

Tobacco use among the elderly: a systematic review and meta-analysis

Uso de tabaco entre idosos: revisão sistemática e meta-análise

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Abstract

The aim of this study was to combine the results of identified surveys on the prevalence of tobacco use in old age to estimate world prevalence of tobacco use and possible factors related to such behavior among the elderly. The literature search included electronic databases such as MEDLINE, LILACS, and Biological Abstracts, hand-searching of specialist journals and cited reference searches. The combined global prevalence was estimated using the random effects model. The total number of elderly subjects included in all surveys was 140,058, with data available from all the continents. Overall prevalence of tobacco use was 13% in both genders (22% male and 8% female). The prevalence rates were heterogeneous among surveys and were associated with smoking definition, questionnaire application, and country economic status. Few epidemiological studies assessed tobacco use among the elderly. A higher prevalence rate of tobacco use in males who live in higher income countries could be found, although additional evidence regarding elderly samples is still required.

Tobacco; Smoking; Aged

Introduction

Tobacco use is responsible for almost 10,000 deaths each day and approximately 4.9 million deaths per year worldwide ¹. Cigarette smoking has been linked to several diseases such as respiratory and ischemic heart diseases, stroke, lung, upper respiratory and digestive tract cancers, and peptic ulcer ¹. This habit may contribute to the morbidity and disability associated with many of those illnesses, and it results in a burden of US\$ 157 billion in health-related economic costs in the United States ².

Smoking is now recognized as a major public health problem also among the elderly. Risk of death among older smokers is higher than among their nonsmoking counterparts. Morbidity and mortality from cancer, stroke, cardiovascular, and respiratory diseases are also higher among elderly smokers ^{3,4}. Some data suggest that, as a group, the elderly not only smoke for a longer period of time than younger smokers, but are also less aware of the potential harms of tobacco use. As a result, they are more resistant to quit smoking, do not report a greater number of quitting attempts or methods, and tend not only to underestimate the risks but also to overestimate the benefits of smoking ^{3,5}. Among the barriers that impact the success of smoking cessation attempts, the elderly have high rates of nicotine dependence ⁶ and are more likely to be dealing with life stresses and social isolation ³.

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The need to gather information about tobacco consumption in vulnerable groups of individuals was previously reinforced as an important step for the development of appropriate intervention strategies to cessation⁷. Factors affecting tobacco use and its prevalence among the elderly are not completely understood. Understanding the values, beliefs, attitudes, and behaviors in relation to smoking among older individuals may help in the development of strategies that seek to reduce the associated morbidity and mortality. Consequently, the aim of this paper is to evaluate the prevalence of tobacco use among the elderly and to identify factors that are associated with variation in prevalence across studies.

Method

Search strategy

In order to gather as many studies as possible on the issue, the strategy for data collection aimed to identify papers which presented broad definitions of tobacco use, either everyday or some day use, regardless of the amount of smoking. The following sources were searched looking for cross-sectional studies: (i) electronic databases (MEDLINE, LILACS, and Biological Abstracts); (ii) hand-searching of specialist journals (journals most likely to contain surveys in this area have been searched such as *Am J Public Health*, *Addiction*, *Tob Control*, *MMWR Morb Mortal Wkly Rep*, and *Prev Med*); and (iii) cited reference searches.

As a first step, the search strategy used the following terms: (tobacco OR smok* OR cigarette) AND (elder* OR aged OR old) AND (epidemiology OR survey OR prevalence), which identified only three studies on the frequency of tobacco use in the elderly. In an attempt to find more studies, we performed a second search with the terms (tobacco OR smok* OR cigarette) AND (epidemiology OR survey OR prevalence).

Inclusion/exclusion criteria

All relevant surveys published between 1992 and 2004, with no language restrictions, were considered for this review. Surveys were eligible if they were conducted in the community with locally representative randomly selected samples, including persons from all age groups. Only data on the elderly were considered for the present review. Furthermore, studies were included if the questionnaires were designed to measure smoking habits with the definition specified in the text, no matter the type of use, amount and kind of tobacco product.

Studies were excluded for the following reasons: absence of aged subjects in the sample; lack of relevant information such as number of elderly people in the sample, prevalence rates of tobacco use in the elderly not reported; articles on tobacco-related medical conditions; review articles and technical impairment to access full text article (such as non availability on web, medical libraries, and at least two email contacts with the author).

Data management

The methodological procedures of the selected trials was assessed by two independent reviewers (V.M. and S.L.B.), who also extracted the data. In cases where the studies failed to describe the total elderly sample, or the method in use, the authors of the original studies were contacted for additional information (at least two email contacts with the author).

Data extraction

The country, year of data collection, socio-demographic measures, sample size of the elderly, prevalence rates, and methodological characteristics (such as type of interview and smoking definition) of the studies were extracted from the selected papers.

Statistical analysis

Studies which reported data from samples aged 60 years or more were analyzed together with those which reported data from samples with individuals above 65 years of age. We included studies which allowed the calculation of the standard error ($n = 32$). Homogeneity was evaluated by chi-squared test with significance level of 0.05 and I-squared statistic⁸. As the data were very heterogeneous, the random effects model was used. Analyses were carried out for both genders, together and separately, including other socio-demographic variables. Statistical analysis was performed using the "meta" command from Stata 10 program (Stata Corp., College Station, USA). Meta-regression was used to investigate variables associated to prevalence estimates.

Results

Of the 1,400 papers found, 160 abstracts were reviewed and 48 studies were included. We identified three epidemiological studies dealing with tobacco use among community-dwelling elderly^{9,10,11}. The other 45 studies were carried out in

community-living adults which included elderly samples. All these data were further checked reading the full paper.

Table 1 outlines the methodological characteristics of the included surveys.

Data were available from surveys carried out in all the continents and both north and south hemispheres. The adult population was largely assessed in all surveys, and the elderly subjects represented a small proportion of them. There was a wide variation in the number of participants aged 60 years and older included in the surveys, ranging from 52¹² to 40,146 subjects¹³, and the total number of elderly subjects included in all surveys was 140,058 (median = 1,233).

Questionnaire application was not homogeneous. Three studies were via telephone calls^{12,14,15}; three studies performed interviews both via telephone calls and personally in the household^{16,17,18}. Respondents were invited to attend a health center where they were interviewed in one survey¹⁹, and in another one the questionnaire was either completed in a health center or sent to the respondents' houses²⁰. The other 37 studies were solely conducted in household.

Information on adult current cigarette use was provided by the interviewee, except in nine surveys that allowed for proxy responses^{11,13,18,21,22,23,24,25,26}.

