To the Editor: Nonarteritic anterior ischemic optic neuropathy (NAION) is a common acute optic neuropathy disease that is common in the elderly. The incidence of NAION is approximately (2.3–10.2)/100,000, and both eyes are involved in many patients. Xu et al. reported that the incidence in the Chinese population was 1/16,000. Acute visual acuity (VA) damage without any pain and a poor prognosis are the main features of NAION. This study aimed to find the related risk factors for NAION in average individuals to promote the prevention or early diagnosis of NAION.

This study was approved by the Ethics Committees of Kailuan General Hospital, China. The data are anonymous, and the requirement for informed consent was therefore waived.

The study was a retrospective study based on the Kailuan study and the Kailuan medical database. The Kailuan study is an ongoing longitudinal cohort study that began in 2006 and is based on the Kailuan community. The Kailuan study includes employees and retirees of the Kailuan Group Company. All participants underwent questionnaire assessments and clinical and laboratory examinations, which were conducted in the 11 hospitals responsible for the health care of this community, residing in Tangshan city. The information collected had been reported before. The study was performed according to the guidelines of the Helsinki Declaration and was approved by the Ethics Committee of the Kailuan General Hospital. All participants signed a written informed consent form.

The diagnosis of NAION was searched in the Kailuan medical database of the Kailuan Corporation between 2006 and 2015 and was confirmed by detailed records in the hospital where the disease was diagnosed. All the other people in the 2006 Kailuan study database composed the control group. The inclusion criteria were as follows: (1) a history of sudden visual loss, without other ocular, systemic, or neurological diseases that might cause visual damage; (2) optic disc edema; and (3) optic disc-related VF defects.

Exclusion criteria were as follows: (1) other diseases that can cause edema of the optic disc, such as a brain tumor; (2) other ocular diseases that can cause VF defects, such as retinal detachment, vitreous hemorrhage, and glaucoma; (3) complications from systemic autoimmune diseases; and (4) any evidence suggestive of temporal arteritis, such as a history of scalp tenderness, Westergren sedimentation rate ≥40 mm/h, or positive C-reactive protein; and (5) those without a detailed medical record.

A retrospective cohort analysis method was used for this study. First, the measurement data and enumeration data were statistically analyzed with the t-test and Chi-square test, respectively. Then, single variable logistic regression was used to analyze the related risk factors. Gender, age, and factors with a significant difference in the single variable logistic regression analysis were included in the multivariate logistic regression analysis. SPSS 13.0 software was used.

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There were 85 patients in the database with a diagnosis of NAION. A total of 38 patients were included as the case group to make an analysis according to the criteria. There were 101,510 patients in the Kailuan study group in 2006. Therefore, the other 101,472 patients served as the control group. The mean age of the NAION group was 54.55 ± 8.19 years. The mean age of the control group was 51.93 ± 12.67 years. Age and gender were not significantly different between the two groups.

There were 18 patients (44.4%) with a VA better than 0.3. A total of 12 patients (31.6%) had a VA between 0.1 and 0.3. A total of eight patients (21.1%) had a VA below 0.1. A total of two patients (5.3%) had a VA between 0.1 and 0.2 after taking medicine to improve microcirculation. In addition, six patients (15.8%) had a worse VA after taking the medicine. The other 30 patients (78.9%) had no change in VA. The automated perimeter was used to test the VF in 30 patients (78.9%). VF defects were present in all of these patients, three cases of whom had inferior altitudinal defects, seven cases of whom had superior arcuate scotoma defects, five cases of whom had nasal periphery defects, four cases of whom had temporal periphery defects, and two cases of whom had tubular VF defects. The other nine patients had irregular VF defects.

A total of 30 patients (78.9%) in the NAION group underwent cranial CT scan, and nine of these patients (30.0%) had infarction. The lesion location was either single or multiple. The basal ganglia were involved in five patients (55.6%). The centrum semiovale was involved in four patients (44.4%). The brainstem, parietal lobe, and lateral ventricles were also occasionally involved.

