Planimetrically Determined Vertical Cup/Disc Ratios and Related Factors

Tae Tsutsumi, Atsuo Tomidokoro, Makoto Araie, Aiko Iwase, Hiroshi Sakai, and Sboichi Sawaguchi

PURPOSE. To evaluate the distribution and factors related to planimetrically determined vertical cup/disc (v-C/D) and rim width/disc diameter (Rw/Dd) ratios of the optic discs in a population-based study of Japanese subjects without glaucoma.

METHODS. Of 4632 eligible residents 40 years of age and older, 3762 residents underwent a detailed ophthalmic examination including sequential optic disc stereo photography with a digital nonmydriatic fundus camera. The photographs were assessed by computer-assisted planimetry. The authors studied both eyes of 2511 nonglaucomatous subjects and only one right (left) eye of 196 (175) subjects for whom disc stereo photographs were of acceptable quality.

RESULTS. The median (2.5th and/or 97.5th percentile) disc area, v-C/D, its asymmetry, and the superior- and inferior-minimal Rw/Dd ratios were 2.56 (1.68, 3.71) mm², 0.56 (0.70), 0.05 (0.14), 0.18 (0.10), and 0.21 (0.12), respectively. Multiple regression analysis showed that males had larger discs and superior Rw/Dd and smaller inferior Rw/Dd ratios. Increased age was correlated with increased v-C/D and decreased superior and inferior Rw/Dd ratios. Higher intraocular pressure (IOP) and thinner central corneal thickness (CCT) were correlated with higher v-C/D and smaller inferior rim/disc ratios, and lower diastolic ocular perfusion pressure (OPP) with greater v-C/D and smaller superior Rw/Dd ratios.

CONCLUSIONS. In nonglaucomatous eyes, increased v-C/D and decreased superior and inferior Rw/Dd ratios were significantly correlated not only with increased age and disc size but also with higher IOP, lower diastolic OPP, and thinner CCT, suggesting that these simple disc parameters also represent vulnerability to glaucoma.

Evaluation of optic disc morphology is essential for diagnosing and managing glaucoma. Among the disc parameters, the vertical cup/disc ratio (v-C/D) and the rim width/disc diameter ratio (Rw/Dd), determined using a ruler or eyepiece graticule without planimetry and correction of magnification or any modern devices (e.g., Heidelberg Retina Tomograph [HRT]; Heidelberg Engineering, Heidelberg, Germany), have been widely used as simple, but important and useful clinical indexes for diagnosing and managing glaucoma.

Many prospective and retrospective studies have identified the v-C/D as an important factor for predicting future development of glaucoma. The 97.5th percentile of the v-C/D and its intereye asymmetry in normal populations have been proposed as criteria for glaucoma screening by the International Society for Geographic and Epidemiologic Ophthalmology (ISGEO) and have been widely adopted in population-based glaucoma surveys. The Rw/Dd of 0.1 or smaller at the superior or inferior portions was also adopted as an ISGEO criterion for diagnosing glaucoma by assuming 0.1 as a surrogate for the 2.5th percentile in normal populations. Further, the v-C/D and Rw/Dd ratios should be of practical importance in glaucoma care in less developed regions of the world, where many individuals have glaucoma-related visual loss, although ophthalmologic infrastructures are limited. Supporting the usefulness of these parameters, our recent study showed that the prevalence of the v-C/D with the overall peripapillary damage was as good as that of the rim area obtained by the HRT II or that of the ellipse average obtained by scanning laser polarimetry with variable corneal compensation (GDx-VCC; Carl Zeiss Meditec, Dublin, CA) in the same eyes. In addition, the Rw/Dd for a given sector that was correlated with damage in the corresponding subfield was as good as that of the rim/disc (R/D) area ratio obtained by the HRT II or that of the average retinal nerve fiber layer (RNFL) thickness obtained by GDx-VCC.