Tobacco users were classified as *smokers*, *regular smokers*, *tobacco smokers*, *cigarette smokers*, *current smokers*, and *hardcore and heavy smokers*.

Definition of *smokers* were: (i) "those smoking every day"²⁷; (ii) "subjects who smoke daily or sometimes at the time of examination"^{28,29,30,31}; and (iii) "smoking one or more cigarettes weekly for 6 months or more before the survey"³².

Definition of *regular smokers* included those people who: (i) "reported that they currently smoke daily or occasionally"³³; (ii) "those adults who smoked at least on a weekly basis"³⁴; (iii) *Cigarette Smokers Regular light smokers* – "those who smoked less than one packet a day"²².

Current smokers were defined as those: (i) "smoking at least one cigarette each day"^{19,35}; (ii) "smoking one or more cigarettes daily for 6 months or more before the survey"^{36,37}; (iii) "smoking tobacco products at the time of the survey"^{15,38,39,40,41,42}; (iv) "having smoked at least 100 cigarettes in one's lifetime and currently smoke every day or some days or continue to smoke regularly or were still smoking daily at the time of the interview"^{10,11,12,14,17,26,43,44,45,46,47}; (v) individuals who gave positive response to the questions "Have you ever smoked regularly?", and "Do you currently smoke?", or "Do you still smoke?"⁴⁸; (vi) "those who had smoked in the past month"²¹;

(vii) "respondents who reported that they had smoked in the three months prior to the survey"⁴⁹. Furthermore, some surveys considered *current smokers* as: (i) *regular or daily smokers* – "who at the time of the interview smoked at least one cigarette per day"; (ii) *occasional smokers* – "who at the time of interview did not smoke every day"^{49,50}; (iii) *ever smokers* – "more than 100 cigarettes in their lifetime"⁵¹.

Heavy smokers were defined as: (i) "smokers with a daily consumption of more than 14g of tobacco"²⁸; (ii) "individuals who consumed more than 25 cigarettes per day"⁵¹; (iii) "those currently smoking ≥ 15 cigarettes per day"²⁵. Definition of *hardcore smokers* comprised people who answered: (i) "less than a day without cigarettes in the past five years"⁷; (ii) "no attempt to give up smoking in the past 12 months"⁷; (iii) no to "Do you want to give up smoking altogether?"⁷; (iv) "no intention to give up smoking"⁷; and (v) *Regular heavy smokers* – "those who smoked one packet or more daily"²².

Some other definitions that were found included: (i) *cigarette smoking* – self-reported daily use of these products⁵²; (ii) *tobacco smokers* – "people who answered 'yes' to the question of smoking tobacco"¹³; (iii) *occasional smokers* – "those who smoked less than one cigarette a day"²². In some studies there was no definition of smoking status and smokers were classified as current smokers^{20,23,53,54}. Data derived from these less specific definitions were analyzed as "No definition", therefore separately from the better delineated definitions listed above.

In three surveys, definition of tobacco use included local tobacco products such as *beedies*⁴⁴, *toombak*⁵⁵, *waterpipe*²², and one included other forms of tobacco use such as *chewing of tobacco*¹³. Data on local and non-inhaled tobacco products were not included for analysis.

Overall prevalence of tobacco use was higher for men. Smoking prevalence among males was highest in Indonesia (84.5%)²¹, and lowest in Australia (11%)³⁴. Among females, the smoking prevalence was highest in Tonga (26.1%)⁴⁹, and lowest in Kazakhstan (0.4%)³⁵ and Bulgaria (0%)²⁷. Some studies described prevalence rates for both genders and rates varied from 6.8% in the United States¹⁷ to 63% in Copenhagen, Denmark²⁸.

Meta-analysis results can be seen in Figures 1, 2 and 3. A statistical procedure confirmed the initial assumption of a greater prevalence in men, with an overall prevalence of 13.5% (95%CI: 12.0-15.1). Smoking prevalence rates by gender were 22.5% (17.0-28.1) and 8.7% (6.8-10.6) for men and women, respectively. The chi-squared test for homogeneity and I-squared statistic showed

Table 1

Methodological characteristics of included surveys.

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Gilmore et al. ³⁵ (2004)	Questionnaire survey	USSR: household interview	No	Current smokers: respondents reporting currently smoking at least 1 cigarette per day	18,428 participants aged ≥ 18 years	Participants aged ≥ 60 years: Armenia: 560; Belarus: 558; Georgia: 558; Kazakhstan: 376; Kyrgyzstan: 318; Moldova: 520; Russia: 1,118; Ukraine: 852	≥ 60 years. Total sample (M: 37%/W: 1.5%), Armenia (M: 44.4%/W: 1%), Belarus (M: 40.3%/W: 0.9%), Georgia (M: 33.9%/W: 3.4%), Kazakhstan (M: 50%/W: 0.4%), Kyrgyzstan (M: 25%/W: 1.7%), Moldova (M: 24.7%/W: 1.1%), Russia (M: 42.3%/W: 2.5%), Ukraine (M: 35.7%/W: 1%)
INCA ⁴⁷ (2004)	Questionnaire survey	Brazil (Manaus, Belém, Fortaleza, Natal, João Pessoa, Recife, Aracaju, Campo Grande, Distrito Federal, Belo Horizonte, Vitória, Rio de Janeiro, São Paulo, Curitiba, Florianópolis, Porto Alegre): household survey	No	Current smokers: persons who reported both having smoked ≥ 100 cigarettes during their lifetime and currently smokes every day or some days	23,457 participants aged ≥ 15 years	Participants aged ≥ 60 years: Manaus: 142; Belém: 145; Fortaleza: 270; Natal: 95; João Pessoa: 140; Recife: 147; Aracaju: 83; Campo Grande: 69; Distrito Federal: 154; Belo Horizonte: 269; Vitória: 83; Rio de Janeiro: 460; São Paulo: 118; Curitiba: 242; Florianópolis: 112; Porto Alegre: 236	≥ 60 years: Manaus (M: 21.7%/W: 11%), Belém (M: 18.6%/W: 3.5%), Fortaleza (M: 21.1%/W: 8.7%), Natal (M: 21.1%/W: 3.5%), João Pessoa (M: 15.4%/W: 6.8%), Recife (M: 21.2%/W: 7.4%), Aracaju (M: 21.2%/W: 8%), Campo Grande (M: 15.2%/W: 11.1%), Distrito Federal (M: 15.9%/W: 9.9%), Belo Horizonte (M: 15.2%/W: 2.8%), Vitória (M: 8.6%/W: 8.3%), Rio de Janeiro (M: 16.2%/W: 8.2%), São Paulo (M: 24.1%/W: 9.4%), Curitiba (M: 20.8%/W: 14.7%), Florianópolis (M: 12.5%/W: 8.3%), Porto Alegre (M: 19.6%/W: 12.5%)
Lima-Costa ²⁴ (2004)	Questionnaire survey	Brazil: household interview	Yes – proxy interviews represented 28% of total sample	Current smokers	13,701 both sex aged ≥ 20 years	1,774 participants aged ≥ 60 years	≥ 60 years (12.8% both sex)

