



Incidence and causes of visual impairment in Japan: the first nation-wide complete enumeration survey of newly certified visually impaired individuals

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Abstract

Purpose To investigate the visual impairment certification status in Japan.

Study design Observational cross-sectional study.

Methods We asked all welfare offices throughout Japan to submit data concerning age, sex, causative diseases, and visual impairment grades for newly certified visually impaired individuals aged ≥ 18 years in the fiscal year of 2015. The certification was based on criteria of the Act on Welfare of Physically Disabled Persons.

Results In total, data were collected for 12,505 newly certified visually impaired individuals. The most common age group for these individuals was 80–89 years (29.6%), followed by 70–79 (26.3%) and 60–69 (17.3%) years. The most common causative disease was glaucoma (28.6%), followed by retinitis pigmentosa (14.0%), diabetic retinopathy (12.8%), and macular degeneration (8.0%). Glaucoma was the most common causative disease in both sexes (30.2% in men and 27.0% in women). The most common impairment grade was grade 2 (31.8%), followed by grades 5 (24.3%) and grade 1 (16.1%). The number of visually impaired individuals with underlying glaucoma had increased in comparison with the number in the most recent surveys (from fiscal years 2007 to 2009), whereas the number of individuals with underlying diabetic retinopathy and macular degeneration had decreased.

Conclusion To our knowledge, this is the first nation-wide complete enumeration survey of newly certified visually impaired individuals in Japan. These findings may contribute to administrative activities concerning medical welfare as well as educational activities for preventing visual impairment.

Keywords Visual impairment · Japan · Glaucoma · Diabetic retinopathy · Survey

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Introduction

Visual impairment markedly reduces the quality of life and greatly affects an individual's capacity to maintain social relationships and take part in education or work. In the elderly in particular, visual impairment increases the risk of fractures caused by falls leading to subsequent gait

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impairment, depression, and social isolation. Furthermore, visual impairment increases the burden of care on a patient's family, increases healthcare costs, and is reported to increase the risk of mortality [1–8]. These have emerged as serious social and economic problems in Japan, which has the most aged society in the world with approximately 26% of the population aged 65 years or older [9].

Among the main causative diseases for visual impairment in Japan are chronic diseases associated with aging and lifestyle-related risk factors [10–12]. Therefore, healthcare and social welfare policies, including the implementation of preventive measures at all levels (primary to tertiary), need to be conducted effectively by lowering the incidence or preventing the progression of visual impairment. In order to promote such healthcare and social welfare policies, it is important to assess and understand the latest trends in visual impairment certification. In particular, understanding the relationship between changes in causative diseases of visual impairment and shifts in the demographic composition, the emergence of effective treatment, and lifestyle changes [13] is the basis for determining future healthcare and social welfare policies. Furthermore, since each municipality is responsible for healthcare and social welfare policies it is important to investigate the visual impairment certification status at the municipal level.

In Japan, the Ministry of Health, Labour and Welfare (MHLW) conducts annual national surveys of the number of new visual impairment certifications [14]. However, these surveys do not include factors such as age and causative diseases. To date, three additional national surveys have been conducted in order to determine these factors [10–12]. However, all these surveys divided Japan into 6–8 regions and sampled a single welfare office in each region; resulting in sampling bias.

Previous attempts at nation-wide surveys have primarily been conducted as sampling surveys because a survey targeting all newly certified visually impaired individual in Japan would require vast amounts of time, effort, and money. Data related to disability certification were stored on paper by individual welfare offices, at each municipality; therefore, the investigators were forced to visit each welfare office to collect and tabulate data. However, welfare offices have recently been digitalizing their disability certification data, thereby facilitating quicker, easier, and cheaper collection of data. Hence, in the fiscal year of 2015, we conducted the first nation-wide complete enumeration survey of newly certified visually impaired individuals. Here we report our findings pertaining to age, sex, causative diseases, and visual impairment grades.

