Cigarette smoking is one of the most important preventable causes of cardiovascular diseases, cancer and respiratory tract infection, among others. The annual number of deaths due to smoking is much higher than the total deaths from AIDS, alcohol, addictive drugs, accidents, murder and suicide globally. Smoking has an important role on the global burden of diseases. It is the risk factor for many non-communicable diseases such as cancer. Smoking was the direct cause of 4,623 deaths in Iran in 2012.

In addition to adverse health outcomes of smoking for the smokers, it is responsible for a significant financial healthcare burden for society due to smoking-attributable diseases. Cigarette tax, banning the sale of cigarettes for younger age-groups and smoking ban on public places are some of the strategies to reduce tobacco consumption. Despite these tobacco control policies to reduce smoking prevalence, the monetary profits of smoking cigarettes for the manufacturing companies and excessive smuggling of this substance make cigarettes available cheaply in different places, especially in low- and middle-income countries (LMICs).

Although tobacco provides significant tax revenues to governments, smoking has a significant impact on households’ budgets as well as the health status of individuals and societies as a whole. Tobacco accounts for 6% of all healthcare costs worldwide. The total economic cost of smoking was US$1,436 billion in 2012, equivalent to 1.8% of gross domestic products (GDP) of the entire world. The total economic cost of smoking-attributable diseases in Iran was estimated to be US$1.46 billion accounting for approximately 0.26% of Iran’s GDP in 2014.
Studies have shown that tobacco and poverty constitute a
defective cycle that exacerbates each other1. In most countries,
smoking is more common among low-income communities,
with 84% of smokers living in LMICs 7. Due to budget
constraints, the money spent on cigarettes cannot be used for
the consumption of basic needs such as nutrition, housing,
education and health. Smoking can worsen poverty because
smokers and their families are more susceptible to early death
from a heart attack, cancer, respiratory distress and other
smoking-attributable diseases. As poor households often do
not have enough protection against healthcare spending,
smoking-attributable diseases can result in catastrophic out-of-
pocket payment for healthcare and lead to impoverishment.

According to WHO, a reduction was in the number of
smokers by 20 million in the world between 2015 and 2025 11.
While the reduction in the number of smokers among women
is satisfactory to reach the 2025 estimate, slower progress
among men is a concern 12. Thus, it is essential to identify
factors affecting consumption of smoking to provide up-to-
date information for formulating a tobacco control policy
worldwide. Although there have been several studies13,14
that aimed to assess the determinants of smoking in different
countries, determinants of cigarette smoking are rarely
documented in Iran as a whole. The existing studies
highlighted the importance of personal, behavioural,
environmental, and social factors on smoking in Iran.
Nevertheless, the financial burden of smoking in Iran has not
been investigated in Iran.

We aims to fill this gap in the literature by investigating the
determinants of cigarette smoking frequency and expenditures
among Iranian households.

Methods

In this cross-sectional observational study, 39,864
households from 31 provinces of Iran were enrolled. The
required data were extracted from the 2016 Household Income
and Expenditures Survey (HIES), conducted by the Iranian
Statistical Center (ISC). In this survey, data on
sociodemographic and socioeconomic characteristics (age,
sex, household size, education level, employment status,
income and wealth index), living area, number of cigarettes
smoked and cigarette expenditure for households were
obtained from the HIES.

Data were collected using face-to-face interviews with the
household head. The HIES collects information from all
households living in rural and urban areas of Iran, excluding
temporary foreign residents. The survey uses a standard
questionnaire, designed under supervisions and
recommendations of the United Nations. Households were
chosen using a clustered random sampling technique and
counties as clusters into urban and rural regions.

Study variables

The two outcome variables of interest in the study were the
number of cigarettes smoked per month and monthly
expenditures on cigarettes in the household. Cigarette smoking
is defined as smoking of regular cigarette brands and does not
contain hookahs and e-cigarettes. Based on the previous
studies, annual income, place of residence (urban or
rural region), wealth index, number of females in each
household, household size, number of illiterate people in each
household, number of people with a university degree in each
household, number of household members between 17 and 30
yr old were included in the analysis as explanatory variables in
the analysis. We used the modified principal component
analysis (MPCA) to calculate the wealth index of the
household. Type of house ownership, home area surface (less
than 65 m²; between 65 and 110 m²; between 110 and 200 m²;
more than 200 m²), type of house skeleton, type of major
building materials, ownership of cars, bicycles, motorcycles,
radios, televisions, videos, computers, mobile phone,
refrigerator, stove, vacuum machines, air conditioners,
drinking waters, electricity, gas, central heating and cooling
systems were entered in the MPCA. Based on wealth scores
obtained from the MPCA, households were divided into ten
wealth decile groups.

