INTRODUCTION

According to a World Health Organization (WHO) consultation report, a person with low vision is someone who has: an impairment of visual function, even after treatment or refractive correction; a visual acuity of less than 6/18 (20/60) to perception of light or a visual field of less than 10° in the better eye, but who uses, or is potentially able to use, vision for the planning and/or execution of a task (1). Low vision is one of the priorities in the global initiative, VISION 2020—The Right to Sight, along with cataract, trachoma, onchocerciasis, childhood blindness, and refractive error (2). In Korea, there are 216,881 patients on record as having visual impairment which includes low vision and binocular or monocular blindness (3). However, there has not been any clinical data collected from the large number of low vision patients in Korea. It is important to collect and analyze data from low vision patients in order to offer low vision care. Therefore, we investigated characteristics of low vision patients such as age and sex distribution, cause of low vision, type of prescribed low vision aids, and changes of the characteristics over a ten year period in Korea. We expect these data can be useful for planning low vision services, active care and rehabilitation.
daily activity that he or she wanted to achieve in the future. On the third visit, we prescribed the LVAs that were the easiest and most comfortable for the patient to use. Each patient revisited the clinic after one month, whereupon we determined if the LVA met his or her needs.

In order to investigate changes in the characteristics of low vision patients over time, we compared the data of 350 patients including age, the cause of low vision, and the prescription of LVAs from May 1995 to April 1999 with those of 331 patients from May 1999 to December 2008.

Statistical Package for the Social Sciences (SPSS) software program, version 16.0 (SPSS Inc., Chicago, IL, USA.), and results were considered statistically significant when the \( P \) value was <0.05.

Our study was approved by the Institutional Review Board of Chung-Ang University College of Medicine (IRB No. C2009091[278]).

**RESULTS**

There were 440 (64.6%) men and 241 (35.4%) women, with an age range of 5 to 90 yr (mean age of 33.8 yr) included in this study. The largest age group was those between 10 and 19 yr of age (20.4%), followed by that between 20 and 29 yr of age (16.4%), and below 10 years of age (16%) (Table 1). When comparing the data from May 1995 to April 1999 with that from May 1999 to December 2008, the proportion of low vision patients under 20-yr-old decreased (43.1% to 20.9%) (Pearson's chi-square test, \( P \)<0.05). And the proportion of low vision patients over 60-yr-old increased (12.6% to 26.3%) significantly (Pearson's chi-square test, \( P \)<0.05). With regard to sex distribution, the proportion of women increased (31.7% to 39.3%) significantly. (Pearson's chi-square test, \( P \)<0.05)

The most common cause of low vision was optic nerve atrophy (28.3%), followed by macular degeneration (20.8%). When comparing the data from 1995 to 1999 with those from 1999 to 2008, the proportion of optic atrophy, congenital cataract, and amblyopia decreased more than 1%, while the proportion of macular degeneration, diabetic retinopathy, and other diseases increased (Table 2).

One thousand five LVAs were prescribed for 681 patients (1.46 ±0.62 aids for each patient) (Table 3). Among these, LVAs for near vision (39.2%, 394 aids) were prescribed more than LVAs for distance vision (60.8%, 611 aids). When comparing the data from 1995 to 1999 with those from 1999 to December 2008, the number of prescribed IVAs for each patient showed a significant increase (1.32±0.53 aids per patient to 1.64±0.77 aids per patient) (paired t-test, \( P \)<0.05). The prescribed proportion of telescope and spectacle-type LVAs decreased and that of magnifier LVAs increased. The prescription of prism lenses and electronic LVAs including EYE FINE® (Nittoh & Kogaku, Nagano, Japan) and PocketViewer® (HumanWare, Christ Church, New Zealand) began in 2000.

Before the use of LVAs, distance BCVA was typically worse than 20/100 (91.2%). There were 245 (36.0%) patients whose distance BCVA was between 20/200 and 20/100 (the largest group). After the use of LVAs, distance BCVA was typically better than 20/63 (88.2%), and there were 328 (48.2%) patients whose distance BCVA was better than 20/32 (the most prevalent group) (Table 4).

Near BCVA was also typically worse than 20/100 (88.0%), and

| Age (yr) | No. of patients (%) in 1995-2008 | No. of patients (%) in 1995-1999 | No. of patients (%) in 1999-2008 |
|---------|---------------------------------|---------------------------------|---------------------------------|
|         | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| <10     | 51   | 46     | 97 (14.2) | 39 | 29 | 68 (19.4) | 12 | 17 | 29 (8.8) |
| 10-19   | 76   | 47     | 123 (18.1) | 54 | 29 | 83 (23.7) | 22 | 18 | 40 (12.1) |
| 20-29   | 78   | 21     | 99 (14.5) | 36 | 8 | 44 (12.6) | 42 | 13 | 55 (16.6) |
| 30-39   | 55   | 27     | 82 (12.0) | 41 | 12 | 53 (15.1) | 14 | 15 | 29 (8.8) |
| 40-49   | 45   | 23     | 68 (10.0) | 20 | 7 | 27 (7.7) | 25 | 16 | 41 (12.4) |
| 50-59   | 48   | 33     | 81 (11.9) | 19 | 12 | 31 (8.9) | 29 | 21 | 50 (15.1) |
| 60-69   | 49   | 22     | 71 (10.4) | 16 | 5 | 21 (6.0) | 33 | 17 | 50 (15.1) |
| 70-79   | 26   | 17     | 43 (6.3) | 10 | 6 | 16 (4.6) | 16 | 11 | 27 (8.2) |
| 80<     | 12   | 5      | 17 (2.5) | 4 | 3 | 7 (2.0) | 8 | 2 | 10 (3.0) |
| Total   | 440 (64.6%) | 241 (35.4%) | 681 | 239 (68.3%) | 111 (31.7%) | 350 | 201 (60.7%) | 130 (39.3%) | 331