The 97.5th percentile of the v-C/D was 0.70 based on population-based studies in Asia and Africa. In those studies, however, the v-C/D was determined with an eyepiece graticule by slit-lamp microscopy, and the median v-C/D in the same population (Tanjong Pagar Study participants) determined using the above-cited method was reportedly somewhat smaller than that determined using stereo photography–based planimetry (0.47 vs. 0.57). Further, no previous studies have investigated Rw/Dd and its statistics in normal populations. Because of interethnic differences in disc parameters including sequential optic disc stereo photography with a digital nonmydriatic fundus camera, the authors studied both eyes of 2511 nonglaucomatous subjects and only one right (left) eye of 196 (175) subjects for whom disc stereo photographs were of acceptable quality.

Optic disc morphology in normal populations has been studied in several population-based surveys using simultaneous or sequential stereo or nonstereo photography–based planimetry or HRT. Some surveys have evaluated the v-C/D and/or its correlation with sex, age, disc size,
intraocular pressure (IOP), or refraction. Blood pressure (BP) and central corneal thickness (CCT) are two important recently recognized prognostic factors for glaucoma,\textsuperscript{41,42} however, only one study reported its correlation with BP,\textsuperscript{43} and no study reported a correlation with CCT. No studies have investigated a correlation between systemic or ocular factors and the Rw/Dd.

A population-based study of ocular diseases was conducted recently in Kumejima in southwest Japan. Stereo disc photographs were obtained routinely during screening examinations, and the results, including disc size, v-C/D, and Rw/Dd, were analyzed using computer-assisted planimetry, which was confirmed to yield sufficiently high inter- and intraobserver reproducibility.\textsuperscript{19} In the present study, the distributions of the v-C/D and Rw/Dd at the superior and inferior poles, their upper and lower limits, and related systemic and ocular factors were studied in nonglaucomatous eyes of participants in the Kumejima Study.

METHODS

Population Sampling

The Kumejima Study, a population-based survey focusing on ocular abnormalities including glaucoma, followed the tenets of the Declaration of Helsinki and regional regulations. The ethics board of the regional council approved the study protocol. All participants provided written informed consent before the examinations. The survey was conducted between May 2005 and August 2006 in Kumejima, a south-west island in Okinawa Prefecture, Japan. Kumejima had 5249 residents 40 years of age or older in 2005 according to the official household registration database. After excluding 617 residents who died, moved, or could not be located during the study period, 4632 eligible residents were invited to participate.

Examinations and Diagnosis

The screening examination consisted of a structured interview about occupation, health history, surgery and trauma history, and smoking habits. Experienced examiners measured the body weight, height, and BP, and ophthalmologists performed ocular examinations that included measurement of the uncorrected and best-corrected visual acuity (VA), refraction using an autorefractometer (ARK-730; Topcon, Tokyo, Japan), IOP, CCT by specular microscopy (SP-2000; Topcon), central anterior chamber depth, and axial length (using the IOLMaster; Carl Zeiss Meditec), slit-lamp examination, ophthalmoscopy, fundus photography (45° of the visual angle) and sequential stereoscopic disc photographs at a parallax of approximately 8° (30° of the visual angle) using a digital nonmydriatic fundus camera (TRC-NW7; Topcon), and visual field (VF) testing using frequency-doubling technology (FDT) perimetry with the C-20-1 screening program (Carl Zeiss Meditec). The IOP was measured three times using a Goldmann applanation tonometer under topical anesthesia and the median value was recorded. The peripheral anterior chamber depth was scored according to the van Herick method and the gonioscopic findings according to Shaffer’s grading system using a Goldmann two-mirror lens. Participants were referred for a definitive examination if they had one or more of the following: corrected VA of 20/50 or less; IOP of 19 mm Hg or higher; an abnormality suggestive of glaucoma or other ocular diseases on ophthalmoscopy, fundus photographs, or stereoscopic disc photographs including a v-C/D of 0.6 or higher, superior (11 to 1 o’clock hours) or inferior (5 to 7 o’clock hours) R/D ratio of 0.2 or lower, bilateral asymmetry of the v-C/D of 0.2 or higher, a nerve fiber layer defect, a splinter disc hemorrhage, any abnormalities on slit-lamp examination, an angle width of grade 2 or less (van Herick method), and at least one abnormal test point (P ≤ 0.05) on FDT VF testing. An independent photograph screening committee judged the fundus and stereo disc photographs.

