




Prevalence, Associated Factors and Awareness of Hypertensive Retinopathy among an Elderly Population with Hypertension in Nepal: The Bhaktapur Retina Study

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ABSTRACT

Introduction: Hypertensive retinopathy is a common complication in patients with hypertension. This study aims to assess the prevalence, associated factors and awareness of hypertensive retinopathy among an elderly population with hypertension in Bhaktapur, Nepal.

Materials and methods: This is a population-based, cross-sectional study conducted from 2013 to 2015 in Bhaktapur district, Nepal. The sample size was 2100 subjects aged 60 years and above. From this sample, all diagnosed patients with hypertension were analyzed. A detailed history was obtained, and an ocular examination was performed.

Results: Information was complete for 1860 (88.57%) subjects. The age of the study population ranged from 60 to 95 years with the mean age of 69.64±7.31 years. Hypertension was found in 643 subjects (34.61%), of which 224 (12.04%) were newly diagnosed cases. Among the subjects with hypertension, hypertensive retinopathy was found in 81 cases (12.6%). Hypertensive retinopathy was more frequent in the age group 70-79 years (15.23%), males (13.25%), illiterates (13.56%), diabetics (16.49%), and body mass index (BMI) ≥25 kg/m² (14%). None of the factors was found to be statistically significant. Among the study participants, awareness regarding the effect of hypertension on eye, retina and vision was found to be 13.84%, 8.4%, and 11.98% respectively.

Conclusion: Prevalence of hypertension and hypertensive retinopathy among an elderly population of 60 years and above in Bhaktapur district, Nepal were similar to other countries. Hypertensive retinopathy was higher among males, illiterates, diabetes and BMI > 25kg/m². Awareness of hypertensive retinopathy was 8.4% among hypertensive subjects. Emphasis should be directed toward improving awareness campaigns.

Key words: Awareness, Elderly, Hypertension, Hypertensive retinopathy, Nepal.

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INTRODUCTION

Hypertension is a major non-communicable disease affecting both high income and low middle income countries (LMIC) [Perkovic et al, 2007]. Hypertension affects vital organs of the body such as the eye, brain, kidney and heart leading to various morbidities. Hypertension is a major risk factor for coronary heart diseases and stroke and has been a silent killer of millions around the world each year [WHO, 2013]. Globally, 31.1% of adults suffered from hypertension, affecting 31.5% of adults from LMICs and 28.5% from high income countries [Mills et al, 2020]. A meta-analysis of hypertension reported hypertension in 28.4% in urban regions and 24.4% in rural areas in Nepal [Huang et al, 2019]. The prevalence of hypertension in Nepal is increasing rapidly; there was an almost three-fold rise within twenty-five years [Vaidya et al, 2012]. Hypertension in Nepal increases with age, with a prevalence of 19.7% at 18 years and above, 36% at 40 years and above in suburban areas, and 43% over 60 years of age [Huang et al, 2019; Vaidya et al, 2012; Sharma et al, 2006; Chataut et al, 2011; Dhakal et al, 2017].

Hypertension is associated with various ocular morbidities affecting both the anterior and posterior segments of the eye. Common eye problems associated with hypertension are sub-conjunctival haemorrhage, retinal vein occlusion, retinal artery occlusion, hypertensive retinopathy, ischemic optic neuropathy and cranial nerve palsy [Thapa et al, 2010; Thapa

