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Knowledge about tobacco and its health risks in Costa Rica: a structural analysis

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Abstract

Aim: To identify tobacco knowledge and consumption risk determinants based on the Global Adult Tobacco Survey carried out in Costa Rica in 2015.

Methods. Cross-sectional study using a multi-stage cluster sample, nationally representative of Costa Rica (n = 8 607). A structural equation model was conducted. A latent endogenous (dependent) variable called knowledge was constructed. Exogenous (independent) observed variables were: sociodemographic factors, household wealth, prior smoking, cessation attempt, exposure to advertising, and information on the dangers of smoking included in the Global Adult Tobacco Survey.

Results. Knowledge about tobacco and the risks of consumption increased with age, it was higher in men and urban areas. Smokers had less knowledge about passive smoking and more about diseases.

Conclusions. Global Adult Tobacco Survey allowed to measure the level of knowledge about the risks associated with tobacco and study its socioeconomic determinants.

Keywords: tobacco; knowledge; structural equation model; epidemiological determinants.

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Smoking represents one of the major preventable risk factors associated with chronic diseases and mortality worldwide, with a particularly high burden of disease in low- and middle-income countries.[1]

Among the many determinants linked to tobacco, health knowledge has been defined as those facts, information, and skills acquired through experience or education, as well as theoretical or practical understanding of a topic related to health and health care.[2] According to some authors[3] health knowledge is part of health literacy, defined by the World Health Organization (WHO) as "the level of knowledge, personal skills, and confidence to take action to improve personal and community health by changing lifestyles and personal living conditions.[4] Since knowledge increases people's competencies to make health decisions, it has been widely studied, mainly to corroborate whether knowledge levels on specific topics increase the likelihood of health empowerment.[5]

To explain tobacco consumption, different theoretical models have been applied, which consider the potential role of knowledge, since it is estimated that an improvement of them can favor changes in attitudes and health behaviors.[6-8] The Health Beliefs model has been referred to in the framework of health promotion and smoking prevention, based on the subjective perception that each human being has about the risk of getting sick.[9] Thus, knowledge levels could have a positive impact on health behaviors.[4]However, some studies are not always consistent about the influence of knowledge on tobacco-related attitudes and practices. A study in the United States showed that smokers had on average good levels of knowledge. [10] In Italy, ex-smokers had the best knowledge of the health risks of smoking[11]. In low- and middle-income countries, there are different patterns. Using the 2010 *Global Adult Tobacco Survey* (GATS) in Vietnam, it was found that respondents' overall knowledge of the health risks of smoking was on average good. However, when asked about the impact of smoking on specific diseases, the results were poor. In addition, non-smokers and people with higher levels of education were shown to have better knowledge than smokers and people with primary education, respectively.[12] In Iraq, smokers showed generally poor knowledge about the specific health effects of smoking, such as its association with impotence, heart attacks, and premature aging.[13] Finally, some studies suggest that knowledge may be crucial for initiation and cessation of smoking.[14]

Article 4 of the WHO Tobacco Control Convention states that "everyone should be informed about the health consequences, addictive nature and deadly threat posed by tobacco use and exposure to tobacco smoke".[15] Identifying levels of knowledge about the health risks associated with tobacco is an important step for future tobacco control efforts at the national level.

Numerous factors can be associated with knowledge of the health risks caused by smoking, however, it is difficult, a priori, to establish the weights of the different items on a global variable of knowledge. For this, statistical techniques such as structural equation modeling (SEM) are used. This is a multivariate model that allows us to study the relationship between a latent variable and other variables that are observed.[16] The use of these models is rare in health research and epidemiology.[17] There may be socioeconomic determinants that could have different effects on a latent variable of knowledge in different population groups in Costa Rica.

The objective of this research was to identify factors associated with knowledge about tobacco and the risks of tobacco use based on the GATS conducted in Costa Rica.