Table 1. Age and sex distribution of 681 low vision patients

| Cause of low vision | No. of patients (%) in 1995-2008 | No. of patients (%) in 1995-1999 | No. of patients (%) in 1999-2008 |
|---------------------|---------------------------------|---------------------------------|---------------------------------|
| Optic atrophy       | 192 (28.2) | 121 (34.6) | 71 (21.5) |
| Macular degeneration| 141 (20.7) | 58 (16.6) | 83 (25.1) |
| Retinitis pigmentosa| 65 (9.5) | 32 (9.1) | 33 (10.0) |
| Diabetic retinopathy| 50 (7.3) | 22 (6.3) | 28 (8.5) |
| Congenital cataract  | 37 (5.4) | 27 (7.7) | 10 (3.0) |
| Amblyopia           | 31 (4.6) | 18 (5.1) | 13 (3.9) |
| Corneal opacity     | 28 (4.1) | 15 (4.3) | 13 (3.9) |
| Nystagmus           | 24 (3.5) | 11 (3.1) | 13 (3.9) |
|ROP                 | 21 (3.1) | 11 (3.1) | 10 (3.0) |
| Albinism            | 22 (3.3) | 12 (3.4) | 10 (3.0) |
| Retinal detachment  | 19 (2.9) | 8 (2.3) | 11 (3.3) |
| Aniridia            | 14 (2.1) | 8 (2.3) | 6 (1.8) |
| Other               | 37 (5.4) | 7 (2.0) | 30 (9.1) |
| Total               | 681 | 350 | 331

Table 2. Causes of low vision in 681 low vision patients in Korea

ROP, Retinopathy of prematurity.
there were 267 (39.2%) patients whose near BCVA was between 20/200 and 20/100 (the largest group) prior to the use of LVAs. After the use of LVAs, near BCVA was typically better than 20/63 (82.1%), and there were 376 (55.2%) patients whose near BCVA was better than 20/32 (the most prevalent group) (Table 5).

**DISCUSSION**

Low vision is a very important public health problem. Previous worldwide population-based studies have demonstrated consistently that the prevalence of low vision has been increasing significantly and that most low vision patients are elderly (4). In contrast, young patients accounted for a large proportion of the low vision patients (46.8% under 30-yr-old) in this study. This is possibly because low vision clinics and care have been largely unknown to the elderly and there are many young low vision patients detected from vision tests in schools. However, when comparing the data from May 1995 to April 1999 with those from May 1999 to December 2008, the proportion of low vision young patients, especially those under 20-yr-old, showed a significant decrease and the proportion of low vision elderly patients showed an obvious increase. An increasingly older population, increasing attention on the health, increasing social behaviors, and increasing concern and publicity regarding low vision are possible reasons for this changed trend. The increased number of low vision clinics (there are presently 11 low vision clinics in Korea) likely explains the decrease in the number of low vision patients from 1999 to 2008 compared to that of 1995 to 1999 in this study.

Concerning the causes of low vision, in this study, the most common cause was optic nerve atrophy, which is consistent with other low vision reports in Korea (5). However, since 1999, the most common cause of low vision has been macular degeneration including age-related macular degeneration and diabetic retinopathy which showed increased proportions. This may be related to the increase in elderly low vision patients. As congenital cataract, amblyopia, and corneal opacity are preventable with early treatment, the proportion of these low vision causes has decreased and may decrease further. The reason why other causes of low vision have increased is likely because unexplained
optic atrophy or retinal degeneration have been more readily identified with advanced diagnostic methods.

Most low vision aids are used for near vision, and it is important to consider a patient’s working distance and purposes when prescribing LVAs (6-8). So near LVAs like magnifiers and spectacle-type aids were more prescribed than distance LVAs like telescopes. This suggests that near vision activities, such as reading, have been more important for low vision patients. Recently, EYE FINE® (Nitto & Kogaku), which has an advantage of usability in both near and distance viewing by auto-focusing according to working distance and PocketViewer® (HumanWare), a compact portable hand-held electric magnifier, have been developed and put to use. These electric LVAs have been used by low vision patients since 2000. Prism lenses have been also used recently for eccentric viewing, visual field shift, or field expansion.

Although the detailed data were not shown in this paper, there were more prescribed LVAs in each cause of low vision. For example brown or pink colored tinted glasses and bifocal lens were used for albinism. But the kind of prescribed LVAs are mostly dependent upon visual function of each patient, not the causes of low vision. So each visual function should be considered first when prescribing the LVAs.

In most patients, both near and distance BCVA were much improved when using the LVAs. This suggests that LVAs are effective in the improvement of visual function.

In summary, although young patients still represent the majority of patients visiting the low vision clinics, we found that the number of elderly low vision patients is increasing and macular degeneration is becoming a leading cause of low vision. Rehabilitation using LVAs has improved the visual function of low vision patients. However, rehabilitation with LVAs is not yet sufficient in low vision patients. Even if this study does not fully represent the characteristics of all low vision patients in Korea, it is the first survey for a large number of low vision patients over ten years in Korea. We believe that more active care and rehabilitation of low vision patients, especially elderly patients, are important and need in Korea and that this study will help in the planning of low vision services in Korea.

ACKNOWLEDGMENTS

We would like to thank Jong Hwa Park, MD and the optometrists at Chung-Ang University Hospital for their comments and help with data collection.

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