Do we really know how many people smoke in a general population? The case of Italy

Giuseppe Verlato
Roberto de Marco

Unit of Epidemiology and Medical Statistics, Department of Public Health and Community Medicine, University of Verona, Verona, Italy

Address for correspondence:
Giuseppe Verlato, MD
Unit of Epidemiology and Medical Statistics
Istituti Biologici 2B, Strada Le Grazie 8
37134 Verona, Italy
Phone: +39 045 8027628
Fax: +39 045 8027154
E-mail: giuseppe.verlato@univr.it

Summary

Smoking prevalence is usually assessed by mailed questionnaire or personal interview on general population samples. However, participation in epidemiological surveys is decreasing throughout the world. This declining trend not only reduces precision in prevalence estimates, but can also bias these estimates, as current smokers tend to be late responders to epidemiological surveys.
In Italy estimates of smoking prevalence, yielded by different surveys, are rather consistent, irrespective of the methodological approach used: samples withdrawn from the general Italian population or within participating centers; mailed questionnaires or personal interviews; replacing or recontacting non-available subjects.
However, inconsistency can occur among surveys performed in the same period, or even within the same type of survey repeated one-year apart. Hence combining the results of different surveys rather than relying on the results of a single survey is advisable.

KEY WORDS: smoking prevalence; Italy; epidemiological survey; non-response; selection bias.

Decrease response: a challenge to epidemiology

Smoking prevalence is usually assessed by mailed questionnaire (1) or personal interview (2, 3) on general population samples. However, participation in epidemiological surveys is decreasing throughout the world.
In the last two decades three mailed epidemiological surveys on respiratory health were performed on the Italian population aged 20-45 years, using similar methodologies: the Italian branch of the European Respiratory Health Survey (ECRHS) (4), the Italian Study on Asthma in Young Adults (ISAYA) (5) and the study on Gene-Environment Interactions in Respiratory Diseases (GEIRD) (6). The average response proportion significantly ($p<0.001$) decreased from 86.2% in 1991-1993 (ECRHS) to 72.7% in 1998–2000 (ISAYA) and to 57.2% in 2007-2010 (GEIRD) (7). Likewise in Sweden the response percentage declined from 86%, recorded in ECRHS in 1990, to 60%, recorded in GA^{2}LEN in 2008 (8). An even larger drop was observed in parental compliance to school-based child health surveys, which decreased from 92% in 1991 to 30.2% in 2006 in a British study (9). This negative trend could be partly attributed to increased complexity of the questionnaires used. However, in England family physicians observed a decreasing trend when using exactly the same questionnaires on the same population: response percentage declined from 76.3% in 1991 to 68.9% in 2001 (10).

The declining response to epidemiological surveys reduces precision in prevalence estimates, but it can also bias these estimates, as current smokers tend to be late responders to epidemiological surveys.

Interestingly in Italy the negative trend in people participation is not restricted to epidemiological surveys, but it does affect also political elections, although to a smaller extent. The proportion of people voting for the lower house of the Italian Parliament (Camera dei Deputati) has decreased from 87.35% in 1992 to 75.2% in 2013. An even larger decrease was recorded in administrative elections: in the three centers participating in ECHRS (Pavia, Verona, Torino) the proportions of voters in regional elections has decreased from 88-92% in 1990 to 65-68% in 2010 [http://elezionistorico.interno.it/].
The declining response to epidemiological surveys poses a challenge to epidemiology: reduced response not only reduces precision in prevalence estimates, but it can also bias these estimates, as current smokers tend to be late responders to epidemiological surveys. Moreover, reduced social acceptability of smoking could induce smokers to hide/understate their cigarette consumption.

