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Smoking prevalence in the 1982 birth cohort: from adolescence to adult life, Pelotas, Southern Brazil

ABSTRACT

OBJECTIVE: To assess smoking prevalence in adolescents and young adults of a population-based birth cohort.

METHODS: Prospective birth cohort study of infants born in 1982, in the city of Pelotas, Southern Brazil, and interviewed in 1997, 2000-2001 and 2005. In the 1997 and 2000-2001 follow-up visits, the outcome studied was smoking, defined as the consumption of at least one cigarette in the previous week. In the 2005 follow-up visit, the dependent variable was current smoking. Adjusted analysis was performed using Poisson regression.

RESULTS: Smoking prevalences among males were 5.9%, 20.2% and 27.6% in the 1997, 2000-2001 and 2005 follow-up visits, respectively. Among females, respective values were 9.3%, 27.5% and 23.6%. Mean age of smoking onset was 15.1 years (SD=2.5). In the multivariate analysis, lower maternal level of education, low income level in 1982, poverty during the follow-up period and maternal smoking were significantly associated with higher smoking prevalences in both sexes. Being non-white was associated with higher risk of smoking among females exclusively. Breastfeeding was not associated with smoking. Among females, smoking was inversely associated with birth weight in the crude analysis, but lost its significance in the adjusted analysis.

CONCLUSIONS: Higher incidence of smoking in poorer groups suggests that behavior such as avoiding smoking during pregnancy and increasing cigarette prices can have an important population impact.

DESCRIPTORS: Adult. Smoking, epidemiology. Socioeconomic Factors. Health Inequalities. Cohort Studies. Brazil.

INTRODUCTION

Studies on international literature, with a cross-sectional design in their majority, show smoking prevalences in distinct locations and age groups.[5,6,8,a] There has been reduction in smoking in high-income countries, especially among men, whereas in medium- and low-income countries there has been an increase, especially among women. Adolescents, particularly females,[8,9] have shown high smoking prevalence, even in some high-income countries.[b]

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[a] World Health Organization. Tobacco Free Initiative - TFI. Geneva; 2007[cited 2007 Jan 28]. Available from: http: www.who.int./tobacco

[b] International Network of Women Against Tobacco. Women the next wave of the tobacco epidemic: an overview. Vancouver; 1999[cited 2006 Oct 13]. Available from: http://www.inwat.org/inwatmtalk.htm

In 1994, Lopez et al[11] described four smoking epidemic stages, where the differences in smoking-related prevalence and mortality between sexes are emphasized. In Brazil, the smoking epidemic pattern for developing countries, including Latin America, described by Lopez et al,[11] is not observed. Some of the characteristics of this epidemic in the country are similar to those of developed countries, whereas others are similar to developing countries. Socioeconomic level, assessed by income as well as level of education, has been one of the key factors responsible for this epidemic. Literature is consistent in terms of the inversely proportional association between smoking and distinct economic indicators.[13,14,17]

The present study aimed to analyze smoking prevalence in a birth cohort of infants born in the city of Pelotas, in 1982, and the association between smoking in the last follow-up visit, according to socioeconomic variables, and health conditions.

METHODS

In 1982, all births that occurred in the city of Pelotas, Southern Brazil, were monitored in the city hospitals, including 5,914 live births, of which 3,073 were males and 2,877 were females.[19] Details on the methodology have been published previously.[4,19,20] In 1997, a systematic sample of 70 censor tracts, out of the 259 censor tracts existing in the city, was randomly selected, and adolescents born in 1982, aged 15 years, were interviewed. Other three follow-up visits were conducted for this cohort in 2000, 2001, and 2004-2005. In 2000, men (aged 18 years) who were present for the military call-up were interviewed; in 2001, the same systematic sample of 1997 was visited, and female adolescents born in 1982 (aged 19 years)[20] were interviewed; and in 2004-2005, the whole cohort, aged 23 years,[19] was tracked. Follow-up rates for the 1997, 2000, 2001 and 2004-2005 visits were 71.8%, 78.9%, 69% and 77.4%, respectively.[19]

In the 1997 and 2000-2001 follow-up visits, the outcome was defined as "smoked at least a cigarette in the previous week". In the 2004-2005 follow-up visit, the dependent variable was current smoking. These outcomes are called "smoking" throughout the article. The following independent variables were analyzed: sex, ethnicity, maternal level of education in years of study, family income in monthly minimum wages in 1982, change in income between 1982 and 2005, birth weight, maternal smoking during all pregnancy and breastfeeding. For the variable "change in income", "poor" was defined as individuals included in the lower third of income range.[2] Age of smoking onset, the number of cigarettes smoked and ex-smokers' age of smoking cessation were also investigated.

