Data mining approach for exploring socioeconomic patterns in cancer

Leila Hosseini,1 Hossein Vatanpour,2* Mehdi Mohammadzadeh,1 Mohamadreza Abdolahi,1 Rita Motidostkomleh1

ABSTRACT

Background: Cancer has become an increasingly important issue for health expenditure and in the public sector. Therefore, identification of socioeconomic patterns is essential for developing novel methods of cancer prevention. A cancer risk prediction system is proposed here, which is easy and cost-effective, also saves time.

Methods: Initial data were collected from surveys with a digital audio recorder on 2014 cancer dependent and independent smokers. Patterns were found using a decision tree model. As socioeconomic patterns are neglected altogether, this study will pave the way for public health policies.

Results: This study shows that a death rate in cancers by smoking around 24.3%. According to them, the type of cancers attributed to smoking was oral cavity (8.2%) and bladder (8.2%) cancer. Some risk factors related to smoking and cancers were included male patients (66%), age <35 years old group (56.3%), employee (86.3%), married (86.2%), as well as have very good public insurance (96.5%). In addition, 98% cancer patients were known have public insurance.

Education levels have been shown most of the patients with cigarette smoking had less than a college education and in the absence of police, they use fewer safety belts. Those with risk factors for failing to wear a seat belt under a doctor to quit smoking. Although the health situation in cancers attributed to smoking vs. non-smoking attributed to worse evaluated. The age factor is effective in counseling for the doctor to quit smoking, and people aged 35–65 are the most advised to quit smoking.

Conclusion: Smoking-related costs in Iran are high. The cost methodology presented is useful for policy making. Cost estimates can be used to evaluate the level of cigarette taxes and other policies related to smoking.

Keywords: cancer, smoking, socioeconomic class, data mining, health policy

Cite This Article: Hosseini, L., Vatanpour, H., Mohammadzadeh, M., Abdolahi, M., Motidostkomleh, R. 2018. Data mining approach for exploring socioeconomic patterns in cancer. Bali Medical Journal 7(1): 97-103. DOI:10.15562/bmj.v7i1.652

INTRODUCTION

There is ample evidence of the association between the incidence and mortality of cancer and socioeconomic factors; however, only a little-published data have been paid attention to the effects of socioeconomic and demographic patterns.1,2,3,4,5

Despite the importance of the socioeconomic level of cancer patients, there is still a paucity of evidence on this issue. Cancers are an increasingly important area of health expenditure and the public sector. A great number of factors lead to cancers, such as smoking, which has received considerable critical attention and a question of great interest to wide range of fields in the relationship between smoking and cancers

Some previous studies confirm the role of socioeconomic status in the incidence of cancers and mortality. One of them is Body Mass Index (BMI) were increasing a 5 kg/m2 in BMI in men has been observed to be strongly associated with esophageal adenocarcinoma as well as thyroid, colon, and renal cancers. In addition, a strong relationship has been recorded in women between a 5kg/m2 increase in BMI toward to endometrial, gallbladder, and renal cancers. A weak positive relationship also has been reported between increased BMI and rectal tumors as well as threatening melanoma in men, postmen basal breast, pancreatic, colon cancer in women, leukemia, multiple myeloma, and non-Hodgkin lymphoma in both genders.6,2

Studies have shown that the number of students who smoked one pack of cigarettes or more every week increased with the decreasing social class, as measured by their fathers’ occupations. This pattern was seen for both male and female students. The number of fathers who smoked demonstrated a corresponding relationship with social class. However, the number of mothers who smoked did not fluctuate by social class. The number of students who smoked and especially those who were heavy smokers was low in families where both parents did not use fewer safety belts. Those with risk factors for failing to wear a seat belt under a doctor to quit smoking. Although the health situation in cancers attributed to smoking vs. non-smoking attributed to worse evaluated. The age factor is effective in counseling for the doctor to quit smoking, and people aged 35–65 are the most advised to quit smoking.