et al, 2013; Grosso et al, 2005; Ikram et al, 2006; Klein et al, 1994]. Some of the eye problems due to hypertension can lead to visual impairment and blindness when diagnosis or treatment is delayed. Control of blood pressure and regular eye check-ups can help to reduce these complications. Hypertensive retinopathy is a common complication of hypertension and a major retinal disorder [Thapa et al, 2013; Grosso et al, 2005; Ikram et al, 2006; Klein et al, 1994]. Population-based studies have reported prevalence of various grades of hypertensive retinopathy ranging from 6% to 20% among subjects with hypertension [Klein et al, 1994; Wong et al, 2003; Cugati et al, 2006; Wang et al, 2003; Klein et al, 1993; Jeganathan et al, 2010; Sun et al, 2008]. Duration of hypertension, severity of hypertension, poor control of blood pressure, ageing, smoking, concurrent hyperlipidaemia and high plasma level of endothelin-1 are major risk factors associated with hypertensive retinopathy [Grosso et al, 2005; Ikram et al, 2006; Klein et al, 1994; Wong et al, 2003; Cugati et al, 2006; Wang et al, 2003; Klein et al, 1993; Jeganathan et al, 2010; Sun et al, 2008; Zhang et al, 2019].

Hypertensive retinopathy predicts the long-term risk of stroke and cardiovascular diseases, independent of blood pressure, even with good hypertension control [Ong et al, 2013; Suri et al, 2008]. Awareness of hypertensive retinopathy is low among patients with hypertension [Sarkar et al, 2014]. Awareness of hypertensive effects in the eye is very important

to promote compliance and regular eye check-ups by patients with hypertension. However, studies on the awareness are scarce, and there are no population-based studies on awareness of hypertensive ocular effects or prevalence and risk factors associated with hypertensive retinopathy in Nepal. This study aimed to assess the prevalence, associated factors, and awareness of hypertensive retinopathy among an elderly population with hypertension in Bhaktapur district, Nepal.

MATERIALS AND METHODS

Study Population: The study population for this study originates from the Bhaktapur Retina Study (BRS) [Thapa et al, 2020]. Detailed methodology has been given in companion papers [Thapa SS et al, 2013; Thapa R et al, 2020]. In brief, BRS is a population-based, cross-sectional study conducted on the age group 60 years and above in Bhaktapur district, Nepal. The total sample studied was 2100, after assuming 7.05% prevalence of retinal disorders among the age group 60 to 69 years, a relative precision of 25%, 85% compliance, and a design effect of two [Thapa SS et al, 2013]. All participants diagnosed with hypertension were analyzed in this study. Two female community health workers conducted home visits with study subjects and invited them to participate. The duration of study was from August 2013 to December 2015.

Assessment and definitions of associated factors: Study participants visited the primary eye care center in Bhaktapur district. All

study subjects provided a detailed history and underwent an ocular examination. A structured questionnaire was developed to assess the prevalence, associated factors of hypertensive retinopathy and awareness of hypertension's ocular effects on the eyes, retina and vision. Age, gender, literacy, occupation, presence of diabetes mellitus, hypertension, use of tobacco, and alcohol consumption were elicited from the self-reported history. Mid-level ophthalmic personnel were involved to record a detailed history. Two fellowship-trained retina specialists examined the study subjects. No respondents reported difficulties in answering the questionnaire in pretesting. Visual acuity was obtained, and the anterior and posterior segments of both eyes were examined in detail under mydriasis using 90 diopter and 20 diopter lenses. Height, weight and abdominal girth were measured with standard techniques. Non-fasting blood sugar was assessed from venous blood samples. Blood pressure was measured on all study participants. Participants able to read and write in the national language were categorized as literate as defined by the Government of Nepal. The predominant profession was considered when defining the occupation.

Diagnostic criteria: Hypertension was diagnosed if systolic blood pressure (BP) was 140 mmHg or more, if diastolic BP was 90 mmHg or more in subsequent two measurements, or if participants used antihypertensive medications. Hypertensive retinopathy was graded according to the Modified Scheie Classification [Schubert HD, 1998]. Briefly, hypertensive retinopathy was classified as, grade 0: no changes; grade

1: barely detectable arterial narrowing; grade 2: obvious arterial narrowing with focal irregularities; grade 3: grade 2 plus retinal hemorrhage and/or exudates; grade 4: grade 3 plus disc swelling. The diagnosis of diabetes mellitus was based on either the use of diabetic medications or a random blood sugar level of 200 mg/dl or greater [Thapa R et al, 2020].