(continues)

Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Santos & Barros ⁵¹ (2004)	Questionnaire survey	Portugal: household interview	No	Current smokers: included both daily (at least 1 cigarette per day at the time of the survey) and occasional smokers (less than a cigarette per day)	1,690 participants both sex aged ≥ 18 years	-	60-69 years (M: 26.2%/W: 4.5%), ≥ 70 years (M: 13.9%/W: 1.4%)
Villabí et al. ³¹ (2004)	Questionnaire survey	Spain: household interview	No	Smokers: included both daily and occasional smokers	8,833 participants both sex aged ≥ 15 years	2,140 participants aged ≥ 64 years (M: 827 men/W: 1,314)	≥ 64 years (M: 20.4%/W: 2%/both sex: 9.2%)
Jarvis et al. ⁶ (2003)	Questionnaire survey	England: household interview	No	Hardcore smoker: less than a day without cigarettes in the past 5 years; no attempt to give up smoking in the past 12 months; no to "Do you want to give up smoking altogether?"; no intention to give up smoking	7,766 both sex cigarette smokers aged ≥ 16 years	1,083 participants aged ≥ 65 years	≥ 65 years (16% both sex/5% both sex hardcore smoking)
Lau et al. ¹⁵ (2003)	Questionnaire survey	Hong Kong, China: telephone interview	No	Current smokers: smoking tobacco products at the time of the survey	39,963 women aged ≥ 18 years	6,176 women aged ≥ 61 years	61-65 years (1.9%), 66-70 years (2.4%), > 70 years (2.7%)
Rani et al. ¹³ (2003)	Questionnaire survey	India: household interview	Yes – the questionnaire was administered to the head of the household or to any other competent adult member of the household	Chewing of tobacco: those people who answered "yes" to the question on chewing tobacco/ Tobacco smokers: those people who answered "yes" to the question of smoking tobacco	334,553 participants both sex aged ≥ 15 years	40,146 participants aged ≥ 60 years	Tobacco smoking: ≥ 60 years (M: 38.1%/W: 5.2%); chewing of tobacco: ≥ 60 years (M: 22.4%/W: 37.4%)

(continues)

Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Shapo et al. ¹⁹ (2003)	Questionnaire survey	Albania: respondents were invited to attend a health center in Tirana where they were interviewed	No	Current smokers: smoking at least one cigarette each day	1,120 participants both sex aged ≥ 25 years	229 participants aged ≥ 65 years; 135 (25.2%) men and 94 (16.1%) women	≥ 65 years (M: 26.7%/W: 18.1%/both sex: 23.1%)
White et al. ³⁴ (2003)	Questionnaire survey	Australia: household interview	No	Regular smokers: those adults who smoked at least on a weekly basis	All samples included both sex participants aged ≥ 18 years. 1980 sample: 3,696; 1983 sample: 5,087; 1986 sample: 8,513; 1989 sample: 5,314; 1992 sample: 6,304; 1995 sample: 5,149; 1998 sample: 7,852; 2001 sample: 23,376	Aged ≥ 60 years. 1980 sample: 733; 1983 sample: 1,002; 1986 sample: 1,819; 1989 sample: 1,175; 1992 sample: 1,386; 1995 sample: 1,414; 1998 sample: 1,928; 2001 sample: 4,992	≥ 60 years. 1980 sample: (M: 22%/W: 18%/both sex: 20%), 1983 sample (M: 26%/W: 17%/both sex: 21%), 1986 sample (M: 22%/W: 17%/both sex: 19%), 1989 sample (M: 18%/W: 15%/both sex: 17%), 1992 sample (M: 16%/W: 12%/both sex: 14%), 1995 sample (M: 15%/W: 12%/both sex: 13%), 1998 sample (M: 12%/W: 12%/both sex: 12%), 2001 sample (M: 11%/W: 8%/both sex: 10%)
Woollery et al. ⁴⁶ (2003)	Questionnaire survey	USA: household interview. Data from the NHIS	No	Current smokers: persons who reported both having smoked ≥ 100 cigarettes during their lifetime and currently smokes every day or some days	NHIS 2001: 33,326 participants both sex aged ≥ 18 years		≥ 65 years (10.1% both sex)
Bursac et al. ¹⁴ (2002)	Questionnaire survey	Oklahoma (USA): telephone interview. Data from the BRFSS, Oklahoma BRFSS, Oklahoma REACH 2010 BRFS	No information about proxy interviews	Cigarette smoker: individual that smoked 100 or more cigarettes in their lifetime and currently smokes every day or some day	3,732 surveys from 7 strata		≥ 65 years (16.4% both sex American Indians/ Alaska Natives)
Steyn et al. ³³ (2002)	Questionnaire survey	South Africa: household interview	No	Regular smokers: those people who reported that they currently smoke daily or occasionally	13,826 participants both sex aged ≥ 15 years	1,473 aged ≥ 65 years	≥ 65 years (M: 38.5%/W: 7.6%)

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Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Gilmore et al. ⁴⁸ (2001)	Questionnaire survey	Ukraine: household interview	No	Current and previous smoking: subjects who gave a positive reply to the questions: "Have you ever smoked?" and "Do you still smoke?"	1,590 participants both sex aged ≥ 18 years		≥ 60 years (M: 32.6%/W: 0.8%)
Gilmore et al. ⁵³ (2001)	Questionnaire survey	Belarus: household interview	No	Current smokers	1,090 participants both sex aged ≥ 18 years	269 aged ≥ 60 years	≥ 60 years (M: 41.9%/W: 0.7%)
Lima-Costa et al. ¹¹ (2001)	Questionnaire survey	BambuÍ (Brazil): household interview	Yes – proxy interviews represented 5.6% of total sample	Current smokers: subjects who reported having smoked ≥ 100 cigarettes during their lifetime and who currently smoked	1,606 participants both sex aged ≥ 60 years	1,606 aged ≥ 60 years	≥ 60 years (18.7% both sex)
Nasir & Rehan ⁴⁴ (2001)	Questionnaire survey	Pakistan: household interview	No	Smoker: smoked more than 100 cigarettes or beedies in the lifetime and was still smoking	13,104 participants both sex aged ≥ 8 years	818 aged ≥ 65 years	≥ 65 years. Regular smokers (M: 38.5%/W: 7.6%), daily smokers (M: 35.4%/W: 6.6%)
Ohida et al. ⁴² (2001)	Questionnaire survey	Japan: self-administered questionnaire	No	Current smokers: smoking tobacco products at the time of the survey	38,710 participants both sex aged ≥ 15 years	8,432 aged ≥ 60 years (M: 3,655/W: 4,777)	≥ 60 years (M: 42.9%/W: 7.7%)
Shah et al. ⁴⁵ (2001)	Questionnaire survey	Ghizar District (Pakistan): household interview	No	Cigarette smokers: respondents who were currently smoking and who had smoked ≥ 100 cigarettes in their lifetime	4,203 participants both sex aged ≥ 18 years	562 aged ≥ 60 years	≥ 60 years (M: 25.4%/W: 18.3%)
Clausen et al. ⁹ (2000)	Questionnaire survey	Mmankodi Village (Botswana): household interview	No	Daily smokers: those reporting smoking on a daily basis	337 participants both sex aged ≥ 60 years	337 aged ≥ 60 years	≥ 60 years (11% both sex)

