatment.

If you have any questions regarding this study, please contact Dr. Varduhi Petrosyan at 51 25 64 or Marine Nalbandyan at 51 20 27.

In case if you feel that you have been treated unfairly or have been hurt by participating in this study, please contact the Chief of Departmental IRB Dr. Yelena Amirkhanyan at 51 25 92.

Appendix 3

Study Instrument



GARO MEGHRIGIAN INSTITUTE FOR PREVENTIVE OPHTHALMOLOGY
CENTER FOR HEALTH SERVICES RESEARCH AND DEVELOPMENT
AMERICAN UNIVERSITY OF ARMENIA

Outcomes of cataract surgery and Predictors of Poor Outcome in Sevan ROU

Patient ID # _ _ _ _ _

Hospital _____

Ophthalmologist _____

Date of Surgery __ __/__ __/__ __ (day/month/year)

Follow-up Date __ __/__ __/__ __ (day/month/year)

Socio-Demographic information and Behavior/Lifestyle

1. Birth date: __ __/__ __/__ __ (dd/mm/yy)

2. Gender: Male Female

3. What is your ethnicity?

Armenian Other nationality (Curd, Yezidi, Greek, Russian, other) _____

4. Are you a refugee/emigrant? Yes No

5. Who is the breadwinner in your household? (***Mark all that apply***)

- Myself My Children
- My wife Relatives living abroad
- My Husband Other source of family income (***Please, specify***) _____
- My Parents All family members are jobless (***Go to #7***)

6. What is the job of breadwinner? (***Mark all that apply***)

- State job/office worker Farmer
- Factory worker Shopkeeper
- Construction workers Driver
- Fishing Other (***Please, specify***) _____

7. Do you or somebody else from your family receive state allowance/welfare, pension, or any other type of assistance?

Yes No I don't know

8. What is your family's monthly income (*Include all family members' income, welfare payments, financial support from relatives/friends outside the household*):

- Less than 25,000.00 ARMD
- 26,000.00-50,000.00 ARMD
- 51,000.00-100,000.00 ARMD
- More than 100,000.00 ARMD
- Don't know

9. How many live in your household, excluding yourself?

- Children age (0-6) _____ School-age children (7-17) _____
- Adults (18+) _____

10. How many rooms do you have in your house, excluding kitchens, closets, toilets?

11. What type of bathroom do you have?

- Bathroom and toilet are outside the house
- Bathroom and toilet are inside the house
- Washbasin is inside the house and the toilet is outside the house
- Other (*Please, specify*) _____

12. Do you have a central heating?

- Yes No (*Go to # 12b*)

If yes,

12a. How many rooms do you heat? _____

12b. What other type of heating do you use in you house in winter? (*Mark all that apply*)

<input type="checkbox"/> Wood	<input type="checkbox"/> Electricity
<input type="checkbox"/> Cow dung	<input type="checkbox"/> None
<input type="checkbox"/> Gas	<input type="checkbox"/> Other (<i>Please, specify</i>) _____

13. What kind of stove do you use for heating?

<input type="checkbox"/> Completely open (gas stove, electric stove)	<input type="checkbox"/> Don't use any (<i>Go to #16</i>)
<input type="checkbox"/> A stove with chimney	<input type="checkbox"/> Other (<i>Please, specify</i>) _____

<input type="checkbox"/> Completely enclosed stove	
--	--

13a. If you have a stove, is it factory made?

- Yes No

14. What type of fuel do you usually use for cooking? (*Mark all that apply*)

<input type="checkbox"/> Wood	<input type="checkbox"/> Electricity
<input type="checkbox"/> Cow dung	<input type="checkbox"/> None
<input type="checkbox"/> Gas	<input type="checkbox"/> Other (<i>Please, specify</i>) _____

15. What kind of stove do you use for cooking?

<input type="checkbox"/> Completely open (gas stove, electric stove)	<input type="checkbox"/> Don't use any (<i>Go to #16</i>)
<input type="checkbox"/> A stove with chimney	<input type="checkbox"/> Other (<i>Please, specify</i>) _____
<input type="checkbox"/> Completely enclosed stove	

15a. If you have a stove for cooking, is it factory made?

- Yes No

16. What education did you receive?

- 8 years or less of schooling
 Secondary school
 College/vocational training
 Graduate degree
 No formal education

17. What is your current occupation/main work? (*Any paid or unpaid job or a domestic job*)

<input type="checkbox"/> State job/office worker/	<input type="checkbox"/> Housewife
<input type="checkbox"/> School teacher/health worker	<input type="checkbox"/> Driver
<input type="checkbox"/> Farmer	<input type="checkbox"/> Fishing
<input type="checkbox"/> Factory worker	<input type="checkbox"/> Doesn't work (<i>Specify the reason</i>) _____
<input type="checkbox"/> Shopkeeper	<input type="checkbox"/> Other (<i>Please, specify</i>) _____
<input type="checkbox"/> Construction worker	

18. What was your occupation for the past 5 years (*Please use info from the list above*)

19. Are you currently a smoker?

Yes

No

If no,

20. Have you ever smoked?

Yes

No

21. How often do you use alcohol drinks?

<input type="checkbox"/> Every Day	<input type="checkbox"/> On special occasions
<input type="checkbox"/> Every Other Day-Once a Week	<input type="checkbox"/> Never (<i>Go to #25</i>)
<input type="checkbox"/> Monthly or less	<input type="checkbox"/> Other (<i>Please, specify</i>) _____

25. What type of alcohol do you usually drink? (*Mark all that apply*)

Wine

Vodka _____ glasses

Beer

Brandy

Other (*Please, specify*) ____

None

26. How much do you usually drink? _____ (# of glasses)

27. How much alcohol did you drink last week? (*Mark all that apply*)

28. How would you assess your overall health as compared with other people of your age?

Poor

Medium

Good

Excellent

29. Have you ever been hospitalized because of?

Heart attack

Stroke

Never been hospitalized because of heart attack or stroke

30. Could you show the medications that you are taking regularly?

(Please, provide details: name, group, dose and how long you have you been taking it?)

Doesn't use any medications regularly

Drug Category	Specific Names/group	Dose	Duration of Intake

Detailed Eye Screening Form

1. Visual Acuity

OD _____ OS _____

2. Visual Acuity with the best possible correction

OD _____ OS _____

3. Eye position (*If no strabismus, go to # 6*):

Normal Exsophthalm Enophthalm Strabismus

4. Type of Strabismus _____

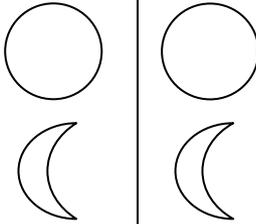
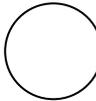
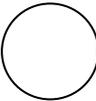
5. Strabismus angle (*Please use Girshberg's method*): _____

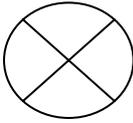
6. Diplopia: Yes No

7. Eye Movements:

Restricted Full Nystagmus

Please, check the anterior segment using a slit lamp and check all that applies:

8. External part of the eye: Normal Anophthalmia Atrophy of the eye Dry eye Anterior staphyloma Other (<i>Please, specify</i>)	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	9. Eye lids/Lashes/Lachrymal tract Normal Ptosis Entropion/Ectropion Trichiasis Blepharitis Other (<i>Please, specify</i>)	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____
10. Conjunctiva: Normal Pterygium Scar/Symblepharon Conjunctivitis: Bacterial Viral Allergic Dermato- Conjunctivitis Vernal Other (<i>Please, specify</i>)	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	11. Sclera: Normal Inflammation Neoplasm Other (<i>Please, specify</i>)	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____
12. Cornea: Normal Precipitation Corneal Dystrophy Decreased Corneal Reflexes Edema Opacity <i>(Please, illustrate the localization)</i>  Other (<i>Please, specify</i>)	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>   _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>   _____	13. Anterior Chamber: Normal Depth: Shallow Deep Iris Bombe Hyphema Inflammation Other (<i>Please, specify</i>) Can't be determined	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> _____
14. Iris: Normal Neovascularisation Iridectomy/Iridotomy Aniridia Atrophy Pseudo exfoliation in papillary margin	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	15. Lens: 1. Normal 2. Localization of cataract: Capsular Nuclear Cortical Anterior and posterior polar Lamellar	OD <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	OS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Rubeosis	<input type="checkbox"/>	<input type="checkbox"/>	Total	<input type="checkbox"/>	<input type="checkbox"/>
Periph. anterior synechiae	<input type="checkbox"/>	<input type="checkbox"/>		<i>(Please, illustrate the localization)</i>	
Coloboma	<input type="checkbox"/>	<input type="checkbox"/>	1. According to the appearance time:		
Other <i>(Please, specify)</i>	_____	_____		Congenital	<input type="checkbox"/>
Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>	Acquired <i>(please specify)</i>	_____	_____
16. Pupil:			2. Aphakia	<input type="checkbox"/>	<input type="checkbox"/>
Normal	<input type="checkbox"/>	<input type="checkbox"/>		3. Pseudophakia	<input type="checkbox"/>
Position: Miosis	<input type="checkbox"/>	<input type="checkbox"/>	4. Subluxated lens	<input type="checkbox"/>	<input type="checkbox"/>
Mydriasis	<input type="checkbox"/>	<input type="checkbox"/>	5. Dislocation of lens	<input type="checkbox"/>	<input type="checkbox"/>
Eccentric	<input type="checkbox"/>	<input type="checkbox"/>	6. Other <i>(Please, specify)</i>	_____	_____
Afferent defect	<input type="checkbox"/>	<input type="checkbox"/>	7. Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>
Reaction: Sluggish	<input type="checkbox"/>	<input type="checkbox"/>			
Absent	_____	_____			
Other <i>(Please, specify)</i>	<input type="checkbox"/>	<input type="checkbox"/>			
Can't be determined					
17. Vitreous:	OD	OS			
Normal	<input type="checkbox"/>	<input type="checkbox"/>			
Destruction	<input type="checkbox"/>	<input type="checkbox"/>			
Detachment	<input type="checkbox"/>	<input type="checkbox"/>			
Hemorrhagia	<input type="checkbox"/>	<input type="checkbox"/>			
Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>			
Other <i>(Please, specify)</i>	_____	_____			

Fundus:

Please check the fundus using a vertical ophthalmoscope

18. Optic Disc:	OD	OS	19. Macula:	OD	OS
1. Normal	<input type="checkbox"/>	<input type="checkbox"/>	Normal	<input type="checkbox"/>	<input type="checkbox"/>
2. Effaced disc borders	<input type="checkbox"/>	<input type="checkbox"/>	Large, soft drusen	<input type="checkbox"/>	<input type="checkbox"/>
3. Excavation: 0.3- 0.5	<input type="checkbox"/>	<input type="checkbox"/>	Scar	<input type="checkbox"/>	<input type="checkbox"/>
0.6-0.8	<input type="checkbox"/>	<input type="checkbox"/>	Exudative ARMD	<input type="checkbox"/>	<input type="checkbox"/>
0.8 +	<input type="checkbox"/>	<input type="checkbox"/>	Geographic atrophy	<input type="checkbox"/>	<input type="checkbox"/>
4. Asymmetry: R>L <input type="checkbox"/>			Macular Edema	<input type="checkbox"/>	<input type="checkbox"/>
L>R <input type="checkbox"/>			Hole	<input type="checkbox"/>	<input type="checkbox"/>
5. Nasalisation of vessels	<input type="checkbox"/>	<input type="checkbox"/>	Maculodystrophy	<input type="checkbox"/>	<input type="checkbox"/>
6. Flame Hemorrhage	<input type="checkbox"/>	<input type="checkbox"/>	Other (<i>Please, specify</i>)		
7. Retinal nerve fiber layer defect	<input type="checkbox"/>	<input type="checkbox"/>	Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>
8. Optic Nerve Atrophy:			20. Vessels:		
Primary	<input type="checkbox"/>	<input type="checkbox"/>	20.1 Arteries		
Secondary	<input type="checkbox"/>	<input type="checkbox"/>	Normal	<input type="checkbox"/>	<input type="checkbox"/>
9. Other (<i>Please, specify</i>)			Narrowed	<input type="checkbox"/>	<input type="checkbox"/>
10. Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>	Twisted	<input type="checkbox"/>	<input type="checkbox"/>
			Dilated	<input type="checkbox"/>	<input type="checkbox"/>
			Other (<i>Please, specify</i>)		
			Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>
			20.2 Veins		
			Normal	<input type="checkbox"/>	<input type="checkbox"/>
			Narrowed	<input type="checkbox"/>	<input type="checkbox"/>
			Twisted	<input type="checkbox"/>	<input type="checkbox"/>
			Dilated	<input type="checkbox"/>	<input type="checkbox"/>
			Other (<i>Please, specify</i>)		
			Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>
			21. Periphery:		
			Normal	<input type="checkbox"/>	<input type="checkbox"/>
			Retinal hole/break/detachment	<input type="checkbox"/>	<input type="checkbox"/>
			Peripheral degeneration	<input type="checkbox"/>	<input type="checkbox"/>
			Reattachment surgery	<input type="checkbox"/>	<input type="checkbox"/>
			Other (<i>Please, specify</i>)		
			Can't be determined	<input type="checkbox"/>	<input type="checkbox"/>

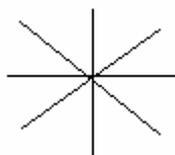
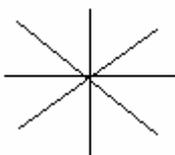
22. IOP

OD _____ OS _____

23. Range of Vision

OD

OS



24. Prescription of eye glasses

Prescription of eye glasses

OD

OS

DP _____

Sph _____ cyl _____ ax _____

Sph _____ cyl _____ ax _____

25. Other analyses

26. Post-surgery complications

- None
- Corneal edema
- Hyphemia
- Uveitis
- Cystoid macular edema
- Failure of the sutures
- Increase of intraocular pressure
- Other (please specify) _____

27. Cause

- Trauma
- Infection
- Other (please specify) _____

28. Did you take all medications prescribed by the physicians? (Please, provide details: name, group, dose, how long you have you been taking it?)

- Didn't use any medication

Drug Category	Specific Names/group	Dose	Duration of Intake

29. Clinical Diagnosis:

OD _____

OS _____

Recommendation (please, indicate all recommendations provided to the patient):

30. Did you visit the clinic _____ weeks after the surgery?

Yes

No (*go to #3*)

32. If YES, what was the reason for visit?

Pain

Discomfort

Infection

Sudden decrease of vision

Trauma

Other (*Please specify*) _____

33. What kind of daily tasks do you perform after the surgery?

Activities	Time spent daily (<i>in minutes</i>)
<input type="checkbox"/> Farming	
<input type="checkbox"/> Gardening	
<input type="checkbox"/> Looking after animals	
<input type="checkbox"/> Housecleaning	
<input type="checkbox"/> Cooking	
<input type="checkbox"/> Looking after children	
<input type="checkbox"/> Constructional work	
<input type="checkbox"/> Driving	
<input type="checkbox"/> Machinery work	
<input type="checkbox"/> Other (<i>Please, specify</i>) _____	

34. Blood Pressure

FIRST measurement		Second measurement	
Systolic blood pressure (mm Hg)	Diastolic blood pressure (mm Hg)	Systolic blood pressure (mm Hg)	Diastolic blood pressure (mm Hg)
If blood pressure is not available, please state the reason why: <ol style="list-style-type: none"> 1. Patient refused 2. Machine gives error message -6. Other (specify) 			

WHO/PBD Visual Functioning Questionnaire

The first questions are about your overall eyesight. I will read out a choice of five answers and you will choose the one that describes you best.

		1. Very good	2. Good	3. Moderate	4. Bad	5. Very bad
1	Overall, how would you rate your eyesight using both eyes – with glasses or contact lenses if you wear them?					
2	How much pain or discomfort do you have in your eyes (e.g. burning, itching, aching)?	1. None	2. Mild	3. Moderate	4. Severe	5. Extreme

(NOTE: If the responses were "Very good" and "None" to the above two questions, END the interview.)

