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The Role of Age, Period, and Cohort Effects on Smoking among the Students of Tehran University of Medical Science

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Abstract

The aim of the study is to determine age, period, and cohort effects on trends in student's cigarette smoking in Tehran University of medical science from 2006 to 2009. We analyzed data from subjects aged 18 to 23 years from Aids Researches Center with Cooperation Environment Researches Center and Accessory collegian. Intrinsic Estimator was used for analysis, that is a new method for resolving linear dependency between age, period, and cohort in linear regression models. In the present study, age effects exhibited increased for both sexes. Also, aging proportion of smoking increased. For both sexes log coefficients were negative at young ages. Period effects for females showed declines but for males there was no significant difference. Cohort effects for females were small and gradual declines were shown for male cohorts. Proportion of smoking at young cohorts was less than old cohorts and log coefficients were negative. There was an increasing trend on age effect .Although a reduction period effect was observed from 2006 to 2009 in females that can be due to utilizing smoking policies in previous years but such a trend was not showed for males. Cohort effect was observed for males and smoking proportion at young cohorts was less than old cohorts.

Keywords: smoking, cigarette, prevalence, age period cohort

Introduction

Nicotine is an addictive substance that its dependency occurs very rapidly and its related mortality is high (Ziaedini et al., 2008). Cigarette smoking is one of the most important public health and health promotion program problems (Mansorian, Saadat & Hagiri,2010) . According to WHO's report (2008), smoking is the first predictable cause of mortality and resulted in about 5.4 million deaths in the world (Gallus et al., 2011) and predicts to be 8.4 million in 2020 (Rohafza, Sadegi & Emami, 2003) . Recently, smoking prevalence is declining in developed countries as USA, Canada and Western Europe. In the USA, proportion of male adult smokers decreased 23.8% from 1965 to 1991. In Denmark and Netherlands prevalence of male smoking decreased 20% within 20 years. In South Korea, smoking prevalence decreased from 72.37% to 52.43 % in male aged 30 and older from 1992 to 2006 (Park et al., 2006). In Japan, smoking prevalence between male physicians declined from 27.1 % to 21.5 % from 2000 to 2004 and between female did not change a lot (from 6.8% to 5.4%)(Kaneita et al.,2008).In Switzerland, cigarette use decreased from 1985 but in one study , 2010, it is shown that Smoking prevalence did not change from 1996 (28.0 %) to 2006 (26.5 %)(Etter,2010). An age ,period, cohort study in Sweden revealed smoking rates have decreased

from 1968 to 2002 (Ahacic, Kennison & Thorslund,2008) .Smoking prevalence has increased in developing countries in young people (Rohafza, Sadegi & Emami, 2003).In a cross-sectional survey in the Seychelles, a rapidly developing country in the Indian Ocean, 2006, smoking prevalence for students aged 11 to 17 years was 30 % and 21 % for males and female respectively. It is revealed smoking was prevalent and clustered among adolescents (Fae et al., 2006). In Syria, a developing Arab country, 2002, crude prevalence among adult was 48% for males and 9 % for females that resulted from combination information of 9 studies .In Aleppo smoking prevalence of male students was 23.3 % in 1999 (Maziak,2002) . In Tanzania , East Africa, smoking prevalence for males ≥15 years was 27 % and in female was 5 % (Jagoe et al.,2002).In a global study from 7 study in 139 country in 2002, 29% of persons ≥ 15 years were smokers in 1995. In East Asia and the Pacific, the prevalence of smoking was high (38 %). In Europe and central Asia was 34 % and in sub-Saharan Africa was low (18 %). Smoking prevalence for male was 74 % and for female was 11% (Jha et al.,2002).In one study in Tehran universities in 2002, smoking prevalence was 16.3 % that 25.4 % was male and 5 % was female. 12.3 % of freshman students and 20.1 % of senior students was smoking (Masjedi et al.,2002). In anothr study in Tehran in 2008 in Shahid Beheshti University, 61.5 % of male students experienced cigarette use (Heidari, Ramezankhani & Masjedi,2010) . In another study in Tabriz university among dormitory students in 2010, 8.9 % were smoking, among which 18 % were male and 1.4 % were female (Shamsi poor et al.,2010) .In another study in Damghan (Iran) in 2009, smoking prevalence was 19 % in female and 23 % in male (Mansorian, Saadat & Hagiri,2010). Some studies showed that experience and use of cigarette increased in seniors in comparison with before entrance to university in Iran (Masjedi et al.,2002 ; Mansorian, Saadat & Hagiri,2010 ; Heidari, Ramezankhani & Masjedi,2010).In this paper, we analyzed age, time period and cohort effects on cigarette smoking trends in Tehran University students from 2006 to 2009.

