

Ocular manifestations in bidi industry workers: Possible consequences of occupational exposure to tobacco dust

Saurabh Mittal, DNB; Apoorva Mittal, DO;
Ramakrishnan Rengappa, MS

Tobacco consumption is the leading preventable cause of disease, disability, and premature death but little is known about its deleterious effect on the ocular health of workers handling tobacco. The goal of this study was to identify probable effects of occupational tobacco exposure among south Indian bidi-industry workers. This study included 310 females (mean age, 34.8 ± 10.9 years) actively involved in bidi-rolling presenting with eye symptoms to a tertiary eye care hospital. Results suggested that a wide spectrum of ocular complications exist among these workers. Common ocular symptoms were defective vision, dull-aching headache and eye irritation. The main ocular findings were papillary conjunctival hyperplasia, hyperpigmentation of ocular surface, punctate epithelial erosion or superficial punctate keratitis, cataract or pseudophakia and segmental optic atrophy. Abstaining from work, supplementation of Vitamin B complex rich in B₁₂ and appropriate surgical or medical management reversed visual loss due to corneal disease or cataract but was not effective in optic neuropathy.

Key words: Ocular manifestations of tobacco, tobacco industry workers, tobacco occupational exposure

Indian J Ophthalmol 2008;56:319-22

Tobacco-related industry is a major commercial enterprise around the world. Over the years, production and consumption of tobacco products has alarmingly increased throughout the world. In India, more than five million individuals are involved in the production of bidi (a raw form of cigarette).^{1,2} These individuals work in small factories or at household-based enterprises in an environment laden with tobacco dust. Individuals working six to 10 hrs/day inhale, swallow, and expose their skin and mucous surface to significant amounts of particulate tobacco.^{3,4} The constituents of tobacco get absorbed into the body, get bio-activated and result in increased risk of developing ailments for which tobacco consumption is a major risk factor, including chronic obstructive pulmonary disease, cardiovascular system abnormality, carcinomas and premature death.⁵ Although the potential of the above diseases exists among workers

of the tobacco industry, little information is available about the adverse ocular health effects of this exposure among bidi-workers.^{3,4} The objective of our study was to obtain information about the probable effects of tobacco dust on the ocular health of bidi-rollers.

Materials and Methods

This hospital-based observational case study was conducted at a tertiary eye care center located in a rural area of south India from March through October 2006. The subjects enrolled ($n = 310$) were females actively involved in bidi-rolling (a process in manufacturing of bidi where tobacco is filled manually in Tendu or Bidi leaves *Diospyros Melonoxylon*) and presented at outpatient department with ocular complaints. After obtaining informed consent, questionnaire about work, eye symptoms, smoking and alcohol habits, general health was completed for each subject. Complete ocular examinations including color vision and visual field testing were performed to identify any anterior or posterior segment pathology. Hemoglobin was estimated by digital colorimeter (model M-98, Coronation instruments, India: using Drabkin's hemoglobin solution) as an indicator of general health for all patients.

Statistical methods

Clinical features related to ocular complaints of patients, noticed or aggravated after involving in bidi-rolling were tabulated for analysis. Data were analyzed using Microsoft Excel 2004 and SPSS v10.0. Results are presented as percentages, means and standard deviations. Pearson correlations of age, levels of hemoglobin, and total amount of work done in years with equivalent decimal best corrected visual acuity (BCDVA) in a randomly selected eye were also studied to look for any significant association between age, general health, work and eye disease.

Results

The demographic details and systemic features of 310 study patients are provided in Table 1. The patients were estimated to have rolled on an average three million bidis/person in their life at the time of presentation. All patients belonged to the poor socioeconomic strata. Their mean hemoglobin was 10.2 ± 1.5 gm% (range, 6.1-2.9). There was no significant correlation between hemoglobin levels and amount of work ($P = 0.079$), patient age ($P = 0.055$) or BCDVA ($P = 0.098$).

Chief ocular complaints were defective vision ($n = 195$, 62.9%), constant dull-aching headache ($n = 166$, 53.6%) and irritation/foreign body sensation ($n = 118$, 38.1%). Main clinical features observed were papillary conjunctival hyperplasia ($n = 304$, 49.0%), increased pigmentation of conjunctival and/or corneal surface ($n = 89$, 14.4%), punctate epithelial erosions (PEE) or superficial punctate keratitis (SPK; $n = 40$, 6.5%), cataract or pseudophakia ($n = 68$, 10.9%) and optic neuropathy ($n = 121$, 19.5%). Detailed summary of ocular features is tabulated in Table 2.