Methods

The data were obtained from GATS conducted during 2015. It is an epidemiological, observational, cross-sectional study with national representation (n=8607); which was obtained with two types of clusters: by sex and area of residence (urban and rural). A probabilistic sampling was designed in three stages: selection proportional to the size of the primary sampling units, systematic selection of dwellings, and random selection of adults 15 years of age and older. The sample size was calculated considering the prevalence of tobacco use (14.4% in 2010), an estimation error of 3.0%, a confidence level of 95%, and a design effect of 2.0. The final sample adjusted for nonresponse was 9,600 individuals. A total of 4 850 households were visited in urban areas and 4 830 in rural areas.[18]

Construction of the knowledge variable

The dependent variable is a latent variable that measures individuals' knowledge of smoking and its risks. Eighteen questions were used to construct it;

4 questions related to passive smoking (relationship with serious diseases in general, heart disease in adults, lung disease in children, lung cancer in adults) and 14 questions related to active smoking (relationship with serious diseases, stroke, heart attack, lung cancer, emphysema, chronic bronchitis, bladder cancer, breast cancer, stomach cancer, premature birth, dental caries, sexual impotence, hair loss, addiction). Respondents answered "Yes," "No," "Don't know," or "No answer" to each of these questions. The "No" and "Don't know" responses were merged into one category. The response "No answer" accounted for less than 0.1% of the responses for all questions, and was considered missing data. The knowledge questions used in that study are presented in Table 2.

Demographic variables (independent variables) and tobacco use variables included in GATS such as age (in categorized years), sex, and area of residence were used as determinants of knowledge. Socioeconomic variables were constructed: household composition (single person and several adults/presence of children under 15); level of education (completed secondary education/did not complete secondary education) and appliances in the home (advantaged, intermediate, and disadvantaged); [19] tobacco use (non-smoker, ex-smoker for more than 10 years, current smoker); exposure to information about the dangers of cigarette smoking (Yes/No) and exposure to cigarette promotion. Exposure to information about the dangers of cigarette smoking was measured using five media: newspapers, television, radio, billboards, and others. A person was considered exposed if he or she responded that he or she had been exposed to advertisements through any of these media. Exposure to cigarette promotion was considered if they reported noticing an advertisement or event promoting cigarettes or a brand (seventeen questions).

Odds ratios were calculated from weighted bivariate logistic regression between each variable and each knowledge question. All variables were summarized in two modalities: age (44 years and younger/45 years and older), smoking (yes/no), appliances in the house (advantaged/intermediate and disadvantaged), household composition (single or not).

The structural equation model

For data analysis, the *gsem* function of the STATA 14 software was used. The equations relating knowledge and the answers given to the different questions about smoking and its risks were logistic regression equations. The error variance of the latent variable was restricted to 1. The observations were weighted from the GATS weights to obtain a representative sample of the Costa Rican population.

Sensitivity analysis

The sensitivity of the variables included was tested by eliminating the 4 questions about passive smoking, and the sensitivity of the model was tested by using a linear regression model to estimate the relationship between knowledge and the independent variables; to confirm or confirm the SEM results. The dependent variable knowledge was created by adding the responses to the 18 questions about smoking and its risks.

Construction of the variable false beliefs

A second model was created, in which the latent variable measures false beliefs about smoking and its risks. The same 18 questions were used. Yes" and "Don't know" responses were merged into a single category. GATS was considered exempt from review by a scientific ethics committee, as it was part of the work of the Ministry of Health and complied with article 7 of Law No. 9234: Biomedical Research Regulatory Law. Informed consent was not required, as it was a secondary analysis of public databases.

Results

Descriptive statistics for the sample are presented in Table 1. The percentage of people who answered correctly ("Yes") to each question about tobacco and its risks is shown in Table 2. The percentage of correct answers exceeded 90% in 9 questions; 98% of the respondents knew the relationship between tobacco and lung cancer; 96% knew that passive smoking is dangerous, and 95% knew that cigarettes are addictive. On the other hand, the percentage of correct answers did not exceed 70% for 5 questions. Only 43% of respondents were aware of the relationship between smoking and bladder cancer, 54% with breast cancer, and 47% with hair loss. 21.6% of the weighted population answered the 18 knowledge questions correctly.