Methodology

Study population and data collection

This analysis focused on the university students of Tehran Medical Science, aged 18 to 23 years from 2006 to 2009.Data were collected from Aids Researches Center with Cooperation Environment Researches Center and Accessory collegian. These data were used primarily for assessing smoking, alcohol and drug use prevalence. We used a questionnaire to collect data. The questionnaire was built by WHO Model Core Questionnaire Self-Administered Format ،Monitoring The Future Study Sample Question Sets, Global School-based Student Health Survey (GSHS) Core Questionnaire Modules and WHO-ASSIST. We structured Self-Administered Format Questionnaire by local condition in Iran. In order to determine the validity, indirect style was used. In order to fill the questionnaires, the questionnaire went to classrooms and after explaining the questionnaire, the questionnaires were distributed among the classrooms. Students were free to answer the questionnaires. The incorrect questionnaires were discarded. We recorded the number of students and completed questionnaires in order to calculate the response rate. The response rate was 96.8 % in 2006, 96.1 % in 2007, 90.7 % in 2008, and 90.6 in 2009.

Variables of the study

Independent variables were age in 6 groups (18, 19, 20, 21, 22, 23), and with one year interval period in 4 years (2006, 2007, 2008, 2009) and with one year interval and birth cohort in 9 groups (1983 , 1984 , 1985 , 1986 , 1987 , 1988 , 1989 , 1990 , 1991).Dependent variable was cigarette use. It was measured by a question which asked about the use of 1 cigarette in the last year. It was answered in yes or no format. The age-specific proportion of cigarette users was accounted in

every year. (Number of cigarette users in every age group divided by total people in the same age group in every year). We inputted the proportion of cigarette use in the Stata software for apc analysis.

Sample size

Sampling method was Census. This sample is done for the study of smoking, alcohol and illegal addictive substances but in this paper we just showed smoking trends. As the range of use was between 2 % and 20 %, we selected a sample size that covered this range. So, we computed sample size (n = 246 in prevalence 20 %, $\alpha = 0.05$, n = 753 in prevalence 2 %, $\alpha = 0.01$). For comparison of an attribute frequency with prevalence 20 and 25 %, we needed 1090 sample. By using available studies, we guessed annual prevalence of drug use has increased to 8%. In order to determine the sample size with10 % increase in drug use, we computed 1716 subject by using N query adviser software. In order to survey the trend of annual use, total sample was computed 1500 in every year. As number of eligible students was about the same, we chose Census method. Total sample was 1761 in 2006,1741 in 2007, 1755 in 2008 and 1568 in 2009.In the present study, we included students aged 18-23 years, sample size for cigarette use in study was ó(n= 1584, in 2006) (n= 1521 in 2007) (n= 1572 in 2008) (n= 1399 in 2009).

APC modeling

Frost was one of first users of age, period and cohort method in his classic study of tuberculosis, whose method was used as one of the most popular tools in epidemiology. It was a descriptive Analysis in which he used the graphs to evaluate patterns of disease rates over time. Nowadays, researchers apply statistical regression models in addition to descriptive method to quantify the effect of these three factors separately. APC accounting models are measures for analysis of the trend of incidence, prevalence and mortality (Robertson, Gandini & Boyle, 1999 ; Yang, J. Fu & C. Land, 2004; Szklo, F.Javier, 2007).They are used widely for identifying the effects of age, time period and cohort for incidence rates and mortality in epidemiology and demography (Robertson, Gandini & Boyle, 1999 ;Yang, J. Fu & C. Land, 2004).