Best corrected visual acuity (BCVA) of 145 eyes (23.4%)

Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Tirunelveli, Tamil Nadu, India

Correspondence to Dr Saurabh Mittal, Aravind Eye Hospital and Postgraduate Institute of Ophthalmology, Tirunelveli - 627 001, Tamil Nadu, India. E-mail: dr_saurabhmittal@hotmail.com

Manuscript received: 07.05.07; Revision accepted: 21.09.07

Table 1: Demographic profile, work characteristic, ocular symptoms and associated systemic illness in bidi industry workers at presentation

| Demographic characteristics | | |
|------------------------------------|--|----------------------|
| Total patients (n) | | 310 |
| Age (years) | Mean ± SD (range) | 34.8 ± 10.9 (15-80) |
| Sex | Female | 310 (100%) |
| Socioeconomic status | Poor | 310 (100%) |
| Work characteristics | | |
| Working years | Mean ± SD (range) | 13.9 ± 9.8 (1-60) |
| Daily working hours | Mean ± SD (range) | 8.1 ± 3.6 (2-16) |
| Bidis rolled per day | Mean ± SD (range) | 638 ± 278 (100-1500) |
| Presenting ocular symptoms, n (%) | | |
| | Defective vision | 195 (62.9%) |
| | Headache | 166 (53.5%) |
| | Irritation/foreign body sensation | 118 (38.1%) |
| | Redness | 20 (6.5%) |
| | Eye pain | 35 (11.3%) |
| | Watering/discharge | 20 (6.5%) |
| | Photophobia | 11 (3.5%) |
| | Giddiness | 11 (3.5%) |
| | Others | 17 (5.5%) |
| Associated systemic illness, n (%) | | |
| | Skin tanning | 71 (22.9%) |
| | Rough skin | 37 (11.9%) |
| | Peripheral neuropathy | 36 (11.6%) |
| | Obstetric disease | 18 (5.8%) |
| | Miscarriages (abortions or stillbirth) | 15 (4.8%) |
| | Menstrual disturbances | 3 (1.0%) |
| | Respiratory illness | |
| | Tuberculosis | 5 (1.6%) |
| | Upper respiratory tract infection | 7 (2.3%) |
| | Joint pains | 6 (1.9%) |
| | Migraine | 2 (0.6%) |
| | Diabetic mellitus | 2 (0.6%) |
| | Hypertension | 1 (0.3%) |
| | Raynaud's phenomenon | 1 (0.3%) |

was < 20/20. Optic neuropathy ($n = 58$, 40.0%), cataract ($n = 46$, 31.7%) and corneal disease ($n = 19$, 13.1%) were the main causes of visual function loss. Decimal best corrected visual acuity had a significant negative correlation with the amount of work (correlation $r = -0.267$, $P < 0.001$) and the patient age ($r = -0.304$,

$P < 0.001$) suggesting that increasing work and age were related with poor visual function.

Intramuscular and/or oral vitamin supplements rich in B₁₂ (such as Neurobion forte injection twice a week for one month or once daily tablets of vitamin B complex with B₁₂, Merck Limited, India) administered for one month showed improvement in visual functions in cases with corneal involvement but were not significantly effective in reversing visual loss due to optic neuropathy.

Discussion

Bidi manufacturing is the second largest industry in India.¹ It provides employment to millions of women and children mostly from the poor socioeconomic strata.^{1,2} Investigations show that these tobacco-processors are exposed to extremely high levels of inspirable tobacco particulates.^{3,4} Considering the high content of nicotine and other chemicals in bidi tobacco (compared with cigarette tobacco), these workers are at an extremely high risk of developing systemic illness.⁶

Nicotine is a major component of tobacco, and has potential adverse health consequences. In addition, tobacco has about 4000 active chemical compounds of which more than 50 are carcinogenic; the list includes nitrosamines, polycyclic aromatic hydrocarbons, radioactive elements, and cadmium.⁷

Eyes get involved secondary to generalized toxic levels of these chemicals in the body, or from direct exposure of the ocular surface to the dust-laden environment. Direct exposure may lead to painful stimulation of conjunctival and corneal nerve endings, development of papillary conjunctival reaction, chromosomal damage, metaplastic change, death and erosion of ocular surface cells and deposition of melanin pigment on the surface.^{8,9} In a rare event, infective keratitis can develop.