Conclusion: Smoking-related costs in Iran are high. The cost methodology presented is useful for policy making. Cost estimates can be used to evaluate the level of cigarette taxes and other policies related to smoking.

Keywords: cancer, smoking, socioeconomic class, data mining, health policy

Cite This Article: Hosseini, L., Vatanpour, H., Mohammadzadeh, M., Abdolahi, M., Motidostkomleh, R. 2018. Data mining approach for exploring socioeconomic patterns in cancer. Bali Med J 7(1): 97-103. DOI:10.15562/bmj.v7i1.652

INTRODUCTION

There is ample evidence of the association between the incidence and mortality of cancer and socioeconomic factors; however, only a little-published data have been paid attention to the effects of socioeconomic and demographic patterns.1,2,3,4,5

Despite the importance of the socioeconomic level of cancer patients, there is still a paucity of evidence on this issue. Cancers are an increasingly important area of health expenditure and the public sector. A great number of factors lead to cancers, such as smoking, which has received considerable critical attention and a question of great interest to wide range of fields in the relationship between smoking and cancers

Some previous studies confirm the role of socioeconomic status in the incidence of cancers and mortality. One of them is Body Mass Index (BMI) were increasing a 5 kg/m2 in BMI in men has been observed to be strongly associated with esophageal adenocarcinoma as well as thyroid, colon, and renal cancers. In addition, a strong relationship has been recorded in women between a 5kg/m2 increase in BMI toward to endometrial, gallbladder, and renal cancers. A weak positive relationship also has been reported between increased BMI and rectal tumors as well as threatening melanoma in men, postmen basal breast, pancreatic, colon cancer in women, leukemia, multiple myeloma, and non-Hodgkin lymphoma in both genders.6,2

Studies have shown that the number of students who smoked one pack of cigarettes or more every week increased with the decreasing social class, as measured by their fathers’ occupations. This pattern was seen for both male and female students. The number of fathers who smoked demonstrated a corresponding relationship with social class. However, the number of mothers who smoked did not fluctuate by social class. The number of students who smoked and especially those who were heavy smokers was low in families where both parents were regular smokers.6

Given the effect of gender on smoking, it was argued that in Spain, from 1987 to 2001, differences in smoking have increased in both sexes. Males as the result of a higher reduction in the prevalence of smoking amongst them are the most advantaged clusters, and in women, it is because of a greater risk among the less advantaged clusters. Males in more
deprived areas show a higher probability of smoking. For women, the likelihood of smoking is greater when residing in less deprived urban areas up to 1995–97.

Individual and environmental, social and societal issues, including social capital, social networks or socioeconomic position, affect smoking patterns. Lower education, more disadvantaged social clusters living in regions in the worst socioeconomic circumstances, are more likely to smoke than advanced working class and educational levels. So that, the models take into account age, marital position, urban size, and employment position.7

High SES and living in local urban areas have a lower smoking prevalence than other clusters. Alaska Natives, low SES, rural inhabitants had both high smoking prevalence (48%) and constituted a large percentage of the country’s smokers (nearly 10%).

With non-native high-SES urban inhabitants, making up the largest percentage of users despite the lower prevalence, and Alaska Natives, low SES, and Ural inhabitants have high prevalence and make up a large percentage of users.8,9,10

The study in Britannia evaluated the effect of three important factors: socioeconomic conditions, psychological health, and the partner’s smoking position. The study agrees that female smoker are more disadvantaged than the wider population of women, both concerning their socioeconomic condition. In this disadvantaged group, higher cigarette consumption was linked to more socioeconomic disadvantage and poorer psychosomatic health to partner’s smoking position.11

Low schooling level, old beliefs, literacy level, SES and employment, and status—all affect cigarette smoking among adult males. Although poor people smoked more and spent more of their incomes on cigarettes, another causes-like educational level, and old beliefs were found to affect the practice of cigarette smoking. In men, a significant relationship is found between cigarette smoking and religion, literacy, the level of education, employment, wealth index and the rate of reading media, attention to radio and television. The relationship between the type of cigarette smoking, place of habitation or protection by health insurance were not significant.