The three different effects are defined as follows:

Age effects: Age effects exhibit the variation associated with different age groups resulting from physiological changes, gathering of social experiences, and condition changes (Yang, J. Fu & C. Land, 2004; Yang, C. Land. 2006).

Period effects: Period effects demonstrate alteration over time periods that affect all age groups concurrently that these changes can be due to variation in social, cultural and economic positions, or physical environments (Yang, C. Land, 2006).

Cohort effects: Cohort effects represent changes among groups of individuals that experience a primitive event such as birth in the same year or years (Yang, J. Fu, C. Land, 2004,).

The challenge on these models is identification problem. It is due to the exact linear dependency between age, period, and cohort (cohort = period - age) (Robertson, Gandini, Boyle, 1999) .There are several methods to resolve the problem .We used Intrinsic Estimator (IE) method. There were some desirable statistical properties that made us to use like estimability and unbiasedness properties at small periods and table of rates and there is no need to determine reference category for the age , period , cohort coefficients (Yang, Fu, and Land, 2004, 2008; Yang 2008) The APC model is used in this paper is a poisson log- linear model:

$\text{Log}(r_{ijk}) = \log(d_{ijk} / n_{ijk}) = \mu + \alpha_i + B_j + \gamma_k$

Where r_{ijk} represents the smoking use proportion in age-period-cohort cell (i, j, k)

d_{ijk} represents the number of cigarette user and is supposed to be distributed as a Poisson variate

n_{ijk} is the population at risk

μ represents the intercept

α_i represents the ith row age effect for i = 1, . . . , a age groups;

β_j represents the jth column period effect for j = 1, . . ., b periods;

and γ_k represents the kth diagonal cohort effect for k = 1, . . . , (a + b – 1) cohorts, with k = a – i + j.

Results

Descriptive analysis

In this study, students aged 18 to 23 years were included because sample size was small for the others. In 2006, sample size was 1584 that 32.39 % was male and 67.61 % was female. In 2007 (n = 1521) and 34.7 % was male and 65.35 was female, in 2008 (n=1572) and 32.7 % was male and 67.3 % was female and in 2009 (n=1399) and 32.17 % was male and 67.83 % was female. Figures 1 and 2 show annual prevalence of cigarette use in females and males aged 18 to 23 years from 2006 to 2009 respectively. Age effects showed an increasing trend in both sexes. As the prevalence of cigarette use was less in young ages and increased with aging. The proportion of cigarette use displayed declines in 2008 and 2009 in comparison with 2006 and 2007 in females. Figures 3 and 4 show cohort effects. Prevalence of smoking was less in younger cohorts in comparison with older cohorts.

IE regression analysis:

Results were obtained by full APC model and IE method for both ages separately. Tables1 and 2 present summary results for females and males respectively. For ease of interpretation, figures of 5 and 6 present log coefficients of age, period and cohort effects whit 95 % confidence interval. Age effects showed increases for females. There were no significant differences in ages of 20 and 22 in females. So a fall is seen at ages of 22 is not statistically significant. Age effect coefficients for males showed increases from 18 to 23 gradually. Also Log coefficients are negative in young ages and are positive in old ages for both sexes. Period effects showed declines for females. Log coefficients were negative for 2009. Period effects showed increasing trend for males but it was not in confidence interval. Cohort effects for females were small and there was significant difference only for cohort of 1990. Gradual declines were shown for male cohorts and log coefficients for young cohorts were negative. Figure 1 to 7 show the comparison of IE effects of age, period and birth cohort among males and females