The most common systemic comorbidity in the NAION group was hyperlipidemia (19 patients, 50%), which was followed by hypertension (12 patients, 31.6%), stroke (nine patients, 23.7%), diabetes mellitus (seven patients, 18.4%), and coronary heart disease (five patients, 13.2%). In the control group, hyperlipidemia was also the most common comorbidity (69,868 patients, 68.8%), which was followed by hypertension (44,212 patients, 43.6%) and diabetes mellitus (9,482 patients, 9.3%).

The basic overall information analysis showed that waist circumference, hip circumference, abdominal circumference, BMI, physical exercise, drinking, fasting plasma glucose (FPG), hyperlipidemia, and stroke history showed significant differences between the two groups [Table 1]. Single variable logistic regression analysis showed that BMI ($P = 0.023$, odds ratio $[OR] = 1.113$, 95% confidence interval $[CI]: 1.015–1.220$), FPG ($P < 0.001$, $OR = 1.221$, 95% CI: 1.105–1.349), hyperlipidemia ($P = 0.015$, $OR = 0.453$, 95% CI: 0.240–0.855), and stroke history ($P < 0.001$, $OR = 12.012$, 95% CI: 5.680–25.400) showed significant differences between the two groups. Multivariate logistic regression analysis showed that BMI ($P = 0.042$, $OR = 1.109$, 95% CI: 1.004–1.225), FPG ($P < 0.001$, $OR = 1.218$, 95% CI: 1.093–1.357), and stroke history ($P < 0.001$, $OR = 9.291$, 95% CI: 3.185–27.107) were the independent risk factors for NAION. The other factors showed no significant differences between the two groups.

NAION is an optical neural lesion accompanied by acute microcirculatory disturbances. Many risk factors for NAION have been hypothesized, including smoking and drinking, hypertension, obesity, hyperlipidemia, physical work, and a poor lifestyle. It is likely that the existence of these factors is responsible for some patients developing NAION. In this study, we only selected the factors that were consistent with previous studies and included them in our analysis. We aimed to set up a comprehensive risk factor model for NAION.

### Table 1: Overall information analysis

| Variables | Control group (n = 101,472) | NAION group (n = 38) | Total (n = 101,510) | P |
|-----------|----------------------------|---------------------|---------------------|---|
| Male, n (%) | 81,090 (79.9) | 20 (76.9) | 81,110 (79.9) | 0.704 |
| Age (years) | 51.93 ± 12.67 | 54.55 ± 8.19 | 51.93 ± 12.67 | 0.116 |
| Hip circumference (cm) | 97.35 ± 8.87 | 101.72 ± 7.08 | 97.35 ± 8.87 | 0.014 |
| Waist circumference (cm) | 87.06 ± 10.03 | 92.06 ± 9.66 | 87.06 ± 10.03 | 0.013 |
| Abdominal circumference (cm) | 89.53 ± 10.66 | 94.68 ± 10.55 | 89.53 ± 10.66 | 0.016 |
| BMI (kg/m²) | 25.04 ± 3.49 | 26.38 ± 3.28 | 25.04 ± 3.49 | 0.031 |
| Heart rate (beats per minute) | 73.79 ± 10.20 | 74.61 ± 9.90 | 73.79 ± 10.20 | 0.699 |
| Systolic pressure (mmHg) | 131.07 ± 21.08 | 132.54 ± 23.18 | 131.07 ± 21.08 | 0.728 |
| Diastolic pressure (mmHg) | 83.49 ± 11.78 | 85.76 ± 14.70 | 83.49 ± 11.79 | 0.335 |
| TC (mmol/L) | 4.95 ± 1.15 | 4.87 ± 1.35 | 4.95 ± 1.15 | 0.731 |
| LDL-C (mmol/L) | 2.35 ± 0.91 | 2.39 ± 0.73 | 2.35 ± 0.91 | 0.832 |
| HDL-C (mmol/L) | 1.55 ± 0.40 | 1.59 ± 0.50 | 1.55 ± 0.40 | 0.670 |
| FPG (mmol/L) | 5.48 ± 1.69 | 6.91 ± 2.86 | 5.48 ± 1.69 | <0.001 |
| eGFR (ml·min⁻¹·1.73 m⁻²) | 81.25 ± 19.72 | 81.85 ± 20.39 | 81.25 ± 19.72 | 0.881 |
| Physical work, n (%) | 89,864 (92.3) | 23 (95.8) | 89,887 (92.3) | 0.513 |
| Physical exercise, n (%) | 15,275 (15.1) | 6 (15.8) | 15,281 (15.1) | <0.001 |
| Smoking, n (%) | 30,282 (29.8) | 8 (21.1) | 30,290 (29.8) | 0.194 |
| Drinking, n (%) | 17,589 (17.3) | 6 (15.8) | 17,595 (17.3) | 0.045 |
| Snore, n (%) | 13,783 (13.6) | 7 (18.4) | 13,790 (13.6) | 0.384 |
| Myocardial infarction, n (%) | 1315 (1.3) | 1 (4.2) | 1316 (1.3) | 0.231 |
| Stroke, n (%) | 2556 (2.5) | 9 (23.7) | 2565 (2.5) | <0.001 |
| Hypertension, n (%) | 44,212 (43.6) | 12 (31.6) | 44,224 (43.6) | 0.136 |
| Hyperlipidemia, n (%) | 69,868 (68.8) | 19 (50.0) | 69,887 (68.8) | 0.012 |
| Diabetes mellitus, n (%) | 9482 (9.3) | 7 (18.4) | 9489 (9.3) | 0.055 |
| Cancer, n (%) | 377 (0.4) | 0 (0) | 377 (0.4) | 0.760 |
| Fatty liver, n (%) | 32,176 (31.7) | 16 (42.1) | 32,192 (31.7) | 0.168 |