Methodological problems in assessing smoking prevalence

Validity of self-reported smoking habits. Information obtained by questionnaire or by personal interview is self-reported and hence its validity should be

© CIC Edizioni Internazionali

It is essential to make all possible efforts to achieve high response percentages in prevalence studies on smoking habits. For instance, dealing with non-responders to the first mail we suggest to contact them again first by post and then by phone.

checked, for instance, by comparison with biochemical measures or with legal sale data. In 1991-93, a good agreement (Cohen's k=0.93) was found between self-reported smoking habits and serum cotinine levels in one centre participating to ECRHS (Verona) (11). However, in the last two decades under-reporting of cigarette consumption seems to have substantially increased, in parallel with the increasing social disapproval of smoking: Gallus et al. (12) compared self-reported cigarette consumption with legal sale data, and found an under-reporting of about 1% in 1990, 25% in 2001 and 35% in 2008.

Non-response bias. The decreasing response to epidemiological surveys can bias prevalence estimates (13). Indeed in ISAYA "the proportion of current smokers increased from 29.2% in the first postal contact to 38% in the third phone contact, while the proportion of ex-smokers decreased from 16.5% to 10.1%" (14). Hence, when response percentage is low, the prevalence of ex-smokers is overestimated, while the proportion of current smokers is underestimated (14).

It is essential to make all possible efforts to achieve high response percentages in prevalence studies on smoking habits. For instance, in several Italian surveys dealing with respiratory health (ECRHS, ISAYA, GEIRD) non-responders to the first mail were contacted again first by post and then by phone. Moreover response percentages should be always reported to allow interpretation of results and international comparisons (14). A review of the literature pointed out that response percentage was reported in only 61% of mail surveys published in medical journals (15).

To correct for non-response bias during data analysis, several methods have been proposed (13, 16-19), which usually rely on the assumption that non-responders are similar to late responders. However, the effectiveness of these correction methods is the highest when response percentage is at least 60%, as the trend in prevalence across subsequent contacts is not constant, and hence not fully predictable (14).

Different methods used to assess smoking prevalence in Italy

National surveys. The Italian National Institute for Statistics (**ISTAT**) performs surveys on samples of more than 100,000 non-institutionalized subjects twice a decade, using household interviews [2, http://www3.istat.it/dati/dataset/20110810_00].

Other national surveys are carried out every year by the **DOXA-Mario Negri-ISS (Istituto Superiore di Sanità)** on national samples of about 3000 using a computer-assisted personal in-house interview (3). Differently from other surveys [ECRHS, ISAYA] where only subjects who had died or moved out of the area could be replaced or excluded, in the DOXA-Mario Negri-ISS surveys "whenever the selected participants were unavailable, they were replaced by selecting amongst neighbors (living in the same floor/building/street) within the same sex and age group" (3).

Multi-centric surveys. **ECHRS** (4), **ISAYA** (5) and **GEIRD** (6) are multi-centre surveys, performed respectively in three (Torino, Pavia, Verona), nine (Torino, Pavia, Verona, Sassuolo, Ferrara, Udine, Pisa, Sassari, Siracusa) and eight (Torino, Pavia, Verona, Sassari, Ancona, Terni, Salerno, Palermo) Italian centres. These centres were not chosen randomly, but on the presence of experienced research teams willing to carry out the survey. In each centre a sample of about 3,000 subjects, with a male to female ratio of one, was selected from the general population aged 20-44 years, using local health authority registry.

These centres were not chosen randomly, but on the presence of experienced research teams willing to carry out the surveys.

General Practice Database. In 1998 the Italian College of General Practitioners (Società Italiana Medici Generici, SIMG) established the **Health Search Database**, which has included 909,638 individuals older than 14 years by December 2009, corresponding to 1.5% of the total Italian population served by general practitioners. Health information was provided by 700 general practitioners, who accepted to participate on a voluntary basis, ensured the required data quality and cared for a population representative of the whole Italian population (20; http://www.healthsearch.it/).

Problems faced by different surveys

Personal interviews or self-administered questionnaires allow to collect a large bulk of information, whose validity however is strictly dependent on the interviewee's characteristics. Hence this information should be validated by objective methods, such as serum cotinine levels for smoking habits or IgE levels and skin prick tests for allergic diseases.