Statistical analysis

Due to zero-inflated data of our outcome variables, we used the
following Tobit regression model to examine the
association between the number of cigarette smoking (or
cigarette expenditures) in the household and its main
determinants:

\[ y_{it} = \beta_1 + \beta_2inc_i + \beta_3inc_i^2 + \beta_4wealth_i + \beta_5female_i + \beta_6age_i + \beta_7ill_i + \beta_8hs_i + \beta_9uni_i + \beta_{10}work_i + \varepsilon_i, \]

(1)

where \( y \) is the outcome variable of interest, \( inc \) is the
yearly income of the households (USS), \( inc_i^2 \) indicates
the second-order of households’ annual income, \( wealth \) denotes
wealth status of the household, \( female \) is the number of
females in the household, \( age \) indicates the number of
household members aged between 17 and 30 years old, \( hs \)
is the household size and \( ill \) is the percentage of illiterate
members of the household. \( uni \) is the percentage of household members with a university degree. \( work \) denotes the
percentage of people working in the household. The
population weighting method was used to pool the data
collected from the urban and rural regions. To have a better
understanding of differences in cigarette consumption and
spending across different regions of Iran, we also visually
illustrated the spatial distribution of the number cigarettes
smoked per month and monthly expenditures on cigarettes in
the household in all counties in Iran. All statistical analyses
were performed at 0.05 significance levels. All analyses were
conducted using STATA software SE v 13.1.

Results

Each Iranian household smoked 85.25 cigarettes per month
and spent US$ 2.64 on cigarettes per month. The average
yearly income of Iranian households was US$ 4,847, and the
average household size was 3.55. Besides, 52.13% of
household members were women, and 30.13% were illiterate,
26.7% employed and 14.2% had a university degree. Out of
39,864 households, 33015 (82.81%) households did not smoke
any cigarettes over the period of study.

Table 1 shows the results of the Tobit regression for the
determinants of the number of cigarette smoking and cigarette
expenditures. As reported in the table, the results of the
Variance Inflation Factor (VIF) test did not find high
collinearity between explanatory variables. The coefficient on
living in urban areas was 3.87 for the number of cigarettes
smoked model and 142.02 for cigarette expenditures model.
Both these coefficients are statistically significant; (P=0.001
of both coefficients) indicating that people living in urban
areas, on average, smoked more cigarettes and spent more on cigarettes. The higher percentage of household members with an academic degree was negatively associated with both cigarette consumption and its spending. In contrast, there were positive and significant associations between the percentage of the illiterate member of household and household’s cigarette consumption and expenditures ($P=0.001$ for both coefficients).

The results also suggested significant and negative relationships between the number of females in the household and cigarette expenditures and cigarette consumption ($P=0.018$). Furthermore, the wealth of household had a positive impact on the number of cigarettes smoked and cigarette expenditures. After controlling for other covariates, the number of cigarettes smoked (cigarette expenditures) in the household increased until 7th ($6^{th}$) decile, before decreasing in higher wealth deciles. The coefficients on the first and second orders of household income indicated that the relationships between income and cigarette consumption and spending is nonlinear and had a peak (see the first order of income had a significant positive relationship with dependent variables while the coefficient of the second-order of income was significant and negative).

| Variable | Expenditures on cigarettes | Number of cigarette smoking |
|----------|-----------------------------|-----------------------------|
|          | Coefficient | SE | $P$ value | Coefficient | SE | $P$ value |
| Household size | 2.71 | 0.18 | 0.001 | 86.84 | 6.28 | 0.001 |
| Number of household members aged 17 -30 years old | 0.59 | 0.25 | 0.018 | 10.26 | 8.40 | 0.222 |
| Number of females in the household | -0.76 | 0.12 | 0.001 | -12.38 | 3.34 | 0.001 |
| Urban | 3.87 | 0.42 | 0.001 | 142.02 | 14.35 | 0.001 |
| Number of household members working | 0.06 | 0.22 | 0.792 | 4.44 | 7.60 | 0.558 |
| Percentage of household members with a university degree | -4.41 | 0.29 | 0.001 | -144.89 | 10.02 | 0.001 |
| Percentage of illiterate members in the household | 2.26 | 0.24 | 0.001 | 75.48 | 8.35 | 0.001 |
| Wealth deciles | | | | | | |
| 2 | 2.89 | 1.08 | 0.008 | 124.90 | 37.41 | 0.001 |
| 3 | 4.55 | 1.07 | 0.001 | 186.51 | 37.14 | 0.001 |
| 4 | 6.24 | 1.07 | 0.001 | 273.76 | 36.93 | 0.001 |
| 5 | 6.67 | 1.08 | 0.001 | 275.92 | 37.21 | 0.001 |
| 6 | 7.02 | 1.09 | 0.001 | 302.36 | 37.41 | 0.001 |
| 7 | 7.15 | 1.10 | 0.001 | 298.62 | 37.79 | 0.001 |
| 8 | 4.48 | 1.12 | 0.001 | 207.74 | 38.66 | 0.001 |
| 9 | 3.57 | 1.14 | 0.002 | 190.97 | 39.38 | 0.001 |
| 10 | 1.81 | 1.20 | 0.134 | 128.96 | 41.39 | 0.002 |
| Annual income (1000 dollars) | 1.05 | 0.11 | 0.001 | 28.55 | 3.99 | 0.001 |
| Annual income (1000 dollars) squared | -0.02 | 0.00 | 0.001 | -0.58 | 0.14 | 0.001 |
| Consent | -41.05 | 1.14 | 0.001 | -1421.48 | 39.70 | 0.001 |
| VIF test results | | | | 2.238 | 2.238 |

