RESEARCH COMMUNICATION

Decreasing Trends of Smoking and Smoking Cessation in Successive Thai Birth Cohorts: Age-period-cohort Analysis from 1991-2007 National Surveys

Rassamee Sangthong*, Virasakdi Chongsuvivatwong, Alan F Geater, Walailuk Jitpiboon

Abstract

Background: Many tobacco control policies have been implemented to reduce tobacco use throughout the world including Thailand. This study made use of surveillance data of the past two decades to examine age-period-cohort effects on smoking in Thailand. Methods: Six nationally representative datasets collected during 1991-2007 were used to determine the prevalence of current smoking, former smoking, and never smoking. Effects of age-period-cohort on current, former, and never smoking were examined using age-period-cohort analysis. Results: Overall tobacco consumption in Thailand has substantially decreased during the past two decades. However, a sluggish decline of smoking trend has been observed in the last decade. Age-period-cohort models showed significant effects of all three of these component factors on current smoking, former smoking, and never smoking, with the exception of an age effect only on former smoking in females. Age-specific prevalence of current smoking in successive birth cohorts increased with age towards 27 years in males and then fell with age while smoking cessation tended to increase with age. Newer cohorts tended to smoke less but were less likely to quit smoking than those in earlier cohorts. Conclusions: Although newer cohorts had less susceptibility to smoking, smokers in newer cohorts had lower odds of smoking cessation. Effective smoking cessation methods should be promoted.

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Introduction

Tobacco control is one of the effective means of cancer prevention. Overall prevalence trend of smoking in Thailand has decreased over time which is partly due to tobacco control policy in the country (Levy et al., 2008; Sangthong et al., 2011). This change of smoking trend can also be affected by age structure and birth cohort but they have never been examined in Thailand.

Age-period-cohort analysis using data from multiple cross-sectional surveys can be used to describe trends of interesting events (Yang, 2008). Age structure could account for the increasing or decreasing trend of smoking. Age effects reflect biological and social processes of aging and represent developmental changes across the life course. Period effects are defined as variation over time periods or calendar years that influence all age groups simultaneously. Cohort effects are associated with a change in rates in successive age groups in successive time periods whereby different cohorts have different exposures. The latter two effects are important in the context of time trends where cohort effects are associated with long-term exposures.

In Thailand, national surveys on smoking behavior have been conducted since 1976 by the Thailand National Statistical Office. Initially the surveys were part of the Health and Welfare Survey and Labor Force Surveys conducted every five years. From 1990 onwards, the surveys have examined specifically smoking and drinking behaviors and have been conducted on a three-yearly basis (Thailand National Statistical Office, 2008). This study used age-period-cohort analysis of six national surveys during 1991-2007 (the latest data available) to examine prevalence trends in current smoking, former smoking, and never smoking during the past two decades in Thailand.

Methods

Data on smoking behaviour in 1991, 1996 and 2001 were obtained from the Health and Welfare surveys and data for 1999, 2004 and 2007 were obtained from a survey of Cigarette Smoking Behaviour and two surveys of Alcohol Drinking and Smoking Behavior, respectively. All six surveys were conducted at the national level and used similar sampling methods and measures of smoking.

Data in each survey were collected from every province in the country. Stratified two-stage sampling

*Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand *For correspondence: rassamee_sangthong@yahoo.com*

Table 1. Smoking Prevalence (%) by Sex and Age Group in 1991-2007

Year	n	Over all (%)	Male (%) Age (years old)						Female (%) Age (years old)					
			11-20	21-40	41-60	61-80	>80	Overall	11-20	21-40	41-60	61-80	>80	Overall
1991	78,851	28.4	19.0	66.4	68.0	61.3	52.0	52.5	0.7	3.7	9.3	9.1	8.9	4.4
1996	64,935	26.1	16.2	60.6	61.7	54.1	40.9	49.3	0.4	2.8	5.5	6.5	2.6	3.0
1999	72,098	24.0	13.0	55.1	56.8	51.4	33.1	45.4	0.1	2.0	5.7	5.9	6.1	3.0
2001	183,792	23.4	12.0	54.4	55.7	44.9	33.9	44.4	0.3	1.9	4.6	5.5	3.5	2.6
2004	56,380	21.1	12.0	48.7	48.6	41.3	23.7	40.1	0.2	1.9	4.2	4.1	2.0	2.4
2007	174,320	19.7	13.0	45.4	47.3	36.7	26.0	38.5	0.1	1.0	3.2	3.6	2.6	1.8