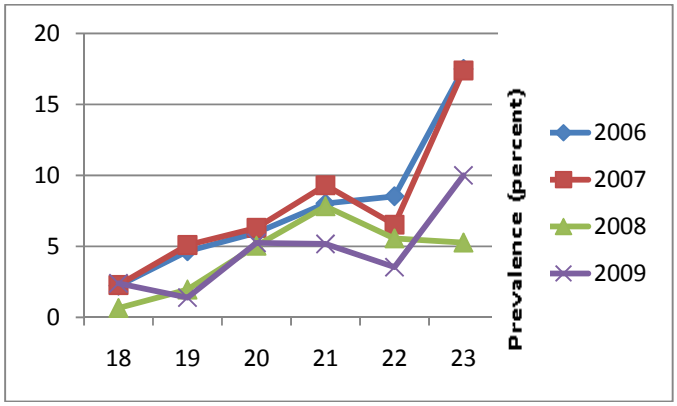


Figure 1.Annual prevalence of cigarette use in females aged 18 through 23, 2006-2009

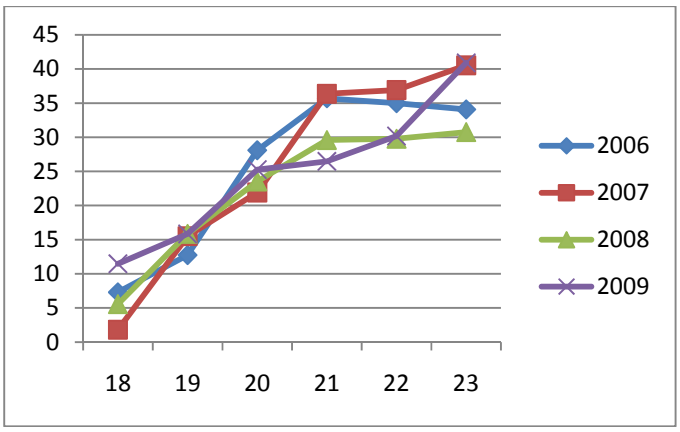
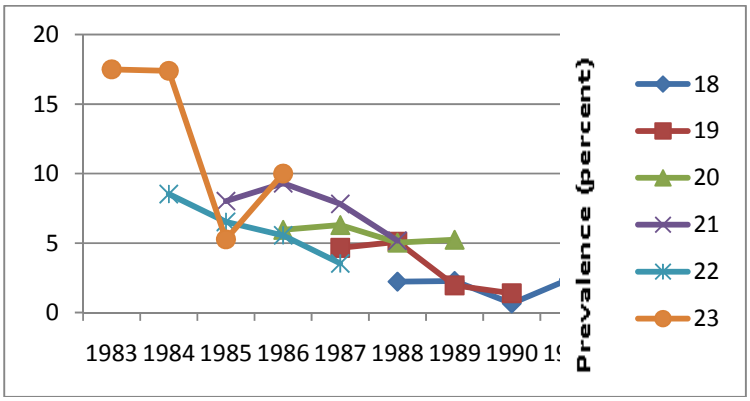
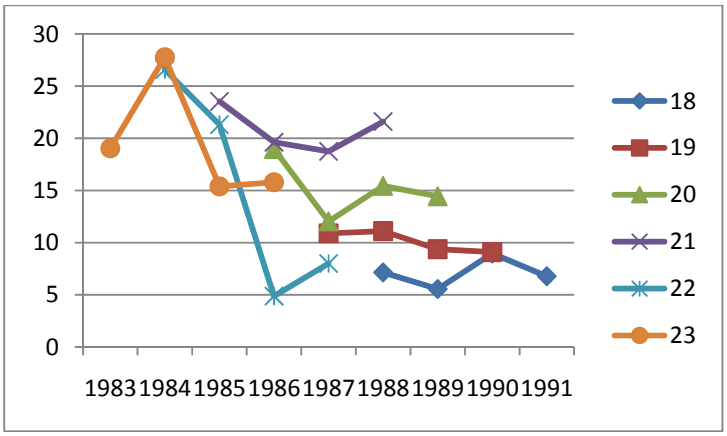