Figure 1 shows the relationship between household income and household number of cigarettes smoked and cigarette expenditures in fit plots. Accordingly, there was a peak for at the annual income of US$ 30,000 and US$ 50,000 for the number of cigarettes smoked and cigarette expenditures, respectively.

Figure 2 shows the average household number of cigarettes smoked and cigarette expenditures among Iranian provinces (after adjusting for household size). Households living in South Khorasan, Sistan va Baluchestan, Kakhkilooye va Boirahmad with US$ 0.19, US$ 0.46 and US$ 0.53, respectively, had the lowest monthly expenditures on cigarettes. Charaharmahal va Bakhtiari, East Azerbaijan and Ardebil with US$ 6.15, US$4.84 and US$4.64, respectively, had the highest household expenditures on cigarettes. The lowest average numbers of cigarette smoke in the household were found in Sistan & Baluchestan (8.33), South Khorasan (9.75) and Hormozgan (16.44). East Azerbaijan (175.4), Hamedan (155.31), Markazi (148.75) and Charaharmahal va Bakhtiari (148.18) had the highest numbers of cigarette smoked in the household.

Figure 3 shows the consumption and expenditures of cigarette by Iranian counties. The numbers of cigarette smoked, and expenditures on cigarettes were shown in the spectrum below the maps. The counties with higher amount of expenditures (consumption) are darker than others. The western compared to the eastern region in Iran generally are darker than other regions; indicating the higher cigarette expenditures (consumption) in the western counties compared to eastern counties in Iran.
Cigarette Smoking and Its Financial Burden

Discussion

We aimed to find the determinants of the consumption and spending on cigarettes smoking among Iranian households. We found that Iranian households, on average, smoked 85.25 cigarettes and spent US$ 2.64 on cigarette smoking per month. The results indicate that residing in urban areas had a positive and significant relationship with smoking and spending on cigarettes in Iran. There was no relationship between the number of people employed in the household and the number of smoking cigarettes in Iranian households. These results are in contrast with another study that showed a positive association between the unemployment rate and cigarette consumption in Iran. Unemployment increases smoking expenditures in Iran. It also increases psychosocial disorders like emotional isolation or inability to control and these factors are important drivers of smoking in people.

Our study showed that higher educational attainments (higher percentage of members with a university degree in the household) in the household had a negative effect on the consumption and spending on cigarettes among Iranian households. In contrast, lower educational attainments (i.e., a higher percentage of illiterate members in the household) had a positive relationship with tobacco consumption. A similar relationship between literacy rate and smoking too. For instance, increasing illiteracy rates at the household level would increase smoking. Another study concluded that increasing literacy rate decreases smoking. It is obvious that people with higher education levels have more awareness about the harms of smoking so they smoke less than others.

Figure 2: Household average number of cigarettes smoked and cigarette expenditures (US$) per month among Iranian provinces

Note: 0 indicates the lowest amount of cigarette consumption per month and 9.8 is the highest level of consumption. The darker color suggests a higher number of cigarette consumption and vice versa.

Figure 3: The average number of cigarettes smoked (A) and cigarette expenditures in US$ (B) per month among Iranian counties

Note: 0 indicates the lowest amount of cigarette expenditures (US$) per month and 300 (US$) is the highest level of cigarette expenditures. The darker color suggests a higher amount of cigarette expenditures and vice versa.
A study in Isfahan, Iran also showed that lower education attainment of fathers in the household increased the probability of smoking in both genders, especially among girls in households. The results also indicated that the number of household members aged 17-30 had a positive relationship with household spending on cigarette expenditures.