In the next section, I am going to ask you how much difficulty, if any, you have doing certain activities. I will read out a choice of five answers and you will choose the one that describes you best.

		1. None	2. Mild	3. Moderate	4. Severe	5. Extreme / Cannot do
3	Because of your eyesight, how much difficulty do you have in going down steps or stairs?					
4	How much difficulty do you have in noticing obstacles while you are walking alone (e.g. animals or vehicles)?					

5	How much difficulty do you have in seeing because of glare from bright lights?					
6	Because of your eyesight, how much difficulty do you have in searching for something on a crowded shelf?					
7	How much difficulty do you have in seeing differences in colours?					
8	Because of your eyesight, how much difficulty do you have in recognizing the face of a person standing near you?					

		1. None	2. Mild	3. Moderate	4. Severe	5. Extreme/ Cannot do
9	How much difficulty do you have in seeing the level in a container when pouring?					
10	Because of your eyesight, how much difficulty do you have in going to activities outside of the house (e.g. sporting events, shopping, religious events)?					
11	Because of your eyesight, how much difficulty do you have in recognizing people you know from a distance of 20 metres?					
12	How much difficulty do you have in					

	seeing close objects (e.g. making out differences in coins or notes, reading newsprint)?					
13	How much difficulty do you have in seeing irregularities in the path when walking (e.g. potholes)?					
14	How much difficulty do you have in seeing when coming inside after being in bright sunlight?					
15	How much difficulty do you have in doing activities that require you to see well close up (e.g. sewing, using hand tools)?					
16	Because of your eyesight, how much difficulty do you have in carrying out your usual work?					

In the next section, I am going to ask you how you feel because of your vision problem. I will read out a choice of five answers and you will choose the one that describes you best

		Never	Rarely	Sometimes	Often	Very often
17	Because of your eyesight, how often have you been hesitant to participate in social functions?					
18	Because of your eyesight, how often have you find that you are ashamed or embarrassed?					
19	Because of your eyesight, how often have you felt that you are a burden on others?					
20	Because of your eyesight, how often do you worry that you may lose your					

	remaining eyesight?					
--	---------------------	--	--	--	--	--

*Do your vision problems affect your life in ways we have not mentioned?
If YES, describe how.*

Record the answer as fully as possible.	
---	--

Appendix 4



ՃՅՍԵՐԻ ՅՇ ՍՈՒՆՈՒՄՆԻ ՄԱՍԻՆ ԵՆՆԻՆ
ՀԵՎՈՇԻ ԶՆՆՆԻՆ ԻՆՅՆՆԻՆ ԵՎ ԼՈՒՍՈՒՄՆԻՆ ՆՈՒՆՆԻՆ
ԻՆՆՈՒՄՆԻՆ ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ ՆՈՒՆՆԻՆ

ԻՆՆԻՆ ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ
ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ
ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ ԵՎ ԵՎՆՆԻՆ

ՃՇԻ ՅՇԻՆ ԵՎ ՆՈՒՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ _____

ՃՇԻ ՅՇԻՆ ԵՎՆՆԻՆ _____

ԵՎՆՆԻՆ ԵՎՆՆԻՆ _____

ԻՆՆԻՆ ԵՎՆՆԻՆ ԵՎՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ _____ (ՈՒՆՆԻՆ ԵՎՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ)

ԻՆՆԻՆ ԵՎՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ _____ (ՈՒՆՆԻՆ ԵՎՆՆԻՆ ԵՎ ՆՈՒՆՆԻՆ)

8. àñù³ ±Ý ĸ Ĩ³ ½ÚáóÙ Ò»ñ ÁÝì³ ÝÇùÇ³ Ùè»Ĩ³ Ý »Ĩ³ Úáóì Á (ματάν Αΐι³ ÝÇùÇ³
 ³ Ý¹³ ÙÝ»ñÇ »Ĩ³ Úáóì Á Ý»é³ ñł³ Ē, Ý³ .. à»ì³ Ĩ³ Ý ù. ÝáóÁłáóÝ/ Ááβ³ Ĩ,
 μ³ ñ»Ĩ³ ÙÝ»ñÇó/Áΐι»ñÝ»ñÇó γÇÝ³ Ýè³ Ĩ³ Ý ù. ÝáóÁłáóÝ)

25,000.00 ĐĐ ¹ñ³ ÙÇó à³ Ĩ³ è

26,000.00-50,000.00 ĐĐ ¹ñ³ Ù

51,000.00-100,000.00 ĐĐ ¹ñ³ Ù

100,000.00 ĐĐ ¹ñ³ ÙÇó³ Ĩ³ »É

° è ã Çì »Ù

9. Ò»ñ ÁÝì³ ÝÇùáóÙ ù³ ÝÇ±³ Ý¹³ Ù Ĩ³, μ³ óÇ Ó»½³ ÝÇó, áñáÝù³ àñáóÙ »Ý Ò»ñ
 Ñ»ì

° ñ»É³ Ý»ñ (0-6) _____, àñáó³ Ĩ³ Ý Ñ³ è³ ĨÇ »ñ»É³ Ý»ñ (7-17) _____,

à³ ÷³ Ñ³ èÝ»ñ (18+) _____

10. ø³ ÝÇ±³ è»Ýł³ Ĩ³ Ò»ñ Ĩ³ ÝÁ, ãÑ³ βì³ Ĩ³ ĒáÑ³ ÝáóÁ, à³ ÑáóÝ»ñ,
 ½áó.³ ñ³ ÝÝ»ñ _____

11. ÆÝãÇçÇ±Ý ĸ Ò»ñ Éá.³ ñ³ ÝÁ

Éá.³ ñ³ ÝÁ .. ½áó.³ ñ³ ÝÁ Ĩ³ ÝÇó ¹áóñè »Ý

Éá.³ ñ³ ÝÁ .. ½áó.³ ñ³ ÝÁ Ĩ³ ÝÝ »Ý

Èì³ ó³ ñ³ ÝÁ Ĩ³ ÝÁ, ÇèĨ ½áó.³ ñ³ ÝÁ ¹ñéáóÙ

²Ē (ÉÝ¹ñáóÙ »Ýù Ýβ»ù) _____

12. àóÝ»±ù³ ñ¹łáù Ĩ³ Ýì ñáÝ³ Ĩ³ Ý Ç»éáóóáóÙ

²łá

àã (³ Ýó»ù #12 μ)

° Ā»³ łá,

12.³ . ø³ ÝÇ±³ è»Ýł³ Ĩ³ »ù Ç»éáóóáóÙ _____

12. μ. ÆÝãÇçÇ±³ Ē Ç»éáóóó³ Ý ÙÇçáóÝ»ñ »ù ù. Ĩ³. áñĨ áóÙ ÓÙé³ ÝÁ Ĩ³ áóÝÁ
 Ĩ³ ù³ óÝ»Éáó Ñ³ Ù³ ñ

ò³ Ē	¾É»Ĩ³ Ĩ³ Ĩ³ Ý Ñáè³ Ýù
²Ā³ ñ	àã ÙÇ Ĩ³ »è³ ĨÇ
¶³ ½	²Ē (ÉÝ¹ñáóÙ »Ýù Ýβ»ù) _____

13. $\text{Æ} \pm \text{Y} \tilde{\text{a}} \text{ i} \gg \text{e}^3 \text{ I} \zeta \text{ i}^3 \text{ e}^3 \text{ n}^3 \text{ Y} \gg \text{u} \cdot \text{u} \cdot \text{i}^3 \cdot \text{a} \tilde{\text{n}} \text{ I} \text{ a} \tilde{\text{o}} \text{ U} \zeta \gg \text{e} \text{ a} \tilde{\text{o}} \text{ U}^3 \text{ Y} \tilde{\text{N}}^3 \text{ U}^3 \tilde{\text{n}}$