methods were used. Each province was stratified into inside- and outside- municipality areas. Primary sampling units inside- and outside-municipality areas were enumeration district (ED) and village, respectively. EDs and villages were selected by systematic random sampling with probability proportional to size of number of households. Fifteen households in each ED and 10-12 households in each village were selected by systematic random sampling method. Face-to-face interview using a structured questionaire was used to obtain information. Respondents were asked whether they currently smoked ("Do you currently smoke of any types of tobacco?"). If they did not currently smoke, they were asked if they had ever smoked in lifetime but had currently stopped) or never smoked at all. Information of all household members aged above 11 years, was obtained from the head of household. The set of main questions related to smoking was consistent across the six surveys.

Data exploration for possible errors and data cleaning for sex, birthyear, survey year, and smoking status of each individual were done. Subsequently these variables were merged into one dataset. Age of each respondent was created by subtracting the birthyear from the year of the survey.

A total of 640,376 records were retrieved from 6 datasets. Those who were born before 1902 were excluded and thus 99.97% of them could be used for analysis. Since prevalence of smoking in males and females is substantially different, analysis was done separately for males and females throughout the study. Prevalence of each smoking status in each survey was computed with sampling weight adjustment. The sample was divided into 5-year birth cohorts and plotted against midage of each 5-year birth cohort. Analysis of age-period-cohort models by multivariate logistic regression for current smoking, former smoking among smokers aged above 25 years, and never smoking was done. Since age, period and cohort effects are inter-related, they were adjusted for one another to see their independent associations with each on smoking and tested by likelihood ratio tests. Data analysis was done using survey (Lumley, 2004) and epicalc (Chongsuvivatwong, 2009) packages in R software (R Development Core Team, 2009).

Results

Table 1 shows an absolute decrease in overall smoking prevalence of approximately 10 percentage points from 1991 to 2007. The smoking prevalence, however, tended to change only moderately after 2001.

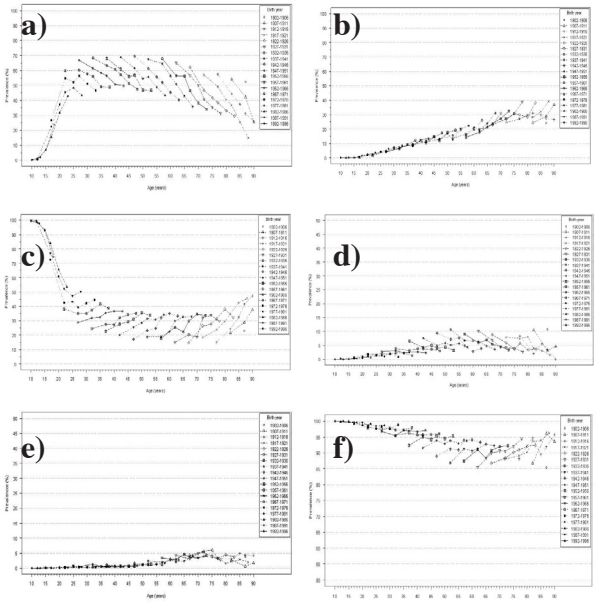

Figure 1. Age-Specific Data. a) Prevalence of current smoking in males; b) Prevalence of former smoking in males; c) Prevalence of never smoking in males; d) Prevalence of current smoking in females; e) Prevalence of former smoking in females; f) Prevalence of never smoking in females

In both males and females of each survey, smoking prevalence was markedly higher in 21-40 year-olds than in 11-20 year-olds and was similarly high in 41-60 year-old males and 61-80 year-old females, but slightly lower in the more elderly. This suggested age effect on smoking prevalence. Although the smoking prevalence among male youths, aged 11-20 years, was lower than that of other age groups in all survey years and declined up to 1999, it subsequently stabilized at between 12 and 13%.

Figure 1a shows the age-specific prevalence of current smoking in successive birth cohorts in males. Each line represents one birth cohort passing through time and age. The more recent cohort lines are downward shifted compared to the older cohorts. This indicates a cohort effect in which the newer cohorts have lower smoking prevalence than older ones at the same age point. The gaps between the lines appeared to be similar except among the young males in the four latest cohorts, in which no evidence of a reduction in age-specific prevalences over cohort could be seen.