The definitive examination included detailed slit-lamp, gonioscopic, and fundus examinations and VF testing with a field analyzer (Humphrey Field Analyzer [HFA]; Carl Zeiss Meditec), central 24-2 Swedish interactive threshold algorithm standard program. In eyes without contraindications, the pupils were dilated to observe the fundus by direct and indirect ophthalmoscopy; in eyes with a contraindication, examinations were performed with undilated pupils.

The details of the disc, fundus, and VF examination and diagnosis of glaucoma were essentially the same as those previously reported.\textsuperscript{11,44} A photograph reading committee, comprised of members who were different from the members of the photograph screening committee and did not have other information about the eyes, evaluated the pairs of digital stereo color fundus photographs of all the participants undergoing a definitive examination. When the assessments by the committee members did not agree with each other, consensus was obtained by a discussion with reference to all available photographs. The VF reading committee examined results of the HFA tests and did not have access to other ocular information. VFs with fixation loss below 33% and false positives and negatives below 20% were considered reliable and abnormal VFs, defined as the presence of at least one abnormal hemifield that was determined based on the criteria of Anderson and Patella.\textsuperscript{11,45} A panel of glaucoma specialists, including those who were members of the photograph reading committee, determined the final glaucoma diagnosis based on clinical records obtained during all examinations. Glaucoma was diagnosed based on evaluations of the disc, RNFL, and VFs based on the ISGEO criteria.\textsuperscript{9} In glaucoma diagnosis, anomalous discs, including tilted discs, were excluded.

Determination of Disc Parameters

For the present study, an experienced ophthalmologist (TT) reexamined all stereo disc photographs. A pair of photographs was viewed three-dimensionally using an electronic shutter glass (CrystalEyes; Stereophotographics, San Rafael, CA) that was synchronized with the LCD monitor flickering. While stereoscopically viewing the optic disc, the disc contour (defined as the inner edge of the scleral rim) was determined by a series of seven points with spline interpolation, and the cup contour (defined as the point of change of slope from the cup wall to the neural rim) was determined as a free closed curve by an unlimited number of points placed on the computer monitor using a computer mouse.\textsuperscript{19} The disc center was calculated automatically as the center of gravity of the disc area.

After correcting for magnification by corneal curvature, axial length, and refractive error according to the formula\textsuperscript{46–48} provided by the manufacturer, the accompanying software automatically calculated the disc area, v-C/D, horizontal C/D ratio, the maximal vertical (horizontal) cup diameter/maximal vertical (horizontal) disc diameter (h/C/D),\textsuperscript{49} and the Rw/Dd (the rim width on an axis through the center of the disc at a given angle/disc diameter at the same axis calculated for every 5° of the disc).\textsuperscript{50} The superior and inferior Rw/Dd values were calculated as the means of the Rw/Dd between the 11 and 1 o’clock and the 5 and 7 o’clock positions, and superior-minimal and inferior-minimal Rw/Dd values were the smallest between the 11 and 1 o’clock and the 5 and 7 o’clock positions.

Data Analysis

Distributions of the parameters studied are expressed as the mean, SD, median, and the 0.5th, 2.5th, 97.5th, and 99.5th percentiles. Associations between the disc parameters and systemic and ocular factors were evaluated using multiple regression analysis in which each parameter was the dependent variable and other factors and the disc area were the explanatory variables. Analyses were performed using a commercial analytical software package (SPSS 15.0J for Windows; SPSS Japan Inc., Tokyo, Japan).