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Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Cox et al. ³⁸ (2000)	Questionnaire survey	Mauritius: household interview, 3 samples collected	No	Smokers: those reporting current smoking at the time of survey	1987 sample: 5,072 participants, both sex, aged 25-74 years; 1992 sample: 6,573 participants, both sex, aged ≥ 25 years; 1998 sample: 6,281 participants, both sex, aged ≥ 20 years		1987 sample: 60-69 years (M: 54%/W: 7.7%), ≥ 70 years (M: 49.3%/W: 11.9%); 1992 sample: 60-69 years (M: 35.8%/W: 5.6%), ≥ 70 years (M: 36%/W: 3.9%); 1998 sample: 60-69 years (M: 36.2%/W: 3.6%), ≥ 70 years (M: 26.8%/W: 2.3%)
Hu & Tsai ⁴¹ (2000)	Questionnaire survey	China: household interview	Not informed	Current smokers: smoking cigarettes at the time of the interview	24,996 participants both sex aged ≥ 15 years		≥ 60 years (32.4% both sex)
Jarallah et al. ³⁶ (1999)	Questionnaire survey	Saudi Arabia: household interview	No	Current smokers: smoking one or more cigarettes daily for 6 months or more before the survey	8,310 participants both sex aged ≥ 15 years	1,230 aged ≥ 61 years	≥ 61 years (8% both sex)
Kamimoto et al. ¹⁷ (1999)	Questionnaire survey	USA: data from the BRFSS and from the NHIS	No	Current smokers: persons who reported smoking ≥ 100 cigarettes during their lifetime and who currently smoke every day or some days	NHIS 1993-1995: 17,754 participants, both sex, aged ≥ 55 years; BRFSS 1995-1997: 116,690 participants, both sex, aged ≥ 55 years		NHIS sample: 65-74 years (15.2% both sex), ≥ 75 years (8.4% both sex); BRFSS sample: 65-74 years (13.3% both sex), ≥ 75 years (6.8% both sex)
Markides et al. ¹⁰ (1999)	Questionnaire survey	USA: household interview. Data from the H-EPESE and the HHANES	No	Current smokers: ever smokers (those who smoked at least 100 cigarettes in their lifetime) who were current smokers at the time of the survey	HHANES 1982-1984: 753 participants, both sex, aged ≥ 55 years; H-EPESE 1993-1994: 2,890 participants, both sex, aged ≥ 65 years	HHANES 1982-1984: 247 participants, both sex, aged ≥ 65 years; H-EPESE 1993-1994: 2,890 participants, both sex, aged ≥ 65 years	HHANES sample: 65-74 years (M: 41.2%/W: 19.2%); H-EPESE 1993-1994: 65-74 years (M: 19.6%/W: 9.8%), 75-84 years (M: 15.8%/W: 6.6%)

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Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Yang et al. ⁴⁰ (1999)	Questionnaire survey	China: household interview	No	Current smokers: those smoking tobacco products at the time of the survey	120,298 participants, both sex, aged 15-69 years	13,628 aged 60-69 years	60-69 years (35% both sexes)
Arnett et al. ⁵² (1998)	Questionnaire survey	Minnesota (USA): household interview	No	Current smokers: included both ever smokers (more than 100 cigarettes in their lifetime) and heavy smokers (individuals who consumed more than 25 cigarettes per day)	1980-1982 sample: 4,051 participants, both sex, aged 25-74 years; 1985-1987 sample: 5,733 participants, both sex, aged 25-74 years; 1990-1992 sample: 5,994 participants, both sex, aged 25-74 years		1980-1982 sample: 65-74 years (M: 19.4%/W: 21%); 1985-1987 sample: 65-74 years (M: 15.4%/W: 18.3%); 1990-1992 sample: 65-74 years (M: 13.8%/W: 16.3%)
Balabanova et al. ²⁷ (1998)	Questionnaire survey	Bulgaria: household interview	No	Smokers: those smoking every day	1,550 participants, both sex, aged ≥ 18 years	482 participants aged ≥ 60 years	60-69 years (M: 15.5%/W: 1.5%), ≥ 70 years (M: 6.2%/W: 0%)
Gilliland et al. ¹⁶ (1998)	Questionnaire survey	New Mexico (USA): data adapted from the BRFSS for use with the American Indian population (AIBFRS)	No information about proxy interviews	Current smokers: ever smokers (those who smoked at least 100 cigarettes in their lifetime) who were current smokers at the time of the survey	1,275 participants, both sex, aged ≥ 18 years	80 participants aged ≥ 65 years	≥ 65 years (15.3% both sexes)
Haidinger et al. ⁵⁰ (1998)	Questionnaire survey	Austria: household interview	No	Current smokers: included both regular smokers (who at the time of the interview smoked at least 1 cigarette per day) and occasional smokers (who at the time of interview did not smoke every day)	2,073 participants, both sex, aged ≥ 15 years	289 participants aged ≥ 65 years (M: 103/W: 186)	≥ 65 years (M: 27.2%/W: 9.7%)