The impact of a religious conviction on tobacco use differs across the SES. Islam impacts tobacco use more in the poor SES group, while Christianity impacts it more in the opulent SES groups.

Plaintiffs in the poor SES groups who cannot read at all and have no education use more tobacco. However, those with secondary school education in the richer SES appear to use more tobacco than others. Another factor is financial stress. As data were cross-sectional, reliable inferences cannot be drawn about the causal relationship between smoking and financial stress. It is probable that they both affect each other. Certainly, expenditure on tobacco will decrease available funds that could otherwise be used to alleviate financial stress.12

The study discovered that various effects of cigarette smoking on BMI: smoking raises BMI at low/moderate BMI level and reduces BMI at higher BMI levels.13

In addition, regarding the effect of culture on smoking, some evidence was found for both individual and societal teenage smoking, which was interrelated in a mixed model, regardless of culture or smoking rates. Individual factors include academic success, life gratification and future-orientedness, and social influences (aggression, social association, and perceived friends’ smoking).

A major issue in early cancer research concerned socioeconomic status, which suggests a deep understanding of how society works or how it should work. The fact is that there is no definition of SES that is agreed upon because the construct necessarily entails political ideologies about existing and desired social structures.

This study outlines a critical role for SES in cancer patients. Till date, various methods have been developed and introduced to measure SES status. Data mining was used in this study.

METHODS AND MATERIALS

Data mining methods have become a widely-used research tool for medical researchers to identify and use patterns and relationships among a large number of variables. Decision tree learning is one of the most widely used and practical methods for classification. In this approach, learned trees can be characterized as a set of if-then rules. Decision trees are very useful in recognizing and understanding domain experts. A decision tree is a tree where each non-terminal node is a test or decision on the data item considered. The selection of the optimistic branch depends upon the outcome of the test. To classify a particular data item, we start at the root node and follow the claims down until we reach a terminal node. A decision is made when a terminal node is approached. Decision trees can also be taken to refer to a unique form of a rule set, characterized by their hierarchical union of rules.

Statistical analysis was carried out using SPSS-Clementine software. The survey was conducted by data gathering via telephonic interviews and recorded on a digital audio recorder. The ethical committee of the University approved the study, and informed consent was then obtained from all the patients. The research data in this study were carried out from three main sources: Tehran, Iran, Shahid
Beheshti health administrators and 35,500 cancer patients. Then, about 12,000 participants from cancer patients residing in Tehran province during 2014 were divided into two groups. The first group, according to ICD10, had cancer due to smoking, and the second group did not depend on smoking.

The first group, including ICD (00-C14 (lip, oral cavity, pharynx), C15 (oesophagus), C16 (stomach gastric), C25 (pancreas), C32 (larynx), C33-C34 (trachea, lung, bronchus), C53 (cervix, uterus), C64-C65 (kidney and renal pelvis), C67 (urinary bladder) and there was not a code C92 (acute myeloid leukaemia). The second group included other cancers.

The design of the survey was based on questions, including smoking history (light, moderate, heavy), insurance coverage (public and private), health status (excellent, very good, good, fair to poor, based on Likert Index), socio-demographic characteristics (such as age, marital status, education, monthly family expenditure), risk behaviours (such as obesity, seat belt), and annual expenditures on healthcare services (such as inpatient hospitalization, ambulatory, outpatient visits and medication).

RESULTS

The association between socioeconomic levels and cancers was determined by a questionnaire and data was then analyzed using statistical tests through data mining, based on a decision tree model. To extract knowledge from data, we compared the overall final questionnaire between two groups of cancers, independent from and dependent on smoking. Data are presented in the tables.

According to the Table 2, the data gathering show 1,565 patients have cancers with smoking independence while 521 participants have cancers with smoking dependence. The response rate in both groups is about 8 percent, and a death rate in cancers by smoking dependence is about three times (Table 2).