Subjects and methods

Survey subjects

The subjects were individuals aged ≥ 18 years who were newly certified as visually impaired on the basis of certification criteria in the Act on Welfare of Physically Disabled Persons (Online Resource 2) between April 1, 2015 and March 31, 2016. Survey subjects who met these criteria are hereafter referred to as “visually impaired individuals”.

Survey methods and items

This study was approved by the Ethics Committee of Okayama University Hospital, Okayama, Japan, and all investigative procedures conformed to the tenets of the Declaration of Helsinki. There were 141 regional welfare offices throughout Japan with data related to disability certification. Anonymized data related to visual impairment certification were collected from the all these welfare offices. If a physical disability certificate contained multiple causative diseases, the disease listed first was considered the causative disease.

Visual impairment grade

Visual impairment was divided into six grades in accordance with the certification criteria. Briefly, as shown in Online Resource 2, the severity of visual impairment is determined separately for the corrected visual acuity and visual field, and the final visual impairment grade is determined by the combination of these grades [15].

Distribution of visually impaired individuals according to the causative disease

To calculate the number of individuals registered for each causative disease we added the totals registered in each year within each of the two previous surveys as well as the survey conducted in 2015 [14] and averaged that total. The averages were then multiplied by the percentage given for individuals registered under each causative disease.

Major outcome measures

Age, sex, causative diseases, and visual impairment grades among newly certified visually impaired individuals.

Results

Visual impairment certification data were requested from all welfare offices throughout Japan (141 welfare offices), and responses were received from 135 offices; the population coverage rate was 96.5%. In the 135 welfare offices, 12,505 individuals were newly certified as visually impaired in the fiscal year of 2015. In a white paper by the MHLW, there were 12,561 newly certified visually impaired individuals in fiscal 2015 [14]; therefore, 99.6% of these individuals were sampled in the present survey.

The most common age group of visually impaired individuals was 80-89 years (29.6%), followed by 70-79 (26.3%) and 60-69 (17.3%) years (Fig. 1). In total, 89.0% visually impaired individuals were aged ≥ 50 years.

Causative diseases/conditions (Fig. 2). The most common causative disease/conditions was glaucoma (28.6%), followed by retinitis pigmentosa (14.0%), diabetic retinopathy (12.8%), and macular degeneration (8.0%). Distribution of causative diseases/conditions in each age group is shown in Table 1. For the age groups of ≥ 60 years, the most common cause was glaucoma.

The most common causative disease among both men and women was glaucoma (men, 30.2%; women, 27.0%; Fig. 3a). The male:female ratio for each of the main causative diseases/conditions is shown in Fig. 3b. Both chorioretinal atrophy and high myopia were more common among women than men.

In total, 31.8% individuals exhibited grade 2, 24.3%, grade 5, and 16.1%, grade 1 visual impairment (Fig. 4). The distribution of causative diseases/conditions according to each visual impairment grade is shown in Online Resource 3.

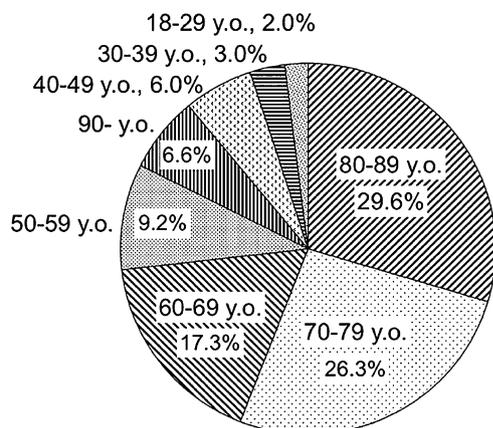


Fig. 1 Proportion of newly certified visually impaired individuals in Japan according to the age group. y.o.: years old