Figure 2.annual prevalence of cigarette use in males aged 18 through 23, 2006-2009



Birth cohort

Fig3.annual prevalence of cigarette use in females aged 18 through 23, 1983-1991



Birth cohort

Fig4. Annual prevalence of cigarette use in males aged 18 through 23, 1983-1991

Table 1. IE method for females cigarette use

females	Cigarette	
	Coef	[95% Conf. Interval]
constant	-2.968	-3.106 , -2.829
age 18	-1.019	-1.363 , -.6756
19	-0.362	-.594 , -.130
20	0.097	-.110 , .303
21	0.448	.236 , .660
22	0.134	-.137 , .406
23	0.702	356 , 1.048
period 2006	.178	.020 , .337
2007	.220	.059 , .382
2008	-.151	-.321 , .0190
2009	-.248	-.454 , -.042
cohort 1983	.344	-.114 , .803
1984	.210	-.123 , .562
1985	-.190	-.499 , .091
1986	-.065	-.342 , .213
1987	.003	-.258 , .265
1988	-.014	-.267 , .231
1989	-.041	-.338 , .256
1990	-.751	-1.25 , -.254
1991	.503	-.199 , 1.205

Table 2. IE method for males cigarette use

males	cigarette	
	Coef	[95% Conf. Interval]
constant	-1.489	-1.579 , -1.399
age 18	-1.131	-1.412 , -.8419
19	-.158	-.330 , .014
20	.242	.095 , .389
21	.391	.249 , .533
22	.309	.156 , .462
23	.347	.154 , .540

period 2006	-.097	-.206 , .012
2007	-.024	-.134 , .086
2008	.027	-.085 , .139
2009	.094	-.026 , .213
cohort 1983	.162	-.132 , .456
1984	.239	.0358 , .443
1985	.164	-.039 , .368
1986	.0755	-.097 , .248
1987	-.199	-.377 , -.020
1988	-.239	-.411 , -.066
1989	-.274	-.489 , -.058
1990	-.291	-.555 , -.028
1991	.361	-.167 , .889