Based on frequencies of cancers by type in ICD code, it indicates that the breast cancers have the highest percentage among them (23.4%), followed by digestive organs cancer (14.5%), skin cancer (8.6%), as well as urinary bladder cancer (8.2%), and lip, pharynx, and oral cavity cancer (8.2%) (Table 3).

The results obtained from the preliminary analysis of data related to the demographics in two cancer patient groups smoking-dependent and smoking-independent are shown in Table 4.

According to the type of cancers among both groups, breast cancer is known as the most common cancer among the smoking-dependent

### Table 1 An overview of the data gathering process

| Interviewer | Attributed to smoking | Not Attributed to smoking | Interviewer | Dependent on smoking | Independent of smoking |
|-------------|-----------------------|---------------------------|-------------|----------------------|------------------------|
| Successful call | 18.1% | %18.56 | Successful call | 18.1% | %18.56 |
| No response in three phone calls | 29.43% | %48.58 | No response in three phone calls | 29.43% | %48.58 |
| The patient died | 24.38% | %8.08 | The patient died | 24.38% | %8.08 |
| Unwillingness to cooperate | %3 | %3.4 | Unwillingness to cooperate | %3 | %3.4 |
| Inability to answer due to illness | 2.39% | %0.49 | Inability to answer due to illness | 2.39% | %0.49 |
| No response | 0.9% | %14.55 | No response | 0.9% | %14.55 |
| Moving and relocation | 13.16% | %6.03 | Moving and relocation | 13.16% | %6.03 |
| Do not speak Farsi | 0.24% | %0.06 | Do not speak Farsi | 0.24% | %0.06 |
| Non-resident of Tehran Province and non-Iranian | 7.43% | %0.05 | Non-resident of Tehran Province and non-Iranian | 7.43% | %0.05 |
| Not enough time | 0.97% | %0.20 | Not enough time | 0.97% | %0.20 |
| Total | 100% | 100% | Total | 100% | 100% |
| INTERVIEWER | Attributed to smoking | Not Attributed to smoking | INTERVIEWER | Dependent on smoking | Independent of smoking |

### Table 2 The response and death rate among patients who have cancers in smoking independence or dependence groups

| All participants | 11294 patients | 12.2% died |
|------------------|----------------|------------|
| Not Attributed to Smoking | 8431 patients | 8% died |
| Attributed to Smoking | 2863 patients | 24.3% died |
| 521 participants | 1565 participants |
Table 3  The Frequencies of Cancer according to ICD Code

| Percentage | Type of cancer                                      |
|------------|----------------------------------------------------|
| 8.2        | C0-C14-s-lip. Oral cavity. Pharynx                |
| 1.5        | C15-s-esophagus (digestive)                       |
| 1.5        | C16-s-Stomach (gastric)                          |
| .1         | C25-s-Pancreas                                    |
| 1.3        | C32-s-Larynx                                      |
| 1.0        | C33-C34-s-Trachea, Lung, Bronchus                 |
| 1.5        | C53-s-Cervix.Uteri                                |
| 1.4        | C64-C65-s-Kidney and Renal pelvis                 |
| 8.2        | C67-s-Urinary bladder                             |
| 14.5       | C17-C26-Digestive organs                          |
| 1.2        | C30-C31.C38-Respiratory and intrathoracic organs  |
| 5.2        | C40-C41-Bone and Articular cartilage              |
| 8.6        | C43-C44-Skin                                      |
| 23.4       | C50-Breast                                        |
| 3.3        | C52-C57-Female genitals                           |
| .2         | C66.C68-Urinary tract                             |
| 1.8        | C69-C72-Eye, brain and other parts of central nervous system |
| 3.5        | C73-75-Thyroid and other endocrine glands         |
| 4.4        | C76-C80-Ill-defined secondary and unspecified sites |
| .5         | C48-C49-Mesothelial and soft tissue               |
| .1         | C24-Other and unspecific parts of biliary tract   |
| .0         | C26-There and ill-defined digestive organs        |
| 7.9        | C60-Malignant neoplasm of prostate                |
| .0         | C61-Malignant neoplasm of penis                   |
| .2         | C70-Malignant neoplasm of meninges                |
| 100.0      | Total                                              |

