RESEARCH ARTICLE

The Comparison of Age-related Change in Retinal Nerve Fiber Layer and Ganglion Cell Complex Thicknesses between Glaucoma Suspects and Healthy Individuals

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Abstract

Aim: The purpose of this study is to investigate the difference of change in the retinal nerve fiber layer (RNFL) and the ganglion cell complex (GCC) thickness according to age in glaucoma suspect individuals and healthy subjects.

Materials and methods: Thicknesses of RNFL and GCC were measured with spectral domain optical coherence tomography (SD-OCT) in glaucoma-suspected individuals and healthy subjects. The differences in age, overall mean, four quadrants, and 12 clock-hour sectors of RNFL and overall mean, superior half, and inferior half GCC thicknesses between glaucoma suspects and healthy participants were analyzed and compared using linear regression analyses.

Results: There were 201 glaucoma-suspect individuals and 121 healthy subjects with a mean age of 38.89 and 40.26 years, respectively ($p = 0.27$). The mean overall RNFL thickness was found to be 97.76 and 97.43 µm in healthy individuals and glaucoma suspects ($p = 0.72$). The mean overall GCC thickness was found to be 111.30 and 104.67 µm in healthy individuals and glaucoma suspects, respectively ($p < 0.001$). There was a 0.11 µm decrease per year found in overall GCC thickness in glaucoma suspects and 0.23 µm decreases per year in overall GCC thickness in healthy individuals ($p < 0.001$). There was a 0.02 µm decrease per year found in overall RNFL thickness in glaucoma suspects and a 0.29 µm decrease per year in overall RNFL thickness in healthy individuals ($p < 0.001$). However, these per-year decreases in GCC thickness glaucoma suspects and healthy individuals were not found to be statistically significant ($p = 0.21$); on the other hand, this difference for RNFL thickness was significant ($p < 0.001$).

Conclusion: It was found that the thicknesses of RNFL and GCC were different between glaucoma suspects and healthy individuals. However, age-related decay in the RNFL and GCC thicknesses was not uniform in healthy individuals and glaucoma suspects.

Clinical significance: It was found that the RNFL thickness and GCC thickness were lower in glaucoma suspects than in healthy controls eyes. However, an age-related decrease of RNFL and GCC thicknesses were found to be less in glaucoma suspects compared with healthy controls.

Keywords: Case-control study, Ganglion cell complex, Glaucoma, Glaucoma suspects, Retinal nerve fiber layer, Spectral domain optical coherence tomography.

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Introduction

Glaucoma is an optic neuropathy that features continuous destruction of retinal ganglion cells (RGCs) and their axons (RNF), resulting in progressive visual field loss.[1,2] SD-OCT is a crucial diagnostic tool for glaucoma, which is capable of measuring the thickness of the RNFL and GCC together with the other optic nerve head (ONH) and macular parameters.[3]

Standard automated perimetry (SAP) detects visual-field defects prior to 30–50% of RGC damage; thus, it is used as a gold standard diagnostic tool for detecting functional loss in glaucomatous optic neuropathy.[3] Diagnosing the RGC loss promptly is the main goal to hamper permanent visual-field defects, and therefore SD-OCT has an important place in detecting early RGC loss by its feature to measure quantitative parameters like RNFL ve GCC thicknesses used in the diagnosis.[4,5]

Although several histological studies demonstrate that the RNFL thickness and GCC thickness decreases with age, some OCT-based studies showed conflicting results on the role of aging in RNFL thickness change in healthy participants.[6–9] We aimed to investigate these glaucoma suspects. Glaucoma-suspect individuals can be characterized as having increased intraocular pressure (IOP) (IOP > 21 mm Hg) with glaucomatous ONH appearance [cup-to-disc ratio (C/D) of 0.6 or greater] and an intact visual field.[10]

Studies can be found in the English literature about the conditions that affected the retinal layers in glaucomatous eyes[11,12]; however, to the best of our knowledge, there are no studies found

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in the English literature that investigated the age-related change in the RNFL and GCC thickness in glaucoma suspected eyes.

This study aimed to compare the alterations in the thickness of the RNFL and GCC layer with aging between glaucoma-suspected individuals and healthy controls.

Materials and Methods

This retrospective study is composed of 322 pairs of eyes of 322 patients who applied to the Acıbadem University, Atakent Education and Research Hospital, Opthalmology clinic between 2011 and 2017. Patients were divided into healthy and glaucoma suspects according to their eye examination and patient history. Each participant has signed informed consent. The study protocol was approved by the Acibadem University Ethical Committee in agreement with the provisions of the Declaration of Helsinki. Inclusion criteria comprised of participants whose refractive status features spherical equivalent between −6.00 and +3.00 diopters, those participants who had best-corrected visual acuity of 20/40 or higher and have no history of intraocular surgery. Participants with ophthalmological findings excluding glaucoma and cataract, peripapillary atrophy reaching 1.7 mm from the middle point of the optic disc, uncertain standard automated perimetry (SAP) parameters (>33% fixation losses, >15% false-negative rates, and >15% false-positive rates) and low quality of OCT images were precluded (<35).