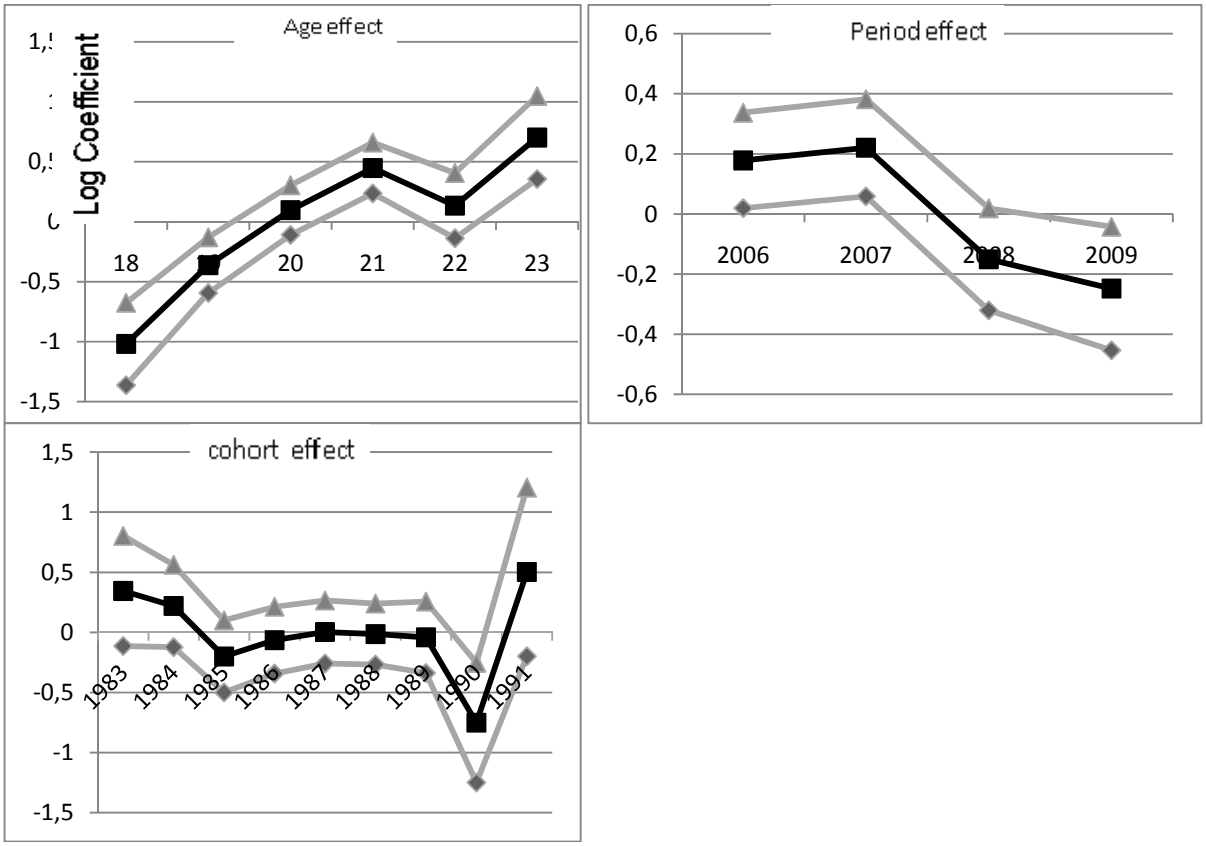


Fig 5. IE coefficient estimates and 95 % confidence intervals of the age, period, and cohort effects on cigarette use for females 2006-2009

