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Original Article

Significant effect of education & income on cancer control: Policy consideration for third world

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ARTICLE INFO

Article history:

Received 14 August 2015

Accepted 8 March 2016

Available online 30 March 2016

Keywords:

Head and neck cancer

Education

Income

Socioeconomic status

ABSTRACT

Background: Head and neck squamous cell cancer (HNSCC) is maximally encountered in India across the globe, and the environmental influences/interactions leading to cancer particularly education and income are very different in the developed countries than the third world.

Material and methods: A prospective assessment of 707 histologically proven HNSCC patients was undertaken regarding the possible role of 2 determinants viz. education and income on cancer prevalence. Standard questionnaires were filled up for the outpatients in the department of otolaryngology and variables such as demographics, site of involvement, the education and family income were analyzed accordingly.

Observations: The cancer was seen more among those with the education status of less than grade V (58%), than between VI and VIII grade (21%) or between IX and XII grade (8.5%) and higher. Of those with the education category of less than grade V, oral cavity was the most common site involved (29%). The cancer rates among income category of less than Rs. 1000/- (46%) was significantly more than those of Rs. 1001–2000 (29%) and Rs. 2001–4000 (10%). Thereafter there was a drastic fall in the cancer rates among the further higher income categories.

Conclusions: Two points have emerged from this study; that is likely to have the highest impact on cancer control: (1) implementing compulsory education till class VI and (2) Enhancing family income to Rs. 4000/INR per month. These are likely to have a complicated interaction with various procarcinogenic practices and environment and their correction is very likely to reduce the cancer occurrence through prevention.

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Head and neck squamous cell cancer (HNSCC) is the most common cancer seen among males in Indian subcontinent and is maximally encountered in India across the globe. The environmental practices herein probably have a larger

contribution in carcinogenesis (among the genetically predisposed) than the hereditary component as such. India is unique in terms of cancer related practices,¹ wherein pro- and anti-cancer practices vary widely across the different regions of the

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<http://dx.doi.org/10.1016/j.cegh.2016.03.001>

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country. The individual preference of a particular practice is influenced by the education status and financial affordability of a person. Among the low-socioeconomic groups the existing literature reflects the favorable role of enhanced socioeconomic status on patients with bone/joint sarcomas, skin melanomas, endometrial carcinomas^{2–4} and cervical cancer⁵ in terms of prognosis. Education too has been cited as a strategic factor in cost effective cancer control^{5,6} in China, but no such study has been conducted in India to establish the minimum requirement of income and education needed to positively impact a cost effective cancer control. Hence an effort here has been made to work out the possible role of such variables in the capital city of the most populated province of India that harbors one of the largest populations of HNSCC across the country.

1. Patients and methods

This study is a prospective assessment of 707 patients of HNSCC that were selected randomly from the outpatient department of Otolaryngology (including referrals from the department of Radiotherapy) KG Medical University Lucknow, India from 2006 to 2013. The draining geographical areas of this center include the entire province (UP), the adjoining provinces (Bihar, MP, Jharkhand, Uttaranchal) and the adjoining part of Nepal. The inclusion of cases was done throughout the year on 3 days in a week except in the months of June and July. The exclusion criteria included those patients from Nepal/abroad or those with mental retardation and infants. Moreover the incompletely recorded or doubtful patient-information was not considered in the analysis. Apart from routine anamnesis the following information was obtained as a part of routine workup: (1) age, (2) sex, (3) education status, (4) income status, (5) site of involvement [categorized as per ICD-10 into nose including paranasal sinus (ICD D38.5, C76.0), oral cavity [ICD C02.0 (C02.1, C02.2, C02.3, C02.4, C02.8, C02.9), C03 (C03.0, C03.1, C03.9), C04 (C04.0, C04.1, C04.8, C04.9), C05 (C05.0, C05.1, C05.2, C05.8, C05.9), C06 (C06.0, C06.1, C06.2, C06.8, C06.9)], pharynx including oropharynx/nasopharynx/hypopharynx (ICD C01, C09 (C09.0, C09.1, C09.8, C09.9), C10 (C10.0, C10.1, C10.2, C10.3, C10.8, C10.9), C12, C13, C13.0, C13.1, C13.2, C13.8, C13.9), larynx (ICD D38.0, D37.01), salivary gland including parotid/submandibular gland (ICD C07, C08 (C08.0,

C08.1, C08.8, C08.9)], and ear (ICD D38.5, D48.5)]. In case of involvement of more than one site the respective case was categorized as per the site of maximum involvement. Every case was histologically proven squamous cell carcinoma while those with unknown primary had nodal metastasis proven by FNAC. An orientation program was conducted prior to the initiation of the data collection in order to train the postgraduate residents regarding the methodology of data collection. Daily random check up by the principal investigator was undertaken to ensure the quality of data collection.