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Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Hill et al. ⁵⁴ (1998)	Questionnaire survey	Australia: household interview	No	Current smoker: cigarettes only, cigarettes plus cigars nor pipes, cigars only (ex-cigarettes), pipes only (ex-cigarettes), cigars only (never cigarettes), or pipes only (never cigarettes)	Aged ≥ 16 years (M: 2,819/W: 2,880)	369 men aged 60-69 years, 332 men aged ≥ 70 years, 374 women aged 60-69 years, 339 women aged ≥ 70 years	60-69 years (M: 18.2%/W: 14.7%), ≥ 70 years (M: 14.2%/W: 8%)
Idris et al. ⁵⁵ (1998)	Questionnaire survey	Nile State (Sudan): household interview	No	Cigarette smoking or toombak use: self-report daily use of these products	21,594 participants, both sex, aged ≥ 4 years	587 aged 60-69 years, 336 aged 70-79 years	60-69 years (M: 16.9%); 70-79 years (M: 15.5%); women prevalence not reported (was too low)
McKee et al. ³⁹ (1998)	Questionnaire survey	Russia: household interview	No	Current smokers: subjects who gave a positive reply to the questions: "Do you smoke now?"	1,599 participants, both sex, aged ≥ 18 years	221 participants aged ≥ 65 years	≥ 65 years (M: 41%/W: 5%)
Osler et al. ²⁹ (1998)	Questionnaire survey	Copenhagen (Denmark): self-administered questionnaire	No	Smokers: subjects who smoke daily or sometimes at the time of examination; heavy smokers: smokers with a daily consumption of more than 14g of tobacco	33,655 participants, both sex, aged ≥ 30 years	15,478 aged 50-69 years; 2,408 aged ≥ 70 years	50-69 years (current smokers: 63% both sex/heavy smokers: 27% both sex), ≥ 70 years (current smokers: 48% both sex/heavy smokers: 9% both sex)
Pagano et al. ²⁵ (1998)	Questionnaire survey	Italy: household interview	Yes – proxy interviews represented 25% of total sample	Current smoker: heavy current smoker (those currently smoking ≥ 15 cigarettes per day)	50,585 participants, both sex, aged ≥ 15 years	2,553 men aged 65-74 years; 1,240 men aged ≥ 75 years; 3,107 women aged 65-74 years; 2,034 women aged ≥ 75 years	65-74 years (current smokers: M: 24.3%/W: 6.9%; heavy smokers: M: 8.8%/W: 1.4%); ≥ 75 years (current smokers: M: 14.1%/W: 3.1%; heavy smokers: M: 3.1%/W: 0.4%)

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Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Smedslund & Ahn ²⁰ (1998)	Questionnaire survey	Stanford, California (USA): interview held in a health center/Bergen and Trondheim (Norway): questionnaires were sent to respondents homes	No information about proxy interviews. The questionnaire was sent to the houses	Current smokers	California sample: 2,189 participants, both sex, aged 18-74 years; Norway sample: 5,014 participants, both sex, aged 19-92 years		California sample: 60-69 years (M: 24%/W: 15%), 70-79 years (M: 11%/W: 15%); Norway sample: 60-69 years (M: 23%/W: 20%), 70-79 years (M: 19%/W: 17%)
Wiecha et al. ¹² (1998)	Questionnaire survey	Massachusetts (USA): telephone interview	No	Current smokers: those who had smoked at least 100 cigarettes and who had smoked any part of a cigarette in the past 30 days	774 Vietnamese men residents in Massachusetts aged ≥ 18 years	52 participants aged ≥ 60 years	≥ 60 years (M: 36.5%)
Nebot et al. ²⁸ (1996)	Questionnaire survey	Spain: household interview	No	Smokers: smoking tobacco products at the time of the survey	1983 sample: 3,134 participants, both sex, aged ≥ 15 years; 1992 sample: 5,004 participants, both sex, aged ≥ 15 years		1983 sample: ≥ 65 years (M: 40.1%/W: 4.7%), 1992 sample: ≥ 65 years (M: 26.4%/W: 3.6%)
Resnicow et al. ³⁰ (1996)	Questionnaire survey	Harlem, New York (USA): self-administered questionnaire	No	Smokers: smoking tobacco products at the time of the survey	7,761 participants, both sex, aged ≥ 18 years		≥ 60 years (M: 33.9%/W: 24.8%)
Shopland et al. ²⁶ (1996)	Questionnaire survey: <i>Current Population Survey</i>	USA: household interview	Yes	Current smokers: if they had ever smoked at least 100 cigarettes in their entire lifetime and if they currently smoked cigarettes every day or some days	266,988 participants, both sex, aged ≥ 20 years		60-69 years (M: 20.5%/W: 17.3%), 70-79 years (M: 11%/W: 8.8%)
Ganiwijaya et al. ²¹ (1995)	Questionnaire survey	West Java (Indonesia): household interview	Yes	Current smokers: defined as those who had smoked in the past month	13,863 participants, both sex, aged 25-74 years	834 participants aged 65-74 years	65-74 years (M: 84.5%/W: 6.8%)

(continues)

Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Gong et al. ⁴³ (1995)	Questionnaire survey	Minhang District (China): household interview	No	Current smokers: persons who had smoked more than 100 cigarettes in their lifetimes and who were still smoking daily at the time of the interview	7,016 participants, both sex, aged ≥ 15 years	780 aged 60-69, 453 aged ≥ 70	60-69 years (M: 56.6%/W: 4.3%/both sex: 30.1%), ≥ 70 years (M: 45.3%/W: 4.3%/both sex: 19.9%)
Gutiérrez et al. ³² (1995)	Questionnaire survey	Valparaíso and Viña del Mar (Chile): household interview	No	Smoker: smoking one or more cigarettes weekly for 6 months or more before the survey	1,959 participants, both sex, aged ≥ 8 years		≥ 60 years (M: 27.4%/W: 8.1%)
La Vecchia et al. ²³ (1994)	Questionnaire survey	Italy: household interview	Yes – proxy interviews represented 8% of total sample	Current smoker	55,989 participants, both sex, aged ≥ 15 years	5,332 aged 65-74; 2,972 aged 75-84; 572 aged ≥ 85	65-74 years (M: 29%/W: 6.7%), 75-84 years (M: 18.9%/W: 2.5%), ≥ 85 years (M: 17.1%/W: 0.7%)
Woodward et al. ⁴⁹ (1994)	Questionnaire survey	Tonga: household interview	No	Current smokers: those respondents who reported that they had smoked in the three months prior to the survey	4,065 participants, both sex, aged ≥ 20 years	775 participants aged ≥ 60 years	60-64 years (M: 66.4%/W: 16.3%), 65-69 years (M: 54.5%/W: 26.1%), 70-74 years (M: 60.9%/W: 15.5%), 75-79 years (M: 43.4%/W: 14.6%), ≥ 80 years (M: 43.9%/W: 25.9%)
Lolio et al. ³⁷ (1993)	Questionnaire survey	Araraquara (Brazil): household interview	No	Smoker: cigarette and/or piper and/or cigar for 6 months or more, every day, up to the moment of the interview	1,199 participants, both sex, aged 15-74 years		65-74 years (M: 58%/W: 6.6%)