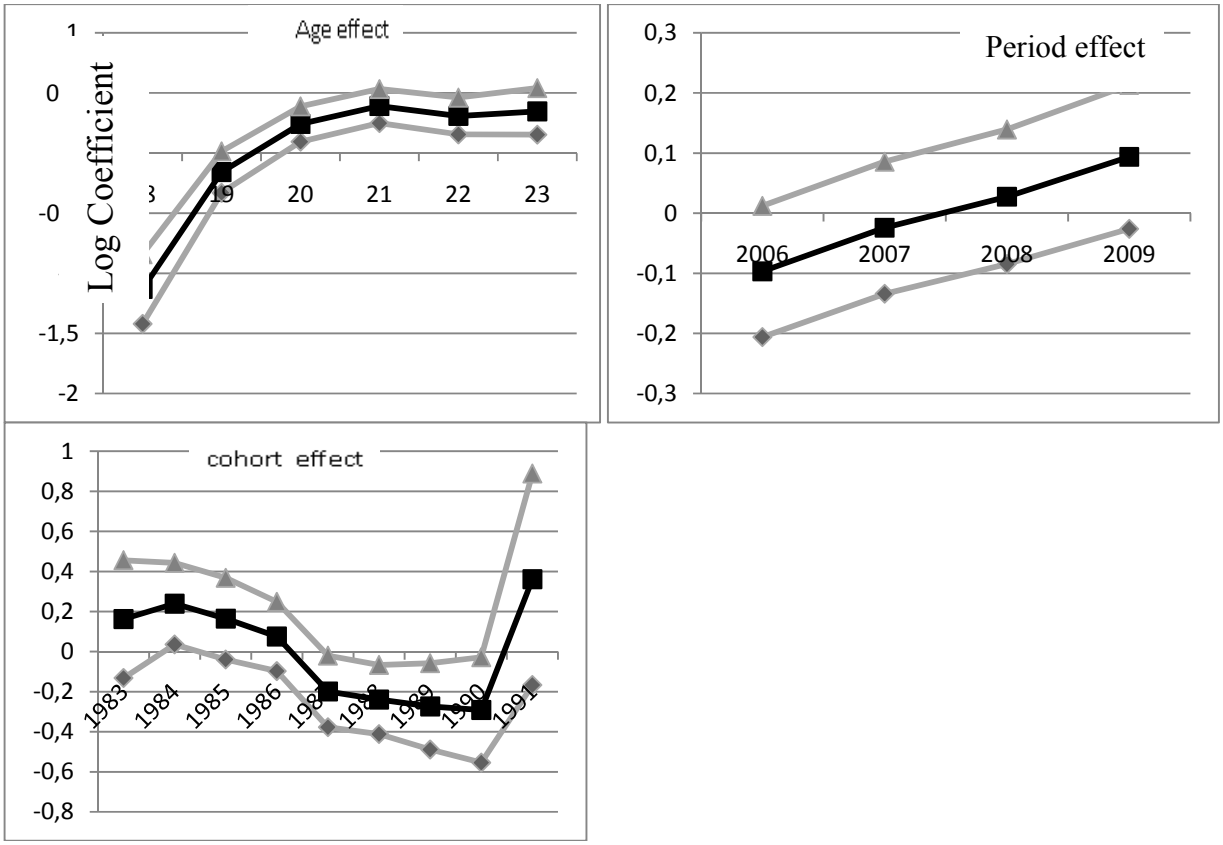
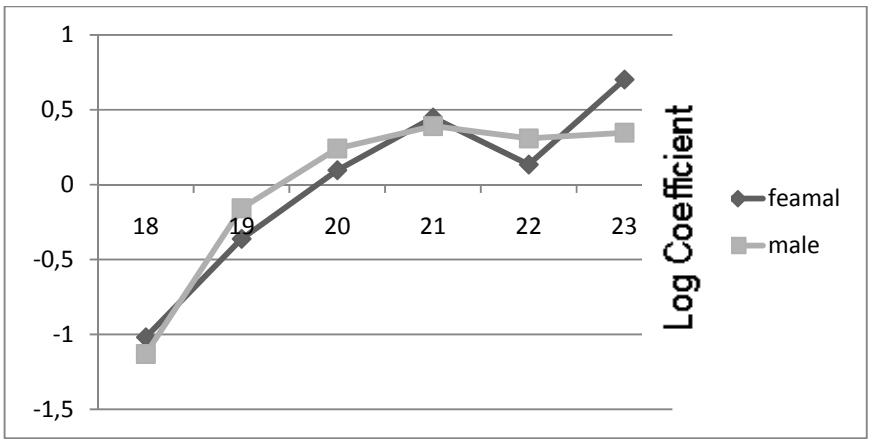


Figure 6. IE coefficient estimates and 95 % confidence intervals of the age , period, and cohort effects on cigarette use for males 2006-2009