A disadvantage of multi-centric studies is the enrollment of samples, who are not representative of the national population, but rather of people within participating centers.

An advantage of multi-centric studies is that they can easily allow to validate questionnaire information, especially when participating centers are selected on the presence of experienced research teams including pneumologists or allergologists. Indeed both in ECRHS (21) and in GEIRD (6) random and symptomatic subsamples were drawn from responders to the postal questionnaire, and invited to attend a clinical visit. For this purpose ECRHS adopted a two-phase sampling, while GEIRD a nested (multi)case-control design.

A disadvantage of multi-centric studies is the enrollment of samples, who are not representative of the national population, but rather of people within participating centers. Hence multi-centric should try to recruit

© CIC Edizioni Internazionali

centers all over the country: in 1991 the ECHRS managed to recruit only three centers in Northern Italy (Pavia, Torino, Verona) (4), while in 2007 GEIRD succeeded in enrolling seven centers spread throughout Italy, i.e. Pavia, Torino and Verona in the Northern Italy, Ancona and Terni in Central Italy, Sassari in Sardinia, Salerno and Palermo in the South (6).
Difficulties in assessing smoking habits are surely faced also in General Practice. Indeed, in a recent study Cazzola et al. (20) assessed smoking habits in subjects with asthma and COPD directly from the Health Search Database, but used as reference smoking habit data of the general Italian population provided by ISTAT.
Replacing unavailable subjects by neighbors could lead to a selection bias, as smokers are late responders in postal/phone surveys on respiratory health (14).

Smoking prevalence in Italy: consistency of results

Estimates of smoking habits, yielded by different surveys on the general Italian population, were rather consistent. ISTAT (2) and GEIRD group found similar prevalence of current and ex-smokers in the age classes 20-44 years, both in men and in women (Table 1). DOXA-Mario Negri-ISS reported a similar prevalence among men, oscillating between 28.9% and 36.5% in the age class 25-44 years in the period 2007-2010, and a slightly higher prevalence among women, fluctuating between 22.3% and 29.3% (3, 22-24).
Also the number of cigarettes smoked daily were comparable between the surveys, carried out by ISTAT (2), and the GEIRD group, while DOXA-Mario Negri-ISS (24) reported slightly higher values (Table 2).

Smoking prevalence in Italy: inconsistent results

The most striking difference among surveys, dealing with smoking habits in Italy, is the ratio between current and ex-smokers: while ISTAT reported that in 2010 ex-smokers have exceeded current smokers in men and matched them in women (2), current smokers are still the majority of ever smokers according to DOXA-Mario Negri-ISS (24), GEIRD group (25) and Italian General Practitioners Database (26) (Figure 1). As expected, in the three latter surveys, the gap between current and ex-smokers is the highest in people aged 20-45 years (25) and the lowest in people aged 35 years and older (26).

A two year-period is too short to hypothesize dramatic increases in the number of never smokers or decreases in the number of ever smokers due to migration, births or deaths. Hence large random fluctuations among the samples withdrawn in subsequent years can be hypothesized.

According to the DOXA-Mario Negri-ISS survey, the proportion of ex-smokers among Italian men decreased from 24.1% in 2008 to 18.9% in 2009 (Figure 2). The decrease in past smoking was paralleled by a simultaneous increase in current smoking from 26.4 to 28.9%. The Authors interpreted this pattern as smoking relapse due to the economic crisis (27). However the DOXA-Mario Negri-ISS surveys recorded a much larger variation over the same period in the proportion of never smokers, who suddenly increased from 49.5% in 2008 (23) to 52.3% in 2009 (24) and further to 60.4% in 2010 (3) (Figure 2). This sudden increase has no plausible explanation. Indeed a current or ex-smoker cannot turn back into a

Table 1 - Prevalence in percentages of current and ex-smokers in surveys performed by ISTAT (2) or by the GEIRD group.