Chi-square tests for heterogeneity or linear trend were used to test associations in the crude analysis, while the Wald test for heterogeneity and for linear trend were used in the multivariate analysis. For continuous variables, mean and standard-deviation were analyzed. Analysis was stratified by sex and adjusted analysis – performed with Poisson regression – followed a hierarchical model with: ethnicity on the first level; socioeconomic variables, maternal smoking and birth weight on the second level; and breastfeeding on the third level. Adjustment for variables on the same level or upper levels in the hierarchical model was performed. All variables with $p<0.20$ remained in the model, aiming at confounding control. Variables with p-value<0.05 were considered statistically significant.

Oral informed consent was obtained from those responsible for the children in the 1982-1986 period of the study, as this was a common practice at that time, when there were no ethics committees at the *Universidade Federal de Pelotas* (Pelotas Federal University). In more recent years, the University Research Ethics Committee, affiliated to the *Conselho Nacional de Ética em Pesquisa – CONEP* (National Research Ethics Council), approved the study and written informed consent was obtained from participants.

RESULTS

Smoking prevalences by sex, in the 1982 birth cohort follow-up visits, are shown on the Figure. Smoking prevalence among females almost tripled between 15 and 19 years. In contrast, between 19 and 23 years there was a reduction in 14%. Among men, the increase in smoking prevalence between 15 and 18 years was smaller than among women. In addition, men still showed an increase by about 37% in smoking prevalence between 18 and 23 years. The rise in smoking prevalence was statistically significant in both women and men (p-value

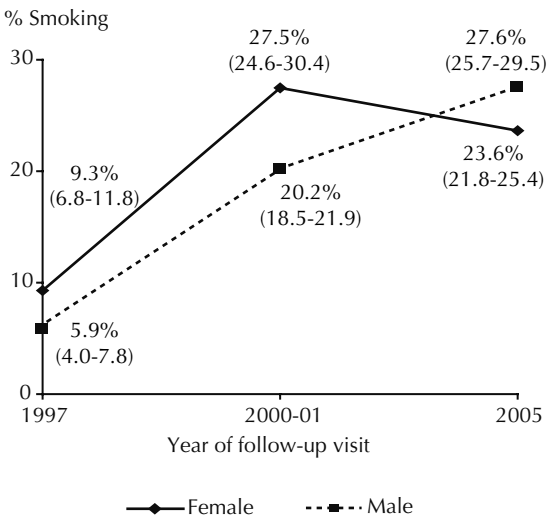

Figure. Smoking prevalences among adults followed in the 1982 birth cohort, according to sex. Pelotas, Southern Brazil, 1982 to 2004-5.

for trend<0.001). Of all the 1,463 smokers in the last follow-up visit, mean age of smoking onset was 15.1 years (sd=2.5). Mean number of cigarettes smoked per day among smokers was 13.1 (sd=9.5).

Table 1 describes smoking prevalence by sex, according to independent variables. Being non-white, lower maternal level of education, low family income in 1982, poverty throughout life and maternal smoking during

Table 1. Smoking prevalence in young adults, according to sociodemographic characteristics. Pelotas, Southern Brazil, 1982 to 2004-5.