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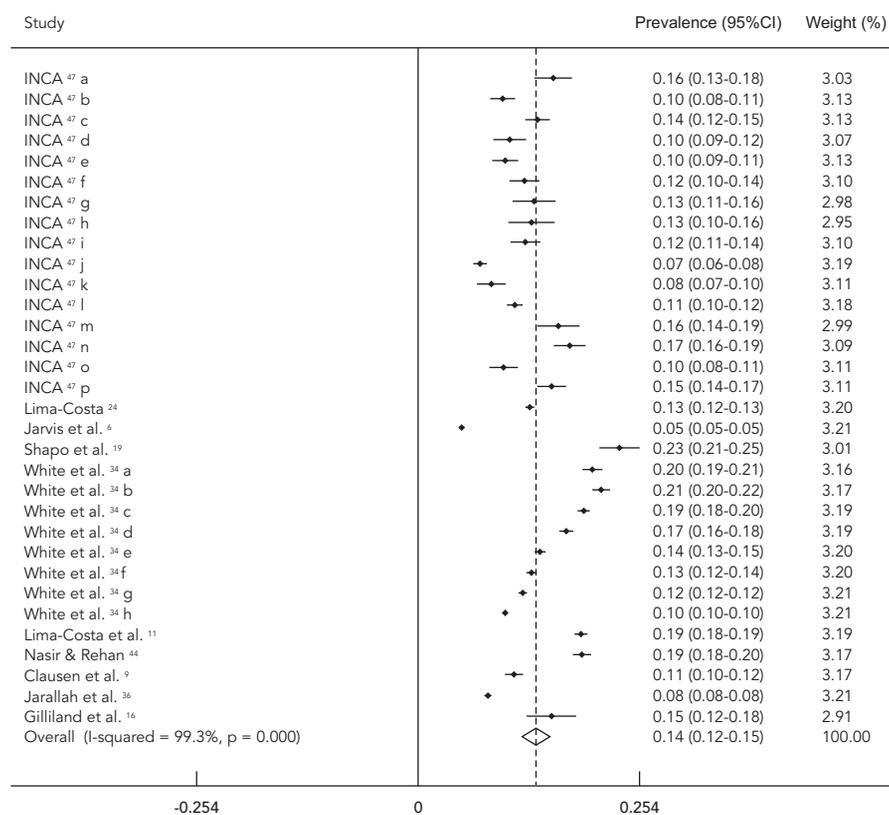
Table 1 (continued)

Author (year)	Methods	Setting	Proxy interviews	Definition of smoking status	Participants	Elderly participants	Prevalence of tobacco use
Maxwell & Hirdes ¹⁸ (1993)	Questionnaire survey	Canada – 1985: household survey; 1986: telephone interview; 1989: telephone interview	1985 – No; 1986 – Yes; 1989 – Yes	Current smokers: those reporting that they smoked cigarettes daily at the time of the survey	1985 sample: 11,200 participants, both sex, aged ≥ 15 years; 1986 sample: 30,799 participants, both sex, aged ≥ 15 years; 1989 sample: 11,634 participants, both sex, aged ≥ 15 years	1985 sample: 3,130 participants, both sex, aged ≥ 65 years; 1986 sample: 4,135 participants, both sex, aged ≥ 65 years; 1989 sample: 1,758 participants, both sex, aged ≥ 65 years	1985 sample: 65-69 years (M: 28.4%/W: 20%), 70-74 years (M: 23.3%/W: 18.1%), 75-79 years (M: 21.4%/W: 13.1%), ≥ 80 years (M: 13.2%/W: 4.6%); 1986 sample: 65-69 years (M: 22.9%/W: 16.5%), ≥ 70 years (M: 16.5%/W: 8.7%); 1989 sample: 65-69 years (M: 23.9%/W: 19.4%), 70-74 years (M: 23.3%/W: 19%), 75-79 years (M: 16%/W: 15.1%), ≥ 80 years (M: 13.5%/W: 9.4%)
Hamadeh et al. ²² (1992)	Questionnaire survey	Bahrain: household interview	Yes – the questionnaire was presented to the head of the household or the eldest person in the presence of adult members of the family	Cigarette smokers: regular light smokers (those who smoked less than 1 packet a day), regular heavy smokers (those who smoked 1 packet or more daily), occasional smokers (those who smoked less than 1 cigarette a day). Waterpipe smokers: regular smokers (those who smoked daily), occasional smokers	9,282 participants, both sex, aged ≥ 15 years		60-69 years (M: 40.9%/W: 16.7%), > 70 years (M: 28.8%/W: 24.8%)

BFRSS: Behavioral Risk Factor Surveillance System; H-EPESE: *Hispanic Established Populations for Epidemiological Studies of the Elderly*; HHANES: *Hispanic Health and Nutrition Examination Survey*; INCA: Instituto Nacional de Câncer [Brazilian National Cancer Institute]; M: men; NHIS: *National Health Interview Survey*; USA: United States; USSR: Union of Soviet Socialist Republics; W: women.

Figure 1

Smoking prevalence rates among the elderly (both sexes).



Note: weights are from random effects analysis.

an important heterogeneity of the prevalence rates among the studies.

Aiming to detect which variables might be responsible for that variability we carried out a meta-regression including: smoking definition, method of questionnaire application (household, telephone), country economic status, and continent. Prevalence varied by age group, with a general tendency of decreasing prevalence rates with advancing age. As studies used different age categories, this hypothesis could not be tested. Some surveys considered as elderly those aged 55-years and older, 60-years and older, 65-years and older and 70-years and older, whereas others used categories of age in more than two groups, 61-65 years, 66-70 years, > 70 years; 55-69; 60-69, ≥ 70 ; 65-74, ≥ 75 ; 50-88 years.