$\text{z} \text{U} \text{m} \tilde{\text{a}} \text{O} \zeta \text{a} \text{I} \zeta \text{Y} \mu^3 \text{o} (\cdot \text{z} \text{u} \zeta^3 \text{E}, \text{z} \cdot \text{f} \cdot \zeta \gg \text{e} \text{a} \tilde{\text{o}} \zeta \tilde{\text{a}})$	$\text{a} \tilde{\text{a}} \text{U} \zeta \text{i} \gg \text{e}^3 \text{I} \zeta$
$\text{I} \text{E} \text{Y} \gg \text{e} \text{a} \tilde{\text{o}} \text{U} \zeta \text{a} \text{I}$	$\text{z} \text{E} (\text{E} \text{Y}^1 \tilde{\text{n}} \text{a} \tilde{\text{o}} \text{U} \gg \text{Y} \text{u} \text{Y} \text{B} \gg \text{u}) \underline{\hspace{2cm}}$
$\text{z} \text{U} \text{m} \tilde{\text{a}} \text{O} \zeta \text{a} \text{I} \zeta \text{Y} \div^3 \text{I}$	

13. $\text{z} \cdot \text{o} \tilde{\text{A}} \gg \text{a} \tilde{\text{o}} \text{Y} \gg \text{u} \text{ i}^3 \text{ e}^3 \text{ n}^3 \text{ Y}, \text{z} \tilde{\text{n}}^1 \text{l} \text{a} \pm \text{u}^3 \text{U} \text{Y} \cdot \text{a} \tilde{\text{n}} \text{I}^3 \text{n}^3 \text{Y}^3 \text{U} \zeta \text{Y}^3 \text{n} \text{i}^3 \text{z}^1 \text{n} \text{a} \tilde{\text{o}} \tilde{\text{A}} \text{U}^3 \text{Y} \zeta$
 $\text{z} \text{l} \tilde{\text{a}} \qquad \qquad \qquad \text{a} \tilde{\text{a}}$

14 $\text{Æ} \text{Y} \tilde{\text{a}} \tilde{\text{a}} \zeta \text{e} \zeta \pm \text{i}^3 \text{e} \gg \text{E} \zeta \text{u} \gg \text{u} \cdot \text{u} \cdot \text{i}^3 \cdot \text{a} \tilde{\text{n}} \text{I} \text{a} \tilde{\text{o}} \text{U} \text{e} \text{Y} \text{a} \tilde{\text{o}} \text{Y}^1 \tilde{\text{a}}^3 \text{i}^3 \text{n}^3 \text{e} \text{i} \gg \text{e} \text{a} \tilde{\text{o}} \tilde{\text{N}}^3 \text{U}^3 \tilde{\text{n}}$

$\text{o}^3 \text{E}$	$\text{z} \text{E} \gg \text{I} \text{i}^3 \text{n}^3 \text{I}^3 \text{Y} \tilde{\text{N}} \text{a} \tilde{\text{e}}^3 \text{Y} \text{u}$
$\text{z} \tilde{\text{A}}^3 \tilde{\text{n}}$	$\text{a} \tilde{\text{a}} \text{U} \zeta \text{i} \gg \text{e}^3 \text{I} \zeta$
$\text{¶}^3 \frac{1}{2}$	$\text{z} \text{E} (\text{E} \text{Y}^1 \tilde{\text{n}} \text{a} \tilde{\text{o}} \text{U} \gg \text{Y} \text{u} \text{Y} \text{B} \gg \text{u}) \underline{\hspace{2cm}}$

15. $\text{Æ} \pm \text{Y} \tilde{\text{a}} \text{ i} \gg \text{e}^3 \text{ I} \zeta \text{ i}^3 \text{ e}^3 \text{ n}^3 \text{ Y} \gg \text{u} \cdot \text{u} \cdot \text{i}^3 \cdot \text{a} \tilde{\text{n}} \text{I} \text{a} \tilde{\text{o}} \text{U} \text{e} \text{Y} \text{a} \tilde{\text{o}} \text{Y}^1 \tilde{\text{a}}^3 \text{i}^3 \text{n}^3 \text{e} \text{i} \gg \text{e} \text{a} \tilde{\text{o}} \tilde{\text{N}}^3 \text{U}^3 \tilde{\text{n}}$

$\text{z} \text{U} \text{m} \tilde{\text{a}} \text{O} \zeta \text{a} \text{I} \zeta \text{Y} \mu^3 \text{o} (\cdot \text{z} \text{u} \zeta^3 \text{E}, \text{z} \cdot \text{f} \cdot \text{e}^3 \text{f} \text{u} \zeta^3 \text{E})$	$\text{a} \tilde{\text{a}} \text{U} \zeta \text{i} \gg \text{e}^3 \text{I} \zeta$
$\text{I} \text{E} \text{Y} \gg \text{e} \text{a} \tilde{\text{o}} \text{U} \zeta \text{a} \text{I}$	$\text{z} \text{E} (\text{E} \text{Y}^1 \tilde{\text{n}} \text{a} \tilde{\text{o}} \text{U} \gg \text{Y} \text{u} \text{Y} \text{B} \gg \text{u}) \underline{\hspace{2cm}}$
$\text{z} \text{U} \text{m} \tilde{\text{a}} \text{O} \zeta \text{a} \text{I} \zeta \text{Y} \div^3 \text{I}$	

15. $\text{z} \cdot \text{o} \tilde{\text{A}} \gg \text{a} \tilde{\text{o}} \text{Y} \gg \text{u} \text{ i}^3 \text{ e}^3 \text{ n}^3 \text{ Y}, \text{z} \tilde{\text{n}}^1 \text{l} \text{a} \pm \text{u}^3 \text{U} \text{Y} \cdot \text{a} \tilde{\text{n}} \text{I}^3 \text{n}^3 \text{Y}^3 \text{U} \zeta \text{Y}^3 \text{n} \text{i}^3 \text{z}^1 \text{n} \text{a} \tilde{\text{o}} \tilde{\text{A}} \text{U}^3 \text{Y} \zeta$
 $\text{z} \text{l} \tilde{\text{a}} \qquad \qquad \qquad \text{a} \tilde{\text{a}}$

16. $\text{Æ} \pm \text{Y} \tilde{\text{a}} \text{ I} \tilde{\text{n}} \tilde{\text{A}} \text{a} \tilde{\text{o}} \tilde{\text{A}} \text{l} \text{a} \tilde{\text{o}} \text{Y} \gg \text{u} \text{e} \text{i}^3 \text{o} \gg \text{E}$
 $\text{z} \tilde{\text{n}} \text{a} \tilde{\text{o}} \zeta \text{B} \text{i}^3 \text{n} \zeta \text{I}^3 \text{U}^3 \text{i}^3 \gg \text{E} \zeta \text{u} \zeta \tilde{\text{a}}$
 $\text{O} \zeta \zeta \text{Y}^3 \text{I}^3 \tilde{\text{n}} \cdot \text{z}^1 \tilde{\text{a}} \tilde{\text{n}} \text{a} \tilde{\text{o}}$
 $\text{o} \text{a} \text{f} \gg \zeta / \text{U} \zeta \zeta \text{Y}^3 \text{U}^3 \text{e} \text{Y}^3 \cdot \zeta \text{i}^3 \text{I}^3 \text{Y}$
 $\text{z}^3 \text{n} \text{O} \tilde{\text{n}}^3 \cdot \text{a} \tilde{\text{o}} \text{Y} \text{I} \tilde{\text{n}} \tilde{\text{A}} \text{a} \tilde{\text{o}} \tilde{\text{A}} \text{l} \text{a} \tilde{\text{o}} \text{Y}$
 $\text{a} \tilde{\text{o}} \text{e} \text{a} \tilde{\text{o}} \text{U} \text{a} \zeta \text{e} \text{i}^3 \text{o} \gg \text{E}$

17. $\text{a} \pm \text{n} \text{Y} \zeta \text{O} \gg \tilde{\text{n}} \text{Y} \gg \tilde{\text{n}} \text{I}^3 \text{U} \zeta \text{e}^3 \text{B} \text{E}^3 \text{i}^3 \text{z}^3 \text{Y} \text{u} \text{A} (\text{I}^3 \text{n} \text{O}^3 \text{i}^3 \text{n} \text{I} \text{a} \tilde{\text{o}} \text{I}^3 \text{U}^3 \text{Y} \text{I} \times^3 \tilde{\text{n}}, \text{A} \text{Y} \text{i}^3 \text{Y} \zeta \text{u} \zeta \tilde{\text{N}}^3 \text{U}^3 \tilde{\text{n}})$