Variable*	n	%	Male		Female	
			n	%	n	%
Skin color**	<0.001***		0.005***		<0.001***	
White	3,238	23.4	1,658	25.6	1,580	21.1
Black or Mixed	908	31.9	471	32.1	437	31.8
Maternal level of education (years)	<0.001****		<0.001****		<0.001****	
0 – 4	1,407	31.0	719	33.7	688	28.2
5 – 8	1,826	25.9	956	27.5	870	24.1
9 – 11	473	18.8	239	20.1	234	17.5
≥ 12	584	17.5	295	18.6	289	16.3
Family income – 1982 (MW)	<0.001****		<0.001****		<0.001****	
≤ 1	852	32.2	438	33.8	414	30.4
1.1 – 3	2,126	26.7	1,095	28.7	1,031	24.5
3.1 – 6	800	21.9	417	24.5	383	19.1
6.1 – 10	252	18.7	130	22.3	122	14.8
> 10	244	14.3	123	13.0	121	15.7
Change in income (1982 → 2004-5)	<0.001****		<0.001****		<0.001****	
Always poor	708	37.9	335	37.9	373	37.8
Not poor → poor	714	31.5	340	33.5	374	29.7
Poor → not poor	665	24.8	360	28.9	305	20.0
Never poor	2,209	20.1	1,178	22.6	1,031	17.4
Maternal smoking (1982)	<0.001****		0.001****		<0.001****	
Did not smoke	2,772	22.9	1,428	25.4	1,344	20.2
1-14 cigarettes	1,156	29.7	576	30.7	580	28.6
15 or more cigarettes	368	34.2	209	34.4	159	34.0
Birth weight (grams)	0.07****		0.50****		0.01****	
< 2,500	301	30.2	136	32.4	165	28.5
2,500 – 2,999	1,021	27.1	451	29.3	570	25.4
3,000 – 3,499	1,634	24.5	849	26.0	785	22.8
3,500 – 3,999	1,098	25.0	612	26.5	486	23.0
≥ 4,000	241	25.3	165	31.5	76	11.8
Breastfeeding (months)	0.93****		0.98****		0.96****	
< 1.0	900	26.6	483	28.8	417	24.0
1.0 – 2.9	1,074	24.4	545	26.1	529	22.7
3.0 – 5.9	954	25.5	485	27.0	469	23.9
6.0 – 8.9	394	26.9	203	31.0	191	22.5
9.0 – 11.9	159	19.5	83	19.3	76	19.7
≥ 12.0	680	26.3	335	28.7	345	24.1
Total	4,296*****	25.7	2,213	27.6	2,083	23.6

MW: Minimum wages
* Of all the 4,297 interviewees in 2004-2005, information about 136 people was missing (3.2% of interviewees)
** A total of 150 interviewees reported their ethnicity was Asian or indigenous.
*** Chi-square test for heterogeneity
**** Chi-square test for linear trend
***** One value of this variable was ignored in the 2004-5 follow-up visit

pregnancy were statistically associated with higher smoking prevalences in both sexes. Duration of breastfeeding was not associated with smoking in neither sex. Birth weight, unlike other variables, was inversely associated with smoking among women exclusively.

Tables 2 and 3 show crude and adjusted analyses with smoking prevalence ratios, according to independent variables, and stratified by male sex and female sex,

Table 2. Crude and adjusted analyses of independent variable effects on smoking prevalence in young male adults. Pelotas, Southern Brazil, 1982 to 2004-5.

Variable*	Crude analysis			Adjusted analysis**		
	PR	95% CI	p	PR	95% CI	p
Skin color***			0.004****			0.12****
White	1	-		1	-	
Black or Mixed	1.25	1.07;1.46		1.13	0.97;1.33	
Maternal level of education (years)			<0.001*****			0.001*****
0 – 4	1.81	1.39;2.34		1.42	1.02;1.97	
5 – 8	1.48	1.14;1.91		1.22	0.89;1.68	
9 – 11	1.08	0.76;1.52		0.94	0.65;1.38	
≥12	1	-		1	-	
Family income – 1982 (MMW)			<0.001*****			0.05*****
≤1.0	2.60	1.61;4.18		1.87	1.08;3.24	
1.1 - 3.0	2.20	1.38;3.52		1.73	1.01;2.94	
3.1 - 6.0	1.88	1.16;3.06		1.66	0.97;2.82	
6.1 - 10.0	1.71	0.98;3.00		1.66	0.95;2.92	
>10.0	1	-		1	-	
Change in income (1982→2004-5)			<0.001*****			<0.001*****
Always poor	1.68	1.41;2.00		1.32	1.08;1.62	
Not poor → poor	1.48	1.24;1.78		1.35	1.12;1.63	
Poor → not poor	1.28	1.05;1.55		1.02	0.83;1.27	
Never poor	1	-		1	-	
Maternal smoking (1982)			0.001*****			0.003*****
Did not smoke	1	-		1	-	
1-14 cigarettes	1.21	1.04;1.41		1.18	1.01;1.37	
15 or more cigarettes	1.36	1.10;1.67		1.29	1.05;1.58	
Birth weight (grams)			0.29*****			0.41*****
< 2,500	1.03	0.74;1.43		0.89	0.64;1.23	
2,500 – 2,999	0.93	0.71;1.21		083	0.64;1.09	
3,000 – 3,499	0.83	0.64;1.06		0.79	0.61;1.01	
3,500 – 3,999	0.84	0.65;1.09		0.82	0.63;1.06	
≥ 4,000	1	-		1	-	
Breastfeeding (months)			0.41*****			0.37*****
< 1.0	1.00	0.81;1.25		0.99	0.79;1.23	
1.0 – 2.9	0.91	0.73;1.13		0.92	0.73;1.14	
3.0 – 5.9	0.94	0.75;1.18		0.98	0.78;1.22	
6.0 – 8.9	1.08	0.83;1.41		1.17	0.90;1.52	
9.0 – 11.9	0.67	0.42;1.08		0.74	0.45;1.22	
≥ 12.0	1	-		1	-	

