

Occupational Health Hazards in Women Beedi Rollers in Bihar, India

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Abstract We studied the health problems of 197 female beedi rollers in Patna, Bihar, India to ascertain the effects of beedi rolling on health. The study found that more than 70% of the beedi rollers suffered from eye, gastrointestinal and nervous problems while more than 50% of the respondents suffered from respiratory problems, mostly throat burning and cough. More than 75% of the respondents faced osteological problems. Total RBC, WBC and platelet counts of the beedi rollers were significantly lower in comparison to the control subjects. Differential leucocyte count showed significantly risen lymphocytes and eosinophils and lowered neutrophils and monocytes in the beedi rollers as compared to the control group. Haemoglobin levels were lower among beedi rollers compared to the control group. SGPT (ALT) enzyme concentration, a parameter of liver dysfunction was significantly higher in the beedi rollers as compared to the control group. Thus, the study concluded that beedi rolling may cause significant health hazards.

Keywords Beedi Rollers · Erythrocyte count · Leucocyte count · SGPT

A beedi is a thin South Asian cigarette made of 0.2–0.3 g of tobacco flake wrapped in a tendu (*Diospyrox melanoxylon*) leaf and secured with coloured thread at both ends. As it is a cheap form of tobacco consumption, it is extremely popular among the non-affluent but it carries greater health risks as it delivers more nicotine, carbon monoxide

and tar than conventional cigarettes. Beedi rolling is a popular small-scale industry in Bihar, India. It is an arduous, labour intensive task because each beedi is rolled individually. Srinivasulu (1997) reported that 90% of beedi workers are women. According to Bagwe and Bhisey (1991) and Swami et al. (1995) beedi rollers are exposed to unburnt tobacco, mainly through the cutaneous and nasopharyngeal routes.

Ranjitsingh and Padmalatha (1995) reviewed that beedi rollers were affected by respiratory disorders, skin diseases, gastrointestinal illness, gynaecological problems, lumbosacral pain and are susceptible to fungal diseases, peptic ulcer, haemorrhoids and diarrhoea. Numbness of the fingers, breathlessness and stomach pains including cramps and gas, have also been reported in beedi rollers (Dikshit and Kanhere 2000; Rajasekhar and Muley 2001). Das and Pande (2000); Kuruvila et al. (2002) and Mittal et al. (2008), found that postural pains, eye problems and burning sensation in the throat are common ailments in women beedi rollers. Bhisey et al. (2006) recorded that inspirable dust of tobacco in the tobacco factory was associated with chronic bronchitis in workers. Ratna and Kaur (1999); Aghi and Gopal (2001) reported induration of the hands and complications of pregnancy in women beedi rollers. Bagwe et al. (1992); Bhisey and Bagwe (1995); Mahimkar and Bhisey (1995) and Umadevi et al. (2003) researched on the cytogenetic toxicity caused by occupational exposure to tobacco. Although a number of occupational health problems have been reported for the women beedi rollers, information on the effects of tobacco dust on various blood parameters of beedi rollers is lacking.

Women beedi rollers who start their profession at a very early stage of life are exposed to tobacco dust for approximately 4–10 h each day. Monitoring of blood parameters may help in the assessment of exposure and risk

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evaluations. We conducted this study with the purpose of collecting information on the health problems faced by the women beedi rollers and to throw some light on the epidemiology of diseases that may result due to exposure to tobacco dust.

Materials and Methods

The study was conducted in the Isopur and Naharpura localities of Phulwari Sharif, Patna, Bihar, India. One hundred ninety-seven female beedi rollers, without tobacco smoking/chewing habits were monitored for occupation related exposure to tobacco flakes and dust. Relevant information was collected by visiting the house of each beedi roller. A second group, comprising of 61 subjects, was the control group. The control group was selected from the general women population (mainly vegetable/fish sellers), with no history of occupational exposure to tobacco, and without any tobacco smoking/chewing habits, but belonged to the same age group and socio-economic status as the beedi rollers. We also ensured that all the subjects did not suffer with any serious disease and were not on any medications.