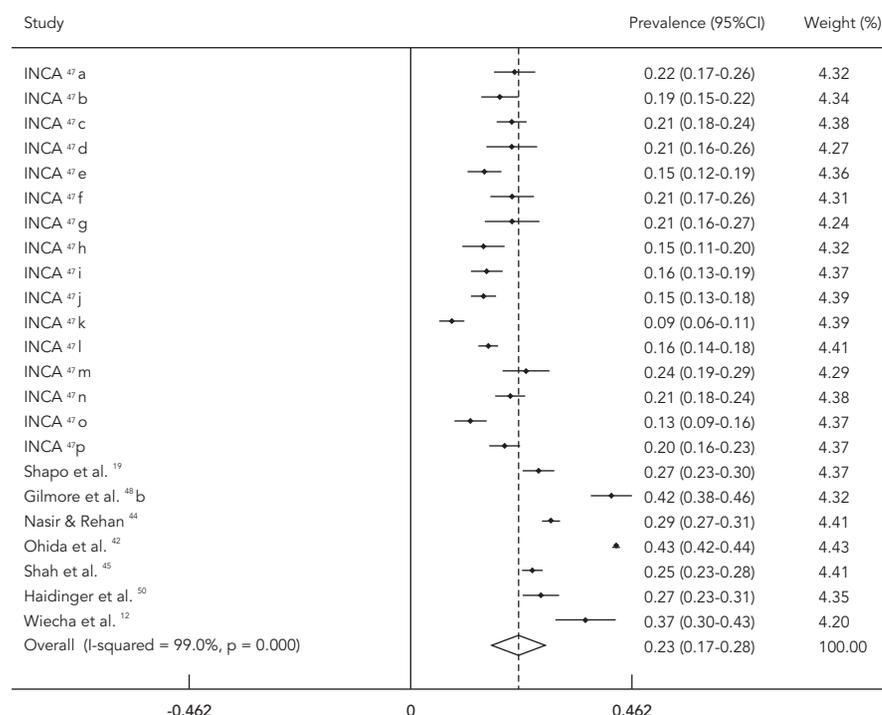
Smoking definition was associated with prevalence variability. Smoking definition according to the Centers for Disease Control and Prevention (CDC) criteria (having smoked at least 100 ciga-

rettes in one's lifetime and currently smoke every day or some days) was considered the more accurate characterization ⁵⁶. The CDC criteria yielded a prevalence which was 22% lower in men and 10% lower in women as compared to less accurate definitions. However, CDC studies showed a higher prevalence than those which did not attempt to define tobacco use among women (8% increase). Questionnaire application (telephone/face-to-face/mailed) also interfered on prevalence rates. Although statistical significance was borderline ($p = 0.08$), the prevalence rates in men were higher in surveys conducted via telephone calls than in face to face surveys. There was also a trend in enhancing smoking prevalence among women in surveys conducted in a health center, 10% higher than household face-to-face surveys.

Demographic factors such as continent and country economy status also had a statistically significant impact on smoking prevalence rates among men. High income countries have a 10%

Figure 2

Smoking prevalence rates among the elderly (male).



Note: weights are from random effects analysis.

higher prevalence rate than lower middle income countries. Taking Latin America as a reference, there was a 10% increase in prevalence rates in Asia and, a 19% increase in North America, whereas Europe showed a 14% increase (Table 2).

Discussion

This review identified a large number of surveys on tobacco use, but only three of them were specifically suited to search health and socio-demographic factors in the elderly population. Almost all surveys included elderly in the total adult sample and used questionnaires tailored to the adult population.

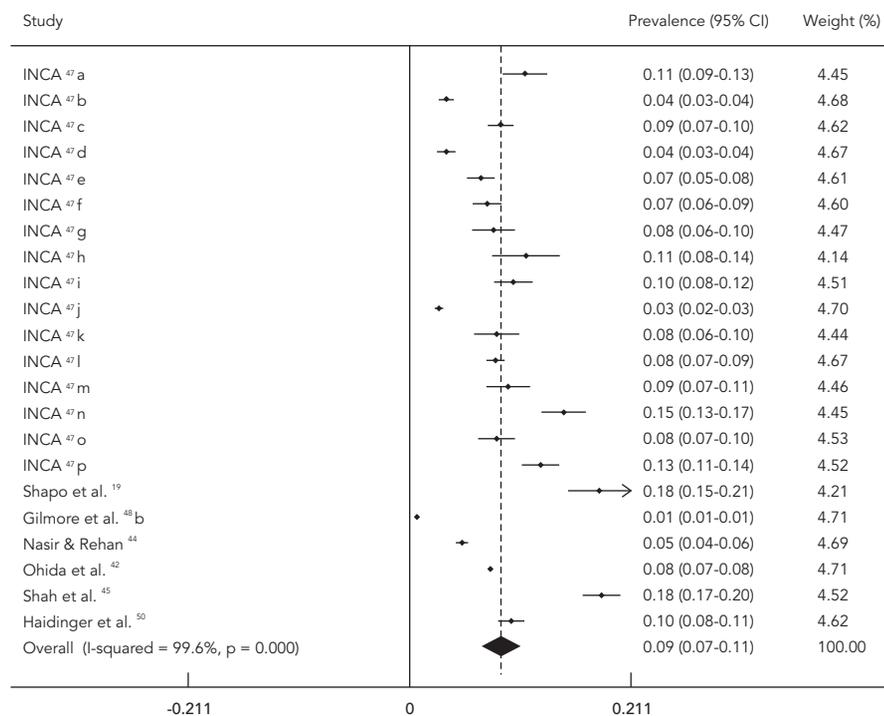
The meta-analysis suggests a higher smoking prevalence among men. Gender differences in tobacco use are well known among adults ⁵⁷, although recent cohorts have shown an increased use in young women ⁵⁸. Such estimates imply that in the future tobacco use may increase among elderly women, reproducing the trend observed in young cohorts.

Concerning age groups, the initial assumption of a decreasing prevalence with advanced age could not be evaluated properly in this study due to methodological issues. Despite the fact that there was a trend in decreasing prevalence rates among the oldest elderly, this could not be established because of the variability in definitions of age groups. Lower prevalence among the very oldest could be explained by selective survival probabilities (smokers die earlier) or by birth cohort effect. Cross-sectional studies do not allow for discrimination between these two possibilities.

The observed heterogeneity in prevalence rates among surveys could be partially explained by different smoking definitions, questionnaire application strategies, and country economic status. Prevalence rates were related to the accuracy in measures of tobacco use. Less accurate definitions produced higher prevalence rates, since they included occasional, daily, and heavy smokers without distinction. Nevertheless, there was an unexpected finding of lower prevalence rates related to studies that classified tobacco

Figure 3

Smoking prevalence rates among the elderly (female).



Note: weights are from random effects analysis.

use as “no definition” as compared to those with more accurate definitions. This could be caused by chance as only one study categorized smokers as “no definition”, and the reported prevalence was very low (0.7%) ⁴⁸.

Several studies show that the methodology of questionnaire application (telephone/face-to-face) does not affect smoking prevalence rates among surveys conducted in the community ^{59,60,61}. However, contrasting results from recent follow-up studies suggest that significant differences regarding socio-demographic variables arise among smokers who gave answers by telephone and by mailing ^{62,63}. Indeed, this is a very important issue when studying community-dwelling elderly, given that this population usually has hearing, visual, and movement impairments that may complicate proper data collection which use these means.