	ISTAT 2010		GEIRD 2007-10	
	Men	Women	Men	Women
Current smokers 20-24 yrs	35.2	18.6	38.4	26.7
25-34 yrs	39.7	24.4	35.5	22.7
35-44 yrs	36.7	19	29.6	22.7
Ex-smokers 20-24 yrs	7.5	7.7	6.9	6.3
25-34 yrs	16.3	15.9	14.2	14.7
35-44 yrs	22.9	18.5	21.9	17.2

Table 2 - Cigarettes smoked daily by Italian current smokers, according to ISTAT (2), DOXA-Mario Negri-ISS (24) and GEIRD surveys.

	ISTAT	DOXA-Mario Negri-ISS	GEIRD
Target population	>=14 years	>=15 years	20-45
Calendar years	2010	2009	2007-10
Men	13.9	16.2	13.8
Women	10.9	11.9	11.1

© CIC Edizioni Internazionali

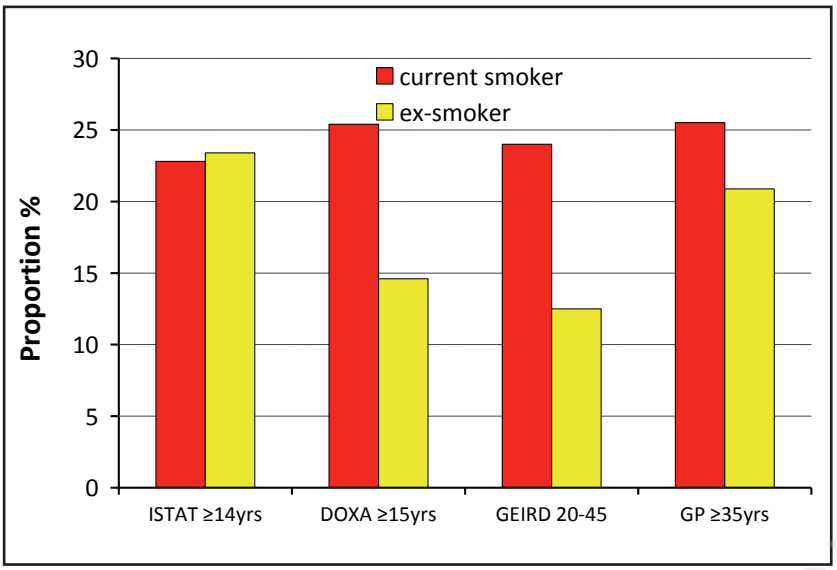

Figure 1 - Proportion of current and ex-smokers according to four epidemiological surveys performed in Italy by ISTAT in 2010 (2), by DOXA-Mario Negri-ISS in 2009 (24), by the GEIRD group in 2007-10 (25) and by General Practitioners in 2009 (26).

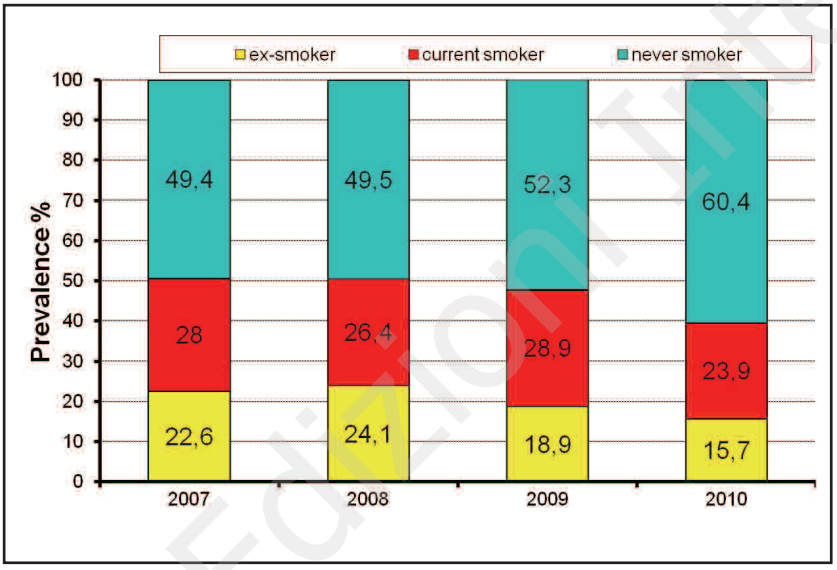

Figure 2 - Proportion of ex-smokers (yellow areas) and current smokers (red areas) in Italian men aged 15 years and over, according to the annual surveys carried out by DOXA-Mario Negri-ISS (3, 22-24).

