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Understanding the Working Status of Optometry Personnel in Ophthalmology Examination Rooms: A Prospective Cross-Sectional Study

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Abstract: As the elderly population increases, geriatric eye diseases are on the rise. In line with the aging society and the increasing number of geriatric eye diseases, the medical device industry has also been continuously growing to prevent and diagnose them promptly and accurately. The role of clinical technologists who perform physiological ophthalmic examinations related to eye diseases is also important. This study aimed to investigate the working status of ophthalmology examination rooms in national hospitals in Korea. In addition, interest in ophthalmologic laboratories that support early diagnosis and prevention of geriatric eye diseases among the elderly in the future was intended to be an index for ophthalmologists and help in hiring personnel. In this study, 18 examiners in charge of practical work in an ophthalmologic examination room at a national hospital were selected. The results showed that various occupations work together in the ophthalmological examination room and that there are examinations available depending on the occupation. To produce high-quality human resources in the field of ophthalmology, support is required at the level of associations and academic societies, and it is necessary that ophthalmologic examination personnel specialize only in clinical pathology through qualitative departmental education.

Keywords: Working Status, Ophthalmology Examination, Optometry Personnel, Clinical Laboratory Technician, Education

1. Introduction

The population of those aged over 65 years is rapidly increasing. According to the National Statistical Office, the population aged ≥ 65 years was 9,018,000 in 2022, accounting for 17.5% of the total population. It has been predicted that Korea will become a super-aged society by 2025, with the older population accounting for 20.6% of the total population[1]. The socioeconomic burden of geriatric eye diseases (e.g., cataract, glaucoma, and age-related macular degeneration) has increased with the increase in the number of older people and the emergence of eye diseases[2]. Starting in 2020, approximately 596 million people worldwide suffered from vision-related disabilities, of which 43 million were visually impaired[3]. Representative eye diseases that threaten eye health include age-related macular degeneration (AMD), diabetic retinopathy (DR), and glaucoma, which are asymptomatic in the early stages and in which the damaged optic nerve does not recover. These conditions require early diagnosis

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and treatment[4]. A joint survey conducted by the Korean Academy of Ophthalmology and the Korea Centers for Disease Control and Prevention reported that the prevalence of AMD and glaucoma was as high as 24.8% and 5.7%, respectively, in individuals aged 70 years or above. Moreover, the prevalence of DR was found to be the highest (23.8%) among individuals belonging to the age range of 50–59 years[4]. The American Diabetes Association has revealed that DR is the most common cause of blindness in adults aged 25–74 years and that an ophthalmic or fundus examination should be performed immediately after the diagnosis of type one or type two diabetes in adults[5].

In line with the aging society and the increasing number of geriatric eye diseases, the medical device industry has also been continuously growing to prevent and diagnose them promptly and accurately. According to the Ministry of Food and Drug Safety, the production of medical devices in 2022 increased by 22.2% compared to 2021. Moreover, the share of domestic medical devices was 46.8%, the highest ever for domestic medical devices[6]. According to a research report, with the increase in the aging population, the proportion of the elderly is expected to increase further, and the proportion of those aged over 65 years is expected to improve in the future due to the development of medical technology[7]. Therefore, in addition to the medical devices used in the ophthalmologic examination room, the role of clinical technologists performing physiological ophthalmic examinations related to eye diseases is also important, and manpower is expected to expand in the future. However, in the ophthalmic examination room of a national hospital, there are various occupations within the treatment department, of which 72% are clinical pathologists. Moreover, there is a paucity of studies examining the working environment and scope of the work of ophthalmic optometrists in medical institutions.

In this study, the types of ophthalmic examinations performed in clinical practice at the ophthalmic examination room in a national hospital in Korea were explored. The status of examiners working in the ophthalmic department and the overall ophthalmic examination personnel were also determined. In addition, regarding the aging society of the future, interest in ophthalmologic examination laboratories supporting the early diagnosis and prevention of geriatric eye diseases was sought to serve as an indicator for ophthalmology optometrists and help in recruiting personnel. Employees who do not have sufficient knowledge of ophthalmology prior to working in an ophthalmological examination room are unable to produce professional test results. Therefore, this study showed that support at the association and academic society levels is necessary to cultivate high-quality human resources in the field of ophthalmology, and that ophthalmological examination personnel need to specialize only in clinical pathology through qualitative department-specific education.

2. Research Methodology

In this study, 18 examiners in charge of practical work in an ophthalmologic examination room at a national hospital were selected as the main study participants for investigation of their working status in May 2023. This study was conducted with a descriptive research design. The researcher simply observed and collected data. Basic information such as gender, age, work experience, daily working hours, lunch breaks, and daily average overtime hours were investigated. In addition, the number of examination types (44) performed in the ophthalmologic examination room was investigated. Since there were no questions that included personal opinions, the survey was not conducted. There were 18 respondents of the study, including clinical laboratory technicians, radiographers, nurses, and other occupations. Statistics were performed and analyzed using Microsoft® Excel®. Through this program, the researchers first collected data and measured statistical values and average values.