$\text{a} \gg \text{i}^3 \text{I}^3 \text{Y} \cdot \tilde{\text{n}}^3 \text{e} \gg \text{Y} \text{U}^3 \text{I}^3 \text{U} \zeta \text{Y}$	$\text{I}^3 \text{Y}^3 \text{U} \zeta \text{Y} \text{i}^3 \text{Y} \text{i} \gg \text{e} \text{a} \tilde{\text{o}} \tilde{\text{N}} \zeta$
$\text{z} \text{B} \text{E}^3 \text{i}^3 \text{z}^3 \text{Y} \text{u} / \text{a} \tilde{\text{o}} \text{e} \text{a} \tilde{\text{o}} \zeta \tilde{\text{a}} /$	$\text{i}^3 \tilde{\text{n}} \text{a} \tilde{\text{n}}^1$
$\text{z}^3 \text{e} \text{a} \tilde{\text{O}} \zeta^3 \tilde{\text{a}}^3 \tilde{\text{N}} \text{a} \tilde{\text{o}} \tilde{\text{A}} \text{U}^3 \text{Y} \text{a} \text{f} \text{a} \tilde{\text{n}} \text{i}^3$	

¶láóõ³ ÿ ÿi »éáóÃláóÝ	ÒìÝáñë
¶láñí³ ñ³ Ý³ ðÇÝ³ ßÉ³ ÿ áó	âÇ³ ßÉ³ ÿ áóÙ (Ýß»ù á³ ÿ Ó³ ñÁ)
Ë³ ÝáóÃá³ Ý	²Ï (ËÝ¹ñáóÙ »Ýù Ýß»ù)_____
ßÇÝ³ ñ³ ñáóÃÙ³ Ý³ ßÉ³ ÿ áóÝ»ñ	

18. Æ±Ýá »ù³ ßÉ³ ÿ »É í »ñçÇÝ ÑÇÝ· ÿ³ ñÇÝ»ñÇ ÁÝÃ³ óùáóÙ, ËÝ¹ñáóÙ »Ýù ù· ÿ³ · áñí »É í »ñÁÝßí³ Ì ÿ³ ñµ»ñ³ ÌÝ»ñÁ _____

19. , áóù Ý»ñí³ láóÙ Í Ëáó±Ù »ù

²Ïá àá

°Ã» áá,

20. °ñµ·ç Í Ë»±É »ù ²Ïá àá

21. Æ±Ýá Ñ³ ×³ Ë³ ÿ³ ÝáóÃÙ³ Ùµ »ù ù· ÿ³ · áñí áóÙ³ Ëí áÑáÉ/ËÙÇáù

²Ù»Ý ùñ	Ð³ ÿ áóí³ éÇÃÇ¹ »áùáóÙ
²Ù»Ý »ñí áó ùñÁ Ù»í – ß³ µ³ ÃÁ Ù»í ùñ	°ñµ»ù (³ Ýó»ù #32)
²ÙÇëÁ Ù»í³ Ý· ß Ù - ²í »ÉÇ Ñ³ ½í³ ¹»á	²Ï (ËÝ¹ñáóÙ »Ýù Ýß»ù)_____

22. Æ±Ýá ÿ »é³ ÌÇ³ Ëí áÑáÉ »ù éáí áñ³ µ³ ñ ù· ÿ³ · áñí áóÙ (Ýß»ù µáíáñ Ñ³ Ù³ á³ ÿ³ éË³ ÝáóÝ»ñÁ)

¶ÇÝÇ	úÕÇ	¶³ ñ»çáóñ
Í áÝÙ³ ÿ	²Ï (ËÝ¹ñáóÙ »Ýù Ýß»ù)	

23. ËÙ»ÉÇë éáí áñ³ µ³ ñ áñù³ ±Ý »ù ËÙáóÙ _____ µ³ Á³ ÿ

24. Ù³ Ëáñ¹ ß³ µ³ Áí³ ÁÝÃ³ óùáóÙ áñù³ ±Ý³ Ëí áÑáÉ »ù ÁÝ¹áóÝ»É

¶ÇÝÇ _____ µ³ Á³ ÿ	úÕÇ _____ µ³ Á³ ÿ	á»Ù ÁÝ¹áóÝ»É
Í áÝÙ³ ÿ _____ µ³ Á³ ÿ	¶³ ñ»çáóñ _____ µ³ Á³ ÿ	²Ï (ËÝ¹ñáóÙ »Ýù Ýß»ù)

25. Ò»ñ ì³ ñçùç³ Ì³ ÝÓ³ Ýó Ñ»ì Ñ³ Ù»Ù³ ì ÇÝã»±è »ù · Ý³ Ñ³ ì áóÙ Ò»ñ
 ÁÝ¹Ñ³ Ýáóñ³ éáÕçáóÃáóÝÁ
 ì³ ì ØçççÝ È³ í ¶»ñ³ ½³ Ýó

26. °ñμ± ç± Ñçì³ Ý¹³ Ýáó ÁÝ¹áóÝì »É »ù Ýßì³ Í Ñçì³ Ý¹áóÃáóÝÝ»ñç á³ ì ×³ éáí
 ÆÝý³ ñìì Î³ Áí³ Í/çÝéáóèì àá

27. °ñμ± »ù Éí³ ÝáóÙ Ò»ñ Ó»éù»ñÁ ù×³ éáí (Ýß»É μάέαñ ÑÝ³ ñ³ í áñ
 ì³ ñμ»ñ³ ÌÝ»ñÁ)

°ñμ»ù
 ¼áó·³ ñ³ Ýçó ù· ì í »Éáóó Ñ»ì á
 »Óáñ³ Ìù (ùñ·³ áùç Ì³ ÆçÉÝ»ñ) ù· ì³ · áñÍ »Éáóó³ é³ ç
 éÝáóÝ¹ á³ ì ñ³ èì »Éáóó³ é³ ç
 ²Ì (ÉÝ¹ñáóÙ »Ýù Ýß»ù)
 99 á· çì »Ù

<p>2Ē (EY'ñáòÙ »Yù ÝB»É) ĐÝ³ ñ³ í áñ ãĵ áñáß»É</p> <p>16. ÇμÁ:</p> <p>ÜánÙ³ É ĵ ÇñùÁ: ØÇá½ ØÇ¹ñÇ³ ½ 2á³ í »Ýí ñáÝ³ ĩÇÝ ¹μ³ ĩÇÝ »ñÇ½Ç íÝ³ ëí³ í ù³ ĩÇÝ á³ í éí³ í ù è»³ í óÇ³ : ³Ý¹³ Ò»óí³ í ³ó³ í³ láòÙ ĵ 2Ē (EY'ñáòÙ »Yù ÝB»É) ĐÝ³ ñ³ í áñ ãĵ áñáß»É</p>			<p>1. Aëi³ é³ ç³ óÙ³ Ý Á³ Ù³ Ý³ íÇ: ¹Ý³ íÇÝ Ò»éùμ»ñáí Ç (EY'ñáòÙ »Yù ÝB»É)</p> <p>2. 2ý³ íÇ³ 3. äë¹¹á³ ý³ íÇ³ 4. àèáÝÙ³ íÇ »YÁ³ Ñá¹³ È³ Èí 5. àèáÝÙ³ íÇ í »Ò³ ß³ ñÁ 8. 2Ē (EY'ñáòÙ »Yù ÝB»É)</p> <p>9. ĐÝ³ ñ³ í áñ ãĵ áñáß»É</p>		
			<p>17. 2á³ í »ÝÙ³ Ý Ù³ ñÙÇÝ: ÜánÙ³ É ĵ »ëí ñáòí óÇ³ Þ»ñí³ ½³ í áòÙ 2ñláòÝ³ ½»ÒáòÙ ĐÝ³ ñ³ í áñ ãĵ áñáß»É 2Ē (EY'ñáòÙ »Yù ÝB»É)</p>	OD	OS