Definition of Healthy Individual/Glaucoma Suspect

Healthy eyes were specified as participants with no first-degree relatives of glaucoma, no history of intraocular surgery, IOP of <22 mm Hg, a healthy optic disc morphology, and normal ophthalmological findings.

Individuals specified as glaucoma suspects have relatively high intraocular pressure (>21 mm Hg), glaucomatous ONH morphology (C/D ratios of 0.6 or greater), and intact visual field.[10]

SDOCT Imaging

SD-OCT (3D OCT-2000; Topcon Corp, Tokyo, Japan) was used to achieve tomographic images of the parapapillary fundus with the three-dimensional (3D) disc scan and 3D macula scan modes. Further details can be found elsewhere.[13]

Entire measurements were run after pupillary dilation with 1% tropicamide, and entire images had signal strength intensity (SSI) of a minimum of 60, as suggested by the manufacturer.

A topographic GCC map was achieved from 7 × 7 mm perpendicular line scans centralized 1 mm temporal to the fovea. GCC thickness was achieved by measurement of the thickness of the nerve fiber layer together with the ganglion cell layer and inner plexiform layer. GCC thickness parameters consisted of overall, inferior, and superior GCC thickness.[14] In comparison, RNFL thickness parameters consisted of the overall four quadrants and 12 clock-hour sectors.

If the right and left eyes were suitable for admission, one eye was chosen randomly for inclusion. Analysis of RNFL deformity and GCC deformity was performed automatically by the device's reference database.

Statistical Analysis

Data were analyzed with R version 3.5.0. For every participant, one eye was selected randomly, and one eye was included in the analysis. Welch two-sample *t*-tests were performed to check the statistical difference in mean age between healthy and glaucoma suspect groups and also for mean differences in RNFL thickness and GCC thickness between healthy and glaucoma suspected participants. To include the effect of increasing age on the retinal thickness of participant groups, a total of 20 linear regression models were built to analyze the relationships between mean RNFL-GCC thicknesses, age, and participant groups. The formulation of regression models is as follows, where the mean thickness for each sector measurement are coefficients that measure the effect of minimum (baseline) age, participant status, and interaction between age and participant status on thickness. A simplified version of the formula is presented in tables for ease of understanding. The association of increasing age with participant status and overall mean, four quadrants, 12 clock-hours sector means of RNFLT and overall mean, and superior-inferior sector means of GCCT was evaluated statistically at 95% confidence interval (CI), $p < 0.05$ significance level. Shapiro–Wilk normality test and Bartlett homogeneity test were conducted on residuals of models to check for data normality and homogeneity, respectively.

Results

The study included 322 randomly selected eyes from 201 glaucoma-suspected individuals and 121 healthy individuals with a mean age of 39.75 ± 10.61 years. The mean ages of healthy and glaucoma-suspected individuals were 38.89 ± 11.22 years and 40.26 ± 10.22 years, respectively, and this difference was not statistically significant (Welch two-sample *t*-test, $p = 0.27$; 95% CI = −3.81 to −1.09). Demographics of the study population are shown in Table 1 (Table 1).

The difference in overall RNFL thickness between glaucoma suspects (97.43 µm) and the control group (97.76 µm) was not statistically significant ($p = 0.72$) (Table 2).

Higher inferior (131.19 µm), superior (119.45 µm), and nasal (75.10 µm) quadrant RNFL thickness in the control group than the values in glaucoma suspects (122.90, 116.21, and 72.54 µm, respectively) was observed, however, the temporal quadrant value was higher in glaucoma suspects (77.34 µm) than the control group (64.26 µm) (Table 2). All differences shown above between the control group and glaucoma suspects were found to be statistically significant ($p < 0.05$).

In terms of clock-hour sector analysis, the RNFL thickness was found to be higher in the control group than the glaucoma suspect group in clock-hour sectors 2, 5, 6, 7, 11, and 12; however, in clock-hour sectors 1, 3, 4, 8, 9, and 10 the RNFL thickness was higher in glaucoma suspects than the control group. In the majority

Table 1: Demographics of the study population

	Control	*Glaucoma suspect*	*Overall*	*p-value*
Sample size	121	201	322	
Age[a], years	38.89 ± 11.22 (21–59)	40.26 ± 10.22 (20–60)	39.75 ± 10.61 (20–60)	0.27[b]
Gender (F/M)	72/49	118/83	190/132	

[a]Values are presented as mean ± standard deviation (range, min to max); [b]*p*-value based on Welch two sample *t*-test

of the clock-hour sectors, statistically significant RNFL thickness differences between glaucoma suspects and the control group were found. The RNFL thickness values in glaucoma suspects and the control group are shown in Table 2.

Higher overall (111.30 µm), upper half (110.81 µm), and lower half (112.57 µm) GCC thicknesses in the control group compared with the values in glaucoma suspects (104.67, 103.97, and 106.11 µm, respectively) was observed (Table 3). Those differences were all found to be statistically significant ($p < 0.01$).