The study subjects were interviewed and a questionnaire was filled for each subject, which included details about their age, educational qualification, monthly income and health problems faced by them. This was followed by analysis of blood profile of 20 female beedi rollers and 20 controls. 10 mL of blood was collected from each subject by venepuncture with a disposable syringe. The blood was then transferred in sterilized vials. Each specimen bottle was labeled with subject identification number and then taken to a reputed laboratory for the analysis of complete blood picture and liver function test. The parameters selected for complete blood picture were total and differential WBC counts, total RBC count, Platelet count, Haemoglobin content and ESR. Liver function was assessed with SGPT test. The tests were carried out with auto-analyzer and automatic electronic blood cell counter.

The results were computed on computer in MS-Excel program. The statistical analysis was conducted using unpaired *t*-test (2-tailed) and the level of significance was taken as *p* value ≤ 0.05 .

Results and Discussion

It was found that women in the age group of 40–50 years were mainly engaged in beedi rolling (Table 1). A large proportion of the women are in this profession for 20–25 years, suggesting they start their profession at an early age. About 90% of the women are illiterate. The average

Table 1 General information of controls and beedi rollers

Parameter	No. of respondents (%) ^a	
	Beedi rollers (n = 197)	Control subjects (n = 61)
Age		
20–30	48 (24.3)	11 (18.03)
30–40	58 (29.4)	21 (34.4)
40–50	60 (30.5)	20 (32.8)
50–60	31 (15.8)	9 (14.8)
Educational qualification		
Illiterate	178 (90.5)	53 (86.8)
Primary (5th Std.)	12 (6.1)	5 (8.2)
Primary (7th Std.)	7 (3.6)	3 (5.01)
Monetary benefit		
Monthly income	Rs. 300–450 (6.5–9.8 \$)	Rs. 200–1100 (4.3–23.7 \$)
Respiratory problems		
TB in family history	13 (6.6)	
Asthma in family history	18 (9.1)	2 (3.3)
Cough	110 (55.8)	14 (22.9)
Throat burning	107 (54.3)	–
Osteological problems		
Shoulder pain	148 (75.1)	23 (37.7)
Neck pain	139 (70.6)	5 (8.2)
Joint pain	113 (57.4)	14 (22.9)
Cramp in arm	131 (66.5)	6 (9.8)
Swelling in limbs	134 (68.02)	7 (11.5)
Posture problem	142 (72.1)	22 (36.1)
Muscle atrophy in extremities of fore limbs	146 (74.1)	6 (9.8)
Other Health problems		
Eye problems	131 (66.5)	22 (36.1)
Eye watering	45 (22.8)	6 (9.8)
Eye burning	67 (34.01)	5 (8.2)
Poor vision	19 (9.7)	11 (18.04)
GI problems:		
Gas	140 (71.1)	20 (32.8)
Constipation	82 (41.6)	7 (11.5)
Nervous problems		
Headache	139 (70.6)	26 (42.6)
Giddiness	72 (36.6)	3 (5.01)
Miscarriage	73 (37.1)	7 (11.5)

^a Percentage (%) of respondents under each category is given in parenthesis

monthly income of women beedi rollers was Rs. 378 (8.2 \$), while that of controls was Rs. 650 (14.2 \$).