Smoking prevalence in each cohort line increases sharply with age towards 27 years before falling. The gradient of the falls (slope of each line) are steeper in the older age groups than in the younger ones. The inverted-U- shaped graph demonstrates age effect on

Table 2. Age-period-cohort Effects on Current Smoking, Former Smoking, and Never Smoking among Males and Females

APC model	Males			Females		
	Current smoking	Former smoking among smokers aged>25 years	Never smoking	Current smoking	Former smoking among smokers aged>25 years	Never smoking
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Age groups (years):						
11-15	Reference	-	Reference	Reference	-	Reference
16-20	23.0 (20.1,26.2)	-	0.05 (0.04,0.05)	6.4 (3.7,11.1)	-	0.16 (0.11,0.25)
21-25	59.1 (51.4,68.0)	-	0.02 (0.02,0.02)	12.8 (7.3,22.3)	-	0.08 (0.05,0.12)
26-30	64.8 (55.8,75.1)	Reference	0.02 (0.01,0.02)	18.8 (10.6,33.6)	Reference	0.06 (0.04,0.09)
31-35	59.5 (50.6,69.8)	1.3 (1.2,1.5)	0.02 (0.01,0.02)	21.3 (11.7,39.0)	1.2 (0.8,1.6)	0.05 (0.03,0.08)
36-40	57.53 (48.3,68.4)	1.5 (1.3,1.6)	0.02 (0.01,0.02)	26.2 (13.9,49.3)	1.2 (0.8,1.8)	0.04 (0.03,0.07)
41-45	52.6 (43.5,63.5)	1.6 (1.4,1.8)	0.02 (0.01,0.02)	30.4 (15.7,59.2)	1.2 (0.7,1.9)	0.04 (0.02,0.06)
46-50	45.5 (37.0,55.8)	1.8 (1.5,2.2)	0.02 (0.02,0.02)	33.1 (16.4,66.9)	1.2 (0.7,2.1)	0.03 (0.02,0.06)
51-55	40.0 (32.0,50.0)	2.0 (1.6,2.4)	0.02 (0.02,0.02)	34.1 (16.3,71.7)	1.5 (0.8,2.9)	0.03 (0.02,0.06)
56-60	32.3 (25.4,41.1)	2.3 (1.8,2.9)	0.02 (0.02,0.03)	31.7 (14.4,69.8)	1.8 (0.9,3.8)	0.03 (0.02,0.06)
61-65	24.3 (18.7,31.5)	2.8 (2.1,3.6)	0.03 (0.02,0.03)	30.9 (13.4,71.4)	2.1 (0.9,4.8)	0.03 (0.02,0.06)
66-70	18.4 (14.0,24.5)	3.3 (2.5,4.5)	0.03 (0.02,0.04)	27.3 (11.2,66.4)	2.5 (1.0,6.4)	0.03 (0.02,0.06)
71-75	13.4 (9.9,18.1)	3.9 (2.8,5.4)	0.04 (0.03,0.05)	22.0 (8.5,56.5)	3.3 (1.2,9.4)	0.03 (0.02,0.07)
76-80	9.8 (7.0,13.7)	4.3 (3.0,6.2)	0.05 (0.03,0.06)	22.1 (8.1,60.2)	3.2 (1.0,9.9)	0.03 (0.02,0.07)
>80	6.0 (4.1,8.6)	5.4 (3.5,8.2)	0.07 (0.05,0.09)	14.7 (5.0,43.4)	4.3(1.2,15.3)	0.04 (0.02,0.09)
Period (year):						
1991	Reference	Reference	Reference	Reference	Reference	Reference