3. Results

3.1 General Characteristics of the Study Participants

Age distribution in both sexes was similar, with the majority of the study population (33%) belonging to the 40–49 year age group, followed by 28% in the 30–39 year age group, 22% in the 20–29 year age group, and 17% in the 50–59 year age group. Regarding work experience, 33% of the study population had the maximum experience of ≥ 15 years, followed by 28% with 3–5 years, 22% with 10–15 years, 11% with less than 1 year, and 6% with 5–10 years. The employment type was mostly full-time (94%), with only one individual being a contract worker (6%). The most common occupation was Clinical Laboratory Technologist (CLT) (72%), followed by nurses (6%), opticians (6%), others (11%), and radiologists (6%). Lastly, the study population comprised of an almost equal distribution of men (44%) and women (56%). The demographic characteristics of the study participants are shown in [Table 1].

[Table 1] Demographic Characteristics of the Study Participants

Demographic characteristics		Total N=18 (100%)
Age (N=18)	20's	4 (22)
	30's	5 (28)
	40's	6 (33)
	50's	3 (17)
Career, year (N=18)	<1	2 (11)
	1~3	0 (0)
	3~5	5 (28)
	5~10	1 (6)
	10~15	4 (22)
	≥15	6 (33)
Employment type (N=18)	Full-time	17 (94)
	Part-time	1 (6)
Occupation (N=18)	CLT	13 (72)
	Nurse	1 (6)
	Optician	1 (6)
	Others	2 (11)
	Radiologists	1 (6)
Sex (N=18)	Female	10 (56)
	Male	8 (44)

CLT: Clinical Laboratory Technologist

3.2 Working Environment

The average amount of overtime work per day was less than an hour (100%), and all lunch breaks were scheduled for 60 minutes (100%). Regarding the scope of work, the majority of them performed inspection-only tasks (89%), and the rest were inspection-related management and auxiliary tasks (11%). The average working hours of the study participants were 8–9 h/day (100%). The working environment of the study participants is shown in [Table 2].

[Table 2] Working Environment of the Study Participants

Working environment		Total N=18 (100%)
Extra working hours (N=18)	None	0 (0)
	<1	18 (100)

	1~2	0 (0)
	2~3	0 (0)
	3~4	0 (0)
	≥4	0 (0)
Lunch time (N=18)	30 minutes	0 (0)
	40 minutes	0 (0)
	50 minutes	0 (0)
	60 minutes	18 (100)
	>60 minutes	0 (0)
Work scope (N=18)	Only testing	16 (89)
	administration, assistance	2 (11)
Working hours (N=18)	< 8	0 (0)
	8~9	18 (100)
	9~10	0 (0)
	>10	0 (0)

3.3 Status of Ophthalmology Inspections and Examinations based on Job Category

Visual function tests performed in the ophthalmology department are presented in [Table 3]. Most examinations were performed by clinical pathologists. However, some of the examinations, such as fluorescein angiography, indocyanine green fluorescein angiography, ultrasonography, and ultrasound biomicroscopic examination were performed only by the radiologists and nurses [Table 4].

[Table 3] Classification of Inspection Items in the Field of Ophthalmology

Ophthalmology function inspection item	Detailed inspection items
Aberrometer	-
Anterior chamber depth test	-
Anterior segment photography	-
Contrast sensitivity test	-
Corneal endothelial microscopy	-
Electro-oculography	-
Electroretinography	-
Fluorescein angiography	Standard fluorescein angiography
	Wide fluorescein angiography
Fundus autofluorescence	-
Fundus photo	Standard fundus photo
	Wide fundus photo
Glare test	-
Ice test	-
Indocyanine green angiography	Standard indocyanine green angiography
	Wide indocyanine green angiography
IOL master	-

Keratometry	-
Lancaster red-green test	-
Nine gaze photography	-
Optical coherence tomography	Glaucoma optical coherence tomography
	Macula optical coherence tomography
Optical coherence tomography angiography	Glaucoma optical coherence tomography angiography
	Macula optical coherence tomography angiography
Pachymetry	-
Retinal nerve fiber layer	-
Stereo disc photography	-
Topography	-
Ultrasonography	A-scan
	B-scan
Ultrasound biomicroscopic examination	-
Video-oculography	-
Visual evoked potential	-
Visual field examination	Goldmann perimetry
	Humphrey perimetry

IOL: intraocular lens

[Table 4] Eye Examinations Performed in the Ophthalmology Department based on Occupation