1.1. Observations

The most common site as seen in the study was larynx 26.6% closely followed by oral cavity in 25.3%. The least common sites were salivary gland and ear. However the combined incidence of cancer oral cavity and oropharynx far exceeded other varieties.

1.1.1. Age and sex distribution (Tables 1 and 2)

An increase in incidence was seen from 3rd decade onwards with oral cavity being predominantly affected. Although oral cavity and oropharynx are in close proximity, yet there was a significant difference in the incidence at both sites especially in 3rd and 4th decades (7% oral cavity vs. 0.8% oropharynx). However in 5th decade, the above trend reversed, where pharyngeal involvement exceeded that of oral cavity (13% vs. 5%) and with further increase in age the involvement was appreciated at other sites as well. The gender bias for males in our population is well evident in Table 2. There appears to be a trend among females to favor pharyngeal/laryngeal involvement than the oral cavity, while the reverse is seen among males.

1.1.2. Education status

The preliminary comparison of education status with occurrence of HNSCC reveals inverse relationship. Accordingly the lower education status cohort showed a higher prevalence of cancer. The cancer was seen more among those with the education status of less than grade V (58%), than between VI and VIII grade (21%) or between IX and XII grade (8.5%) and higher. It is worth noting that with the education category of less than grade V, oral cavity was the most common site involved (29%); its prevalence decreased drastically (14%) with the education category of grades VI–VIII. These improved

Table 1 – Age vs. type of cancer.

Age group	Type of cancer							Percentage	
	Unknown primary	Nose	Oral cavity	Pharynx	Larynx	Salivary gland	Ear	Total	
<10	4	0	0	0	0	0	0	4	0.5
11–20	2	4	1	0	0	0	0	7	1.0
21–30	4	4	12	2	2	0	0	24	3.4
31–40	16	0	43	4	26	4	0	87	12.3
41–50	31	8	36	93	39	1	0	208	29.4
51–60	45	4	65	47	44	1	4	210	29.7
61–70	16	0	19	25	54	0	2	116	16.4
>70	4	0	8	8	23	1	1	45	6.3
Total	122	20	184	179	188	7	7	707	
Percentage	17.2	2.8	26	25.3	26.6	1	1		

Table 2 – Sex vs. type of cancer.

Type	Sex		Total	Ratio (M:F)
	Male	Female		
Unknown primary	101	21	122	4:1
Nose	18	2	20	9:1
Oral cavity	157	29	184	5.6:1
Pharynx	143	36	179	4:1
Larynx	153	35	188	4.2:1
Salivary gland	6	1	7	6:1
Ear	5	2	7	2.5:1
Total	581	126	707	4.6:1

trends continued onwards further with higher education. It is worth noting at this point that majority (67%) of the patents started smoking between 16 and 25 years age. The next common age group to have started smoking was <15 years (22%). In both these age categories the education of less than grade V was most commonly seen. Table 3 further reveals a comparison of education status in 1010 general population (subjects selected randomly from our outpatient attendance) with our current cohort. The Chi-Square test of Goodness of Fit at 6 degrees of freedom for $\alpha = 0.05$ was applied and revealed a value of 2148.22, much above the tabulated value (of X^2 at 6 degrees of freedom for $\alpha = 0.05$) of 11.07, suggesting that the proportions of educational categories were different in general population vs. our cancer patients.

1.1.3. Income status

The occurrence of HNSCC revealed an inverse relationship with income (Table 4). The cancer rates among income

category of less than Rs. 1000/- (46%) was significantly more than those of Rs. 1001–2000 (29%) and Rs. 2001–4000 (10%). Thereafter there was a drastic fall in the cancer rates among the further higher income categories. The oral cavity was more commonly involved in <1000 category while pharyngeal and laryngeal involvement were more common than other categories. Table 4 further reveals a comparison of income status in 1010 general population (subjects selected randomly from our outpatient attendance) with our current cohort. The Chi-Square test of Goodness of Fit at 6 degrees of freedom for $\alpha = 0.05$ was applied and revealed a value of 2525.01, much above the tabulated value (of X^2 at 6 degrees of freedom for $\alpha = 0.05$) of 11.07, suggesting that the proportions of income categories were different in general population vs. our cancer patients.