1996	0.9 (0.9,0.9)	1.2 (1.1,1.3)	1.1 (1.0,1.1)	0.7 (0.6,0.8)	1.1 (0.9,1.4)	1.3 (1.2,1.4)
1999	0.7 (0.7,0.7)	1.6 (1.5,1.7)	1.2 (1.1,1.2)	0.6 (0.6,0.7)	1.3 (1.0,1.6)	1.4 (1.3,1.5)
2001	0.7 (0.7,0.8)	1.4 (1.3,1.5)	1.3 (1.2,1.3)	0.7 (0.6,0.8)	1.1 (0.8,1.4)	1.5 (1.3,1.7)
2004	0.6 (0.6,0.7)	1.9 (1.7,2.1)	1.3 (1.2,1.4)	0.6 (0.5,0.7)	1.5 (1.1,2.1)	1.5 (1.3,1.7)
2007	0.6 (0.6,0.7)	2.4 (2.1,2.8)	1.2 (1.1,1.3)	0.5 (0.4,0.6)	2.0 (1.4,2.9)	1.8 (1.5,2.0)
Birthyear:						
1902-06	Reference	Reference	Reference	Reference	Reference	Reference
1907-11	0.8(0.6,1.2)	1.1 (0.7,1.7)	0.95 (0.7,1.3)	0.7 (0.4,1.3)	0.7 (0.3,1.5)	1.8 (1.2,2.6)
1912-16	0.7 (0.5,1.1)	1.1 (0.8,1.7)	0.94 (0.7,1.3)	0.5 (0.3,1.0)	1.2 (0.6,2.5)	1.6 (1.1,2.3)
1917-21	0.6 (0.5,0.9)	1.2 (0.8,1.7)	1.1 (0.8,1.5)	0.7 (0.4,1.2)	0.8 (0.4,1.5)	1.5 (1.1,2.1)
1922-26	0.6 (0.4,0.8)	1.2 (0.8,1.8)	1.0 (0.8,1.5)	0.6 (0.4,1.2)	1.1 (0.5,2.3)	1.3 (0.9,1.9)
1927-31	0.5 (0.3,0.7)	1.1 (0.8,1.7)	1.3 (0.9,1.8)	0.6 (0.3,1.1)	1.2 (0.6,2.7)	1.4 (1.0,2.1)
1932-36	0.4 (0.3,0.6)	0.99 (0.7,1.5)	1.6 (1.1,2.2)	0.6 (0.3,1.1)	1.1 (0.5,2.5)	1.4 (1.0,2.2)
1937-41	0.4 (0.2,0.5)	0.98 (0.6,1.5)	1.8 (1.3,2.6)	0.6 (0.3,1.1)	1.0 (0.4,2.4)	1.5 (1.0,2.3)
1942-46	0.3 (0.2,0.5)	0.96 (0.6,1.5)	2.1 (1.5,3.0)	0.5 (0.3,1.1)	0.7 (0.3,1.9)	1.8 (1.1,2.8)
1947-51	0.3 (0.2,0.4)	0.95 (0.6,1.5)	2.6 (1.8,3.7)	0.4 (0.2,0.9)	0.6 (0.2,1.8)	2.1 (1.3,3.5
1952-56	0.2 (0.2,0.3)	0.9 (0.5,1.5)	3.0 (2.0,4.3)	0.4 (0.2,0.8)	0.6 (0.2,2.1)	2.4 (1.4,4.0)
1957-61	0.2 (0.1,0.3)	0.8 (0.5,1.3)	3.2 (2.2,4.7)	0.3 (0.1,0.8)	0.6 (0.2,2.3)	2.6 (1.5,4.6)
1962-66	0.2 (0.1,0.3)	0.7 (0.4,1.1)	3.8 (2.5,5.6)	0.3 (0.1,0.7)	0.7 (0.2,2.6)	3.1 (1.7,5.5)
1967-71	0.2 (0.1,0.3)	0.6 (0.3,1.1)	4.3 (2.8,6.4)	0.3 (0.1,0.7)	0.7 (0.2,2.8)	3.3 (1.7,6.1)
1972-76	0.2 (0.1,0.2)	0.5 (0.3,0.96)	5.2 (3.4,7.9)	0.2 (0.09,0.6)	0.9 (0.2,4.2)	3.7 (2.0,7.2)
1977-81	0.1 (0.08,0.2)	0.5 (0.3,0.91)	6.5 (4.2,10.0)	0.2 (0.08,0.7)	0.8 (0.1,4.4)	4.1 (2.0,8.4)
1982-86	0.1 (0.06,0.2)	-	8.5 (5.4,13.2)	0.2 (0.07,0.7)	-	4.4 (2.1,9.5)
1987-91	0.1 (0.06,0.2)	-	8.5 (5.3,13.5)	0.1 (0.04,0.4)	-	5.1 (2.2,12.0)
1992-96	0.1 (0.06,0.2)	-	6.9 (4.1,11.5)	0.1 (0.01,0.6)	-	6.6 (2.0,22.4)

P value (<0.001) from likelihood ratio tests

smoking prevalence.