Eye examination		Total	CLT	Non-CLT
		N = 16 (100%)	N = 13 (81%)	N = 3 (19%)
Aberrometer	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Anterior chamber depth test	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Anterior segment photography	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Contrast sensitivity test	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Corneal endothelial microscopy	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Electro-oculography	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Electroretinography	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Fluorescein angiography*	Y	1 (6)	0 (0)	1 (33)
	N	15 (94)	13 (100)	2 (67)
Fundus autofluorescence	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Fundus photo	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Glare test	Y	14 (88)	13 (100)	1 (33)

	N	2 (13)	0 (0)	2 (67)
Ice test	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Indocyanine green angiography*	Y	1 (6)	0 (0)	1 (33)
	N	15 (94)	13 (100)	2 (67)
IOL Master	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Keratometry	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Lancaster red-green test	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Nine gaze photography	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Optical coherence tomography	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Optical coherence tomography angiography	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Pachymetry	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Retinal nerve fiber layer	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Stereo disc photography	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)
Topography	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Ultrasonography*	Y	1 (6)	0 (0)	1 (33)
	N	15 (94)	13 (100)	2 (67)
Ultrasound biomicroscopic examination*	Y	1 (6)	0 (0)	1 (33)
	N	15 (94)	13 (100)	2 (67)
Video-oculography	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Visual evoked potential	Y	14 (88)	13 (100)	1 (33)
	N	2 (13)	0 (0)	2 (67)
Visual field examination	Y	13 (81)	13 (100)	0 (0)
	N	3 (19)	0 (0)	3 (100)

**Inspections that were not performed by the CLT.*
CLT: Clinical Laboratory Technologist, IOL: intraocular lens, Y: Yes, N: No

3.4 Average Number of Inspections Performed per Day based on Inspection Item

Among the 28 tests in the ophthalmologic examination room, optical coherence tomography was the most performed investigation (245 times per day). Ultrasound biomicroscopic examination and video-oculography were the least performed tests daily (0 case for each). In addition, nine gaze photography (4 cases), aberrometer (1 case), anterior chamber depth test (20 cases), anterior segment photography (20 cases), contrast sensitivity test (2 cases), corneal endothelial microscopy (24 cases), electroretinography (3 cases), fluorescein angiography (11 cases), fundus autofluorescence (25 cases), fundus photo (227 cases), glare test (1 case), indocyanine green angiography (3 cases), intraocular lens (IOL) master (24 cases), keratometry (61 cases), Lancaster red-green test (3 cases), optical coherence tomography angiography (17 cases), pachymetry (6 cases), retinal nerve fiber layer (47 cases), stereo

disc photography (50 cases), topography (20 cases), ultrasound ultrasonography (31 cases), visual evoked potential (1 case), and visual field examination (60 cases) were performed on an average per day [Table 5].

[Table 5] Number of Cases per Day for each Examination

Eye examination	Total	Per day
Aberrometer	10	1
Anterior chamber depth test	361	20
Anterior segment photography	1,004	56
Contrast sensitivity test	28	2
Corneal endothelial microscopy	429	24
Electro-oculography	3	0
Electroretinography	49	3
Fluorescein angiography	204	11
Fundus autofluorescence	443	25
Fundus photo	4,080	227
Glare test	21	1
Ice test	1	0
Indocyanine green angiography	48	3
IOL master	438	24
Keratometry	1,097	61
Lancaster red-green test	49	3
Nine gaze photography \	75	4
Optical coherence tomography	4,406	245
Optical coherence tomography angiography	311	17
Pachymetry	106	6
Retinal nerve fiber layer	845	47
Stereo disc photography	898	50
Topography	366	20
Ultrasonography	564	31
Ultrasound biomicroscopic examination	3	0
Visual evoked potential	25	1
Visual field examination	1,079	60
Aberrometer	10	1

IOL: intraocular lens
Each examination was a statistic collected over 18 days.

4. Discussion

This study investigated the working status and range of examiners working in the ophthalmologic examination room of a national hospital and observed that different ophthalmology personnel were in charge of distinct types of examinations, including the CLT.

The sex and age of the study participants were distributed similarly, while their work experience varied. Except for one individual, the employment type was full-time for all the study participants. A study on the perception of full- and part-time employees in Portugal confirmed that employees' perceptions of job demands were stronger for full-time than for part-time employment[8]. Additionally, another study revealed that full-time workers showed higher commitment to the organization and lower willingness to leave compared to part-time workers[9]. A German study reported that self-employed women who worked full-time were more satisfied with their jobs than women who worked part-

time[10]. It was also found that regular workers had high personal satisfaction and concentration in their work.