Albeit not statistically significant, this study found a higher prevalence among surveys carried out in health centers and among those using questionnaires answered by telephone. Cross-

sectional surveys in health centers are prone to a selection bias. Elderly people who attend senior citizen centers may be in poorer health conditions ⁶⁴ and are more likely to be engaged in unhealthy behaviors, possibly explaining enhanced prevalence rates of smoking found in these facilities. Telephone interviews also produced a non significant statistical increase in smoking prevalence, contradicting an initial postulation that elderly subjects would be less suitable to answer telephone interviews and to give proper answers to the questions on tobacco use. Hence, such a result suggests that telephone interviews can be an accurate way of measuring tobacco use among the elderly, since differences found were small, not statistically significant, and were more likely to over- rather than under-estimate prevalence rates.

Information on tobacco use was mostly obtained by self-reporting, whereas proxy responses were allowed in nine surveys. The impact of proxy responses and the validity of self-reported smoking on estimates of tobacco use among the

Table 2

Meta-regression investigating variables associated with heterogeneity among men and women.

Variable	Coefficient	95%CI
Men		
Tobacco definition		
WHO/CDC criteria	Reference	
Current	0.06	-0.05;0.18
No definition	0.22 *	0.10;0.34
Occasional smokers	0.07	-0.05;0.19
Hardcore + heavy smokers	-	-
Interview methodology		
Face-to-face	Reference	
Telephone	0.15 **	-0.02;0.33
Health center	0.58	-0.08;0.19
Mailed questionnaires	-	-
Country economic status		
High income	Reference	
Lower middle income	-0.10 ***	-0.21;0.01
Upper middle income	-	-
Low income	-	-
Continent		
Latin America	Reference	
Asia	0.10 *	0.06;0.14
North America	0.19 *	0.05;0.32
Europe	0.14 *	0.08;0.19
Oceania	-	-
Africa	-	-
Women		
Tobacco definition		
WHO/CDC criteria	Reference	
Current	0.1 #	-0.003;0.2
No definition	-0.08 ##	-0.14;-0.01
Occasional smokers	0.01	-0.05;0.09
Hardcore + heavy smokers	-	-
Interview methodology		
Face-to-face	Reference	
Health center	0.1 ###	-0.007;0.21
Mailed questionnaires	-	-
Telephone	-	-

* $p < 0.001$;** $p = 0.08$;*** $p = 0.09$;# $p = 0.06$;## $p < 0.05$;### $p = 0.07$.

elderly remain uncertain. Proxy responses might under-estimate smoking prevalence. On the other hand, self-reported responses are considered a safe and economic measure of tobacco use in population studies⁶⁵. The present results suggest that self-reporting screening is also a safe measure of tobacco use among the elderly, since there

was no difference in prevalence rates of proxy responses as compared to those obtained by the former method.

There is also evidence that elderly people living in countries with better socio-economic conditions have higher prevalence rates of tobacco use than those living in under-developed coun-

tries. Countries and continents which include more developed nations were the most likely regions to present higher prevalence rates. This result contrasts with recent findings suggesting that low socio-economic conditions are related with tobacco use, both at individual^{13,33,37,38,46,54,66} and domiciliary level^{66,67}. A possible explanation for such a finding is that rates of cigarette smoking in developed countries have decreased mainly among adults. Tobacco control activities usually focus on young adults, and as a result elderly people living in those countries may not be exposed to those educational programs. Tobacco use among future elderly cohorts may decrease following the trend observed in young cohorts.

A range of different factors precluded the conclusions on frequency of tobacco use among the elderly to be drawn as precisely as we wanted. These included variability in elderly sample size among surveys, study quality and design, heterogeneity in data collection such as differences in smoking definitions and inclusion of regional tobacco products, classification of elderly according to age ranges, and limitations from meta-analysis methodology.

Limitations of this study include those common to all meta-analysis research, since this procedure can be affected by the methodological quality of the original studies. Furthermore, sample size and response rates can represent a selection bias when calculating smoking prevalence, since smokers are less prone to answer questions on tobacco use⁶³. In almost all selected surveys, response rates in the elderly had not been described routinely. Also, not all the countries had elderly samples equally represented and cultural aspects that may affect tobacco use definitions

and the methodology of data gathering might vary between regions and countries studied, becoming a confounder in the causal relationship between country and smoking prevalence. Finally, we must consider that other databases such as Embase, Scopus, PsychLit books, Masters or PhD theses were not included in our research strategy.

Thus, the conclusions on this meta-analysis can not be generalized as representative of a pattern of smoking behavior among elderly subjects worldwide.

Conclusion

Tobacco use among the elderly is an important and potentially preventable health problem. However, few epidemiological studies have assessed rates of tobacco consumption among the aged so far. Additional evidence regarding elderly samples, using questionnaires tailored to investigate their main health problems and socio-demographic distress factors is required. The methodology applied may impact on the results, more precise and strict definitions should be applied as they yield more reliable prevalence rates. Cultural and socio-economic factors contributing to the pattern of tobacco use among the elderly should be evaluated in future surveys. There is also a need of follow-up studies to prospectively evaluate tobacco use patterns among the elderly. In summary, our study is able to conclude that higher prevalence rates of tobacco use are found in males, although there is a possible trend for increasing tobacco use among elderly females, as observed in younger cohorts.

Resumo

O objetivo deste estudo foi combinar os resultados de pesquisas identificadas sobre a prevalência do tabagismo em idosos, para estimar sua prevalência mundial e possíveis fatores relacionados a este tipo de comportamento entre eles. A revisão da literatura incluiu busca nas bases de dados eletrônicas como MEDLINE, LILACS e Biological Abstracts, busca manual em jornais especializados e nas referências citadas. A prevalência global combinada foi estimada usando-se o modelo de efeitos randômicos. O número total de idosos incluídos em todos os levantamentos foi 140.058,

com dados disponíveis em todos os continentes. A prevalência de tabagismo foi de 13% em ambos os sexos (22% homens e 8% mulheres). As taxas de prevalência foram heterogêneas e estiveram associadas com a definição de tabagismo, aplicação do questionário e com a economia de cada país. A maior taxa de prevalência foi encontrada entre idosos do sexo masculino que vivem em países de renda mais alta.

Tabaco; Tabagismo; Idoso

Contributors

V. Marinho reviewed the literature, selected the manuscripts, participated in the data analysis, and in the writing of the article. J. Laks participated in the selection of the manuscripts and in the writing of the article. E. S. F. Coutinho performed the statistical analyses and contributed to the discussion of the data in the manuscript. S. L. Blay designed the study and participated in all the steps, from the elaboration of the protocol to the final review of the manuscript.

Conflicting interests

Dr. Valeska Marinho has been working as a medical manager at GlaxoSmithKline Brazil.

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