TC: Total cholesterol; LDL-C: Low-density lipoprotein-cholesterol; HDL-C: High-density lipoprotein-cholesterol; FPG: Fasting plasma glucose; eGFR: Estimated glomerular filtration rate.
been reported, such as old age, crowded optic discs, hypertension, hyperlipidemia, diabetes mellitus, hypercoagulability, and protein S.

Kosanovic-Jakovic et al.,[3] in the research on the relationship between metabolic syndrome and NAION, reported that obesity was related to NAION. Multivariate Logistic regression analysis showed that BMI was an independent risk factor for NAION. This result means that controlling BMI or obesity can protect patients from NAION.

Many diabetic patients are in a hypercoagulability state, which is accompanied by dysfunction of the microcirculation, inducing susceptibility to NAION.[4] The results of this study showed that diabetes mellitus itself was not an independent risk factor for NAION but that FPG ($P < 0.001$, $OR = 1.218$, 95% CI: 1.093–1.357) is an independent risk factor for NAION. The actual mechanism of pathogenesis of this disease is unclear, but this result may help to identify it.

The main branches of the internal carotid artery system in the brain are the ophthalmic artery, the anterior cerebral artery, the middle cerebral artery, the anterior choroidal artery, and the posterior communicating artery. The basal ganglia are supplied by the deep perforating branch of the middle cerebral artery. Dysfunction in blood circulation in the anterior region of the lamina cribrosa may lead to NAION. Stroke was a common comorbidity in NAION patients, and it mainly involved the basal ganglia region. The results of this study showed that stroke history was an independent risk factor for NAION ($P < 0.001$, $OR = 9.291$, 95% CI: 3.185–27.107). Some researchers reported that the risk for NAION was greater for those with stroke history.[5] The shared vascular origin of these two diseases may be the cause of this outcome.

In this study, the risk factors for NAION were analyzed in a large population, which may lead to a conclusion consistent with the real trend. Controlling BMI and FPG can help prevent NAION. To make an earlier diagnosis and therapy decision in stroke patients, these patients should pay attention to their eyes. The main limitation of our study is the small patient population size. Multicenter data should be utilized in future studies.

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**Conflicts of interest**

There are no conflicts of interest.

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