Optic neuropathy was the commonest cause for permanent visual loss. Optic neuropathy can develop secondary to tobacco-alcohol amblyopia.⁹ Nutritional deficiency can be considered as an important etiological factor as most of our patients belonged to the poor socioeconomic strata. Otherwise, optic neuropathy can result from toxic effects of various tobacco constituents. Nicotine and other vaso-active compounds induce vasoconstriction of posterior ciliary arteries and produce atherosclerotic plaques of the carotid artery system. These lesions are responsible for retinal ischemic attacks and anterior ischemic optic neuropathy resulting in occurrence of visual loss that does not recover with nutritional supplements.^{9,10}

Our findings raise concerns about the potential occurrence of ocular disease and systemic co-morbidities in bidi-rollers. Considering that the Indian bidi-industry is an unorganized manufacturing sector, and that >15 to 25% of employed workers are children below 15 years,² the impact of tobacco on physical and ocular health in future may be alarmingly high. Interventions are required to minimize tobacco exposure, create awareness of disease and provide medical help to

Table 2: Summary of clinical signs and ocular consequences in bidi-rollers

| Characteristics | Patients n (%) | Eyes | | Eyes with BCVA < 20/20 n (%) |
|---|-------------------|------------|----------------------|---------------------------------|
| | | n (%) | Bilateral/unilateral | |
| Total | 310 | 620 | | 145 |
| Refractive errors | | | | |
| Myopia | 133 (42.9) | 248 (40) | 115/18 | 15 (10.3) |
| Hypermetropia | 41 (13.2) | 66 (10.6) | 25/16 | 0 (0) |
| Manifest hypermetropia | 12 (3.9) | 24 (3.9) | 12/0 | 0 (0) |
| Ocular features | | | | |
| Pigmentation of face and lids | 57 (18.4) | 114 (18.4) | 114/0 | 13 (9) |
| Blepharitis/Mebominitis | 25 (8.1) | 40 (6.5) | 15/10 | 5 (3.4) |
| Conjunctival involvement | | | | |
| Papillary hyperplasia | 108 (34.8) | 304 (49) | 78/30 | 63 (43.4) |
| Hyperpigmentation | 32 (10.3) | 89 (14.4) | 23/9 | 16 (11) |
| Injection | 18 (5.8) | 25 (4) | 7/11 | 6 (4.1) |
| Tear film abnormality | 4 (1.3) | 7 (1.1) | 3/1 | 1 (0.7) |
| Inflamed pterygium | 4 (1.3) | 6 (1) | 2/2 | 2 (1.4) |
| Inflamed pinguecula | 2 (0.6) | 2 (0.3) | 0/2 | 0 (0) |
| Conjunctival cyst | 2 (0.6) | 2 (0.3) | 0/2 | 0 (0) |
| Concretions | 1 (0.3) | 2 (0.3) | 1/0 | 0 (0) |
| Foreign body | 1 (0.3) | 1 (0.2) | 0/1 | 0 (0) |
| Cornea involvement | | | | |
| Foreign body | 3 (1) | 3 (0.5) | 0/3 | 0 (0) |
| Superficial punctate keratitis | 12 (3.9) | 22 (3.5) | 10/2 | 12 (8.3) |
| Punctate epithelial erosions | 12 (3.9) | 18 (2.9) | 6/6 | 2 (1.4) |
| Infiltration | 5 (1.6) | 5 (0.8) | 0/5 | 2 (1.4) |
| Pigmentation | 6 (1.9) | 10 (1.6) | 4/2 | 2 (1.4) |
| Scar | 3 (1) | 3 (0.5) | 0/3 | 1 (0.7) |
| Anterior uveitis | 2 (0.6) | 3 (0.5) | 1/1 | 3 (2.1) |
| Lens | | | | |
| Cortical and nuclear cataract | 20 (6.5) | 31 (5) | 11/9 | 23 (15.9) |
| Cortical cataract | 2 (0.6) | 4 (0.6) | 2/0 | 2 (1.4) |
| Nuclear cataract | 4 (1.3) | 8 (1.3) | 4/0 | 8 (5.5) |
| Posterior subcapsular cataract | 5 (1.6) | 10 (1.6) | 5/0 | 10 (6.9) |
| Pseudophakia | 7 (2.3) | 11 (1.8) | 4/3 | 5 (3.4) |
| Complicated cataract | 2 (0.6) | 3 (0.5) | 1/1 | 3 (2.1) |
| Anterior subcapsular cataract | 1 (0.3) | 1 (0.2) | 0/1 | 0 (0) |
| Macular disease | | | | |
| Retinal pigment epithelium degeneration | 11 (3.5) | 21 (3.4) | 10/1 | 5 (3.4) |
| Drusen | 5 (1.6) | 10 (1.6) | 5/0 | 2 (1.4) |
| Healed choroiditis | 2 (0.6) | 2 (0.3) | 1/0 | 2 (1.4) |
| Diabetic retinopathy | 2 (0.6) | 4 (0.6) | 2/0 | 0 (0) |
| Hypertensive retinopathy | 2 (0.6) | 4 (0.6) | 2/0 | 2 (1.4) |
| Epiretinal membrane with lamellar hole | 1 (0.3) | 1 (0.2) | 0/1 | 1 (0.7) |
| Optic nerve disease | | | | |
| Segmental optic disc pallor | 61 (19.7) | 121 (19.5) | 60/1 | 58 (40) |
| Elevated disc | 2 (0.6) | 4 (0.6) | 2/0 | 2 (1.4) |
| Glaucomatous optic neuropathy | 7 (2.3) | 14 (2.3) | 7/0 | 1 (0.7) |
| Congenital anomalous disc | 7 (2.3) | 9 (1.5) | 4/3 | 5 (3.4) |
| Convergence weakness | 5 (1.6) | 10 (1.6) | 5/0 | 2 (1.4) |
| Exotropia/exophoria | 3 (1) | 3 (0.5) | 0/3 | 0 (0) |
| Seventh nerve palsy | 1 (0.3) | 1 (0.2) | 1/0 | 0 (0) |
| Eviscerated socket | 1 (0.3) | 1 (0.2) | 0/1 | 1 (0.7) |
| Phthisis bulbi | 2 (0.6) | 2 (0.3) | 0/2 | 2 (1.4) |