In addition, the majority of the ophthalmological examination personnel were clinical pathologists. The study population also consisted of radiologists, nurses, opticians, and other professionals. Most ophthalmologic examination personnel performed “examination only” tasks, and among them, clinical pathologists conducted several examinations. However, test items such as fluorescein angiography, indocyanine green angiography, ultrasonography, and ultrasound biomicroscopic examination were performed only by nurses and radiologists. Among the 28 types of ophthalmologic diagnostic tests, optical coherence tomography was the most performed investigation daily (245 tests per day), followed by fundus photography (227 tests per day). The examinations performed in ophthalmology laboratories are diverse and the number of cases varies greatly depending on the item.

In Japan, a vision trainer performs the optometric tasks. In the United States, optometrists include doctoral-level optometrists, paraoptometric technicians and assistants, orthoptists, along with ophthalmic technologists and technicians. In addition, Japan prepares and processes opticians, while the United States specializes in preparation and legally prohibits the opticians from performing optometry[11]. In India, the Indian Optometry Federation is currently working to develop and regulate optometry and offers professional training ranging from two years to four years of degree training[12]. On the other hand, the types of examinations in the ophthalmological area performed by clinical pathologists belonging to the ophthalmologic examination room of a national hospital in Korea are extensive and diverse. These include directional oblique photo, aberration meter, anterior chamber depth measurement test, anterior segment optical coherence tomography, contrast sensitivity test, corneal endothelial cell test, safety, electroretinogram, fundus autofluorescence, fundus photography, glare test, ice test, intraocular lens test, corneal curvature test, Lancaster red-green test, optical coherence tomography, optical coherence tomography blood vessels contrast, corneal pachymetry, retinal neural network tomography, corneal topography, visual evoked potential, visual field test, and imaging nystagmus test. In contrast to Japan, the United States, and India, the job description of the domestic ophthalmologists is somewhat ambiguous. Therefore, to produce high-quality human resources in the field of ophthalmology, support is required at the level of associations and academic societies, and it is necessary that ophthalmologic examination personnel specialize only in clinical pathology through qualitative departmental education.

To specialize ophthalmologic examination personnel only as clinical pathologists, the following issues need to be addressed at the level of academic societies, starting with schools. First, it is necessary to subdivide clinical physiology subjects in the university curriculum to secure areas for ophthalmology and acquire knowledge. Furthermore, it is necessary to provide help in the university curriculum so that students can gain interest not only in theory but also in handling equipment and testing directly through school practice. Second, based on foreign cases, it is necessary to actively consider training courses including ophthalmologic examinations related to clinical physiology in online refresher courses for clinical pathologists[13][14]. Thus, it is necessary to provide learning opportunities to all clinical pathologists and help them acquire medical knowledge related to ophthalmology. In addition, it is necessary to ensure that students can obtain high-quality education through training courses and apply it directly to practice so that there is no difficulty in performing clinical tasks. Finally, the Korean Academy of Ophthalmology and Korean Optometric Society, which are eye health expert groups, should actively sponsor the establishment of certification systems for ophthalmologists, such as the certificate of auditory history implemented by the Korean Otolaryngology Society and Korean Audiology Society. In addition, it is necessary to establish an ophthalmological examination research group under the Korean Society of Clinical Physiological Examination to provide high-quality continuing education and grant the necessary credits to maintain a license, actively supporting the examination research group. Efforts in various fields, from university curriculum to academic conferences, would aid in promoting

the quality of ophthalmologic examinations along with the professional work of clinical pathologists as examination personnel in ophthalmologic examination laboratories. According to a study related to the ophthalmology workforce in Canada, it was reported that establishing formal training programs to supply skilled ophthalmology personnel is important[15].

This study had a few limitations. First, the researchers generated statistical data regarding the examiners of an ophthalmologic examination room at a national hospital, and the status of the ophthalmologic examination personnel at other hospitals was not included. Second, there may be differences in the average number of examinations and the work environment because the characteristics of the examination room are different for each examination, and patient difficulty may differ. Nevertheless, this study is considered to have academic value because it is consistent with the results and suggestions of previous studies and has derived useful data from ophthalmology personnel that has not been investigated in Korea.

5. Conclusion

This study aimed to explore the types of ophthalmic examinations performed in clinical practice at the ophthalmic examination room in a national hospital in Korea and determine the status of examiners working in the ophthalmic department and the overall ophthalmic examination personnel. The results of this study showed that various occupations work together in the ophthalmological examination room and that examinations are available depending on the occupation. To support the early diagnosis and prevention of geriatric eye diseases in line with the future aging society, more specialized examinations are needed. Therefore, this study demonstrates that support at the academic level is necessary to train and recruit high-quality human resources in the field of ophthalmology, and that ophthalmologic examination personnel must specialize through department-specific education.

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