never smoker. Moreover a two-year period is too short to hypothesize dramatic increases in the number of never smokers or decreases in the number of ever smokers due to migration, births or deaths. Hence large random fluctuations among the samples withdrawn in subsequent years can be hypothesized.

Conclusions

In Italy estimates of smoking prevalence, yielded by different surveys, are rather consistent, irrespective of the methodological approach used: samples withdrawn from the general Italian population or within participating centers; mailed questionnaires or personal interviews; replacing or re-contacting non-available subjects.
However, inconsistency can occur not only among different surveys but even within the same survey, repeated one-year apart. Hence, combining the results of different surveys rather than relying on the results of a single survey is advisable. Anyway, the possibility to evaluate and interpret small and short-term variations in smoking prevalence remains questionable.
New strategies should be developed to increase participation in epidemiological surveys. For instance, attempts should be made to contact people through new technologies, such as electronic mailing, Facebook® and cell-phones (28).

New strategies should be developed to increase participation in epidemiological surveys. For instance, attempts should be made to contact people through new technologies, such as electronic mailing, Facebook and cell-phones.

© CIC Edizioni Internazionali

Funding. The GEIRD project was funded by the Cariverona Foundation (Verona, Italy) and by the Italian Ministry of Education, Universities and Research (MIUR). The funding sources had no involvement in the study design, in the collection, analysis and interpretation of data, in the writing of the report, and in the decision to submit the paper for publication.