S= attributed to smoking

Table 4  Demographic characteristics of both cancer patient groups in the preliminary data analysis

| Variables                      | Attributed to smoking | Not Attributed to smoking |
|--------------------------------|-----------------------|---------------------------|
| Educational Status             | Illiterate 15.3       | 10.6                      |
| Job status                     | Employee 25.1%        | 15.5%                     |
| Financial stress               | Having a financial stress 54.7% | 48%             |
| Seat belt fastening            | Fastening a seat belt 84.8% | 93.1%             |
| Health status                  | Excellent, very good 3.4% | 13.5%             |
| Public insurance               | Having public insurance 96.5% | 98.4%             |
| Private insurance              | Having a Private insurance 60.5% | 63.9%             |
| Smoking history                | Never smoking 53.2% | 99%                      |
| Age <35 years                  | 4.4%                  | 8.6%                      |
| Age 35-65 years                | 56.3%                 | 56.9%                     |
| Age >65 years                  | 39.1%                 | 34.4%                     |

Published by DiscoverSys | Bali Med J 2018; 7(1): 97-103 | doi: 10.15562/bmj.v71i.652
Table 5. The most common cancers in smoking and without smoking groups

| Not Attributed to Smoking | Attributed to Smoking |
|---------------------------|-----------------------|
| Breast Cancer 23.4%       | Cancer of lip, tongue, oral cavity 8.2% |
| Digestive system 14.5%    | Cancer of bladder 8.2% |
| Skin 8.6%                 |                       |

Table 6. Relationship between cost of treatment and other variables

| Relationship between the cost of treatment and other variables | Private insurance | See more referrals to the public sector |
|---------------------------------------------------------------|-------------------|----------------------------------------|
| Having financial stress                                      |                   | See more referrals to the public sector |
|                                                               |                   | There is a relationship                |
| Education status                                              |                   | See higher education patients use the private sector more than the public sector |
|                                                               |                   | There is a relationship                |
| Revenue status                                                | Higher-income patients refer to the private sector more than public sector |
|                                                               |                   | There is a relationship                |
| Fastening of seat belt                                        | Referrals to public and private sectors are the same. |
|                                                               |                   | There is no relationship               |
| Age                                                           | 35–65-year-old patients referred to private sector more than public sector |
|                                                               |                   | There is a relationship                |
|                                                               | (In non-smoker patients, age is the most important division.) |
| History of smoking                                            | The smokers have more medical expenses than non-smokers, in both the private and public sector. |
|                                                               |                   | (Smoking history is a major division.) |
| Sex                                                           | There is no relationship with referrals to the public and private sectors. |
| Overweight                                                    | There is no relationship with referrals to the public and private sectors. |

Table 7. The relationship between monthly revenue and smoking history

| Monthly revenue in cancer patients | History of smoking |
|-----------------------------------|--------------------|
| Mostly lower-income smokers had 5000000-7500000 thousand rials revenue a month (1 dollar = 3500000 rial) |                      |

Table 8. Insurance coverage status among cancer patients

| Insurance coverage in cancer patients | Public | Private |
|---------------------------------------|--------|---------|
| 98%                                   |        | 63%     |
| 98% cancer patients had public insurance |       | Basic insurance is the most important factor in government spending |

Table 9. Health status among cancer patients

| Assessment of health status (self-reported patient) | Most participants satisfied with their health status | The high mortality rate in cancer patients is a worthwhile point |

Table 10. The relationship between cancer and risk factors

| Cancer and obesity | There is no relationship between cancer and obesity in this study |
|-------------------|-----------------------|
| Cancer and seat belt | There is a relationship between cancer and seat belt |

It is interesting to note that in all these studies comparing two groups of cancers-attributed to and not attributed to different smoking patterns emerged.