The survey revealed that the beedi rollers suffer with many health problems. Of the 197 workers, more than 70% suffered from eye problems, gastrointestinal and nervous problems. This may be because nicotine is absorbed

Table 2 Comparison of blood cell counts between Control and Beedi Rollers

Parameter	Normal range	Control (n = 20)	Beedi rollers (n = 20)	<i>t</i> value	Significance level (<i>p</i>)
RBC Count (million/cu mm)	4–5	4.29 ± 0.1	3.69 ± 0.07	4.83	<0.0001
Platelet Count (lac per cu mm)	1.5–3.0	2.75 ± 0.06	2.05 ± 0.09	6.45	<0.0001
WBC Count (no. per cu mm)	4000–11000	10055 ± 224.6	7997.5 ± 272.7	5.79	<0.0001

Values are Mean ± S.E

through the skin of the fingers and palm and distributed throughout the body. Nicotine excites the sensory nerves of the alimentary tract leading to increased gastrointestinal secretion. Toxic effects of nicotine on nerves have been well explained (Taylor 1996). More than 50% of the respondents suffered from respiratory problems, mostly throat burning and cough. The symptoms may have been caused by the tobacco dust. Respiratory problems in workers occupationally exposed to tobacco has been confirmed by others (Valic et al. 1976; Lander and Gravesen 1988; Kjaergaard et al. 1989; Mukhtar et al. 1991; Osim et al. 1998). More than 75% of the respondents faced osteological problems, mostly shoulder, back and knee pain, possibly caused due to sitting in the same posture for prolonged period. The miscarriage rate was also found to be significantly higher in the beedi rolling group (37% of the beedi rollers as compared to 11.5% of controls). Twenty-six out of the 73 beedi rollers faced more than one miscarriage. Sardesai et al. (2007) found that women beedi rollers deliver low birth weight babies. Histopathological changes were found in the placenta of such women, that can cause fetal hypoxia due to reduced uteroplacental blood circulation, suggesting adverse effects of tobacco dust on pregnancy. Muscle atrophy in extremities of fore limbs was found in 74% of the respondents.

The age difference between beedi rolling women and controls was insignificant ($t = 0.71$, NS). Total RBC count of the beedi rollers was significantly lower in comparison to the control subjects ($t = 4.83$, $p < 0.0001$) (Table 2). In another comparable study, Karafakioglu et al. (2009) found a significant fall in RBC count in women workers who harvest tobacco, after the harvest as compared to the count before the harvest. Metin et al. (2004) and Rajasekhar et al.

(2007) found a reduction in RBC count in smokeless tobacco consumers. Adeniyi and Ghazal (2006) studied the effects of tobacco leaf extracts on Wistar rats and found a significant reduction in RBC count. The platelet count of beedi rollers was also significantly lower as compared to the controls ($t = 6.45$, $p < 0.0001$). Metin et al. (2004) also found a reduction in platelet count in consumers of Maras powder (smokeless tobacco). Adeniyi and Ghazal (2006) found a significant reduction in platelet count in Wistar rats as a result of exposure to tobacco leaf extracts. Total WBC count of beedi rollers was also significantly lower as compared to control ($t = 5.79$, $p < 0.0001$). Decrease in WBC count may be due to exposure to tobacco dust. Metin et al. (2004) and Rajasekhar et al. (2007) also found a reduction in WBC count in smokeless tobacco consumers. Valenca et al. (2008) observed a reduction in leukocyte count in Wistar rats treated with oral nicotine.

There was significant rise in lymphocytes ($t = 2.32$, $p < 0.05$) and eosinophils ($t = 2.81$, $p < 0.05$) and a significant fall in neutrophils ($t = 2.8$, $p < 0.05$) and monocytes ($t = 4.7$, $p < 0.0001$) in the beedi rollers as compared to the control subjects (Table 3). As lymphocytes are concerned with immune response, their number increases in response to infections. Since none of the study subjects were diagnosed with tuberculosis or cancer, it is inferred that lymphocytosis in the beedi workers may have been caused by nicotine inhaled with tobacco dust. Stimulating effect of nicotine on lymphocytes has been confirmed by Corre et al. (1971); Noble and Penny (1975); Taylor et al. (1985); Tollerud et al. (1991); Gillum (1991) and Jensen et al. (1998). However, the mechanism by which nicotine influences lymphocyte blood counts is not known (Jensen et al. 1998). An increased number of