Table 1. Characteristics of the sample: absolute (N), relative (%), weighted relative (%P) frequencies

Features	N	%	%P
Sex			
Men	3544	41,2	50,3
Women	5063	58,8	49,7
Age (years)			
15-24	1377	16,0	23,3
25-44	3049	35,4	40,9
45-64	2662	30,9	26,5
>=65	1519	17,7	9,3
Tobacco use			
Non-smoker	6469	75,2	73,8
Former smoker (over 10 years)	879	10,2	8,6
Former smoker (less than 10 years)	605	7,0	8,7
Current smoker	654	7,6	8,9
Zone			
Urbana	4257	49,5	74,0
Rural	4350	50,5	26,0
Education			
Completed high school	2306	72,8	65,3
Did not complete high school	6264	26,8	34,1
NR	37	0,4	0,7
Artifacts in the house (wealth)			
Favored	3623	42,1	52,9
Intermediate	3883	45,1	39,1
Disadvantaged	1101	12,8	8,0
Household composition			
Single person	1330	15,5	6,0
Several adults	3056	35,5	43,6
Presence of children under 15 years of age	4221	49,0	50,5
Exposure to information			
No	2384	27,7	27,8
Yes	6223	72,3	72,2
Exposure to advertising			
No	6477	75,3	72,6
Yes	2130	24,7	27,4
Total	**8607**	**100,0**	**100,0**

Table 2. Questions and answers about tobacco and its risks (N=8607)

Questions	Knowledge* %	False Beliefs* %
Passive smoking		
Q1. Can breathing in smoke produced by other people cause serious illness in non-smokers?	96	3
Does breathing secondhand smoke cause any of the following conditions?		
P2. Heart Disease in Adults	87	4
P3. Lung diseases in children	97	1
P4. Adult Lung Cancer	96	1
Current Smoking		
A1. Does tobacco smoking cause serious illness?	98	2
A2. Do you think cigarettes are addictive?	95	3
Does smoking tobacco cause any of the following?		
A3. Spill	71	6
A4. Heart Attack	90	3
A5. Lung cancer	98	1
A6. Emphysema	90	2
A7. Chronic bronchitis	95	1
A8. Bladder cancer	43	15
A9. Breast cancer	54	14
A10. Stomach cancer	66	10
A11. Preterm birth	86	3
A12. Dental caries	94	2
A13. Sexual impotence	67	5
A14. Hair loss	47	12

*= Weighted percentage of people who answered "Yes" (Knowledge) and "No" (False beliefs). The rest of the people answered "Don't know" or did not want to answer (<1%). Source: Own production

Table 3 presents the relationships between each sociodemographic variable and each knowledge variable. On average, men had more knowledge than women; mainly related to diseases such as bladder and stomach cancers, or sexual impotence and hair loss. Knowledge increased with age, except for knowledge associated with the effect of passive smoking on children, premature birth, or dental caries, but decreased with poverty level and was not related to education.

Table 3. Odds ratio of the bivariate relationship between each of the knowledge questions and the socioeconomic variables (N=8607)s

Variable	Sex	Age	Poverty	Smoking	Education	Home	Zone	Information	Advertising
Total	--	++	--	NS	NS	NS	--	++	NS
P1	**1,46**	0,97	0,87	0,80	1,21	**0,35**	0,82	**2,26**	0,94
P2	1,06	**1,50**	1,04	1,08	**0,81**	**1,28**	0,97	1,18	0,94
P3	1,31	**0,72**	0,82	**0,61**	**1,48**	**0,53**	**0,69**	1,27	1,40
P4	1,07	0,80	0,92	**0,55**	1,15	**0,70**	0,80	1,09	0,81
A1	1,13	0,86	0,74	0,66	1,18	**0,32**	**0,63**	**2,00**	1,18
A2	0,93	0,88	0,78	1,40	**2,40**	**0,69**	0,90	1,02	0,98
A3	0,98	**1,87**	0,95	1,01	0,93	**1,60**	**0,89**	**1,27**	1,14
A4	0,98	**1,34**	**0,80**	**1,59**	1,14	1,08	**0,79**	**1,31**	1,19
A5	0,96	0,70	**0,46**	**0,54**	1,41	**0,49**	0,78	1,41	1,32
A6	0,87	**1,68**	**0,62**	**1,69**	**1,51**	1,17	**0,55**	0,98	**0,71**
A7	1,05	1,19	**0,63**	0,91	**1,77**	0,85	**0,59**	1,14	1,32
A8	**0,74**	**1,46**	0,96	**1,25**	**0,84**	**1,38**	0,96	**1,19**	0,97
A9	0,89	**1,31**	**0,86**	1,21	0,94	**1,22**	**0,89**	1,09	1,09
A10	**0,80**	**1,12**	0,93	**1,32**	0,94	1,10	0,92	**1,17**	**1,18**
A11	0,88	**0,70**	**0,73**	**1,52**	**1,26**	**0,80**	**0,87**	0,95	**1,39**
A12	1,01	**0,54**	**0,64**	0,79	1,02	**0,61**	**0,79**	1,03	1,10
A13	**0,71**	1,11	**0,69**	**1,39**	**1,23**	1,15	**0,73**	1,06	0,99
A14	**0,86**	**1,18**	0,96	1,01	0,87	**1,41**	**0,90**	1,11	1,11

