Original article

Ocular morbidity among porters at high altitudes

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Abstract

Introduction: High altitude, often characterized by settings over 2400m, can be detrimental to the human body and pose a significant risk to ocular health. Reports concerning various ocular morbidities occurring as a consequence of high altitude are limited in the current literature. **Objectives:** This study was aimed at evaluating the ocular health of porters working at high altitudesof Himalayas in Nepal. **Materials and methods:** A mobile eye clinic was set up in Ghat and patient data were collected from its out- patient unit by a team of seven optometrists which was run for five days. Ghat is a small village in north-eastern Nepal, located at 2860 m altitude. Travellers walking through the trekking route were invited to get their eyes checked at the clinic. Comprehensive ocular examinations were performed, including visual acuities, objective and subjective refraction, anterior and posterior segment evaluations, and intraocular pressure measurements; blood pressure and blood glucose levels were also measured as required. Ocular therapeutics, prescription glasses, sunglasses and ocular health referrals were provided free of cost as necessary. A total of 1890 people visited the eye clinic, among which 57.4% (n=1084) were porters. **Conclusions:** Almost half of the porters had an ocular morbidity. Correctable refractive error was most prevalent, with other ocular health-related complications, including dry eye disease, infectious disorders, glaucoma and cataract. Proper provision of regular and effective eye care services should be made more available for those residing at these high altitudes in Nepal.

Key words: Ocular morbidity, Porters, High altitude, Nepal

Introduction

The present study was conducted to investigate ocular morbidity among porters working at high altitudes of the Himalayan region. High altitude, commonly denoted as an altitude over 2400m, has various effects on the human body, including the eyes. Decrease in

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partial oxygen pressure, hypoxia, exposure to ultraviolet radiation, cold, and increased energy requirements are associated health factors. Many tissues in the eye are affected by high-altitude related hypoxia, with effects that can be observed with the conjunctiva, cornea, intraocular pressure, lens, uvea, retina and the optic nerve (Karakucuk et al, 2000). Most published reports on the effects of high altitude focus on high-altitude retinal haemorrhage (Frayser et al, 1970, 1971), systemic side effects, such as increased blood pressure (Ainslie et al, 2008, Hainsworth et al, 2007), and cardiac side effects (Bernardi, 2007), which can lead to mountain sickness.

Concerning retinal and vitreal effects, high-altitude retinopathy has commonly been noted as dilated and tortuous retinal vessels, with occasional vitreous haemorrhage and papilleodema (Thapa et al, 2013). Ascents above 3,000 meters are shown to produce engorgement and tortuosity of retinal vessels and retinal haemorrhages (Rennie et al, 1975) due to hypoxia and hemoconcentration (McFadden et al, 1981), extreme physical exertion and Valsalva maneuvers (Braun et al, 1997).There is also an increase in retinal arterial and venule diameter with ascent to higher altitudes, which has been shown to return to normal upon descent (Bosch et al, 2009).Common vitreo-retinal changes for those residing at high altitudes have been reported as age-related macular degeneration, hypertensive retinopathy and retinal vein occlusion (Thapa et al, 2013).

Dry eye disease has been shown to be more prevalent at high altitudes due to environmental changes leading to increased tear evaporation (Gupta et al, 2008). Effects on intraocular pressure seem inconclusive, with few studies showing a decrease[7] with ascent to higher altitudes, some showing no alteration (Clarke et al, 1976), and others showing an increase (Bayer et al, 2004). The prevalence of cataract and pseudoexfoliation (Shakya et al, 2008) is shown to be increased among highlanders (Brandt et al, 1982).

A reversible hyperopic shift in refractive error due to central corneal flattening at higher altitudes has been reported (Mader et al, 1996). Hypobaric hypoxia has been shown to induce prominent stromal and endothelial changes potentially related to decreased oxygen tension in the aqueous humor (Mastropasqua et al, 1998). Convergence amplitude is also reported to decrease with raised altitude (Kramar et al, 1983). Additionally, changes in color perception, visual field defects, reduction of and/or stable visual acuity (Bosch et al, 2009), diplopia and defects in neural image interpretation have also been reported (Brandl et al, 1994).

Although some effects on ocular health at high altitudes are well known and persistent, others are either inconclusive or temporary in nature; more studies are needed to compile unequivocal evidence of the ocular effects due to high altitudes.

Materials and methods

This was a community-based cross-sectional study. Study participants were from a five-day long eye camp, organized in Ghat in north-eastern Himalayan region of Nepal. Ghat is a small village located at 2860 m altitude. Subjects were invited to the clinic and services were provided at no cost to participants by the Volunteer Optometric Services for Humanity (VOSH)-Southeast chapter from the USA, and the Nepalese Association of Optometrists (NAO). Verbal consent was received for permission to conduct ocular examinations on those visiting the eye camp. Subjects were examined by a team of seven optometrists from the USA, Nepal, New Zealand, and Canada. The study adhered to the Declaration of Helsinki (2004). Patients were treated with high dignity and their unanimity was not disclosed.