2áùÇ Ñ³ í³ íÁ:

EY'ñáòÙ »Yù³ áùÇ Ñ³ í³ íÁ áòéáòÙÝ³ èçñ»É áòÒ³ Ñ³ ß³ ó óYÁ³ ÈUáèí áááí

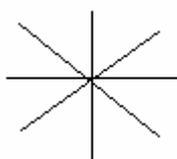
<p>18. í »éáÒ³ í³ ÝÝ»ñí Ç ëí³ í³ é³ íÁ: 1. ÜánÙ³ É ĵ 2. è³ ÑÙ³ ÝÝ»ñÁ Ñëí³ í á»Ý 3. ¼üëí³ í³ óÇ³ : 0,3-0,5 0.6-0.8 0.8 + 4. 2èÇÙ»í ñÇ³ : R>L L>R 5. 2ÝáÁÝ»ñÇ ùÁ³ ĩÇÝ í »Ò³ ß³ ñÁáòÙ 6. éáòñ/Á³ ñÙ ³ ñláòÝ³ ½»ÒáòÙ 7. í »éáÒ³ í³ Ý ÝÙ³ ñ¹³ Á»É»ñÇ ¹»ý»íí</p>	OD	OS	<p>19. Ø³ í áòÉ³ : ÜánÙ³ É ĵ Ø»í³ ó³ í, ÷³ ÷ áòí ¹ñáò½Ý»ñ èáÇ ¼üéáò¹³ í Çí í³ ñÇù³ ĩÇÝ Ù³ í áòÉÙ³ ñ¹» »Ý»ñ³ óÇ³ 2ßÈ³ ñÑ³. ñ³ í³ Ý ³ í ñáyÇ³ Ø³ í áòÉ³ ĩÇ³ ßí áòó Ø³ í áòÉ³ ĩÇ³ á³ í éí³ í ù Ø³ í áòÉá¹Çëí ñáyÇ³ 2Ē (EY'ñáòÙ »Yù ÝB»É) ĐÝ³ ñ³ í áñ ãĵ áñáß»É</p>	OD	OS
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<p>8. \hat{I} »$\acute{e}a\acute{O}^3 \acute{I}^3 \acute{Y} \acute{Y}$»$\acute{n}\acute{I} \acute{C}$ $^3 i \acute{n}a\acute{y}\acute{C}^3$: $^2 \acute{e}^3 \acute{C}\acute{Y}^3 \acute{I}\acute{C}\acute{Y}$ $^0 \acute{n}\acute{I} \acute{n}\acute{a}\acute{n}^1 \acute{I}^3 \acute{I}\acute{C}\acute{Y}$</p> <p>9. $^2 \acute{I}\acute{E}$ ($\acute{E}\acute{Y}^1 \acute{n}\acute{a}\acute{o}\acute{U}$ »$\acute{Y}\acute{U} \acute{Y}\acute{B}$»$\acute{E}$)</p> <p>10. $\acute{D}\acute{Y}^3 \acute{n}^3 \acute{I} \acute{a}\acute{n} \acute{a}_{\acute{z}} \acute{a}\acute{n}\acute{a}\acute{B}$»$\acute{E}$</p>	<p>—</p>	<p>—</p>	<p>20. $^2 \acute{Y}\acute{a}\acute{A}\acute{Y}$»$\acute{n}$: 20.1 $\frac{1}{4}^3 \acute{n}\acute{I}$ »$\acute{n}^3 \acute{I}\acute{Y}$»$\acute{n}$ $\acute{U}\acute{a}\acute{n}\acute{U}^3 \acute{E}$ \acute{U}»$\acute{O}^3 \acute{o}^3 \acute{I}$ $\acute{a}\acute{t}\acute{a}\acute{n}\acute{I}^3 \acute{I}$ $\acute{E}^3 \acute{I}\acute{Y}^3 \acute{o}^3 \acute{I}$ $^2 \acute{I}\acute{E}$ ($\acute{E}\acute{Y}^1 \acute{n}\acute{a}\acute{o}\acute{U}$ »$\acute{Y}\acute{U} \acute{Y}\acute{B}$»$\acute{E}$) $\acute{D}\acute{Y}^3 \acute{n}^3 \acute{I} \acute{a}\acute{n} \acute{a}_{\acute{z}} \acute{a}\acute{n}\acute{a}\acute{B}$»$\acute{E}$</p> <p>20.2 $^0 \acute{n}^3 \acute{I}\acute{Y}$»$\acute{n}$ $\acute{U}\acute{a}\acute{n}\acute{U}^3 \acute{E}$ \acute{U}»$\acute{O}^3 \acute{o}^3 \acute{I}$ $\acute{a}\acute{t}\acute{a}\acute{n}\acute{I}^3 \acute{I}$ $\acute{E}^3 \acute{I}\acute{Y}^3 \acute{o}^3 \acute{I}$ $^2 \acute{I}\acute{E}$ ($\acute{E}\acute{Y}^1 \acute{n}\acute{a}\acute{o}\acute{U}$ »$\acute{Y}\acute{U} \acute{Y}\acute{B}$»$\acute{E}$) $\acute{D}\acute{Y}^3 \acute{n}^3 \acute{I} \acute{a}\acute{n} \acute{a}_{\acute{z}} \acute{a}\acute{n}\acute{a}\acute{B}$»$\acute{E}$</p> <p>21. $\hat{I}^3 \acute{I}\acute{n}^3 \acute{U}^3 \acute{e}\acute{A}$: $\acute{U}\acute{a}\acute{n}\acute{U}^3 \acute{E}_{\acute{z}}$ $\acute{o}^3 \acute{Y}\acute{o}^3 \acute{A}^3 \acute{O}^3 \acute{Y}\acute{A}\acute{C}$ $\acute{a}^3 \acute{i} \acute{e}\acute{I}^3 \acute{I}\acute{U}/\acute{B}$»$\acute{n}\acute{I}^3 \frac{1}{2}^3 \acute{i} \acute{a}\acute{o}\acute{U}$ $\hat{I}^3 \acute{I}\acute{n}^3 \acute{U}^3 \acute{e}\acute{C}^1$ » \acute{Y}»$\acute{n}^3 \acute{o}\acute{C}^3$ $\acute{i} \acute{C}\acute{n}^3 \acute{N}^3 \acute{i} \acute{I}^3 \acute{I}$ $\acute{o}^3 \acute{Y}\acute{o}^3 \acute{A}^3 \acute{O}^3 \acute{Y}\acute{A}\acute{C}$ \acute{B}»$\acute{n}\acute{I}^3 \frac{1}{2}^3 \acute{i} \acute{a}\acute{o}\acute{U}$ $^2 \acute{I}\acute{E}$ ($\acute{E}\acute{Y}^1 \acute{n}\acute{a}\acute{o}\acute{U}$ »$\acute{Y}\acute{U} \acute{Y}\acute{B}$»$\acute{E}$) $\acute{D}\acute{Y}^3 \acute{n}^3 \acute{I} \acute{a}\acute{n} \acute{a}_{\acute{z}} \acute{a}\acute{n}\acute{a}\acute{B}$»$\acute{E}$</p>	<p>—</p>	<p>—</p>
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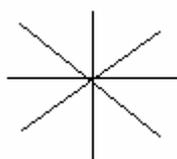
22. \acute{U} » $\acute{n}^3 \acute{I}\acute{Y}^3 \acute{I}\acute{C}\acute{Y}$ x $\acute{Y}\acute{B}\acute{a}\acute{o}\acute{U}$ OD_____ OS_____

23. \hat{I} » $\acute{e}^3 \acute{I}^3 \acute{B}\acute{I}$

úD



OS



$^2 \acute{i} \acute{Y}\acute{a}\acute{o}\acute{Y}$ » $\acute{n}\acute{C} \acute{Y}\acute{B}^3 \acute{Y}^3 \acute{I} \acute{a}\acute{o}\acute{U}$