DISCUSSION

It is interesting to note that in all these studies comparing two groups of cancers-attributed to and not attributed to different smoking patterns emerged.
This study was conducted during 2014 based on 2013 data. Accordingly, there were 521 cancer patients with smokers who compared with 1540 patients non-smokers. Diseases attributed to smoking were compared with diseases which were not attributed to smoking. It was found that about 34% patients from attributed to smoking cancers group vs. 60.8% patients from not attributed to smoking cancers were women. In addition, 66% of the attributing group were men vs. 39.2% from the not attributed group. In a not attributed to the smoking group, 4.4% were less than 35 years old vs. 8.6% is attributed to the smoking group. 56.3% were 35–<65 years old in the first group vs. 56.9% in the second group. According to the age, about 39.14% in the first group were > 65 years old compared with only 34.4% in the second group. It seems 54.7% of all patients not attributed group had financial stress vs. 48% in group attributed to smoking. 13.8% patients not attributed group was overweight vs. 19.9% in the not attributed group. In the attributed group, 3.4% participants evaluated their health status as ‘very good’ vs. 13.5% in the not attributed group. 29.9% of the first group evaluated their health status as good vs. 45.6% in the second group. In the attributed group, 36.6% patients evaluated their health status as fair vs. 29.9% in the second group. In the attributed group, 29.9% had bad health status, vs. 11% in the not attributed group. Fastening seat belt in the absence of police, had bad health status, vs. 11% in the not attributed group. 60.5% participants evaluated their health status as good vs. 45.6% in the second group. The divorce rate was 1.9% in the attributed group vs. 1.3% in the second group. Widows comprised 8.1% in the attributed group vs. 10.5% in the not attributed group.

As far as public insurance in the attributed group was concerned, 96.5% had public insurance as against 98.4% in the not attributed group. 60.5% patients in the first group had private insurance vs. 63.9% in the second group. Financial stress caused more referrals to the public sector. Higher education had a significant relationship with referrals to private sectors and no significant relationship with referrals to public sectors. With higher revenue, patients have more referrals to the private sector. The age factor in non-smokers is the most important factor. Patients aged 35–65 years refer for treatment more frequently. No relationship has been reported between cost treatment and referrals to both sectors with Seatbelt and BMI. Concerning the history of smoking, the smokers experience more medical expenses than non-smokers in both private and public sectors. In smokers, smoking history is a major contributing factor.

Several findings of this study emphasized the high cost of smoking. While most patients in the absence of police fastening seat belt are surprising. Whether the disease is conservative and tends to survive, or it forces the interviewing of individuals into responses.

**CONCLUSION**

This study showed cancer patients with private insurance have more referrals to the private hospitals. Financial stress caused more referrals to the public sector. Higher education had a significant relationship with referrals to private sectors and no significant relationship with referrals to public sectors. With higher revenue, patients have more referrals to the private sector. The age factor in non-smokers is the most important factor. Patients aged 35–65 years refer for treatment more frequently. No relationship has been reported between cost treatment and referrals to both sectors with Seatbelt and BMI. Concerning the history of smoking, the smokers experience more medical expenses than non-smokers in both private and public sectors. In smokers, smoking history is a major contributing factor.

According to the insurance coverage, it was found that 98% patients had public insurance and 63% had public insurance; then basic insurance is the most important factor in government spending. Surprisingly, most of the patients were satisfied with their health status. However, the findings cannot be extrapolated to all patients because of the attention rate. This result may be explained by the factor of time.

According to the monthly revenue, more low-income smokers group had 500-700,000 Tomans (~3000 Tomans = 1 dollar). The most obvious finding to emerge from the analysis is that most common cancers in two groups were different. Breast cancer, digestive system, and skin were more common in the smoking-not attributed group, while in the second group cancers of the lip, tongue, oral cavity and bladder were common in smoking attributed one. This study found that the death rate in cancer- attributed to smoking was three times more than in others. These findings enhance our understanding of socio-economic levels.

People who have been borrowing from their interviews during the past year to pay for their living expenses and use financial resources to use public sector facilities, so the services of this department should be fair and easily accessible to them.