RESULTS

Of the 4632 eligible residents 40 years of age and older, 3762 (participation rate, 81.2%) underwent a screening examina-
Axial length, mm 23.4
SE refractive error, diopters 0.06
IOP, mm Hg 15.1
Diastolic BP, mm Hg 79.1
Systolic BP, mm Hg 140.0
Weight, kg 61.4
Height, cm 156.0
Age, y 57.6 ± 12.2
BMI 25.1 ± 3.6
Systolic BP, mm Hg 140.0 ± 23.6
Diastolic BP, mm Hg 79.1 ± 13.2
IOP, mm Hg 15.1 ± 3.1
SE refractive error, diopters 0.06 ± 1.68
Axial length, mm 23.4 ± 0.9
CCT, mm 0.514 ± 0.035

Table 1 shows the patient and ocular characteristics of 2507 subjects and only the right or left eye of 196 (175) subjects (no other findings suggestive of glaucoma were not encountered and the VFs were normal, eyes with 8.0 or above 5 diopters (14 right eyes, 11 left eyes) were excluded. As a result, both eyes of 2311 subjects and only the right or left eye of 196 (175) subjects (no eyes of 1080 subjects) were analyzed.

Because of the high intereye correlation of all disc parameters in subjects whose eyes were both eligible (Pearson’s correlation coefficients of 0.62 to 0.87; P < 0.001), the results of the right eyes are shown.

Table 1 shows the patient and ocular characteristics of 2507 subjects (1251 males, 1256 females) for whom at least the right eye was eligible. Figure 1 shows the distribution of asymmetry of the v-C/D. Figure 2 shows the distributions of the disc area, v-C/D, and the superior-minimal (inferior-minimal) Rw/Dd. Table 2 summarizes the distributions of each parameter.

Multiple regression analysis showed that males had larger discs and superior and superior-minimal and smaller inferior Rw/Dd ratios. Increased age was correlated with decreased superior, superior-minimal, inferior, and inferior-minimal Rw/Dd ratios and increased v-C/D and h-C/D. Higher IOP and thinner CCT were correlated with smaller inferior and inferior-minimal Rw/Dd ratios and higher v-C/D and h-C/D values. The refractive error, body mass index (BMI), and systolic ocular perfusion pressure (OOP = 2/3 × (BP − IOP)) were not correlated with the previously mentioned parameters, but a lower diastolic OPP was correlated with a higher v-C/D and smaller superior and superior-minimal Rw/Dd ratios. The disc area was not correlated with age, OPP, BMI, IOP, or CCT but was negatively correlated with the refractive error and superior, superior-minimal, inferior, and inferior-minimum Rw/Dd ratios and positively correlated with the v-C/D and h-C/D (Table 3).

Correlations between the disc area and v-C/D and the superior-minimal and inferior-minimal R/D ratios are shown in Figure 3. The v-C/D asymmetry was not correlated with sex, age, bilateral asymmetry of the IOP, refractive error, or CCT (P > 0.13). The mean and the 97.5th percentile values of the v-C/D and superior-minimal and inferior-minimal Rw/Dd ratios in three (small, medium, and large) subgroups of disc area that were divided at the 33.3rd and 66.6th percentiles are shown in Table 4. There were significant differences among the three disc sizes after adjusting for age and sex (P < 0.001, ANCOVA).

Discussion

The disc area was 2.56 ± 0.51 mm² in a nonglaucomatous population in the Kumejima Study. In other population-based studies, the disc area determined by planimetry on fundus photographs averaged (in mm²) 2.17 in Singapore, 2.58 in India, 2.65 in China, 2.94 (Blacks) and 2.63 (Caucasians) in the United States, and 3.37 in South India. Considering the differences in the methods of correction of magnification, the mean disc area in Japanese individuals (2.56 mm²) does not seem to differ substantially from that in other populations, except for that in South India.