OD

OS

DP_____

Sph_____ cyl_____ ax

Sph_____ cyl_____ ax

29. Ê áñÑáóñ¹Ý»ñ/ »Ôáñ³ Ìù³ ÌÇÝ

²Ýí³ ÝáóÙ	»Ôáñ³ Ìù³ ÌÇÝ ÊáóÙμ	»Ô³ á³ ÷	Ú· ï³· áñÍÙ³ Ý Ñ³ ×³ Ê³ ï³ ÝáóÁËáóÝ

è»ÁÇÙ _____

30. ²Ëó»É»±É »ù Í»Ýí ñáÝÁ í Çñ³ Ñ³ ï áóÁËáóÝÇó _____ ß³ μ³ Áí³ ÁÝÁ³ óùáóÙ:
 ²Ëá àá (²Ýó»ù # 3)

31. °Á»³ Ëá, áñÝ çñ³ ÌóÇ á³ ï ×³ ÉÁ:
 ò³ í ²ÝÑ³ ñÙ³ ñ³ í »ï áóÁËáóÝ
 ï³ ñ³ ï î »èáóáóÁË³ Ý ïï ñáóï ÇÇ»óáóÙ
 ï Ý³ èí³ Íù ²Ë (ÉÝ¹ñáóÙ »Ù Ýß»É) _____

32. ï Çñ³ Ñ³ ï áóÁËáóÝÇó Ñ»ï á ÇÝááÇèÇ³ éùñË³ · áñÍ áóáóÁËáóÝÝ»ñ »ù Í³ ï³ ñáóÙ:

¶áñÍ áóáóÁËáóÝÝ»ñ	Úñ³ ï³ Ýï ñ³ Ù³ ïñ³ Í Á³ Ù³ Ý³ ÍÁ (ñáá»)
<input type="checkbox"/> ¶ËáóÓ³ ï Ýï »èáóÁËáóÝ	
<input type="checkbox"/> ²Ë »· áñÍ áóÁËáóÝ	
<input type="checkbox"/> Í »Ý¹³ ÝÇÝ»ñÇÝ ÊÝ³ Ù»É	
<input type="checkbox"/> î Ý³ ÌÇÝ Ù³ ùñáóÁËáóÝ	
<input type="checkbox"/> ÊáÑ³ ñ³ ñáóÁËáóÝ	
<input type="checkbox"/> °ñ»É³ Ý»ñÇ ÊÝ³ Ùù	
<input type="checkbox"/> ßÇÝ³ ñ³ ñ³ ï³ Ý³ ßË³ ï³ Ýù	
<input type="checkbox"/> Ø»ù»Ý³ í³ ñ»É	
<input type="checkbox"/> ²ßË³ ï³ Ýù Ù»ù»Ý³ Ì³ óí³ Í è³ ñù³ í áñáóÙÝ»ñáí	
<input type="checkbox"/> ²Ë (ÉÝ¹ñáóÙ »Ù Ýß»É) _____	

øÝÝáóÁláóÝÝ»ñÇ ³ ñ¹láóÝùÝ»ñÁ`

33. ²ñÙ³ Ý Ù»ç · Éláóí á½³ Ý /èáí ³ Í Á³ Ù³ Ý³ Ì/

²ñ¹láóÝùÁ	²Ùè³ ÁÇí Á	ì ³ ðñÁ

34. ²ñÙ³ Ý ×ÝáóÙÁ

²é³ çÇÝ á³ ÷ áóÙ		°ñí ñáñ¹ á³ ÷ áóÙ	
èÇèí áÉÇí ³ ñÙ³ Ý ×ÝáóÙ (ÙÙ è.è.)	ç³ èí áÉÇí ³ ñÙ³ Ý ×ÝáóÙ (ÙÙ è.è.)	èÇèí áÉÇí ³ ñÙ³ Ý ×ÝáóÙ (ÙÙ è.è.)	ç³ èí áÉÇí ³ ñÙ³ Ý ×ÝáóÙ (ÙÙ è.è.)
<p>°Á» áí³ ³ ñÙ³ Ý ×ÝáóÙ, ÈÝ¹ñáóÙ »Ýù Ýá»É¹ñ³ á³ Ì ×³ éÁ. 3. ðÇí³ Ý¹Á Ù»ñÁ»É ÿ 4. è³ ñù³ í áñáóÙÁ èÈ³ É ÿ óáóó Ì Ì³ ÉÇè -6. ²ÙÉ (Ýá»É)</p>			

2DĪ -Ī EĪ ī »ēáŌáóĀĻ³ Ý yáóŸí ōĻ³ Ç Ń³ ħó³ B³ ħ (20 Ń³ ħó)

2é³ ÇÇÝ Ń³ ħó»ĤÁ Ī »Ĥ³ μ»ĤáŌŪ »Ý Ō»Ĥ ÁÝ¹Ń³ Ýáŋ Ī »ēáŌáóĀĻ³ ÝÁ: 0 ē Ī Ī³ ħ¹³ Ū
ŃÇÝ: á³ Ī ³ ēĒ³ ÝÝ»Ĥ, áĤáÝŌÇŌ, áŌŪ ĪÁÝĪ Ĥ»Ū ³ ŪÝ, áĤÁ ³ é³ Ī áĒ ÝĪ³ Ĥ³. ĤáŌŪ ĸ
Ō»Ĥ Ī Ç×³ ĪÁ:

		β³ Ī É³ Ī	É³ Ī	μ³ Ī³ ħ³ ħ	Ī³ Ī	β³ Ī Ī³ Ī
1	ÁÝ¹Ń³ Ýáŋ ³ éŪ³ Ūμ ÇÝāā»±ē Ī. Ý³ Ń³ Ī »Ū Ō»Ĥ »ĤĪ áŌ ááŪÇ Ī »ēáŌáóĀĻáŌÝÁ, ³ ĪÝáŌáĪ Ī³ Ū ĪáÝĪ ³ ĪĪ ³ ŪÇÝ áēāÝŪ³ ĪÝ»ĤáĪ ("ÉÇÝ½³ ĻáĪ"), »Ā» ³ ŪÝ ĪĤáŌŪ »Ū					
		áā	Ā»Ā"	Ī ³ Ý»ÉÇ	áŌĀ»Ō	β³ Ī áŌĀ»Ō
2	àĤ" ĸ ó³ Ī Ī³ Ū ³ ÝŃ³ ĤŪ³ Ĥ³ Ī »Ī áŌĀĻáŌÝ ½. áŌ±Ū »Ū Ō»Ĥ ³ áŪ»ĤáŌŪ (ŪĤÇÝ³ Ī³ ³ ŪĤáŌ, ó³ Ī áĪ áŌĀĻáŌÝ, ŪáĤ)					

(ŪBáŌŪ. Ī »ĤáŃÇBĻ³ É Ń³ ħó»ĤÇÝ ŠB³ Ī É³ Ī; "ŠááĪ; á³ Ī ³ ēĒ³ Ý»ÉáŌ ¹»áŪáŌŪ
³ Ī³ ĤĪ »Ū Ń³ ħó³ ½ĤáŌĻÁ)

Đ³ ÇáĤ¹ Ū³ éáŌŪ ĪŃ³ ĤŌÝ»Ū Ō»½, Ā» Ç±Ýā ¹ÁĪ ³ ĤáŌĀĻáŌÝÝ»Ĥ »Ū áŌÝ»ÝáŌŪ /»Ā»
áŌÝ»ÝáŌŪ »Ū/ áĤáB³ ĪÇ. áĤĪ áŌáŌáŌáŌÝÝ»Ĥ Ī³ Ī ³ Ĥ»ÉÇē: 0 ē Ī Ī³ ħ¹³ Ū ŃÇÝ.
á³ Ī ³ ēĒ³ ÝÝ»Ĥ, áĤáÝŌÇŌ, áŌŪ ĪÁÝĪ Ĥ»Ū ³ ŪÝ, áĤÁ ³ é³ Ī »É μÝáĤáBáŌŪ ĸ Ō»Ĥ
Ī Ç×³ ĪÁ:

		¹ÁĪ ³ ĤáŌ- ĀĻáŌÝ ááŌÝ»Ū	Ā»Ā"	Ī ³ Ý»ÉÇ	áŌĀ»Ō	β³ Ī áŌĀ»Ō
3	Ō»Ĥ Ī »ēáŌáóĀĻ³ Ý á³ Ī ×³ éáĪ áĤŪ³ ÝáĪ »Ū ¹ÁĪ ³ Ĥ³ ÝáŌŪ ³ ēĪ Ç×³ ÝÝ»ĤáĪ ÇÇÝ»ÉÇē:					
4	ÆÝāŪ³ ÝáĪ »Ū ¹ÁĪ ³ Ĥ³ ÝáŌŪ ŪÇ³ ŪÝ³ Ī Ū³ Ū»ÉÇē ×³ Ý³ á³ ĤŃÇÝ ÉáāÁÝ¹áĪ Ý»Ĥ Ī »ēÝ»ÉÇē (ŪĤ Ī »Ý¹³ ÝÇÝ»Ĥ, Ū»Ū»Ý³ Ý»Ĥ):					
5	àĤŪ³ ÝáĪ ĸ Ī »ēáŌ³ Ī³ Ý ¹ÁĪ ³ ĤáŌĀĻáŌÝÝ»Ĥ á³ Ī ×³ éáŌŪ Ī³ é ÉáŌĻéÁ:					
6	Ī »ēáŌáóĀĻ³ Ý á³ Ī ×³ éáĪ áĤŪ³ ÝáĪ »Ū ¹ÁĪ ³ Ĥ³ ÝáŌŪ ÉÇŪÁ ¹³ Ĥ³ Ī áŌŪ áĤ" ĸ μ³ Ý ÷ ÝĪ Ĥ»ÉÇē:					
7	¶áŌŪ»ĤÁ Ī ³ Ĥμ»Ĥ»ÉÇē áĤŪ³ ÝáĪ »Ū ¹ÁĪ ³ Ĥ³ ÝáŌŪ:					

8	<p>î »eáŌáoĀŪ³ Ý á³ ï x³ éaí áñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ Ò»ñ İáŌuçÝ İ³ Ý. Ý³ İ Û³ ñ¹áo ¹»ŪüÁ x³ Ý³ á»ÉÇè:</p>					
		¹Áí³ ñáo- ĀŌáoÝ ááoÝ»Ū	Ā»Ā	ï³ Ý»ÉÇ	áoĀ»Ō	β³ ï áóĀ»Ō
9	<p>àñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ ï³ ñ³ ŪÇ Ū»ç Ñ»Ōáoİ ÉóÝ»ÉÇè ï »èÝ»É Ñ»Ōáoİ Ç Û³ İ³ ñ¹İÁ:</p>					
10	<p>î »eáŌáoĀŪ³ Ý á³ ï x³ éaí áñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ ï³ ÝÇó ¹áoñè · áñİ áŌáoĀŌáoÝÝ»ñ İ³ ï³ ñ»ÉÇè (uñÇÝ³ İ`É³ ÝáoĀ · Ý³ É, ÑŌáoñ · Ý³ É, »İ»Ō»óÇ Ñ³ x³ É»É):</p>					
11	<p>î »eáŌáoĀŪ³ Ý á³ ï x³ éaí áñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ Ò»½ İ³ ÝáĀ Û³ ñ¹İ³ Ýó x³ Ý³ á»É üè³ Ý Ū»ï ñ Ñ»é³ í áñáoĀŌáoÝÇó:</p>					
12	<p>àñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ Ūaİ Çİ³ é³ ñİ³ Ý»ñĀ ¹Çİ »ÉÇè (uñ Ū»ï³ Ō³ ñ³ Ū»ñ, ĀŌĀ³ ñ³ Ū»ñ ï³ ñμ»ñ»ÉÇè, ï á³ · ñİ³ İ áñ`ç μ³ Ý İ³ ñ¹ÉÇè):</p>					
13	<p>àñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ x³ Ý³ á³ ñŌaİ ü³ Ū»ÉÇè Ýİ³ ï »É ³ ÝŌ³ ñĀáoĀŌáoÝÝ»ñĀ (uñÇÝ³ İ³ ÷ áè»ñĀ):</p>					
14	<p>àñù³ Ýa±í »ù ï »eáŌ³ İ³ Ý ¹Áí³ ñáoĀŌáoÝ áóÝ»ÝáoŪ³ ñ`Ç í³ é éáoŪeÇó Ñ»ï á Ý»ñè Ūİ Ý»ÉÇè:</p>					
15	<p>àñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ Ūaİ ÇİÁÉ³ í ï »èÝ»É á³ Ñ³ ÝçáŌ · áñİ áŌáoĀŌáoÝÝ»ñ İ³ ï³ ñ»ÉÇè (uñÇÝ³ İ` · áñİ »É, Ó»èuÇ è³ ñù»ñ ü· ï³ · áñİ »É):</p>					
16	<p>î »eáŌáoĀŪ³ Ý á³ ï x³ éaí áñù³ Ýa±í »ù ¹Áí³ ñ³ ÝáoŪ Ò»ñ ³ éuñŪ³ ³ βÉ³ ï³ ÝüÁ İ³ ï³ ñ»ÉÇè:</p>					

Ð³ çáñ¹ Ñ³ ï ï³ ï áóÙ »ë ï Ñ³ ñóÝ»Ù, Ā» ÇÝãá»ë »ù Ò»½ ½. áóÙ Ò»ñ ï »ëáÓáóĀÙ³ Ý
 á³ ï ×³ éáí: °ë ï ï³ ñ¹³ Ù ÑÇÝ. á³ ï³ ëĒ³ ÝÝ»ñ, áñáÝóçó, áóÙ ï ÁÝï ñ»ù³ ÙÝ,
 áñĀ³ é³ ï »É ìÝáñááóÙ; Ò»ñ ï Ç×³ ĬĀ

		»ñμ»ù	Ñ³ ½ ï³ ¹»á	»ñμ»ÙÝ	Ñ³ ×³ Ē	β³ ï Ñ³ ×³ Ē
17	î »ëáÓáóĀÙ³ Ý á³ ï ×³ éáí áñù³ ±Ý Ñ³ ×³ Ē »ù Ē áóë³ ÷»É Ù³ ëÝ³ ï ó»É áñ; ÙÇçáó³ éÙ³ Ý:					
18	î »ëáÓáóĀÙ³ Ý á³ ï ×³ éáí áñù³ ±Ý Ñ³ ×³ Ē »ù³ Ù³ ááóÙ ï³ Ù Ò»½³ ÝÑ³ ñÙ³ ñ ½. áóÙ:					
19	î »ëáÓáóĀÙ³ Ý á³ ï ×³ éáí áñù³ ±Ý Ñ³ ×³ Ē »ù ½. áóÙ áñ áóñÇβÝ»ñÇÝ (Ñ³ ñ³ ½³ ï Ý»ñÇÝ, ï áó³ ï ÇóÝ»ñÇÝ) ³ ÝÑ³ Ý. ëï áóĀáóÝ/ ¹Āï³ ñáóĀáóÝ »ù á³ ï ×³ éáóÙ:					
20	î »ëáÓáóĀÙ³ Ý á³ ï ×³ éáí áñù³ ±Ý Ñ³ ×³ Ē »ù ³ ÝÑ³ Ý. ëï³ ÝáóÙ Ò»ñ áóÝ»ó³ Ĭ ï »ëáÓáóĀáóÝĀ ï áñóÝ»Éáó Ñ³ Ù³ ñ:					

Ò»ñ ï »ëáÓáóĀÙ³ Ý ĒÝ¹çñÝ»ñĀ áñ; ³ Ē³ ³ Ēëï »Ó áÝβ ï³ ï áí, ³ ½¹ áóÙ »Ý Ò»ñ
 ï ð³ ÝùÇ ï ñ³: °Ā» ³ Ēá, ³ á³ Ý ï³ ñ³. ñ»ù³ ÇÝãá»ë:

î ñ ï³ ï á³ ï³ ëĒ³ ÝĀ · ñ³ Ýó»ù áñù³ Ý ÑÝ³ ñ³ ï áñ; ï ³ ÙμáÓç³ ï³ Ý:	
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