The study was conducted after approval by the Tilganga Institute of Ophthalmology, Institutional Review Committee (TIO, IRC) on 28 June 2013 (TIO-IRC approval no. 1/2013). The study was conducted as per the guidelines of the Declaration of Helsinki. Written informed consent was obtained from study participants prior to enrollment in the study.

Statistical Analysis: Continuous and categorical variables were used to calculate mean \pm Standard Deviation (SD) and percentages, respectively. Two independent categorical variables were assessed by using Chi-square or Fisher's exact tests. Independent t-tests were used to assess the associations of continuous variables. Results

were considered significant if the p-value was < 0.05 . Statistical analysis was conducted using STATA 13.0, College Station, Texas, USA.

RESULTS

A total of eighteen hundred sixty study subjects (response rate: 88.6%) participated in the study. The age of the study population ranged from 60 to 95 years (Mean: 69.64 ± 7.31 years). Hypertension was found in 643 subjects (34.61%), with 224 newly diagnosed (12.04%). Half of the participants (51.47%) with hypertension were in the 60-69 years age group. Hypertension was found equally among the age groups 60 to 69 years and 70 to 79 years, with the prevalence of 34.8% each, more frequently among females (32.8%), agriculture occupation (34.8%) and literates (34.9%). None of the demographic factors was statistically significant with regard to prevalence of hypertension. (Table 1)

Among the subjects with hypertension, hypertensive retinopathy was found in 81 cases (12.6%). The grades are shown in Table 2.

Table 1: Demographic characteristics of study population and participants with hypertension.

Characteristics		Study population (N=1860) N (%)	Subjects with hypertension (N= 643) N (%)	p-value
Age (Years)	60-69	950 (51.08)	331 (34.84)	0.883
	70-79	697 (37.47)	243 (34.86)	
	≥ 80	213 (11.45)	69 (32.39)	
Sex	Male	821 (44.14)	302 (36.78)	0.214
	Female	1039 (55.86)	341 (32.82)	
Occupations	Agriculture	1351 (72.63)	471 (34.86)	0.762
	Others	509 (27.37)	172 (33.79)	
Literacy	Illiterates	1433 (77.04)	494 (34.47)	0.911
	Literates	427 (22.96)	149 (34.89)	

Abbreviation: N= Number

Table 2: Pattern of hypertensive retinopathy among subjects with hypertensive retinopathy.

Grading of hypertensive retinopathy	Number (N)	Percent (%)
Grade 1	53	65.43
Grade 2	19	23.46
Grade 3	9	11.11
Grade 4	0	0.00
Total	81	100.00

Age, gender, literacy, occupation, mean diastolic blood pressure, diabetes mellitus, body mass index (BMI), smoking, alcohol and pseudophakia were assessed for their associations with hypertensive retinopathy. None of the factors was found to be associated in a statistically significant manner. However,

hypertensive retinopathy was higher in the 70-79 years age group (15.23%) as compared to other age groups, among males (13.25%), illiterates (13.56%), those with other occupations (12.96%), diabetics (16.49%), and BMI ≥ 25 m²/kg (14%). (Table 3)

Table 3: Distribution of various factors associated with hypertensive retinopathy.