The results of our findings indicated that households with middle socioeconomic status (as measured by wealth index) were more likely to smoke and spend on cigarettes in Iran. Specifically, the relationships between income and cigarette consumption and expenditures increased to an annual household salary of US$ 2,898 and then decreases subsequently. This is because two contradictory effects of plausible mediators in the relationship between wealth and smoking. First the income effect: Low income people have lower ability to buy cigarette, so they buy less cigarette than the rich. Second, the awareness effect: Higher income groups are more educated ones and know the harms of smoking, so they smoke less than the poor. These two contradictory mediators led to a nonlinear relationship between income (wealth) and smoking. Dortaj found a significant negative relationship between the monthly income with drug abuse. The association between income and smoking was not linear. In other words, although smoking rate increased with income, the consumption of smoking started to decline after a certain level of income.

We found a wide variation in the number of cigarettes smoked and cigarette expenditures among Iranian provinces. The provinces of Sistan & Baluchestan, South Khorasan and Hormozgan had the lowest cigarette consumption whereas the provinces of East Azerbaijan, Hamedan, Central and Chaharmahal va Bakhtiari had the highest consumption. A study by Bakhshani also showed higher smoking consumption in Ardebil and Chaharmahal va Bakhtiari, and lower smoking consumption in provinces such as Bushehr and Sistan va Baluchestan. While South Khorasan, Sistan va Baluchestan and Kohkiluyeh va Boyerahmad provinces had the lowest monthly average household expenditure on cigarette smoking, provinces of Chaharmahal va Bakhtiari, East Azerbaijan and Ardebil had the highest average monthly spending on cigarette smoking. The order of the provinces based on number of cigarettes smoking per month does not correspond to their order based on the cigarette expenditures. Although this inconsistency may be due to self-reporting bias across different provinces of Iran, it can also be explained by purchasing cheaper brands in some provinces and more expensive ones in others.

The results of this study suggested higher smoking consumption and spending on cigarette smoking in Azerbaijani provinces of Iran compared to other provinces. The Iranian Azerbaijan region includes the north-west and part of the central and southern parts of Iran. As indicated in the map, cigarette smoking consumption and cigarette expenditure in these regions are higher compared to other regions in Iran. The eastern and southeastern provinces of the country had much less cigarette smoking than other provinces. This may be attributed to the use of other alternatives tobacco products which could be a substitute for cigarette smoking. For example, Nass is one of the most favorite drugs which is used instead of cigarette or Waterpipes.

This study had some limitations. First, individual-level information was not available in HIES; thus, we used household-level data to the determinants of cigarette consumption and its financial burden among households in Iran. Second, due to unavailability of information, we could not assess the impact of other factors such as societal norms environmental factors (advertising) and cultural factors (traditional uses of tobacco, acculturation) on cigarette consumption and spending on cigarette among households. Third, the self-reported data were prone to recall bias. Under-reporting bias might also be inevitable.

**Conclusion**

Iranian household, on average, smoked 85.25 cigarettes and spent US$2.64 on cigarette consumption in 2016. Smoking is a significant part of the overall spending among Iranian households. In addition to the cost of cigarettes consumption, smoking also drives substantial direct healthcare spending on treatment of smokers and people exposed to smoke in Iran. The number of males in the household associated with higher cigarette consumption and expenditures. The latter finding could be due to social, cultural, religious and demographic factors, and also the fact that smoking in women compared to men is considered inappropriate in Iran. Due to higher cigarette consumption in urban areas and low-educated households, tobacco control interventions in Iran should focus more on households living in urban areas and less-educated households. There exists a wide variation in the number of cigarettes smoked and cigarette expenditures among Iranian provinces. As the frequency of cigarette smoking was found to be higher in the western region of Iran, comprehensive tobacco control policies should be adopted in western provinces.

**Acknowledgements**

This study was confirmed ethically by Deputy of Research, Guilan University of Medical Sciences. Ethics code: IR.GUMS.REC.1397.488.

**Conflict of interest**

Authors declared no conflict of interests.

**Funding**

This study was supported by Social Determinants of Health Research Center, Guilan University of Medical Sciences.

**Highlights**

- Households with middle socioeconomic status are more likely to smoke and spend on cigarettes in Iran.
- The relationships between income and cigarette consumption and expenditures are nonlinear.
- The eastern and southeastern provinces of the country had much less cigarette smoking than other provinces.
- Smoking consumption and spending on cigarette smoking was higher in Azerbaijani provinces of Iran compared to other provinces.
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