In terms of analyzing the per-year change in RNFL thickness, it was found that a 0.29 µm decrease was present in overall RNFL thickness in the control group; however, there was a 0.02 µm decrease noticed in glaucoma suspects. These two differences in slopes between the control group and the glaucoma suspect group were found to be statistically significant ($p < 0.001$).

In quadrant analysis, superior and inferior quadrants showed 0.43 and 0.50 µm decrease, respectively, in the control group; however, these decreases were 0.05 and 0.10 µm, respectively, in glaucoma suspects. On the other hand, nasal and temporal quadrants showed 0.08 and 0.16 µm change with a 1-year increase in age in the control group though in glaucoma suspects, these differences in the aforementioned quadrants were 0.04 and 0.01 µm, respectively. All differences in regression slopes in all quadrants between these two cohorts were statistically significant ($p < 0.05$).

Analyzing all clock-hour RNFL sectors' change per year showed statistically significant differences between the control group and glaucoma suspect group in 1, 5, 7, 9, 10, and 11 clock-hour sectors ($p < 0.05$). Table 4 gives detailed information about the age-related RNFL thickness change in clock-hour sectors and its differences between the control and glaucoma suspect groups (Table 4).

For ease of follow-up, the scattered plots showed the comparison of the age-related changes in overall quadrants and clock-hour sectors of the RNFL thickness in the control group and glaucoma suspects in Figures 1 to 3, respectively (Figs 1 to 3).

For the analyses of per-year change in overall GCC thickness, it was found that a 0.23 µm decrease was present in the control group; however, this was 0.11 µm in glaucoma suspects. These two differences in slopes between the control and glaucoma suspect groups were found to be statistically significant ($p < 0.05$).

In the upper half GCC thickness, a 1-year increase in age was associated with 0.21 ($p < 0.001$) and 0.13 µm ($p < 0.001$) decrease in control and glaucoma suspect groups, respectively. However, these two differences in slopes between the control and glaucoma

Table 2: The RNFL thicknesses of various quadrants and clock-hour sectors in control group and glaucoma suspect group

	Mean ± SD (min-max)			
	Control	*Glaucoma suspect*	*p*	*95% CI*
RNFL				
Overall	97.76 ± 7.06 (83–114)	97.43 ± 9.18 (73–124)	0.72	−1.47–2.12
Quadrants				
Inferior	131.19 ± 11.98 (105–169)	122.90 ± 14.20 (84–171)	<0.01	5.38–11.20
Superior	119.45 ± 10.71 (95–145)	116.21 ± 12.78 (69–157)	0.02	0.62–5.84
Nasal	75.10 ± 7.65 (59–98)	72.54 ± 12.12 (43–110)	0.02	0.39–4.73
Temporal	64.26 ± 6.54 (49–79)	77.34 ± 12.05 (42–116)	<0.01	−15.12 to −11.04
Clock-hour sectors				
12	120.45 ± 19.54 (75–176)	114.13 ± 18.33 (68–177)	<0.01	2.00–10.65
1	109.91 ± 17.13 (72–153)	112.70 ± 18.14 (60–157)	0,17	−6.76–1.18
2	96.53 ± 13.23 (68–141)	95.34 ± 17.40 (49–135)	0,49	−2.20–4.57
3	60.89 ± 9.96 (39–99)	66.07 ± 13.55 (36–104)	<0.01	−7.77 to 2.59
4	69.98 ± 12.06 (40–107)	75.43 ± 17.46 (27–125)	<0.01	−8.70 to 2.21
5	109.38 ± 18.37 (73–167)	104.14 ± 21.38 (50–161)	0.02	0.81–9.67
6	144.55 ± 17.64 (102–187)	131.84 ± 21.09 (80–195)	<0.01	8.40–17.01
7	137.76 ± 21.49 (83–185)	130.38 ± 19.33 (78–182)	<0.01	2.69–12.08
8	65.24 ± 10.50 (44–97)	70.14 ± 12.51 (43–106)	<0.01	−7.46 to 2.34
9	51.69 ± 5.97 (38–67)	60.94 ± 13.11 (34–167)	<0.01	−11.36 to 7.14
10	77.32 ± 10.42 (58–107)	83.56 ± 13.42 (43–118)	<0.01	−8.87 to 3.60
11	127.59 ± 19.18 (77–171)	121.66 ± 17.90 (66–181)	0.01	1.68–10.17

Table 3: The GCC thicknesses in control group and glaucoma suspect group

	Mean ± SD (range)			
	Control	*Glaucoma suspect*	*p*	*95% CI*
GCC				
Overall	111.30 ± 10.92 (90–140)	104.67 ± 7.72 (75–126)	<0.01	4.39–8.86
Upper	110.81 ± 11.23 (90–145)	103.97 ± 8.07 (84–128)	<0.01	4.54–9.15
Lower	112.57 ± 11.39 (90–142)	106.11 ± 7.43 (88–124)	<0.01	4.17–8.75

suspect groups were not found to be statistically significant ($p = 0.45$). In terms of lower half GCC thickness, a 1-year increase in age was associated with 0.29 ($p < 0.001$) and 0.11 µm ($p < 0.001$) decrease in control and glaucoma suspect groups, respectively. However, these two differences in slopes between the control and glaucoma suspect groups were also not found to be statistically significant ($p < 0.05$). Table 5 gives detailed information about the age-related GCC thickness change in overall, upper and lower halves and its differences between control and glaucoma suspect groups (Table 5).