In the present study, the disc area was significantly larger in males than that in females, after adjusting for other factors (Table 3), and comparable to that in Singapore. The Netherlands, and Blacks and Caucasians in the United States. Some population-based studies but not others reported a significant negative correlation between SE and disc area. A hospital-based study of 1011 subjects also reported that the disc area was independent of SE in a range of −8 to +4 diopters.

In the current subjects, excluding patients with high myopia, a weak positive correlation was seen between the SE and the disc area, which confirmed the findings of another population-based study in Japan in which the disc area was determined by HRT.

v-C/D Ratio and Its Asymmetry

The v-C/D is an important parameter for screening, diagnosing, and managing glaucoma in routine ophthalmologic practices and population-based studies. In the ISGEO criteria for glaucoma, glaucoma is suspected when the v-C/D is equal to or

Figure 1. The distribution of the asymmetry of the v-C/D ratio between the right and left eyes of 2216 subjects with two eligible eyes. The median is 0.04 and the 95th, 97.5th, and 99th percentiles are, respectively, 0.12, 0.14, and 0.17.
larger than the 97.5th percentile of the normal population and diagnosed when corresponding VF damage is found (category 1) or when it is equal to the 99.5th percentile or larger without available or reliable VF results (category 2). Examples of the 97.5th (99.5th) percentiles of the v-C/D have been reported: 0.70 (0.70) in Mongolia, 0.71 (0.82) in Singapore, 0.70 (0.8) in Tanzania, and 0.70 (0.85) in Bangladesh. Recent population-based studies have reported 0.72 (0.86) in Thailand, 0.64 (0.79) in Myanmar, and 0.6 (0.6) in West Bengal. In those studies, the v-C/D was determined using an eyepiece graticule by slit-lamp microscopy, but the median value of the v-C/D in the same population (Tanjong Pagar Study participants) determined using the above method was somewhat smaller than that obtained by stereo photography–based planimetry (0.47 vs. 0.57). The 97.5th (99.5th) percentiles of the v-C/D determined using stereo photography–based planimetry were 0.70 in The Netherlands and 0.68 (0.73) in Australia in nonglaucomatous subjects. The present study reported for the first time that the 97.5th (99.5th) percentile of the v-C/D in a large nonglaucomatous Asian population was 0.70 (0.76) using stereo photography–based planimetry, which agreed with the value in Caucasians. Because the numbers of eyes that exceeded the 99.5th percentile were limited in each study (i.e., 5 of 1000 eyes), the 97.5th percen-
tile should be more robust than the 99.5th percentile. The present study confirmed the validity of 0.7 as a cutoff value irrespective of the population.

However, the reported mean (median) value of the v-C/D in nonglaucomatous subjects determined with an eyepiece graticule or its equivalents varied from 0.30 to 0.47, whereas studies using fundus photography-based planimetry reported values ranging from 0.43 to 0.56. As shown in the same study participants, the latter more objective method is thought to yield a somewhat greater mean (median) value of the v-C/D. The current result (0.56) agreed with the values reported in other Asian countries and Blacks (0.55–0.56) and was greater than that reported in Caucasians (0.43–0.49). The current results, that is, a higher v-C/D in nonglaucomatous Japanese individuals is somewhat smaller than that mentioned previously, for which racial differences might be partly responsible. If the asymmetry is determined in 0.05 intervals in clinical practice, 0.15 but not 0.2 and 0.05 but not 0.3 should be used as the 2.5th and 0.5th percentiles in Japanese subjects. In contrast to a previous study, the present study found no significant correlation between v-C/D asymmetry and other parameters, including disc size and IOP asymmetry, despite that the v-C/D itself was correlated significantly with the IOP and disc size. A relatively small bilateral difference in the IOP and disc size in the current subjects might make it difficult to detect a significant correlation.