Weighted sample. Logistic regression: In bold ($p<0.05$), References: Sex (Male), Age (less than 45 years), Poverty (No), Smoking (No), Education (Not completed), Household (people living with other people), Area (Urban), Exposure to information (No), Exposure to advertising (No). Total: Sum of correct answers. T-Test: -- negative relationship ($p<0.01$), - negative relationship ($p<0.05$), ++ positive relationship ($p<0.01$), + positive relationship ($p<0.05$), NS non-significant relationship ($p>0.05$).

Smokers were less knowledgeable about passive smoking and more knowledgeable about various diseases. There was no difference in knowledge by household composition (living alone or not). However, people living alone had less knowledge about secondhand smoke or preterm birth, and more about stroke or bladder or breast cancer. Exposure to information was positively related to knowledge, but advertising was not.

Figure 1 presents the structural model; out of 18 questions about smoking, 17 were significantly related to the latent variable of knowledge, except variable A2 (cigarette addiction), which was the only variable, which was not related to knowledge.

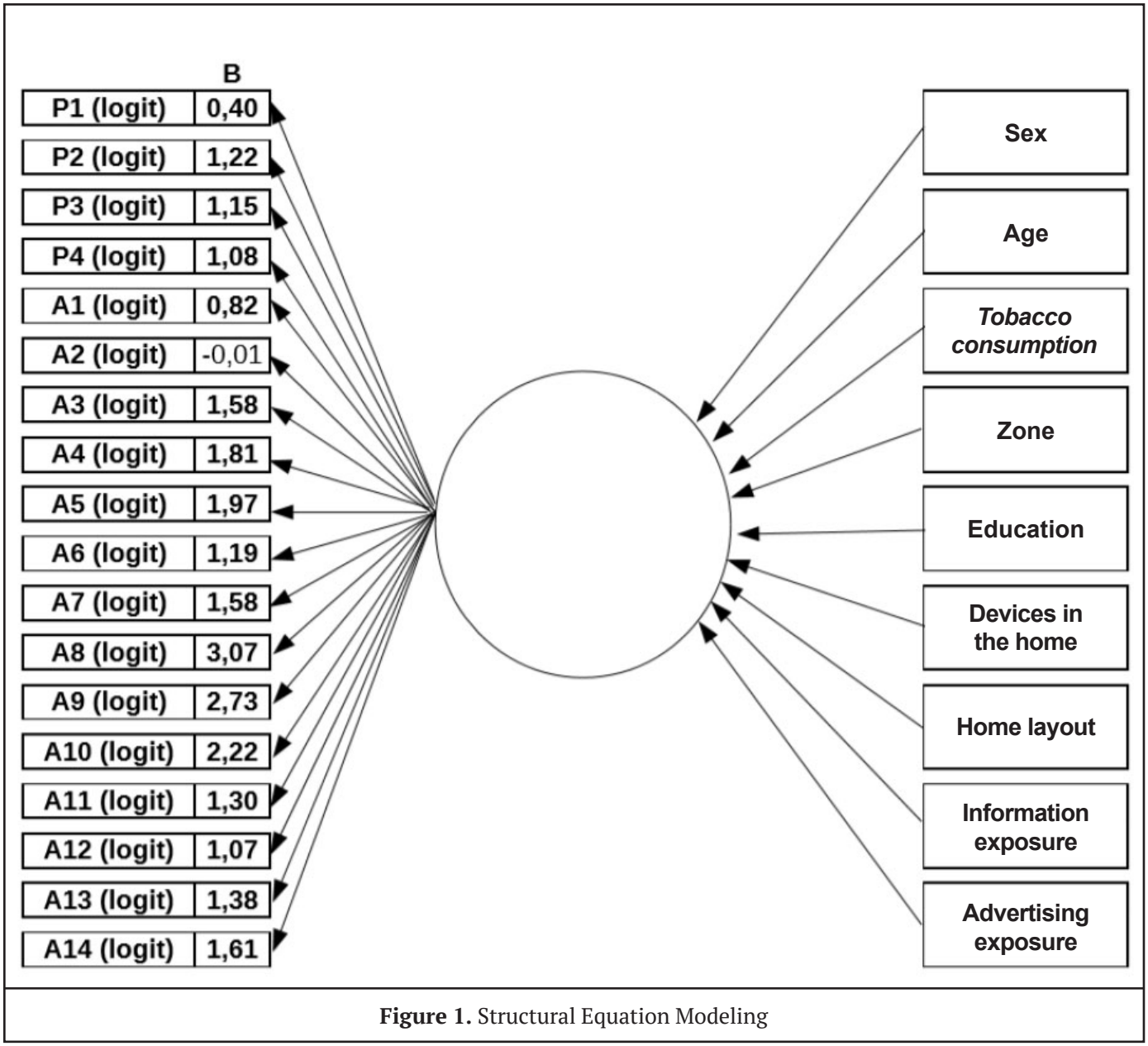

Figure 1. Structural Equation Modeling

Table 4 presents the results of the structural equation related to the knowledge variable and the independent variables. The mean of the knowledge variable increased with age and was higher in men compared to women. It was not related to smoking. Concerning the socioeconomic variables, knowledge was related to wealth, but not to the level of education. Indeed, more affluent people had higher mean knowledge than more disadvantaged people (B3=0.26 [-0.36- -0.16]). People living in urban areas had more knowledge than those in rural areas (BRURAL=0.08 [-0.14- -0.02]). People living alone had more knowledge. There was no relationship between exposure to cigarette promotion and knowledge. People who reported exposure to information about smoking and its risks were more knowledgeable.