For ease of follow-up, the scattered plots showed the comparison of the age-related changes in overall, upper and lower halves of GCC thicknesses in the control group and glaucoma suspects in Figures 4 and 5, respectively (Figs 4 and 5).

Discussion

In this study, we investigated the effect of aging on RNFL thickness in overall quadrants (inferior, superior, nasal, and temporal) and

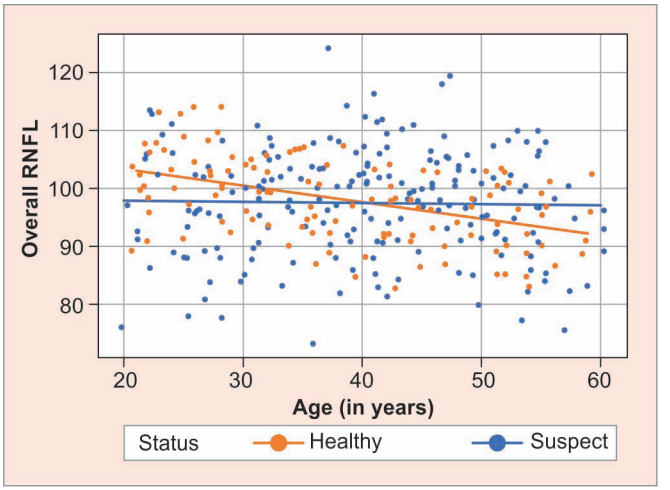

Fig. 1: Scatterplot showing glaucoma suspect and control group's overall RNFL thickness decrease with aging

Table 4: Age related change in RNFL thicknesses of various quadrants and clock-hour sectors in control group and glaucoma suspect group ($y = a + bX$)[c]

	Control	*Glaucoma suspect*	p^d
RNFL			
Overall[e]	Y = 103.16 – 0.29X	Y = 97.84 – 0.02X	<0.01
Quadrants			
Inferior[e]	Y = 140.62 – 0.5X	Y = 124.9 – 0.1X	<0.01
Superior[e]	Y = 127.56 – 0.43X	Y = 117.16 – 0.05X	<0.01
Nasal	Y = 76.61 – 0.08X	Y = 71.76 + 0.04X	0,30
Temporal[e]	Y = 67.28 – 0.16X	Y = 77.18 + 0.01X	0.13
Clock-hour sectors			
12[e]	Y = 126.40 – 0.31X	Y = 112.98 + 0.06X	0.06
1	Y = 120.16 – 0.54X	Y = 113.10 – 0.02X	0.01
2	Y = 99.27 – 0.15X	Y = 96.08 – 0.04X	0.52
3	Y = 63.48 – 0.14X	Y = 63.95 + 0.1X	0.07
4	Y = 74.20 – 0.22X	Y = 73.64 + 0.09X	0.06
5[e]	Y = 118.91 – 0.5X	Y = 101.31 + 0.14X	<0.01
6[e]	Y = 152.68 – 0.43X	Y = 133.12 – 0.06X	0.08
7[e]	Y = 148.87 – 0.59X	Y = 133.69 – 0.16X	0.05
8	Y = 69.16 – 0.21X	Y =70.96 – 0.04X	0.18
9	Y = 54.82 – 0.17X	Y = 59.48 + 0.07X	0.04
10	Y = 83.94 – 0.35X	Y = 84.81 – 0.06X	0.03
11[e]	Y = 138.63 – 0.58X	Y = 124.47 – 0.14X	0.02

[c]a, constant; b, coefficient for one year change in thickness; [d]*p*-value of 1-year change in thickness; [e]significant difference between intercepts (mean thicknesses for minimum age) of participant groups

Table 5: Age related change in GCC thickness in control group and glaucoma suspect group ($y = a + bX$)[c]

	Control	*Glaucoma suspect*	p^d
GCC			
Overall[e]	Y = 115.73 – 0.23X	Y = 106.99 – 0.11X	0.21
Upper[e]	Y = 114.73 – 0.21X	Y = 106.66 – 0.13X	0.45
Lower[e]	Y = 118.13 – 0.29X	Y = 108.26 – 0.11X	0.05

[c]a, constant; b, coefficient for 1 year decrease in thickness; [d]*p*-value of 1-year change in thickness; [e]significant difference between intercepts (mean thicknesses for minimum age) of participant groups

clock-hour sectors with GCC thickness (overall, upper, and lower halves) among glaucoma suspect individuals and compared the results with the healthy participants. It was found that the RNFL thickness and GCC thickness were lower in glaucoma suspects than in healthy controls eyes. However, an age-related decrease of RNFL and GCC thicknesses were found to be less in glaucoma suspects compared with healthy controls.