BCVA - Best corrected visual acuity

minimize the deleterious effect of tobacco in bidi-rollers.

References

1. Shimkhada R, Peabody JW. Tobacco control in India. *Bull World Health Organ* 2003;81:48-52.
2. Aghi MB. Exploiting women and children- India's bidi industry. *In: Ray CS, editors. Database on tobacco control research in India. 2003. p. 201. Available from: <http://www.actindia.org/database/tobaccodatabase/home.html>. [cited on 2007 Apr 14].*
3. Bhisey RA, Bagwe AN, Mahimkar MB, Buch SC. Biological monitoring of bidi industry workers occupationally exposed to tobacco. *Toxicol Lett* 1999;108:259-65.
4. Bagwe AN, Bhisey RA. Occupational exposure to tobacco and resultant genotoxicity in bidi industry workers. *Mutat Res* 1993;299:103-9.
5. US Department of Health and Human Services. The Health Consequences of Smoking: A Report of the Surgeon General. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, USA: 2004.
6. Malson JL, Sims K, Murty R, Pickworth WB. Comparison of the nicotine content of tobacco used in bidi and conventional cigarettes. *Tob Control* 2001;10:181-3.
7. Robert DL. Natural tobacco flavor. *Recent Adv Tob* 1988; 14:49-81.
8. Mahimkar MB, Bhisey RA. Occupational exposure to bidi tobacco increases chromosomal aberrations in tobacco processors. *Mutat Res* 1995;334:139-44.
9. Solberg Y, Rosner M, Belkin M. The association between cigarette smoking and ocular diseases. *Surv Ophthalmol* 1998;42:535-47.
10. Chung SM, Gay CA, McCrary JA. Nonarteritic ischemic optic neuropathy. The impact of tobacco use. *Ophthalmology*. 1994;101:779-82.