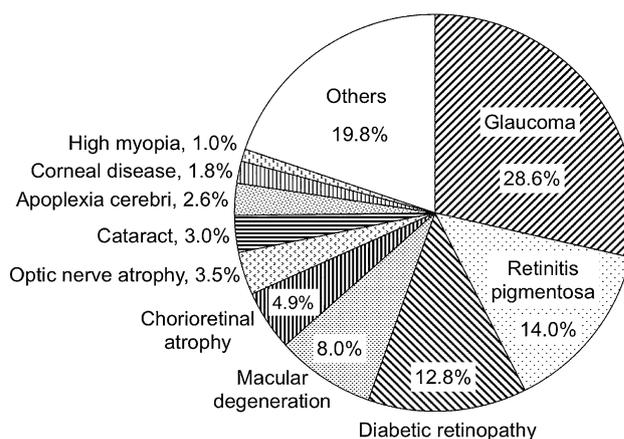


Fig. 2 Distribution of causative diseases/conditions among all newly certified visually impaired individuals

Changes in the number of visual impairment certification in the MHLW white paper [14] are shown in Fig. 5a, while changes in the (estimated) number of visual impairment certifications associated with the most common causative diseases according to the two previous national surveys and the present survey are shown in Fig. 5b. The number of new visual impairment certifications was lower in fiscal 2015 than in the previous two national surveys. The estimated number of visually impaired individuals with causative glaucoma was higher in fiscal 2015 than in the period covered by the previous survey (from fiscal 2007 to 2009). In contrast, the estimated number of visually impaired individuals with causative diabetic retinopathy or macular degeneration was lower in fiscal 2015 than in the period covered by the previous survey (from fiscal 2007 to 2009). The estimated number of visually impaired individuals with causative retinitis pigmentosa remained unchanged.

Discussion

To the best of our knowledge, the present study is the first nation-wide complete enumeration survey of newly certified visually impaired individual in Japan. In total, the survey identified 12,505 individuals who were newly certified as visually impaired in fiscal 2015 (99.6% of all newly certified visually impaired individuals in Japan); this figure is approximately nine times higher than the number of individuals included per year for the three previous national sample surveys [10–12]. The present survey eliminated the sampling bias present in conventional sample surveys, thereby yielding results that more accurately reflect the actual status of visual impairment certification in Japan. In addition, the present survey more accurately grasped the number of visually impaired individuals with various causative diseases/

Table 1 Distribution of causative diseases/conditions in each age group of newly certified visually impaired individuals in Japan

	Age (years old)									Mean age (years old)
	18-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-	
Glaucoma (%)	7.5	10.3	14	16.4	22.7	29.7	40.3	40	50	76.5 ± 12.6
Retinitis pigmentosa (%)	28.9	31	28.7	24.4	19.2	13.1	6	1.7	0	62.1 ± 16.2
Diabetic retinopathy (%)	3.5	13.4	18.1	19.5	21.3	15	6.6	1.2	0	66.7 ± 12.9
Macular degeneration (%)	0.6	1.1	2.5	2.7	4.2	7.5	12.6	18.7	16.7	80.1 ± 11.1
Chorioretinal atrophy (%)	0	0.8	1.1	1.7	3.5	5.7	6.8	6.3	0	77.8 ± 10.2
Optic nerve atrophy (%)	9.2	3.4	4.5	3.1	3.5	4	3.2	4.7	0	69.6 ± 17.7
Cataract (%)	2.3	1.9	1.1	2.8	2	2.5	3.6	8	25	76.8 ± 15.4
Apoplexia cerebri (%)	1.7	2.3	4.5	5.2	4	3.4	1.1	1.4	0	65.9 ± 13.9
Corneal disease (%)	0.6	1.1	1.7	0.9	1.3	1.5	2.5	2.3	0	75.2 ± 14.6
High myopia (%)	0.6	0	0.4	0.2	1.1	1.5	1.1	1	0	75.3 ± 11.5
Others (%)	45.1	34.5	23.4	23	17.1	16.2	16.3	14.5	8.3	67.1 ± 18.5
Total (%)	100	100	100	100	100	100	100	100	100	71.3 ± 15.8

Mean age is given as mean ± standard deviation

conditions (Fig. 5b). Furthermore, the results of this survey will enable comparisons between regions and municipalities.