Factors		No HTN retinopathy N (%)	HTN retinopathy N (%)	p-value
Age in years	60-69	293 (88.52)	38 (11.48)	0.240
	70-79	206 (84.77)	37 (15.23)	
	≥ 80	63 (91.30)	6 (8.70)	
Gender	Male	262 (86.75)	40 (13.25)	0.641
	Female	300 (87.98%)	41 (12.02)	
Literacy	Literates	135 (90.60)	14 (9.40)	0.179
	Illiterates	427 (86.44)	67 (13.56)	
Occupation	Agriculture	421 (87.53)	60 (12.47)	0.871
	Other occupations	141 (87.04)	21 (12.96)	
Diabetes	No	481(88.10)	65(11.90)	0.209
	Yes	81(83.51)	16(16.49)	
Diastolic BP	Mean \pm SD	80.06 \pm 11.64	80.25 \pm 10.86	0.887
Abdominal girth	Mean \pm SD	81.61 \pm 38.17	81.02 \pm 12.37	0.892
BMI (kg/m ²):	≤ 24.9	347 (88.30)	46 (11.70)	0.393
	≥ 25	215 (86.00)	35 (14.00)	
Smoking	No	257 (84.82)	46 (15.18)	0.062
	Yes	305 (89.71)	35 (10.29)	
Alcohol	No	241 (85.46)	41 (14.54)	0.191
	Yes	321 (88.92)	40 (11.08)	
Pseudophakia	No	468 (86.99)	70 (13.01)	0.474
	Yes	94 (89.52)	11 (10.48)	

Abbreviation: N= Number; BP=Blood Pressure, HTN= Hypertension; BMI=Body Mass Index; SD=Standard Deviation

Table 4: Awareness of hypertensive ocular effects among subjects with hypertension.

Awareness of hypertensive ocular effects	Number (N)	Percent (%)
Awareness of hypertension affecting the eyes	89	13.84
Awareness of hypertension affecting the retina	54	8.40
Awareness on hypertension affecting vision	77	11.98

Among the subjects with hypertension, awareness of hypertension affecting the eyes, retina, and vision was 13.84%, 8.4%, and 11.98%, respectively. (Table 4)

DISCUSSION

In our study, hypertension was found in 34.61% among the age group 60 years and above. Hypertension was present in 34.84% at the age 60 to 69 years, 34.86% at the age 70 to 79 years, and 32.39% at the age 80 years and above. Other population-based studies from Nepal reported the prevalence of hypertension ranging from 32.5% to 36.2% at the age 60 years and above [Chataut et al, 2011; Dhakal et al, 2017]. The prevalence of hypertension in our study was almost similar to these studies. Our finding on prevalence of hypertension was consistent with most of the global data and neighbouring countries [Mills et al, 2020; Huang et al, 2019]. However, a population-based study from Ethiopia reported the prevalence of hypertension of 43% at the age 60 to 69 years and 49.3% at the age 70 years and above [Mills et al, 2020; Huang et al, 2019]. The prevalence of hypertension was lower in our study population as compared to this study. The difference could be due to more physical activity in our population as 72.6% of study subjects were farmer by occupation as compared to 4.5% in Ethiopia.

Hypertensive retinopathy was found in 12.6% among the participants with hypertension at age 60 years and above in our study. Hypertensive retinopathy was found in 11.48% at the age 60 to 69 years, 15.23% at the age 70 to 79 years and 8.7% at the age 80 years and above. A population-based study conducted in the USA showed hypertensive retinopathy in 8.9% of African American subjects as compared to 6.3% among whites at the age 63 years to 73 years [Wong et al, 2003]. The prevalence of hypertensive retinopathy in our study was higher as compared to this study. Genetic factors could be a possible cause for this disparity in prevalence of hypertensive retinopathy in our population [Wong et al, 2003]. The Beaver Dam Eye Study from the USA reported the population prevalence of any retinopathy in 10.9% and 10.3% in males and females, respectively, between ages 65 and 74 years among subjects with hypertension. Similarly, the prevalence of any retinopathy was 10.3% and 11.6% among males and females, respectively, at age 75 years and above among subjects with hypertension. The retinopathy findings from our population with hypertension were consistent with this study [Klein et al, 1993].

In our study, grade one hypertensive retinopathy was the most common (65.43%) as compared to



other grades of hypertensive retinopathy. Grade one hypertensive retinopathy, characterized by generalized arteriolar attenuation, was also the most common retinal finding among the hypertensive subjects in other population-based studies [Wong et al, 2003; Klein et al, 1993; Jeganathan et al, 2010; Sun et al, 2008].