References

1. de Marco R, Zanolin ME, Accordini S, Signorelli D, Marinoni A, Bugiani M, et al. A new questionnaire for the repeat of the first stage of the European Community Respiratory Health Survey (ECRHS): a pilot study. Eur Respir J 1999;14:1044-8.
2. ISTAT. Indagine multiscopo sulle famiglie "Aspetti della vita quotidiana". Anno 2010. http://www3.istat.it/dati/dataset/20110810_00. Accessed on July 2013.
3. Gallus S, Muttarak R, Martínez-Sánchez JM, Zuccaro P, Colombo P, La Vecchia C. Smoking prevalence and smoking attributable mortality in Italy, 2010. Prev Med 2011;52:434-8.
4. European Community Respiratory Health Survey – Italy. Prevalence of asthma and asthma symptoms in a general population sample from northern Italy. Allergy 1995;50:755-9.
5. Verlato G, Melotti R, Corsico AG, Bugiani M, Carrozzi L, Marinoni A, et al, for the ISAYA study group. Time trends in smoking habits among Italian young adults. Respir Med 2006;100:2197-206.
6. The GEIRD Study Group (de Marco R, Accordini S, Antonicelli L, Bellia V, Bettin MD, Bombieri C et al.). The Genes Environment Interactions in Respiratory Diseases (GEIRD) Project. Int Arch Allergy Immunol 2010;152(3):255-63.
7. de Marco R, Cappa V, Accordini S, Rava M, Antonicelli L, Bortolami O, et al., for the GEIRD study group. Trends in the prevalence of asthma and allergic rhinitis in Italy between 1991 and 2010, Eur Respir J 2012;39:883-92.
8. Bjerg A, Ekerljung L, Middelveld R, Dahlén S-E, Forsberg B, Franklin K, et al. Increased prevalence of symptoms of rhinitis but not of asthma between 1990 and 2008 in Swedish adults: Comparisons of the ECRHS and GA2LEN surveys. PlosOne 2012;6(2):e16082.
9. Koshy G, Brabin BJ. Parental compliance - an emerging problem in Liverpool community child health surveys 1991-2006. BMC Medical Research Methodology 2012;12:53.
10. Frank PI, Hazell ML, Morris JA, Linehan MF, Frank TL. A longitudinal study of changes in respiratory status in young adults, 1993-2001. Int J Tuberc Lung Dis 2007;11:338-43.
11. Olivieri M, Poli A, Zuccaro P, Ferrari M, Lampronti G, de Marco R, et al. Tobacco smoke exposure and serum cotinine in a random sample of adults living in Verona, Italy. Arch Environ Health 2002;57:355-9.
12. Gallus S, Tramacere I, Buffetta P, Fernandez E, Rossi S, Zuccaro P, et al. Temporal changes of under-reporting of cigarette consumption in population-based studies. Tobacco Control 2011;20:34-9.
13. de Marco R, Verlato G, Zanolin E, Bugiani M, Drane JW. Nonresponse bias in EC Respiratory Health Survey in Italy. Eur Respir J 1994;7:2139-45.
14. Verlato G, Melotti R, Olivieri M, Corsico A, Bugiani M, Accordini S, et al, for the ISAYA study group. Asthmatics and ex-smokers respond early, heavy smokers respond late to mailed surveys in Italy. Respir Med 2010;104:172-9.
15. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. J Clin Epidemiol 1997;50:1129-36.
16. Drane JW. Imputing nonresponses to mail-back questionnaires. Am J Epidemiol 1991;134:908-12.
17. Tennant A, Badley EM. A confidence interval approach to investigating nonresponse bias and monitoring response to postal questionnaire. J Epidemiol Commun Health 1991;45:81-5.
18. Verlato G, de Marco R, Drane JW, Tibara DL. Correcting for non-response bias in epidemiological surveys performed in whatever number of subsequent contacts: an extension of Drane's method. Statistica Applicata 1994;6:425-37.
19. de Marco R, Verlato G, Zanolin E. A multiple imputation-based method to correct non-response bias in prevalence surveys. Statistica 1995, anno LV, n.1, 17-30.
20. Cazzola M, Puxeddu E, Bettoncelli G, Novelli L, Segreti A, Cricelli C, et al. The prevalence of asthma and COPD in Italy: A practice-based study. Respir Med 2011;105:386-91.
21. Burney PGJ, Luczynska C, Chinn S, Jarvis D, for the European Community Respiratory Health Survey. The European Community Respiratory Health Survey. Eur Respir J 1994;7:954-960.
22. Ferketich AK, Gallus S, Iacobelli N, Zuccaro P, Colombo P, La Vecchia C. Smoking in Italy 2007, with a focus on the young. Tumori 2008;94:793-7.
23. Tramacere I, Gallus S, Zuccaro P, Colombo P, Rossi S, Boffetta P, et al. Socio-demographic variation in smoking habits – Italy, 2008. Prev Med 2009;48:213-7.
24. Tramacere I, Gallus S, Pacifici R, Zuccaro P, Colombo P, La Vecchia C. Smoking in young and adult population, Italy 2009. Tumori 2011;97:423-7.
25. Accordini S, Corsico AG, Cerveri I, Antonicelli L, Attena F, Bono R, et al. Diverging trends of chronic bronchitis and smoking habits between 1998 and 2010. Respir Res 2013;14(1):16.
26. Cazzola M, Calzetta L, Bettoncelli G, Cricelli C, Romeo F, Matera MG, et al. Cardiovascular disease in asthma and COPD: A population-based retrospective cross-sectional study. Respiratory Medicine 2012;106:249-56.
27. Gallus S, Tramacere I, Pacifici R, Zuccaro P, Colombo P, Ghislandi S, et al. Smoking in Italy 2008-2009: A rise in prevalence related to the economic crisis ? Prev Med 2011;52:182-3.
28. Bakke PS. Non-response in epidemiological studies - How to cope with it? Respir Med 2010;104(3):323-4.

© Citazione non autorizzata