Overall RNFL thickness in the control group was 97.76 µm in the present study, which was very close to a value reported in Yarmohammadi et al.[15] (99.4 µm), though the value in the present glaucoma suspect cohort was 97.43 µm and it was higher than the one reported in the same study (88.4 µm). Different ranges of age distribution between the present study and the aforementioned study (20–64 years in the present study, 18–85 years in Yarmohammadi et al.) could be one explanation for this difference between studies. In the present study, a yearly increase in age was significantly associated with a 0.29 µm decrease in healthy controls. A recent study by Poon et al. found that there

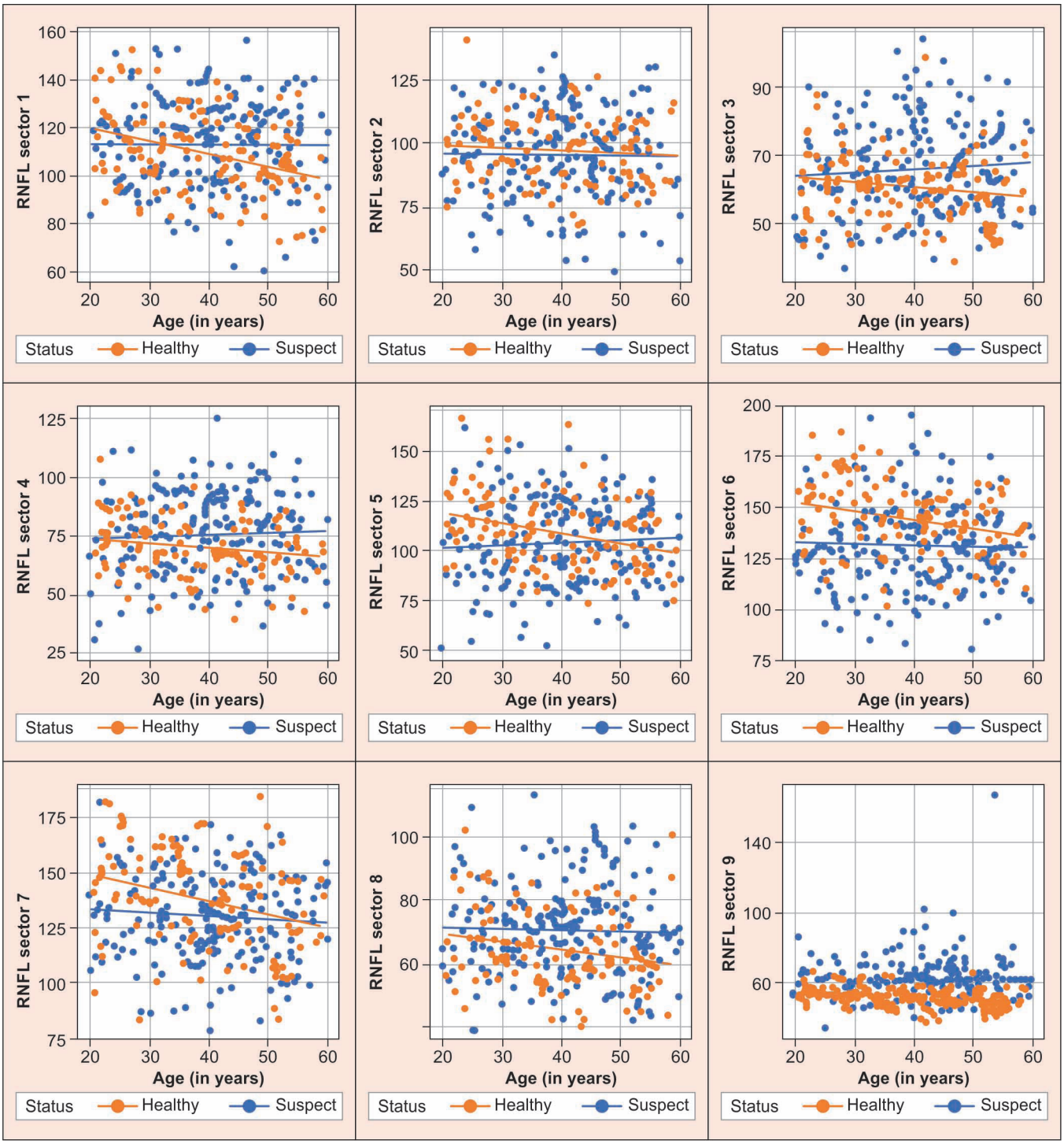

Fig. 2: (Continued)