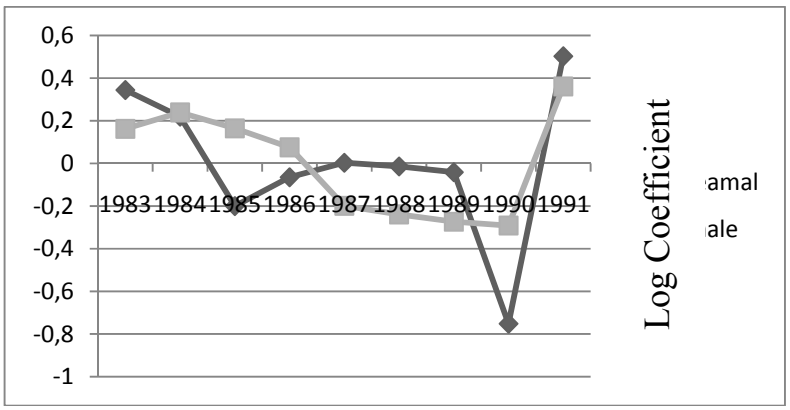
Discussion

The APC model is a statistical method to estimate the trends in epidemiologic and demographic rates based on age, period and cohort dimensions that is used widely in the world .The linear dependency between age, period and cohort cause a parameter identification problem .In this paper, IE method was used to resolve identification problem that is a new procedure and has several desired statistical properties in comparison with other conventional methods like CGLIM. Also, it can help to understand whether the observed descriptive analysis trends (the graphs are plotted using prevalence rates and not with regression methods) are real or not (Yang, 2008). This paper can be useful to predict future trends in smoking among students in Iran. Age effects displayed an increasing trend for both of males and females. Log coefficients are negative in young ages and are positive in old ages that show preventive effects for young ages. It can be due to parental control. When the students are entered into university some factors as living in dormitory, curiosity, lack of safe recreation, pressure of studying, stress, influence of friends and lack of knowledge cause to smoking (Shamsipoor et al., 2010). Period effects showed increasing trend for males but there was no significant difference for log coefficients. For female, period effects displayed a decreasing trend. Log coefficients were negative in 2009. Decreasing trend of period effects were consistent with Mohammad et al (2000)'s study based on two national health surveys. They suggested smoking prevalence decreased from 14.6 % to 11.7% in all of age groups (15-69) in Iran from 1991 to 1999. In the age groups of 15 to 24 years, it decreased from 10.1% to 7.1% for males and from 7 % to 2 %

for females from 1991 to 1999 .Although it should be noted that the way of Analysis in apc is different with their study. In another study, Gorgi et al (1984-2006) displayed smoking had Inverse relationship with cigarettes price . In fact, for every 1 percent increase of cigarette price, there was 0.45% decrease in cigarette use (Gorgy et al .,2009). There was a decreasing trend of smoking in females from 2006 to 2009. According to state law, the results of previous studies can be due to health education programs, forbidding of cigarette advertisement, banning of smoking in closed public places and forbidding of selling cigarette for under age of 18 years, high price of cigarette, low revenue and unfavorable economic situations (Rohafza, Sadegi & Emami, 2003 ; Mohammad et al ., 2000 ; Gorgy et al .,2009 ; M. O'Malley, G.Bachman & D. Johnston 1984 ;Tobaco control program in Iran, 2014).Gradual declines were exhibited for male cohorts and negative log coefficients for young cohorts showed preventive effect in young cohorts. A small Cohort effects were represented for females so that the significant differences were observed only for cohort of 1990.



Age effect



Cohort effect

Figure 7. Comparison of IE coefficient estimates of the age, period, and cohort effects on cigarette use between males and females, 2006-2009

The obtained results of this study were consistent with some other studies that are pointed at follow. In O'malley and colleagues study in American youth aged 18 to 24 years (1976-1986)

decreasing trend in smoking were observed in successive Cohorts (M. O'Malley, G.Bachman & D. Johnston 1984a; M. O'Malley, G.Bachman & D. Johnston,1988b) that was consistent with our results on males effect although we had a small effect in females .Chen et al (2003), in the study of never smokers in California in adolescents aged 12 to 17 years (1990 -1999), showed a limited period effect, an obvious cohort effect and a strong age effect on increasing never smokers. The age effects in this study were incompatible with our study. Ahacic and colleagues in Sweden studied trends of smoking in youth aged 18 to up years from 1968 to 2002 .Opposite of our study they had decreasing trend on age effects in females and decreasing trend on period effects in males (8) While our results showed decreasing trend on period effects in females but not in males and presented increasing age effects in both sexes.

Conclusion

Increasing age effects were observed in both male and female. Negative Log coefficients in young ages can be due to hangover of parental control before entrance to university. Although a decreasing period effect was observed from 2006 to 2009 in females that can be because of utilizing smoking policies and some obligation in previous years, there was no significant difference for males. Cohort effects were observed for males and smoking proportion at young cohorts was less than old cohorts.

Limitation of the study

1) In this paper we had data in 4 years and their interval was 1 year whereas for obtaining a trusted result we need many periods. In order to resolve this problem, we used IE method that is unbiased estimator for small periods and 1 year interval. But, as any model can have its own problem, we suggest another study with large periods

2) Although the questionnaires were used in this paper were without name, probably there was under-reporting. But, since data collection was the same in all of years, we expected Under-reporting was the same in all questionnaires and was not biased observed trends.

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