Figure 1b shows changes in the prevalence of age-specific former smoking in males. The prevalence of former smoking tends to increase with age. The cohort lines are mostly overlapping and show only a slight cohort effect on the prevalence of former smoking.

Figure 1c illustrates the newer male cohorts had higher prevalence of never smoking than the earlier cohorts at the same age. Discrepancy between each successive cohort line was consistent. Prevalence of never smoking in each cohort line decreases sharply with age until 22 years then gradually increases. The increase is more prominent among the elderly as shown by the steeper slope of the lines.

Similar patterns of cohort and age effects on current smoking-, former smoking- and never smoking were also observed in females but were less marked (Figures 1d-f).

The age-period-cohort models confirmed independent effects of age, period, and cohort on current, former, and never smoking in both males and females (Table 2). Odds of smoking had substantially increased from the younger to the older age groups and gradually decreased in 36-40 year-old males and 56-60 year-old females. The older age groups had higher odds of becoming former smokers in

both males and females but statistical significance was observed only in males. Compared to the reference group, odds of never smoking were lower and were relatively constant across age groups.

Smoking status was moderately affected by time period effects. Odds of current smoking were found to be relatively low whereas odds of former and never smoking were relatively high in the subsequent survey years.

Newer cohorts tended to have lower chance of smoking as indicated by lower odds ratio of current smoking and higher odds ratio of never smoking compared to previous cohorts. Lower odds ratios of smoking cessation, however, were found in newer than in earlier cohorts.

Discussion

Overall tobacco consumption in Thailand has substantially decreased during the past two decades. Adecreasing trend of smoking was also observed in the US, Australia and Japan (Mackay, 2002). However, a sluggish decline of smoking trend has been observed in the last decade in our study.

Prevalence of smoking increased sharply from 11-15 to 26-30 years old then gradually declined in the present study. Consistent with other studies, most people begin to smoke in their teens (Department of Health and Human Service, 1994; Washio, 2003) and the smoking prevalence falls with age after about 25 years of age (Kemm, 2001).

This study further revealed that susceptibility tosmoking in newer cohorts was lower than that in earlier cohorts at the same age. Similar pattern was found in UK and US but not in Spain (Kemm, 2001; Harris, 1983; Freedman, 2002; Fernandez, 2003; Pierce, 2009). Unlike the pattern found in smoking, smokers aged above 25 years in newer cohorts appeared to stop smoking at a slower rate than those in earlier cohorts. Inconsistently, other studies in developed countries reported more attempts to quit smoking in newer cohorts (Morabia, 2002; Messer, 2008).

The present study also reveals that smoking cessation was affected by individual aging rather than cohort replacement. Former smoking prevalence increased with age after 25 years of age in males and was especially marked among the elderly. Smokers encountering serious diseases due to smoking, such as heart disease or lung cancer, had a higher quit rate (Parsons, 2010; Young, 2010). These diseases take time to develop and are manifest at an older age, so that with increasing age, smokers are more likely to stop smoking by themselves when they have symptoms.

The study finding thus suggests that an effective and timely intervention for smoking cessation should be promoted to accelerate the sluggish decline of smoking trend of the country. Stopping smoking is one of the most effective ways to reduce morbidity and premature mortality. Improvements in lung function, coronary artery disease, and survival time in patients with cancer may result from smoking cessation (Department of Health and Human Service, 1990; Parsons, 2010). Quitting on their own was the most common cessation method in Thailand reported by the Global Adult Tobacco Survey (GATS) and the recent Thailand National Health Examination Survey (World Health Organization Regional Office for South East Asia, 2009), (National Health Examination Survey Office, 2009). Tobacco-cessation rate by physician counseling ranged from 10-20% (Kottke et al., 1988; Law and Tang, 1995; Pisinger et al., 2005). The cessation rate could be enhanced by pharmacologic therapies and other multi-disciplinary approaches (Stead et al., 2008; Miller and Sedivy, 2009). Other factors related to successful smoking cessation were young age, low levels of dependence, high prevalence of smoke-free homes, social norm with widespread interest in quitting and mass media advertising campaigns (Bala et al., 2008; Messer et al., 2008).

Regarding limitations and strengths, the prevalence of smoking may have been underestimated as proxy responses for family member were used. However, this approach was employed consistently in all surveys, and should, therefore, have had little effect on smoking trend and APC analysis findings. The sample was very large and age-period-cohort analysis was done to corroborate the descriptive findings.

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