The primary reason for the ability to conduct the complete enumeration survey is the digitalization of records. Therefore, in future, it will be possible to conduct high-quality surveys at short intervals with ease. However, the present study also highlighted problems inherent to national surveys, with the biggest problem being the inconsistency in names used for causative diseases, which are assigned at the discretion of the physician designated by the Act on Welfare of Physically Disabled Persons. Furthermore, the names being used are not actually the names of diseases; rather, they represent conditions and pathologies such as high myopia, macular degeneration, chorioretinal atrophy, and optic nerve atrophy. In future, it will be necessary to facilitate the implementation of more accurate surveys. For instance, the names of causative diseases on the physical disability certificate should be standardized.

In the present study, the most common cause of visual impairment was glaucoma (Fig. 2). In addition, the survey revealed that the number and percentage of visual impairment certifications associated with causative glaucoma had increased in comparison with the numbers in the previous national surveys (Fig. 5b). Specifically, we found that glaucoma was the cause of visual impairment in 28.6% of individuals newly certified, while in both recent national surveys this was approximately 21% [11, 12]. Moreover, relative to the numbers in the previous surveys, the overall number of new visual impairment certifications and the number of visually impaired individuals with causative glaucoma in fiscal 2015 had decreased (Fig. 5a) and increased (Fig. 5b), respectively. Ikesugi et al. report in a 10-year survey of visually impaired individuals in the Japanese prefecture of Mie, that the incidence of glaucoma in visually impaired individuals

and the number of visually impaired individuals with causative glaucoma increased [15]. The results of the present study are consistent with these results.

The present study demonstrates two findings pertaining to glaucoma as a causative disease for visual impairment. One was that visually impaired individuals with causative glaucoma were of advanced age. The other that glaucoma was associated with higher visual impairment grades. The mean age of newly certified visually impaired individuals with causative glaucoma was 76.5 years (Table 1); this result is similar to that of the two previous national surveys, where the mean ages were 75.8 (earlier survey) and 75.7 years (later survey) [11, 12]. Also, as shown in Table 1, glaucoma was the most common causative disease for age groups ≥ 60 years. These results indicate that the increase in the number of visually impaired individuals with causative glaucoma in Japan may be related to the progressive aging of the society [13]. Glaucoma was the causative disease in 29.6% with grade 1 and 34.2% individuals with grade 2 visual impairment (Online Resource 3). In addition, glaucoma was the causative disease for grade 1 or grade 2 visual impairment in 41.3% individuals aged ≥ 70 years (Online Resource 1). These results demonstrate the significance of glaucoma in planning of administrative activities concerning the welfare of visually impaired elderly individuals in Japan. The aging of the Japanese society is expected to progress [13]; consequently, if the present conditions remain unchanged, the number of elderly individuals with serious visual impairment caused by glaucoma is anticipated to increase. In recent years, novel solutions have been developed for the management of glaucoma, and new surgical procedures have been devised [16–18]. However, the pathology of glaucoma must be further elucidated, and novel therapies must be continuously developed. Furthermore, because