In our study, hypertensive retinopathy increased with ageing. Hypertensive retinopathy was higher at the age group 70 to 79 years as compared to 60-69 years. However, hypertensive retinopathy was lower at the age group 80 years and above. This could be due to less number of participants at this age group. Our findings were consistent with other population-based studies where age was a significant risk factor for hypertensive retinopathy [Wong et al, 2003; Cugati et al, 2006; Zhang et al, 2019]. We found hypertensive retinopathy was higher among males, but the difference was not statistically significant. Retinal arteriolar changes have been reported significantly higher among males with hypertension in one study from Asia [Sun et al, 2008]. Our findings were also similar to other studies where gender was not a significant risk factor for hypertensive retinopathy [Wong et al, 2003; Cugati et al, 2006; Klein et al, 1993]. Our study revealed hypertensive retinopathy was higher among the subjects with higher BMI (BMI >25 kg/m²). This finding was consistent with other studies where hypertensive retinopathy was increased with higher BMI and those with obesity [Wong et al, 2003; Cugati et al, 2006; Wang et al, 2003; Jeganathan et al, 2010]. In

our study population, hypertensive retinopathy findings were more common among patients with concurrent diabetes mellitus. As both diabetes and hypertension are systemic diseases that have effects on retinal vessels, this finding was consistent with another report [Grosso et al, 2005].

Smoking has been reported as a risk factor for hypertensive retinopathy in many studies [Wong et al, 2003; Cugati et al, 2006; Zhang et al, 2019]. However, in our study, hypertensive retinopathy was lower among those who smoke compared to non-smokers. This dissimilarity could be related to differences in frequency of smoking and other concurrent comorbid conditions. Our study also showed those who consume alcohol have lower rate of hypertensive retinopathy compared to those who do not consume alcohol. Our finding was similar to the series by Wong et al, 2003.

In our study, awareness of hypertension affecting the retina was found in only 8.4% of subjects with hypertension. A study from India reported awareness of hypertensive retinopathy in the 19.46% range [Sarkar et al, 2014]. Awareness of hypertensive retinopathy is lower in our population as compared to this study. The lower rate of awareness could be due to the high illiteracy rate (77%) in our study participants. There is a lack of data on the awareness of hypertensive retinopathy on a population level. Studies have reported low awareness also for hypertension globally [Mills et al, 2020; Huang

et al, 2019]. This finding highlights the need for awareness campaigns that target populations with high rates of hypertension. Presence of hypertensive retinopathy is indicative of the possibility to develop stroke, cardiovascular diseases and nephropathy in the future [Grosso et al, 2005; Ong et al, 2013; Suri et al, 2008]. Patients with hypertensive retinopathy should be made aware regarding possible end-organ damage and should be counseled regarding blood pressure control, compliance with treatment, and routine follow up. This could help to avoid vision threatening and serious life-threatening consequences and may also reduce the financial burden.

The strength of our study is that the sample size was a large elderly population with approximately one-third suffering from hypertension. The limitation of our study was that the duration of hypertension was not available for all patients, lipid panels were not tested, and full information on status of other systemic target organs was not available to evaluate for the possible association with other comorbid conditions.

CONCLUSION

Hypertension was found in 34.61% of an elderly population aged 60 years and above, and

hypertensive retinopathy was present in 12.6% of people with hypertension in Bhaktapur, Nepal, similar to other countries. Grade 1 hypertensive retinopathy was the most common (65.43%), while grade three comprised 11.11%. Hypertensive retinopathy was higher among male, illiterates, those with diabetes, and BMI >25 kg/m². However, none of these factors was found to be significant. Awareness of hypertension's effects on the retina was found in only 8.4% of hypertensive subjects, so increased emphasis should be given for awareness campaigns to reduce the preventable blinding sequelae and life-threatening complications due to hypertension.

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