Table 3 Comparison of leucocyte counts between Controls and Beedi Rollers

Parameter	Normal range (%)	Control (n = 20)	Beedi rollers (n = 20)	<i>t</i> value	Significance level (<i>p</i>)
Neutrophils(%)	55–65	67 ± 0.84	63.3 ± 0.99	2.8	0.05
Lymphocytes(%)	25–35	27.35 ± 0.8	30.7 ± 1.2	2.32	0.05
Monocytes(%)	01–06	1.95 ± 0.18	1.05 ± 0.05	4.7	0.0001
Eosinophils(%)	1–06	3.7 ± 0.27	5.05 ± 0.4	2.81	0.05

Values are Mean ± S.E

Table 4 Comparison of certain blood parameters between Controls and Beedi Rollers

Parameter	Normal range	Control (n = 20)	Beedi rollers (n = 20)	<i>t</i> value	Significance level (<i>p</i>)
Haemoglobin (g/dl)	14.6	11.93 ± 0.14	11.0 ± 0.2	3.74	0.01
ESR (mm/hr)	5–20	40.3 ± 6.14	70.85 ± 5.13	2.66	0.0001
SGPT (ALT) (U/L)	5–35	16.6 ± 0.84	30.5 ± 3.17	4.2	0.05

Values are Mean ± S.E

eosinophils usually indicates the response of the body to an abnormal substance that can cause an allergic reaction. Pantaleo et al. (1994) showed in his studies that eosinophils are the predominant inflammatory cells in allergic reactions. Long term exposure to tobacco dust may cause allergic problems and is harmful to the airways of the tobacco workers (Lander and Gravesen 1988). When the neutrophil count falls, the risk of infection increases greatly. Similar finding has been reported by Metin et al. (2004). A low number of monocytes in the blood can occur in response to the release of toxins into the blood of people exposed to tobacco dust. Krombach et al. (1997) suggested that a decrease in monocyte count indicates suppressed immune activity.

Haemoglobin levels were lower among beedi rollers compared to the control group ($t = 3.74$, $p < 0.01$) (Table 4). Rajasekhar et al. (2007) also found a reduction in haemoglobin percentage in smokeless tobacco consumers. Adeniyi and Ghazal (2006) found a reduction in haemoglobin level of Wistar rats in response to extract of tobacco leaves. Karafakioglu et al. (2009) found a significant decrease in haemoglobin level in women workers who harvest tobacco, after the harvest as compared to the level before the harvest. Low haemoglobin levels with or without an absolute decrease of RBCs may lead to symptoms of anaemia. ESR ($t = 2.66$, $p < 0.05$) was significantly higher in the beedi rollers as compared to the controls. Omolade et al. (2005) also found that ESR was higher in smokers as compared to non-smokers. A very high ESR usually has an obvious cause, such as a marked increase in globulins that may be due to a severe infection. Gupta et al. (2005) also supported the view that rising ESR can mean increase in inflammation or a poor response to a therapy. SGPT (ALT) enzyme concentration ($t = 4.2$, $p < 0.0001$) was significantly higher in the beedi rollers as compared to the control group.

It is suggested that nicotine may be absorbed through the skin of the fingers and palm and distributed throughout the body. It is finally metabolized by the liver (Cashman et al. 1992; Snyder and Sheafar 1999; Neurath 1994). Karafakioglu et al. (2009) also found a significant rise in SGPT level of women workers who are involved in the harvest of tobacco.

The study revealed that women beedi rollers face numerous health problems possibly due to direct inhalation

of tobacco flakes and dust. There is a need to impart education to the women beedi rollers regarding the health hazards caused by tobacco and the need to use protective clothing such as gloves, masks etc. Also, there is a need to provide alternative livelihood options from the point of view of economic viability and skills of women. The recommended possibilities includes home based occupation like paper recycling and making paper products, farming of herbal and medicinal plants, vegetable selling and preparation of indigenous snacks.

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