Table 4. Structural models (N=8607). Model 1 (M1), with the latent variable: knowledge. Model 2 (M2), with the latent variable: False beliefs.

Socio-economic and demographic variables	**M1: Knowledge**		**M2: False Beliefs**	
Sex				
Men	0		0	
Women	-0,13 [-0,19- -0,07]	<0,01	0,07 [0,01- 0,13]	<0,05
Age (years)				
15-24	0		0	
25-44	0,10 [0,02-0,18]	<0,05	-0,08 [-0,16-0,01]	<0,05
45-64	0,23 [0,14-0,32]	<0,01	-0,16 [-0,24- -0,08]	<0,01
>=65	0,24 [0,14-0,35]	<0,01	-0,22 [-0,32- -0,13]	<0,01
Tobacco use				
Non-smoker	0		0	
Former smoker (over 10 years)	0,05 [-0,05-0,16]	NS	-0,12 [-0,22- -0,01]	<0,05
Former smoker (less than 10 years)	-0,03 [-0,15-0,09]	NS	-0,02 [-0,13-0,09]	NS
Current smoker	0,07 [-0,05-0,18]	NS	0,11 [0,02-0,21]	<0,05
Zone				
Urbana	0		0	
Rural	-0,08 [-0,14- -0,02]	<0,01	-0,16 [-0,21- -0,10]	<0,01
Education				
Completed high school	0		0	
Did not complete high school	0,05 [-0,02-0,12]	NS	-0,01 [-0,07-0,05]	NS
Artifacts in the house (wealth)				
Favored	0		0	
Intermediate	-0,09 [-0,16- -0,03]	<0,01	0,01 [-0,05-0,07]	NS
Disadvantaged	-0,26 [-0,36- -0,16]	<0,01	0,12 [0,03-0,22]	<0,01
Household composition				
Single person	0		0	
Several adults	-0,09 [-0,17- -0,00]	<0,05	-0,13 [-0,20- -0,06]	<0,01
Presence of children under 15 years of age	-0,08 [-0,17- 0,00]	NS	-0,35 [-0,42- -0,27]	<0,01
Exposure to information				
No	0		0	
Yes	0,11 [0,05-0,18]	<0,01	-0,13 [-0,19- -0,07]	<0,01
Exposure to advertising				
No	0		0	
Yes	0,03 [-0,04-0,09]	NS	0,16 [0,10-0,22]	<0,01
Variance Error	1		1	

NS: non-significant relationship.