MMW: Monthly minimum wages
* Of all the 4,297 interviewees in 2004-5, information about 136 people was missing (3.2% of interviewees)
** Analysis adjusted for: ethnicity on the first level; socioeconomic variables, maternal smoking and birth weight on the second level; breastfeeding on the third level.
*** A total of 150 interviewees reported their ethnicity was Asian or indigenous.
**** Wald test for heterogeneity
***** Wald test for linear trend

respectively. Non-white women were 35% more likely to smoke than white women. Low maternal level of education, low family income and poverty from birth to adulthood were associated with increased risk of smoking in both sexes. Maternal smoking during pregnancy showed a dose-response effect for smoking prevalences in adulthood. This effect remained even after adjustment for the remaining variables and in both

Table 3. Crude and adjusted analyses of independent variable effects on smoking prevalence in young female adults. Pelotas, Southern Brazil, 1982 to 2004-5.

Variable*	Crude analysis			Adjusted analysis**		
	PR	95% CI	p	PR	95% CI	p
Skin color***			<0.001****			0.001****
White	1	-		1	-	
Black or Mixed	1.50	1.27;1.78		1.35	1.14;1.61	
Maternal level of education (years)			<0.001*****			0.05*****
0 - 4	1.73	1.30;2.31		1.30	0.91;1.84	
5 - 8	1.48	1.11;1.98		1.20	0.86;1.67	
9 - 11	1.08	0.74;1.58		0.93	0.63;1.37	
≥12	1	-		1	-	
Family income – 1982 (MW)			<0.001*****			0.04*****
≤1.0	1.94	1.25;3.00		1.37	0.83;2.27	
1.1 – 3.0	1.56	1.02;2.39		1.21	0.75;1.95	
3.1 – 6.0	1.21	0.76;1.93		1.06	0.65;1.71	
6.1 – 10.0	0.94	0.52;1.70		0.89	0.49;1.62	
>10.0	1	-		1	-	
Change in income (1982 → 2004-5)			<0.001*****			<0.001*****
Always poor	2.18	1.81;2.62		1.81	1.43;2.29	
Not poor → poor	1.71	1.39;2.10		1.62	1.31;2.00	
Poor → not poor	1.15	0.89;1.50		0.97	0.72;1.30	
Never poor	1	-		1	-	
Maternal smoking (1982)			<0.001*****			<0.001*****
Did not smoke	1	-		1	-	
1 - 14 cigarettes	1.41	1.20;1.67		1.34	1.13;1.58	
15 or more cigarettes	1.68	1.32;2.14		1.52	1.19;1.95	
Birth weight (grams)			0.01*****			0.43*****
<2,500	2.41	1.24;4.65		1.97	1.02;3.83	
2,500 – 2,999	2.15	1.14;4.03		1.79	0.95;3.38	
3,000 – 3,499	1.93	1.03;3.60		1.76	0.94;3.31	
3,500 – 3,999	1.95	1.03;3.67		1.92	1.01;3.64	
≥4,000	1	-		1	-	
Breastfeeding (months)			0.96*****			0.80*****
<1.0	1.00	0.77;1.28		1.01	0.79;1.31	
1.0 – 2.9	0.94	0.74;1.20		0.93	0.73;1.18	
3.0 – 5.9	0.99	0.77;1.27		1.06	0.83;1.35	
6.0 – 8.9	0.94	0.68;1.29		1.01	0.73;1.40	
9.0 – 11.9	0.82	0.50;1.34		0.79	0.48;1.31	
≥12.0	1	-		1	-	

MW: Minimum wages
* Of all the 4,297 interviewees in 2004-2005, information about 136 people was missing (3.2% of interviewees)
** Analysis adjusted for: ethnicity on the first level; socioeconomic variables, maternal smoking and birth weight on the second level; breastfeeding on the third level.
*** A total of 150 interviewees reported their ethnicity was Asian or indigenous.
**** Wald test for heterogeneity
***** Wald test for linear trend

sexes. Magnitude of effect was a little greater in females, even though the interaction test was not statistically significant (data not shown). In males, there was no association between low birth weight and smoking. In the adjusted analysis, there was no association between birth weight or breastfeeding and smoking prevalence in neither sex.