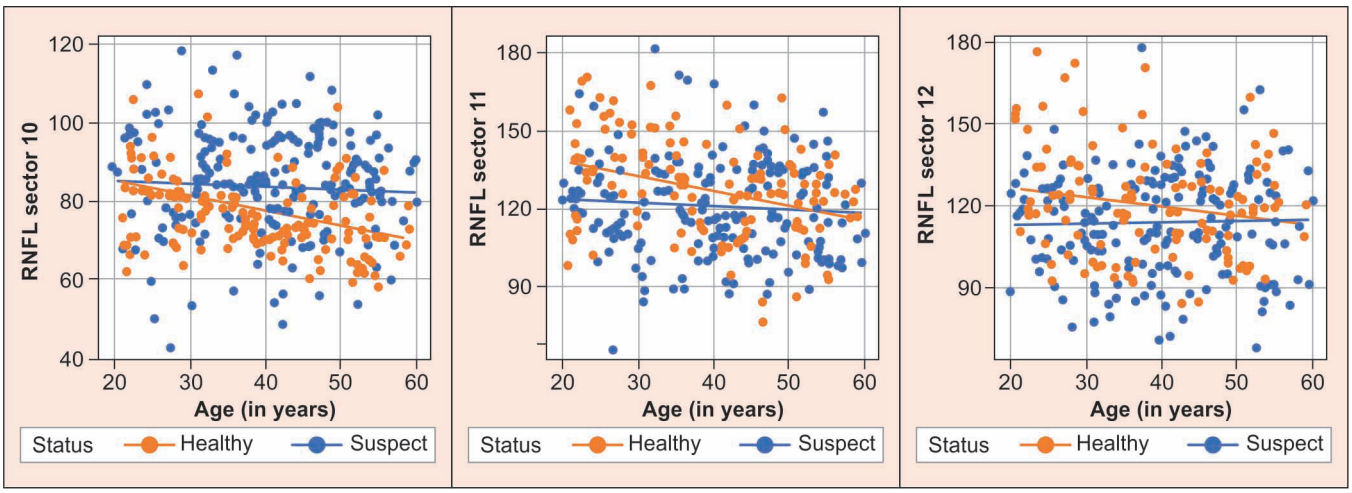

Fig. 2: Scatterplot showing glaucoma suspect and control group's RNFL thickness decrease with aging in 12 sectors