Sensitivity analysis discarding the passive smoking variables showed the same results. Sensitivity analysis using a linear regression model showed similar results. The only notable difference was that household composition was not significantly related to knowledge in the model.

The analysis of false beliefs showed some similarities and differences from the analysis of knowledge. People who were exposed to advertising and smokers were more likely to have false beliefs. Men, older adults, more advantaged people, and those exposed to information about the risks of smoking were less likely to have false beliefs, which is consistent with the knowledge study. Similarly, there was no relationship between the level of education and false beliefs. Those living in rural areas and those living with others, particularly children, were less likely to have such beliefs, although they showed less knowledge.

Discussion

The main results of this study show that tobacco consumption is not related to knowledge of the risks associated with tobacco, but to false beliefs; knowledge increases with exposure to information about tobacco and its risks, age, wealth, is higher in men compared to women and in urban versus rural areas.

The absence of a relationship between knowledge and tobacco use contradicts the results of previous studies. However, the relationship between false beliefs and tobacco use was evident, which is consistent with the literature. For example, Ahluwalia *et al.* showed that knowledge of the risks of smoking was higher in non-smokers than in smokers in most of the middle- and low-income countries studied.[20] Similarly, Stepoe *et al*. showed that the most knowledgeable students were those who smoked the least. [21] Other studies mention, in the case of smokers, that even if they have substantial knowledge about the harmful effects of smokeless tobacco, they are still addicted, due to their psychological and emotional dependence.[22] The difference observed between the knowledge model and the false belief model could indicate that it is not the lack of knowledge that increases the risks of smoking, but the conviction that tobacco is not dangerous.

The study showed that knowledge increased with age, which also contradicts the literature.[23] Gupta and Kumar found using the GATS 2014 survey that knowledge decreased with age in most middle- and low-income countries. This effect was more important in Asian countries (China, Bangladesh, Vietnam, India) compared to Latin American countries (Brazil, Uruguay, Mexico). Only in Russia was it shown that knowledge levels increased with age. In this case, only the two questions related to the danger of smoking and passive smoking were used, without adjusting the model. Regarding these two questions, in this research knowledge did not increase with age. This could be related to the fact that the greatest efforts to inform the population about the risks of smoking in Costa Rica have been concentrated in an adult population. Regarding the association between knowledge levels and sex, this study showed that they were higher in men than in women. Gupta and Kumar[24] found this same result in China and India, but not in Latin American countries. Similarly, results consistent with Gupta and Kumar's reports were found previously, if the analysis is limited to questions on smoking and passive smoking only. It was revealed that knowledge levels were higher in urban than in rural areas, which is consistent with results from Mexico and Brazil. However, false beliefs were also higher in urban areas.

Concerning socioeconomic variables, it was found that knowledge was related to wealth, but not to the level of education. In effect, the more advantaged people had greater knowledge, if compared to the more disadvantaged people, which was already evidenced in the bibliography.[24,25]

These results place Costa Rica among the countries where knowledge is high.[22,25]

People who reported exposure to information about tobacco and its risks were more knowledgeable, which is consistent with the literature,[26404] confirming that the anti-smoking campaigns carried out in the country have been successful; the population has a good level of knowledge about the risks of tobacco use.

The determinants of knowledge were found to vary according to people's exposure to risk. Although knowledge increased with age, it decreased for questions about passive smoking in children, preterm birth, or dental caries. This result deserves further exploration.

The main limitation of the study is related to the concept of knowledge about tobacco risks, which is not an internationally validated and standardized measurement, which restricts its comparability. It was decided to approximate it using an SEM incorporating all questions available in GATS. Indeed, the results could differ if the methodology is modified. The determinants of the responses to each question are variable. However, the sensitivity analysis showed the robustness of the results. Another limitation is related to the design of GATS. Being cross-sectional, it does not allow us to know the effects of knowledge in the long term. The role of knowledge may be important on smoking initiation or cessation.[27, 28]

The study has strengths: GATS is internationally standardized; the weighted sample is representative of the Costa Rican population.

In conclusion, it was shown using a SEM, that the best levels of knowledge associated with smoking have demographic and sociocultural determinants. These results are of policy and health relevance to guide future programs, promoting mass advertising, informing about the harmful effects of tobacco on health, as a factor potentially associated with the initiation or cessation of smoking. It could underline the importance of adapting the means of communicating information about tobacco risks to the type of audience.

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