Among the 1890 subjects visiting the camp,1084 (57.4%) were porters. The 1084 porters were considered for further analysis in the study. To ensure maximum participation, advertisements were conducted, including FM radio announcements and pamphlet distribution throughout the community, starting a month before the initial camp date. The camp was held in the month of September, a peak tourist season, allowing the many porters frequenting the route to participate. Monocular visual screening was conducted in an outdoor setting using a Snellen Chart at six meters and an occluder to cover the eye not being tested. Habitual visual acuity was recorded, with pinhole acuity being taken in cases when visual acuity in an eye was worse than 6/9. A handheld autorefractometer(Retinomax -3) was used to do the objective refraction, while retinoscopy was conducted in eyes with outstanding refractive error, media opacities and among uncooperative children. Wet refraction using 0.5% cyclopentolate followed by post mydriatic test was done among children with high hypermetropia. Trial-frame subjective refraction was conducted to find the optimal correction. Myopia of more or equal to 0.5 D, hypermetropia of 1.0 D and above and astigmatism of 0.75 D and above were considered significant refractive errors. The posterior segment was examined using direct ophthalmoscopy (Heine Beta, 200),with binocular indirect ophthalmoscopy (Welch Allyn, 12500) being employed as indicated. Intraocular pressure was measured using a hand-held applanation tonometer (Perkins, Mk3). Anterior segment examination was done using torchlight and direct ophthalmoscope. Blood pressure was measured with a sphygmomanometer and blood glucose levels with a glucometer. Patients in need were provided with ocular therapeutics, prescription glasses, sunglasses and/or ocular health referrals free of cost. Statistical Package for the Social Sciences (SPSS) version 21 software was used for data entry and analysis.

Results

Ocular examinations were conducted for the 1890 people who frequented the five-day camp. Among them, 1084 (57.4%) were porters. The mean age of the porters was 30.30 (SD 11.59, range 12 to 76) years. Almost all of the porters were male (97.9%) and majority (593, 54.7%) were shown to be between 16 to 30 years old; 20 (1.8%) were below 16 years of age and 129 (11.9%) were above 45 years of age. Majority (888, 81.9%) of the porters belonged to the disadvantaged Janjati group (ethnic classification made by National Planning Commission of Nepal); another 147 (13.6%) were from the Upper Caste group, while the remaining 49 (4.5%) were from the Dalit (Lower Caste) group.

Table 1: Distribution of porters by socio-demographic information (n= 1084)

Socio Demographic Variable	Number	%
Age Group		
0-15	20	1.8
16-30	593	54.7
31-45	342	31.5
46-60	123	11.3
61 and above	6	0.7
Sex		
Male	1062	98
Female	22	2
Ethnicity		
Disadvantaged Janjati	888	81.9
Upper Caste	147	13.6
Dalit (Lower Caste)	49	4.5

A total of 441 (40.7%) porters had at leastone ocular-related complication. Presbyopia (144, 13.3%) and other refractive error (119, 11.5%) were the most common findings, followed by dry eye disease (10%). Infectious cases were diagnosed in 21 (1.9%) porters, while 15 (1.4%) were found to have glaucoma and 10 (0.9%) were found to have cataract or its sequelae. (Table 2)

Table2: Distribution of subjects on the basis of ocular morbidity

Ocular Morbidity	Number	%
Infectious (conjunctivitis, scleritis)	21	1.9
Non Infectious		
Presbyopia	144	13.3
Other refractive error	119	11
Dry eye disease	108	10
Glaucoma	15	1.4
Cataract and its sequelae	10	0.9
Amblyopia and strabismus	5	0.5
Corneal scar	4	0.4
Macular scar	3	0.3

Association of ocular morbidity with age, sex and ethnicity of the subject was not found to be statistically significant. (Table 3)

Table3: Relation between type of ocular morbidity and socio-demographic status of the subjects

Socio demographic variable	Ocular morbidity		Chi square, p-value	Odds ratio, 95% CI
	Infectious	Non Infectious		
Age				
Children (≤15 years)	1	3	3.905, 0.048	0.136, 0.014-1.373
Adult (>15 years)	19	418		
Sex				
Male	20	406	0.738, 0.390	1.037, 1.018-1.056
Female	0	15		
Ethnicity				
Disadvantaged Janjati	18	341	1.022, 0.312	2.111, 0.480-9.285
Others	2	80		

Glasses for distance or near use were prescribed to 267 (24.6%) porters. Antibiotics were prescribed in 10 (0.9%) cases where an infectious condition was found. Anti-glaucoma medications were prescribed to newly diagnosed 14 (1.2%) subjects who had high intraocular pressure and optic nerve head defects, while 16 (1.5%) subjects needing surgical management were referred to their nearest eye-health facility.