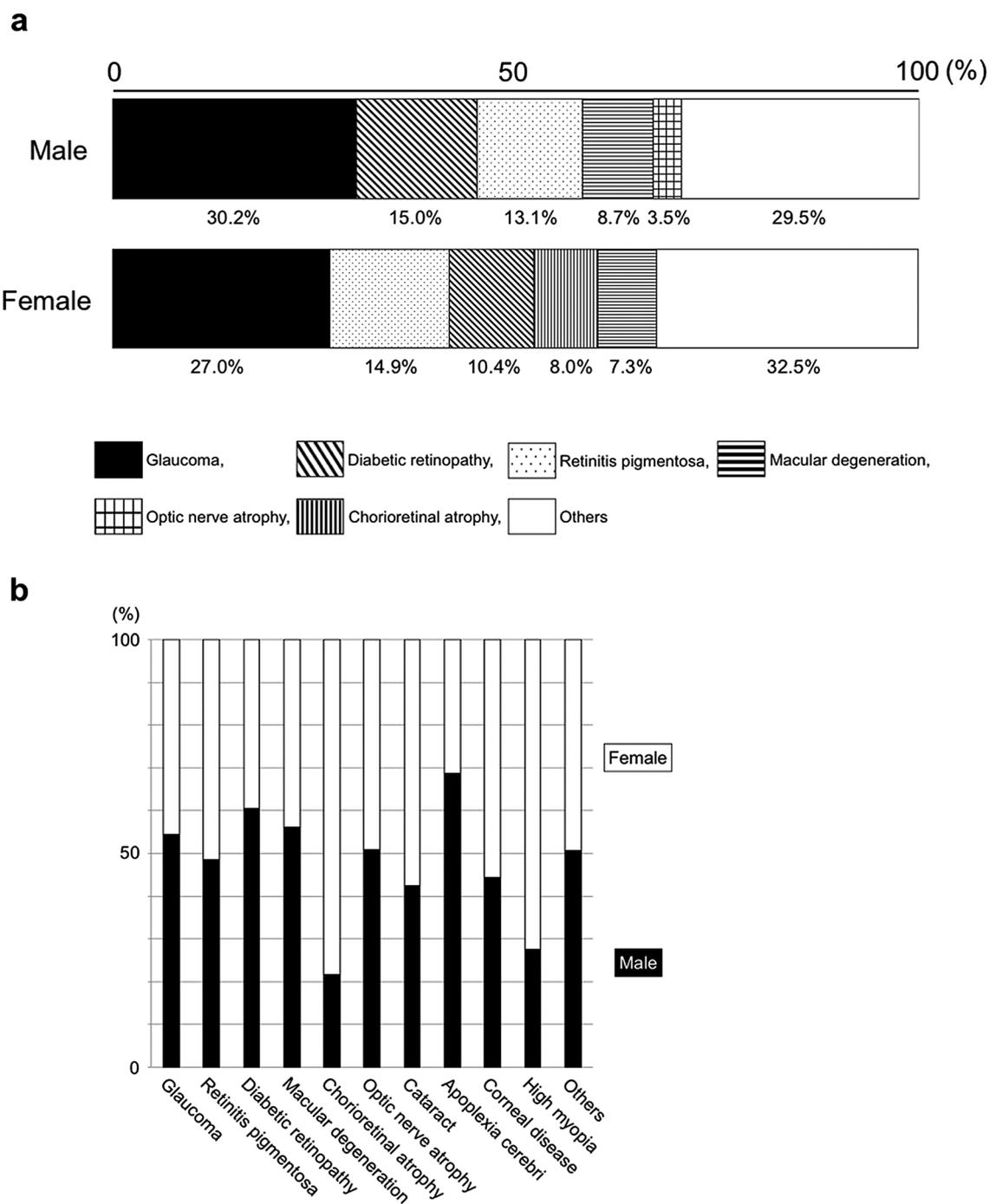


Fig. 3 Distribution of causative diseases/conditions according to the sex of newly certified visually impaired individuals in Japan. **a** Distribution of causative diseases/conditions according to the sex. **b** Male/female ratio for each causative disease/condition

glaucoma is a chronic disease that progresses gradually and presents with few subjective symptoms, active implementation of secondary prevention measures is important to prevent visual impairment from becoming severe and maintain the quality of life of elderly individuals. It may be necessary to implement measures such as the incorporation of

ophthalmological examinations into routine health checkups conducted by local governments or insurers.