While most patients in the absence of police monitoring the safety belt are surprising. Whether the disease is conservative and tends to survive, or it forces the interviewing of individuals into responses.
according to culture, and should, therefore, be mainstreamed from sociology and psychology.

Studies show that stress and discontent among single people than married and divorced and widowed More and more we turn to smoking to relieve stress But this pattern was not particularly visible and most of our study population was married, and more research is needed for married people. Stress has been a major contributor to cigarette smoking in the studied community, and it differs from the global model that needs to be examined by psychologists, although individuals in Iran prefer ethical marital considerations.

ACKNOWLEDGEMENT

The project was funded by a grant from the School of Pharmacy, Shahid Beheshti University of Medical Science. We would like to thank the health administration of Iran and Tehran University.

REFERENCES

1. Bettina F. Piko, Aleksandra Luszczynska, Frederick X. Gibbons, Mert Telko zel. A culture-based study of personal and social influences of adolescent smoking. European Journal of Public Health, Vol. 15, No. 4, 393–398 q The Author 2005. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved. doi:10.1093/eurpub/cki008 Advance Access published on 4 July 2005

2. World Health Organization, ECONOMICS OF TOBACCO TOOLKIT, Assessment of the Economic Costs of Smoking

3. Rebecca A. Krukowski, Zoran Bursac, Melissa A. Little, and Robert C. Klesges Karin Bamman, the Relationship between Body Mass Index and Post-Cessation Weight Gain in the Year after Quitting Smoking: A Cross-Sectional Study, PLoS One. 2016; 11(3): e0151290

4. Lijing Ouyang, Sibling effects on teen risky behaviors, Department of economics-Duke university, November 2004.

5. M Siahpush/ R Borland /M Scollo Smoking and Financial Stress On January /10-2012-published by group.bmj.com

6. Ahmed K, Jesmin T, Rahman Z et al. Early Prevention and Detection of Skin Cancer Risk using Data Mining. Asian Pacific J Cancer Prev. 2013; 14(1):593-98

7. Bellachai A, Guven E. Predicting breast cancer survivability using data mining techniques. Department of Computer Science, The George Washington University. 2006; 58(13):1-4

8. CDC, C. for D. C. and P: Medical-care expenditures attributable to cigarette smoking–United States, MMWR. Morbidity and Mortality Weekly Report. 1993; 43(26):469. http://doi.org/10.1001/jama.1994.03520060026013

9. Miller VP, Ernst C, Collin F. Smoking-attributable medical care costs in the USA. Social Science and Medicine. 1999; 48(3):375–391. http://doi.org/10.1016/S0277-9536(98)00344-X

10. Ashkan Babahaydari , A Thesis Submitted in the College of Graduate Studies and Research Culture, In Partial Fulfillment of the Requirements For the Degree of Masters of Arts In the Department of Economics University of Saskatchewan Saskatoon Edited by John Britton, ABC Of Smoking Cessation -Professor of Epidemiology at the University of Nottingham 2004 by Blackwell Publishing Ltd

11. Kaisaeng N, Harpe SE, Carroll NV. Out-of-pocket costs and oral cancer medication discontinuation in the elderly. J Manag Care Pharm. 2014; 20(7):669–75.

12. Kovacevic A, Dragojlovic-Simic V, Rancic N, Jurisevic M, Gutzwille F5, Matter-Walstra K, Jakovljevic M. End-of-life costs of medical care for advanced stage cancer patients. Vojnosanit Pregl. 2015; 72(4):334–41. http://doi.org/10.2298/VSP1504334K

13. Sturm R. The effects of obesity, smoking, and drinking on medical problems and costs. Health Aff. (2002): 21: 245–53.

14. Max W, Rice DP, Sung HY, Zhang X, Miller L. The economic burden of smoking in California. Tobacco Control. 2004; 13(3):264–7. http://doi.org/10.1136/tc.2003.006023

This work is licensed under a Creative Commons Attribution