Among the 119 porters with refractive error, 50 (42%) had myopia, 52 (43.7%) had astigmatism and 17 (14.3%) had hypermetropia. The type of refractive error was not found to have a statistically significant association with age, sex and ethnicity of the porters. (Table 4)

Table 4: Relation between type of refractive error and socio demographic status of the subjects

Socio demographic variable	Type of refractive error		Chi square, p-value	Odds ratio, 95% CI
	Myopia or Hypermetropia	Astigmatism		
Age				
Children (≤15 years)	0	1	1.299, 0.254	1.020, 0.982-1.059
Adult (>15 years)	67	51		
Sex				
Male	64	51	0.588, 0.443	2.391, 0.241-23.675
Female	3	1		
Ethnicity				
Disadvantaged Janjati	56	42	0.159, 0.690	1.212, 0.471-3.119
Others	11	10		

Discussion

There are many high range mountains in the Nepal, making it a favourite destination for tourists from all over the world. Lukla is a town in the Khumbu area of the Solukhumbu district in the Sagarmatha zone of northeastern Nepal. Situated at 2860 metres (9,383 ft), it is a popular place for visitors to the Himalayas and is the gateway to Mount Everest. Khumbu, with less than four thousand inhabitants, receives anything from ten to twenty thousand trekkers a year, and plausibly twice as many porters. Porters from different parts of the country move to these rural, trekking routes to assist foreign guests in exploration.

It is reported that about 80% of Nepal's population and 90% of Nepal's blind population live in rural areas (Shrestha et al,

2014). Analyzing the ocular health status of porters in Nepal in these rural areas is therefore significant, with the high altitude conditions adding an extra element to consider. Statistics on ocular morbidity in Nepal is still limited, and a similar study investigating the ocular morbidity of porters working at high altitude in Nepal, has not yet been reported.

Reports from the 2012 study of Epidemiology of Blindness in Nepal, which followed the 50+ year age group in 14 zones of Nepal, indicate that cataract is still targeted as the most frequent cause of preventable blindness and vision impairment in Nepal (Nepal Netra Jyoti Sangh, 2012). Concerning our study, cataract was not found to be the most frequent finding, likely due to the demographics of the porter population studied, which had a male preponderance and had the vast majority as younger adults of the 16-30 year age group. However, considering, the potential for increased exposure to ultraviolet rays at higher altitudes, and that the majority of porters live in a rural environment and belong to a disadvantaged group, cataract is likely to be a finding that is highly prevalent among those in future studies.

Reports from the 2012 study of Epidemiology of Blindness in Nepal also showed that refractive error is materializing as the most common cause of ocular morbidity and a notable cause of visual impairment in Nepal (Nepal Netra Jyoti Sangh, 2012). In our study, for adults above the age of 40 years involved in the profession, presbyopia was present in all cases as would be expected. More importantly, for our porter population studied, high prevalence of other refractive error -predominantly myopia -was shown. Myopia has also been shown to be widespread among children in high mountain area in Nepal (Adhikari et al, 2013). Findings of uncorrected myopia across different age groups demonstrate the need for increased attention to ocular health treatment in Nepal. For our study specifically, this indicates that some porters are working in harsh visual and physical conditions, where improved vision could facilitate their tasks and increase their safety.

Other than refractive error, anterior segment conditions appeared to be prevalent. Anterior segment conditions have also been shown to be high in other rural environment sat lower altitudes in Nepal. One study from Baglung, Nepal, indicates that the prevalence of these conditions is likely due to the increased exposure to ultraviolet rays and the tendency towards an agricultural lifestyle (Bastola et al, 2012). A study from India, has reported dry eye disease to be more common in those living in high vs. low altitudes and, additionally, higher in those living at high altitudes for prolonged vs. temporary periods. The heightened exposure to ultraviolet radiation and the increase in tear evaporation during these conditions could lead to exacerbated signs and symptoms of dry eye (Gupta et al, 2008). Some of these anterior segment complications, such as pterygium (or even cataract), could have been prevented or delayed by adequate ultraviolet protection, while others, such as dry eye disease and infectious diseases, would need more involved care.

Certain retinal findings reported at high altitude, such as vasodilation and retinal haemorrhages, have been found to be more prevalent among those during short-term ascent of the mountains, and less so in porters accustomed to high altitude conditions (Rennie et al, 1975). Another study done in the Lukla region of Nepal, had shown the most common vitreo-retinal changes in the eye in this region to be age-related macular degeneration, hypertensive retinopathy and retinal vein occlusion (Thapa et al, 2013). The mean age in this study was 56.7 years, while the mean age in our study was 30.3 years. Retinal and vitreo-retinal disease as reported above were likely not as prevalent in our study due to the concentration on local

porters and the significantly younger mean age. Other types of retinal disease and ocular morbidities related to poorer diet and lifestyle choices (such as diabetic retinopathy), were not frequently found, plausibly attributing to the active lifestyle found among porters.

As a developing country, the rate of therapeutic care in Nepal still prevails over that of preventative care. Relating to vision in Nepal, this means that the rate of curative blindness is still high (Shrestha et al, 2014). Our study has shown that porters in high altitude regions could benefit mainly from correction of refractive error and treatment of anterior segment conditions. A correlation with specific effects on ocular health due to high altitude was not found in this study, but a definite need for a focus on development of sustainable programs that can provide more frequent care to these areas/porters in Nepal was found. Further studies are needed to investigate findings in porters in similar areas of Nepal, findings in the female and childhood population, and additionally, to expand on data concerning the effects on ocular health for those living at high altitudes.

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