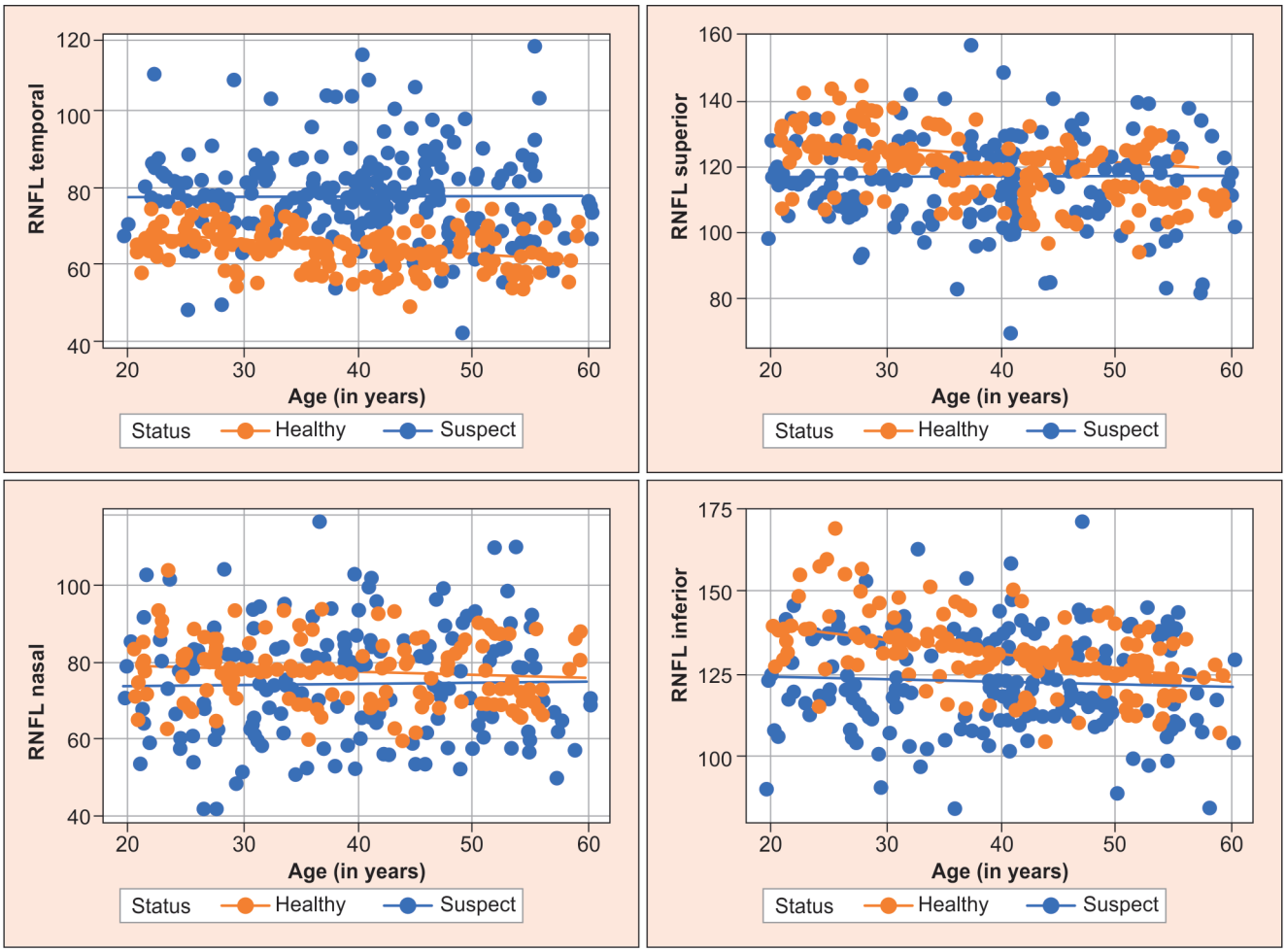

Fig. 3: Scatterplot showing glaucoma suspect and control group's RNFL thickness decrease with aging in four quadrants

was a 0.20 µm decrease per age.[16] It was found in the current study that there was a 0.02 µm decrease in glaucoma suspects; however, in the English literature, there was not a study present that investigated the age-related changes in glaucoma suspects.

In quadrants analysis, the temporal quadrant in our normal population was 64.26 µm, which is quite lower than the value found in Ha et al. (77 µm),[17] however in the glaucoma suspect group in the present study, the RNFL thickness was 77.34 µm and this was higher than the value found in Ha et al. (72.56 µm).[17] In terms of nasal quadrant evaluation, the RNFL thickness in the present study, including healthy cohort and glaucoma suspect, were 75.1 and 72.54 µm, respectively, which were higher than the values found by Ha et al. (70.87 and 65.37 µm, respectively).[17] Inferior quadrant RNFL thicknesses in healthy control and glaucoma suspects

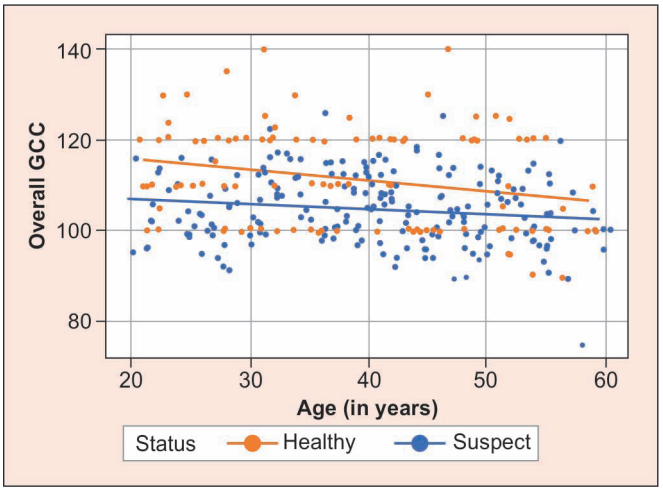

Fig. 4: Scatterplot showing glaucoma suspect and control group's overall GCC thickness decrease with aging

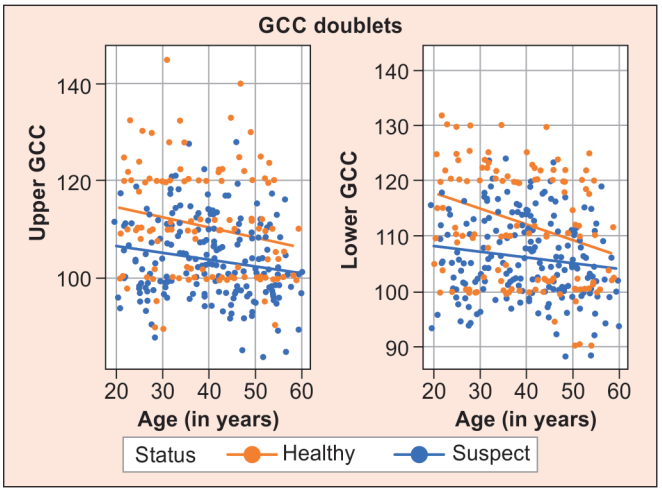

Fig. 5: Scatterplot showing glaucoma suspect and control group's upper and lower half GCC thickness decrease with aging