**Table 2. Representative Values of the Distribution of the Planimetric Parameters in 2507 Normal Subjects for Whom at Least the Right Eye Was Eligible**

<table>
<thead>
<tr>
<th>Planimetric Parameter</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc area, mm²</td>
<td>2.56</td>
<td>0.51</td>
<td>2.50</td>
</tr>
<tr>
<td>Vertical C/D</td>
<td>0.56</td>
<td>0.08</td>
<td>0.56</td>
</tr>
<tr>
<td>Horizontal C/D</td>
<td>0.58</td>
<td>0.09</td>
<td>0.58</td>
</tr>
<tr>
<td>Superior Rw/Dd</td>
<td>0.20</td>
<td>0.05</td>
<td>0.20</td>
</tr>
<tr>
<td>Inferior Rw/Dd</td>
<td>0.24</td>
<td>0.05</td>
<td>0.24</td>
</tr>
<tr>
<td>Superior-minimal Rw/Dd</td>
<td>0.18</td>
<td>0.04</td>
<td>0.18</td>
</tr>
<tr>
<td>Inferior-minimal Rw/Dd</td>
<td>0.21</td>
<td>0.05</td>
<td>0.21</td>
</tr>
<tr>
<td>v-C/D asymmetry</td>
<td>0.05</td>
<td>0.04</td>
<td>0.04</td>
</tr>
</tbody>
</table>

**Table 2.** Representative Values of the Distribution of the Planimetric Parameters in 2507 Normal Subjects for Whom at Least the Right Eye Was Eligible.

**Rw/Dd**

To the best of our knowledge, distribution of the Rw/Dd in normal subjects in a population-based study has not been reported. The Rw/Dd at the superior or inferior portions of 0.1 or less is included in the ISGEO criteria (category 1), assuming a cutoff value of 0.1 as a surrogate for the 2.5th percentile in normal populations. We reported the 2.5th (0.05th) percentiles for the superior- and inferior-minimal Rw/Dd, 0.10 (0.08) and 0.12 (0.09), respectively, here for the first time in nonglaucomatous subjects. When the Rw/Dd is determined in 0.05 intervals, 0.1 is justified for both the superior and inferior portions based on the present study. However, it must be noted that the 0.5th percentile value is closer to 0.1 than to 0.05, which was assumed in the ISGEO criteria.

Multiple regression analysis showed that the superior (inferior) Rw/Dd was slightly but significantly greater in males (females). Considering the significant intersex difference in the disc size, the current finding suggested a small intersex difference in the disc structure. Significant correlations between the smaller inferior and inferior-minimal Rw/Dd and higher IOP, between the smaller superior and superior-minimal Rw/Dd and lower diastolic OPP, and between the smaller superior and inferior Rw/Dd and thinner CCT are compatible with the findings obtained for the v-C/D. These findings might represent a susceptibility factor or early glaucomatous damage too mild to indicate a definitive diagnosis based on the standard criteria but likely to become more obvious glaucoma at a later time.

The associations between a higher IOP and smaller Rw/Dd in the inferior (but not the superior) portion and between a lower diastolic OPP and smaller Rw/Dd in the superior (but not inferior) portion are interesting. Several studies have suggested a difference in relative vulnerability to pressure or other insults between the superior and inferior disc regions. For example, the superior hemifield is damaged more often in early glaucoma, and the correlations between peripapillary atrophy and VF damage differed between the superior and inferior portions of the disc of normal tension glaucoma. The inferior hemifield is more likely to be damaged in patients with open-
TABLE 3. Results of Multiple Regression Analyses for the Association between the Planimetric Parameters and Systemic or Ocular Factors in 2507 Normal Subjects for Whom at Least the Right Eye Was Eligible