As opposed to the incidence of glaucoma, the incidence of diabetic retinopathy and macular degeneration (12.8% and 8.0%, respectively; Fig. 2) was lower in the present study than in the two previous surveys (fiscal years 2001 to 2004:

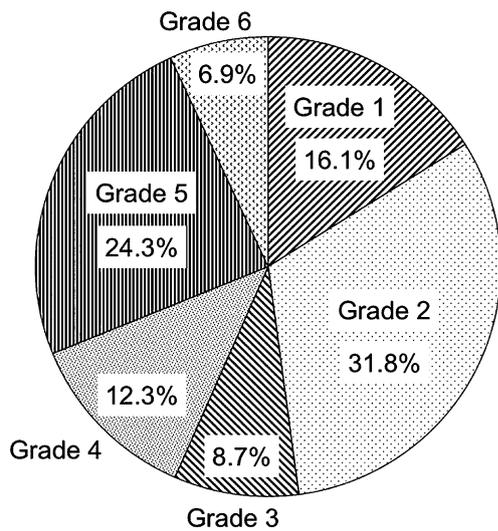


Fig. 4 Distribution of different grades of newly certified visual impairment in Japan

19.0% and 9.3%, respectively; fiscal years 2007 to 2009: 15.6% and 9.5%, respectively) [11, 12]. Diabetic retinopathy was the most common cause of visual impairment certifications in a national survey conducted during fiscal 1988 [10], and it was the second most common cause in the last two national surveys [11, 12]. In the present survey, however, diabetic retinopathy stood third, after retinitis pigmentosa. The numbers of visually impaired individuals with causative diabetic retinopathy and macular degeneration were both lower in the present survey than in the previous surveys (Fig. 5b). However, these results are identical to those in the 10-year survey conducted in Mie Prefecture [15]. There are two conceivable reasons for the decrease in the number of visually impaired individuals with causative diabetic retinopathy, despite the annual increase in the number of patients with diabetes mellitus [19–21]. First, the emergence of agents such as dipeptidyl peptidase-4 (DPP-4) inhibitors, sodium-glucose co-transporter-2 (SGLT2) inhibitors, and glucagon-like peptide-1 (GLP-1) receptor agonists has led to advances in the treatment of diabetes mellitus [22]. Second, advances in treatments for diabetic retinopathy, such as steroids, laser treatment, and vitrectomy, have prevented the progression of visual impairment to a severe stage. The use of anti-vascular endothelial growth factor (VEGF) agents for diabetic macular edema was approved in 2014 in Japan. Therefore, the results of the present survey, conducted in the fiscal 2015, may have been minimally influenced by the effects of anti-VEGF agents. A further decrease in the number of visually impaired individuals with causative diabetic retinopathy is expected.

Age-related macular degeneration accounts for the majority of macular degeneration cases among patients