DISCUSSION

A total of 10 million deaths from smoking per year are estimated for 2020, of which 70% are expected to come from low- and medium-income countries.[A] In addition to the high morbimortality caused by innumerable toxic and cancerous substances in cigarettes, there is the problem of drug addiction to nicotine.[7] Nicotine's addictive effect is known to be one of the most powerful among substances that cause organic dependence, resulting in greater consumption than other drugs, once it is legal.[10] Even though smoking reduction or cessation is among the priorities of all international health agendas, it has been very difficult to meet the expected goals. Nicotine addiction usually begins in adolescence,[10] when 30% of adolescents who try it become addicted.

Prospective cohort studies that can identify smoking trends and the factors that lead individuals to smoke cigarettes may help preventive behavior to be adopted.

The birth cohort study in the city of Pelotas, in 1982, and its follow-up at several moments throughout adolescence and the beginning of adulthood, can provide important contributions to intervention study design, by visualizing smoking trends throughout life and also the effects of early smoking variables in adolescence and adulthood.

There are several ways for the smoking outcome to become operational in epidemiological studies.[12,B] In the Pelotas cohort, the indicators "smoked at least one cigarette in the week prior to interview" for adolescents and "currently smoking" for adults were selected for use. These definitions can result in a certain degree of classification error, once trying cigarettes and occasional smoking, especially among adolescents, are a part of adolescent socialization and, in addition, reports are not always accurate.[12] However, definitions in this study are in accordance with several articles in both national and international scientific literature.[12]

Some of the characteristics of smoking epidemic stages described by Lopez et al[11] were detected in this study. One of them is the fact that female adolescents smoke more than males ($p=0.03$ at 15 years and <0.001 at 19 years). The majority of studies performed in developing countries show higher smoking prevalence in adult males, whereas smoking is more prevalent among females during adolescence.[1,12]

Another finding, already evidenced by a previous cohort study in Pelotas, is the association between maternal smoking during pregnancy and adolescent smoking.[13] Adolescents aged 11 years, whose mothers smoked during pregnancy, were 80% more likely to smoke during adolescence than those whose mothers did not, thus suggesting the existence of an inter-generational smoking effect. This may be partly explained by findings from studies on animals that suggest an increase in the number of nicotine receptors, caused by exposure to intra-uterine nicotine.[16]

In terms of the inverse association with socioeconomic variables, the dose-response effect was evident. This finding is the same, regardless of the variable that represents a socioeconomic indicator – maternal level of education, change in income during the period studied or family income at birth. Study by Monteiro et al[15] showed the smoking trend in Brazilian adults, between 1989 and 2003, with a reduction from 34.8% to 22.4% in this period, which was more significant among men. In addition, data from 2003 show a strong inverse association between level of education and smoking,[15] corroborating the findings of this study.

The magnitude of risks in females was above that in males in all statistically significant associations, in the adjusted analysis. Formal interaction tests by sex did not show statistically significant values (data not shown). Instead, results were shown separately, according to previous publications on smoking in adolescents and adults.[13,15]

In conclusion, the smoking prevalence in individuals of the 1982 birth cohort increased with age, reaching about a fourth of these people at the age of 23. Concentration of smoking in poorer groups suggests that actions such as the increase in cigarette prices – one of the most efficient measures to reduce smoking, according to the World Bank[18] – would have an important impact on the population. Another important measure could be the prevention of smoking during pregnancy, once this practice is a risk factor in both sexes. Results from the 2004 cohort study in Pelotas showed a gestational smoking prevalence of 25.1%, an important reduction, if compared to what was observed in 1982 (35.6%).[3] This reduction can have positive effects on future pregnancies, particularly if the decreasing trend is maintained.

[a] Pan American Health Organization. Framework convention on tobacco control: a public health opportunity for the Americas. Washington; 2001 [cited 2006 Oct 15]. Available from: http://www.paho.org/english/gov/ce/spp/spp35_8-e.pdf
[b] World Health Organization. Tobacco Free Initiative - TFI. Geneva; 2007[cited 2007 Jan 28]. Available from: http: www.who.int./tobacco

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