2. Discussion

The incidence, pattern, geographical distribution, sexual and environmental determinants of HNSCC seem to be a function of economic and educational status. Even the treatment options and prognosis depend upon the same. Not much work has been done for Indian population in HNSCC in terms of economic and educational impact and the policy consideration in India is mainly based on western reports. Being a developing country the priority for medical research gets a backseat and is focused around big cities. With over 70% population living in rural areas a true picture of environmental determinants is often missed in urban setting. This outpatient-study conducted at a university

Table 3 – Education status vs. type of cancer.

Education status	Type of cancer								Control population no. (%)
	Unknown primary	Nose	Oral cavity	Pharynx	Larynx	Salivary gland	Ear	Total	
V or less	75	9	119	96	102	4	4	410	95 (9.4)
VI–VIII	16	7	21	49	55	1	0	149	126 (12.4)
IX–X	16	5	11	7	21	0	0	60	108 (10.7)
XI–XII	5	0	12	15	4	0	1	37	136 (13.4)
Technical	3	0	11	0	1	0	0	15	38 (3.7)
Graduate	3	3	9	5	0	2	4	22	322 (31.8)
Postgraduate	3	0	5	3	1	2	2	14	185 (18.3)
Total	122	20	184	179	188	7	7	707	1010 (100)

Table 4 – Income status vs. type of cancer.

Income range (INR) per month	Type of cancer								Total	Control population no. (%)
	Unknown primary	Nose	Oral cavity	Pharynx	Larynx	Salivary gland	Ear			
<1000	67	5	92	77	79	0	4	324	53 (5.2)	
1001–2000	29	7	43	61	64	4	0	208	163 (16.1)	
2001–4000	9	3	11	27	21	0	0	71	251 (24.8)	
4001–8000	2	5	4	7	17	1	0	36	215 (21.2)	
8001–12,000	11	0	17	0	0	0	2	30	104 (10.2)	
>12,000	0	0	4	3	0	2	1	10	216 (21.3)	
No income	4	0	13	4	7	0	0	28	8 (0.7)	
Total	122	20	184	179	188	7	7	707	1010 (100)	

hospital truly reflects the rural population of 400–500 km radius. Further it is possible that the extreme unapproachable rural population with significant geographical hindrances from the hospital may have been missed.

A significant drop in the cancer rate in the current study is seen with education status of 'VI–VIII class' in comparison with less than V-class educational level. The rate thereafter is more or less constant suggesting the policy makers to compulsorily implement education – for-all status at least till class 6th standard. Gupta⁷ observed greatest tobacco consumption among the illiterate and subjects with lower educational status. This was also noted in the current study as the majority who started smoking regularly before completing their 15th birthday was uneducated lot. It seems that antismoking statutory warning by the government makes no meaning for those who are unable to read it. Such population is likely to respond more to audiovisual impact as well as counseling rather than simple inscribed warning on a cigarette pack. It is not uncommon to see even the best educated lot to use tobacco in all ages but probably the quality of carcinogens is of a better quality than those crude ones used by the uneducated groups.

A better income status always translates into adoption of good cancer preventive measures through better education and enhanced realization. In Mumbai, the expenditure on tobacco products represents a significant proportion of the daily incomes of Indian residents of low-income categories including unemployed individuals. Also in India the household expenditure on alcohol varies from 3% to 45% of income. Noteworthy in our study is the fact that once the monthly income exceeds 4000 INR the cancer rate drastically drops and then remains constant across the more affluent population. Whether the enhanced income has its effect through a better education or through accessibility/affordability of a lesser carcinogenic tobacco product resulting in reduced cancer occurrence is yet to be studied. Hence a government policy of enhancing the family income status above 4000 INR per month is likely to be protective in terms of significantly reducing the cancer burden. It is a real irony that the Central Government of India declares those earning Rs. 1000/- INR per month only as above poverty level. This translates to around 17 US\$ in a month for a person to cross the poverty level. Practically there has been a lot of debate on this issue as it has not been accepted by the masses. There is a gross financial disparity among the Indians and unless the poor (majority) can increase their income many folds the effect of cancer control will be limited. Economic development and compulsory education have been suggested as the two important solutions in raising general disease awareness.⁵ They propose that implementing community-based awareness programs against cervical cancer is realistic, locally affordable and sustainable in low-income countries. Among the low socioeconomic status category of patients in this study the common driving symptoms for the cancer patient to seek attention were pain and bleeding. Madani et al.⁸ have also concluded that low levels of education, working in the fields (farmer) and monthly household income of less than Rs. 5000/- INR were significant risk factors for oral cancer and women were more affected in this regard than men.