<table>
<thead>
<tr>
<th>Factor</th>
<th>Disc Area</th>
<th>Vertical C/D</th>
<th>Horizontal C/D</th>
<th>Superior Rw/Dd</th>
<th>Inferior Rw/Dd</th>
<th>Superior-Minimal Rw/Dd</th>
<th>Inferior-Minimal Rw/Dd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PCC</td>
<td>P</td>
<td>PCC</td>
<td>P</td>
<td>PCC</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Sex (male = 1; female = 2)</td>
<td>-0.090</td>
<td>&lt;0.001</td>
<td>-0.000</td>
<td>NS</td>
<td>0.004</td>
<td>NS</td>
<td>0.047</td>
</tr>
<tr>
<td>Age, y</td>
<td>-0.025</td>
<td>NS</td>
<td>0.124</td>
<td>&lt;0.001</td>
<td>0.078</td>
<td>&lt;0.001</td>
<td>0.047</td>
</tr>
<tr>
<td>BMI</td>
<td>-0.029</td>
<td>NS</td>
<td>-0.011</td>
<td>NS</td>
<td>-0.011</td>
<td>NS</td>
<td>0.047</td>
</tr>
<tr>
<td>Systolic OPP, mm Hg</td>
<td>0.035</td>
<td>NS</td>
<td>0.016</td>
<td>NS</td>
<td>0.014</td>
<td>NS</td>
<td>0.047</td>
</tr>
<tr>
<td>Diastolic OPP, mm Hg</td>
<td>-0.018</td>
<td>NS</td>
<td>-0.050</td>
<td>0.013</td>
<td>-0.041</td>
<td>0.042</td>
<td>0.047</td>
</tr>
<tr>
<td>IOP, mm Hg</td>
<td>-0.021</td>
<td>NS</td>
<td>0.044</td>
<td>0.027</td>
<td>0.053</td>
<td>0.008</td>
<td>0.047</td>
</tr>
<tr>
<td>Refractive error, diopters</td>
<td>0.050</td>
<td>0.013</td>
<td>0.018</td>
<td>NS</td>
<td>0.022</td>
<td>NS</td>
<td>0.047</td>
</tr>
<tr>
<td>CCT, mm</td>
<td>0.002</td>
<td>NS</td>
<td>-0.050</td>
<td>0.012</td>
<td>-0.049</td>
<td>0.014</td>
<td>0.047</td>
</tr>
<tr>
<td>Disc area, mm²</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.484</td>
<td>&lt;0.001</td>
<td>0.047</td>
</tr>
</tbody>
</table>

Associations between the planimetric parameters and systemic and ocular factors were evaluated by multiple regression analysis, in which each planimetric parameter is the dependent variable and systemic and ocular factors and the disc area are the independent variables. Disc area is not included as the dependent variable in the analysis of the disc area. PCC, partial correlation coefficient; NS, not significant (P > 0.05).
angle glaucoma with diabetes mellitus or ischemic changes on cerebral magnetic resonance imaging or in patients with nonarteritic ischemic optic neuropathy. The current findings obtained for the superior and inferior Rw/Dd ratios seem to agree with the previous studies.

A significant correlation between disc size and superior and inferior Rw/Dd ratios indicates that when establishing the screening criteria for glaucoma not only the v-C/D but also the Rw/Dd should be adjusted for the disc size. It is useful to note that the median (2.5th percentile) superior- and inferior-minimal Rw/Dd decreased from 0.20 to 0.16 (0.12 to 0.09) and 0.25 to 0.19 (0.15 to 0.11), respectively, as the disc size increased from small to medium to large.

In conclusion, we evaluated the morphologic parameters of the optic disc using sequential stereo photography and computer-assisted planimetry in a nonglaucomatous Japanese population. The disc area averaged 2.56 mm². The median (97.5th percentile) superior- and inferior-minimal Rw/Dd decreased from 0.20 to 0.16 (0.12 to 0.09) and 0.25 to 0.19 (0.15 to 0.11), respectively, as the disc size increased from small to medium to large.

The disc area was divided at the 3.3rd and 6.6th percentile values. The v-C/D, superior R/D ratio, and inferior R/D area ratio differ significantly among the three subgroups of disc area after adjusting for age and sex ($P < 0.001$, ANCOVA).

## References