were 131.19 and 122.9 µm, respectively, which were still higher than the values presented by Ha et al. (129.10 and 112.22 µm, respectively).[17] In superior quadrant analysis, it was found in the present study that the RNFL thicknesses were 119.45 and 116.21 µm in the control group and glaucoma suspects, respectively, which were still lower than the values represented in Ha et al.'s study for the control group but higher for glaucoma suspects (123.25 and 108.29 µm, respectively).[17] One reason for these differences could be related to the different SD-OCT devices used in different studies. Another reason that could explain this discrepancy could be the different ethnicities in the sample size included in these studies; there was 322 Caucasian population in the current study; however, it was comprised of 183 Asian citizens in the aforementioned study.[17] That study also did not investigate the age-related change in various quadrants in either normal or glaucoma suspect groups. The difference in glaucoma suspect definition between this and our studies might be another reason for variations in measurements. In Anhul et al.'s study, glaucoma suspect was defined as glaucoma suspicious optic disk in stereo photograph review or intraocular hypertension (IOP > 21 mm Hg) without a history of glaucomatous visual field loss. There isn't a common consensus on the definition of glaucoma suspect. In Pomorska et al.'s study,[18] glaucoma suspects were divided into three different categories based on the different etiologies. In Kanamori et al.'s study,[19] the glaucoma suspect definition was limited to the presence of glaucomatous optic neuropathy with normal visual fields. We defined the glaucoma suspects as the presence of glaucomatous optic neuropathy appearance in addition to ocular hypertension with a normal visual field. We did not accept the patients diagnosed with glaucoma in one eye with normal ONH appearance in the fellow eye. Divergent gender proportions between studies could be another explanation for these differences.

In clock-hour sectors, we found a couple of studies that investigated each clock-hour sector in glaucoma suspects and compared it with the normal populations.[18,19] RNFL thicknesses at the 5, 6, and 7 o'clock areas, which resemble the inferior quadrant, in the glaucoma suspect group were significantly decreased compared to the control group. Those results were consistent with the previous results.[18,19] We also noticed that the RNFL thicknesses in 11 and 12 o'clock, which resembles the superior quadrant, in the glaucoma suspect group were significantly decreased compared to the control group. However, the RNFL thickness was higher in the 1 o'clock-hour sector in the control group compared to the glaucoma suspects, but this was not found to be statistically significant. Some studies investigated the age-related decrease in various clock-hours sectors in normal populations. We found 0.43 and 0.31 µm decrease with a per-year increase in age in the control group in the 6 and 12 o'clock-hour sectors, respectively. Those results were similar to previous studies.[8,20]

However, there were not any studies present in the English literature that compared the annual change in RNFL thickness in various clock hour sectors in glaucoma suspects. Also, our study was the first that compared the annual change rate in RNFL thickness between the control group and the glaucoma suspect group.

In the present study, overall GCC thickness in the control group was measured as 111.3 µm, which was higher than a previous study by Aydogan et al. (100.7 µm)[21]; however, it was found lower than the value found in Vidas et al.'s study (119.61 µm).[22] Thus, the overall GCC thickness was 104.67 µm in the present study, which was in the middle of the values found by Aydogan et al. (100.5 µm)[21] and Vidas et al. (112.58 µm) study[22] in the glaucoma suspect group. In overall GCC thickness, age-related decay was present in both control (0.23 µm) and glaucoma suspect (0.11 µm) groups; however, these decays between groups were not found to be statistically significant.

For the upper half GCC thickness analysis, the thicknesses were 110.81 and 103.97 µm in the control and glaucoma suspect groups, respectively. Those values were in the middle of previous studies by Aydogan et al.[21] (101.2 and 99.9 µm, respectively) and Vidas et al.[22] (119.0 and 112.35 µm, respectively). In addition to that, a 1-year increase in the upper half of GCC thickness with age was associated with a 0.21 and 0.13 µm decrease in control and glaucoma suspect groups, respectively.

In the lower half GCC thickness analysis, the values were 112.57 and 106.11 µm in the control and glaucoma suspect groups, respectively. Those values were in the middle of previous studies by Aydogan et al.[21] (100.2 and 101.0 µm, respectively) and Vidas et al.[22] (120.13 and 112.69 µm, respectively). In addition to that, 1-year increase in the lower half of GCC thickness with age was associated with a 0.29 and 0.11 µm decrease in control and glaucoma suspect groups, respectively.

The possible explanation of the difference in GCC thickness values between the present and aforementioned studies[21,22] could be related to the inclusion criteria for the glaucoma suspect group; thus, only having ocular hypertension was deemed as glaucoma suspect. In the present study, two additional criteria as, increased C/D ratio and having a normal visual field test, were also taken into consideration for the glaucoma suspect definition. One other explanation for this difference could also be related to the different SD-OCT machines used in previous studies. The final explanation for this difference could be related to the different ethnicities of people enrolled in each study.

A possible explanation for the difference between the values in the per-year decrease between the control group and glaucoma suspects could be due to delayed degeneration.[23] The delayed, progressive neuronal subclinical damage in the sensory system helped to understand the mechanism of long-term changes in the neural system.[23]

The strength of our study depends on the population size in terms of being one of the highest numbers of participants that were diagnosed as glaucoma suspects in the literature and the ethnically homogenous distribution of the participants as well. The present study was the only study that included the comparison of per-year change of GCC thickness in addition to RNFL thickness among healthy eyes and glaucoma suspects. The major limitation of the present study was related to its retrospective design.

Conclusion

It was found that the thicknesses of RNFL and GCC were different in glaucoma suspects and healthy individuals. In addition to that, age-related decay in RNFL and GCC thicknesses differed in various quadrants and sectors of RNFL and various halves of GCC in glaucoma suspects and healthy individuals.

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