The implications of economic and educational concerns on procarcinogenic outcomes are many folds.

- (1) The tobacco is increasingly used that translates into tobacco-chewing related cancers. For example mouth and pharynx are the 3rd common sites among males in developing countries worldwide while this variety is most commonly seen in India. In the west 98% of such cancers are seen above 40 years of age while the present study revealed 17% being less than 40 years age.
- (2) The educational deprivation/poor understanding translates in to increased prevalence of oral cancer in comparatively younger subjects as in this study 10.4% developed regular/daily smoking habit by the age of 15 years. This is a matter of great concern and reflects an early onset of pro-carcinogenic practices. These include various shades of tobacco smoking in addition to chewing possibly predisposing later on to pharyngeal and supraglottic laryngeal cancer with continuous use.
- (3) The substandard awareness is further reflected by the fact that a 15% rural prevalence⁹ of ear discharge is either overlooked for years or managed by indigenous system of medicine (boiling oil, crude plant extracts etc.). It is well known that a long standing chronic suppurative otitis media predisposes to cancer.
- (4) Majority of the cancer studies across India reflected a predilection for male gender owing to increased prevalence of pro-carcinogenic practices (tobacco, alcohol) but Rani et al.¹⁰ have found enhanced smoking rates among females than males in the adjoining state (Bihar). This may be due either to trends in woman-empowerment or minimal independent income of females translating into initiation of such practices.
- (5) The passive smoking has been seen more at home than at workplace due to poor understanding of the consequences that increases the drive for smoking at home after prolonged abstinence at work/public places (anti-smoking zones).
- (6) The poor income results in consumption of unprocessed tobacco and crude alcohol that carry an enhanced levels of carcinogens e.g. bidi smoking and country-made alcohol. Bidi smoking is very specific for Indian subcontinent and the various types of unprocessed tobacco products available in the country are very unique. Mishra¹ published an exhaustive review of pro- and anti-carcinogenic practices in India. In a study by Rao et al.¹¹ bidi smoking and alcohol drinking emerged as significant risk factor for pharyngeal and laryngeal cancers. They reported illiterates to have 50–60% excess risk for pharyngeal cancers only.
- (7) The illiteracy prohibits the assessment of smoking in terms of cigarette-pack years in rural India due to many reasons. In this study, majority could not recall their exact smoking status in terms of duration, frequency and quality (filtered vs. non-filtered). Secondly bidi smoking is quite different from cigarette and lasts for only a few puffs during which a continuous effort is made to let it 'glow'. The levels of benzo(a)pyrene content/noxious agent in Indian cigarettes (and other smoking modalities viz. bidi and cheroot) to be higher than in currently marketed

western cigarettes. Hence international smoking standard comparison may not be appropriate.

- (8) Despite a vigorous anti-tobacco drive by the government and NGOs the practice of using tobacco-based toothpaste in India as a so-called hygienic oral practice is unique and rampant. Similarly a relatively newer introduction of chewable, flavored tobacco preparations such as 'gutka' has significantly influenced the market and well adopted by 'foolish' Indians.
- (9) Majority of quitters of smoking were in their 5th decade of life and onwards probably due to occurrence/diagnosis of cancer itself (economic burden of treatment) rather than being educated enough to understand the consequences.
- (10) The interaction of poor income/education with nutrition is important in terms of cancer causation. The wasteful expenditure (3–45%) on alcohol results in household being deprived of essential nutrition and various deficiencies of vitamins and trace elements in chronic alcoholics may contribute to carcinogenesis.¹² In heavy drinkers, the entire nutritional status is impaired owing to primary and secondary malnutrition.

Hence the education and income have a complicated interaction with various procarcinogenic practices and environment. Its correction is very likely to dilute the severity of the positive feedback loop mechanism contributing to increased incidence rate of cancer through prevention.

3. Conclusion

The environmental influences/interactions leading to cancer are very different in the developed countries than the third world. With crude/non-standardized products being marketed a standardization-policy needs to be universally implemented by the government of India. Two points have emerged from this study that is likely to have the highest impact on cancer control: (1) implementing compulsory education till class VI and (2) Enhancing family income to Rs. 4000/INR per month. Such a model may be adapted across the third world for an effective cancer control.

Conflicts of interest

The authors have none to declare.

Acknowledgments

The author would like to acknowledge Dr. G.K. Shukla, Professor of Statistics for his inputs and the post graduate students V.P. Singh, P.N. Jaiswal, A.B. Singh, S. Chakraborty, Ruchika Agarwal for helping in some data recording.

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