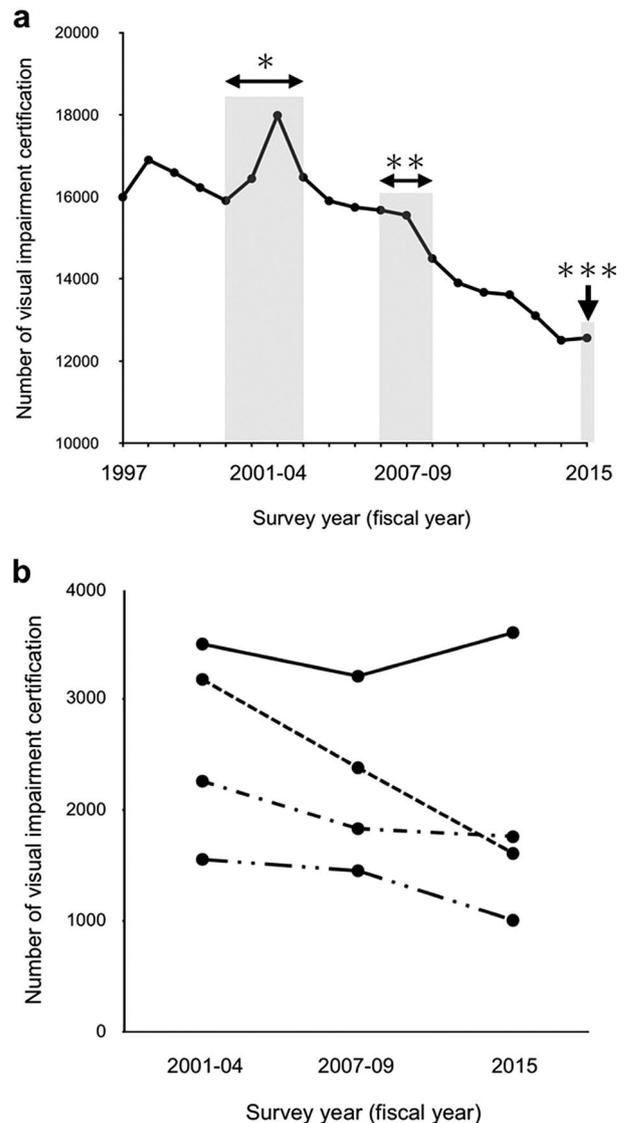


Fig. 5 Changes in the number of newly certified visually impaired individuals in Japan. **a** Changes in the number of newly certified visually impaired individuals aged ≥ 18 years. *: Period of the second most recent survey (from fiscal years 2001 to 2004). **: period of the most recent survey (from fiscal years 2007 to 2009). ***: period of the present survey (fiscal year of 2015). **b** Changes in the number of newly certified visually impaired individuals aged ≥ 18 years and diagnosed with the four most common causative diseases (estimated). The solid line, dotted line, dash-dot line, and dash-dot-dot line represent glaucoma, diabetic retinopathy, retinitis pigmentosa, and macular degeneration, respectively

aged ≥ 18 years. In Japan, age-related macular degeneration is becoming increasingly common as the society ages and lifestyle habits become westernized. For example, in the Hisayama study, a population-based cohort study conducted in Japan, the incidence of age-related macular degeneration increased from 0.9% in 1998 to 1.3% in 2007 [23]. Despite this increase, our survey reports a decrease

in the incidence of visual impairment caused by macular degeneration. This may be attributed to the emergence of treatments such as photodynamic therapy and anti-VEGF drug therapy as well as to the widespread use of optical coherence tomography, which has resulted in improved diagnostic accuracy, earlier initiation of treatment, and rigorous post-treatment follow-ups. Interestingly, according to the present survey, the number of visually impaired individuals with causative macular degeneration decreased in 2008, when ranibizumab was approved for use in Japan (Fig. 5b). This result is also similar to that in the 10-year Mie Prefecture survey [15]. If new drugs are developed and regenerative medicine progresses with the use of induced pluripotent stem cells [24], the number of visually impaired individuals with causative macular degeneration may exhibit a further decrease.

This study has some limitations. First, although the present survey examined individuals who had received visual impairment certification, it should be noted that not all individuals who qualify for visual impairment certification actually apply. Indeed, the percentage of individuals who qualify for certification and have actually obtained it is thought to be low. Even among individuals examined by ophthalmologists, only about 50% eligible individuals actually receive the certification [25, 26]. In addition, Tanito et al. and Fujita et al. report that certification rates vary on the basis of the causative disease/condition, age, and grade of visual impairment [26, 27]. For example, in a patient with diabetes, if the patient has already been certified as having a grade 1 disability due to complications unrelated to visual impairment, such as renal failure, that patient is unlikely to apply for visual impairment certification. Second, causative diseases/conditions were limited to the first disease/condition on the disability certificates. Therefore, for cases with multiple causative diseases/conditions, only one disease/condition name was included in this survey.

In conclusion, the present study revealed that the most common causative disease for visual impairment was glaucoma, followed by retinitis pigmentosa, diabetic retinopathy, and macular degeneration. The number of visually impaired individuals with causative glaucoma had increased compared with the number in previous national surveys, whereas that of visually impaired individuals with causative diabetic retinopathy and macular degeneration had decreased. Although the number of newly certified individuals in a single year only accounts for approximately 3% of all certified visually impaired individuals [28], it will be important to conduct such surveys on a regular basis and consider the latest trends in visual impairment certification during the planning of healthcare and social welfare policies and educational activities for preventing visual impairment. In addition, the findings of such surveys highlight recent developments in ophthalmological care for the society at large.

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