

Nationwide tobacco surveys and sales data in Denmark from 1920 to 2010

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ABSTRACT

INTRODUCTION: Tobacco smoking is an important cause of premature death and morbidity in Denmark. It is therefore important to monitor tobacco consumption. In this paper, tobacco consumption in Denmark is illustrated by two methods: sale of tobacco products and smoking habit surveys.

MATERIAL AND METHODS: Data on sale of tobacco products in Denmark were available for the 1920-2010-period. National smoking habit surveys were found through grey-zone literature, a PubMed search and a report on the Danish population's smoking habits. Ten smoking habit surveys were identified from the 1953-2010-period, three of which have data from multiple years and annual surveys from 1969 onwards.

RESULTS: The changes in tobacco consumption found by the two methods were not parallel. Furthermore, there were significant differences between the proportions of smokers found in smoking habit questionnaires from the same year. This difference may be due to changes in cross-border trade, smuggling, smokers' willingness to participate in smoking habit studies, recognition of own smoking and actual tobacco consumption, and differences in the composition of participants in the smoking habit studies both over time and between different studies.

CONCLUSION: Both sales statistics and surveys have advantages and disadvantages. It may therefore be important to use both when estimating tobacco consumption.

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Smoking is the leading cause of premature death and morbidity in the Western world [1]. The causal association between smoking and a range of cancers, heart disease and chronic obstructive lung disease is well-established [1]. The changes in tobacco consumption over time is interesting to follow, both in respect to estimation of future health expenses, effective allocation of the limited prevention funds and to evaluate the effect of prevention measures.

Tobacco consumption can be measured as tobacco sale and as the proportion of smokers in the population. In most Western countries, surveys of smoking habits are performed regularly by the health authorities, e.g. the Center for Disease Control in the USA [2] and the

Ministry of Health in New Zealand [3]. The sale of tobacco is an indicator of tobacco consumption if fluctuations in the black market and cross-border trade are disregarded. Sale of tobacco is an easy and cheap way to monitor tobacco consumption.

Due to growing social disapproval of smoking, concern about smokers' willingness to participate in surveys and to state their actual smoking habits when participating in such surveys has been growing [3, 4].

A review of studies that used biomarkers to validate self-reported smoking habits found no widespread underreporting, except in some subgroups, e.g. pregnant women [4]. But any over-representation of smokers in the non-participation group would not be recognized with the help of biological markers.

Some countries (e.g. the USA) have seen a decrease in the proportion of daily smokers, but a rise in the proportion of non-daily smokers (who only smoke some days) [2]. New Zealand has witnessed a declining smoking prevalence at the same time as a rise in the sale of cigarettes [3]. This could be a sign not only of a general decline in smoking rates, but also of a change in the pattern of smoking, and/or in how people answer the question: "Do you smoke?".

MATERIAL AND METHODS

Data on sale of tobacco were retrieved from two sources: Statistics Denmark and Osler's report entitled The Danes' Smoking Habits [5, 6]. Sales numbers were based on the sale of taxed tobacco products in Denmark. Estimates on cross-border trade were not included, as these

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A total of 7,702,000,000 cigarettes were sold in Denmark in 2010.

data were only based on surveys for selected years [7]. Sale of tobacco was divided into the following tobacco goods categories: "cigarettes (mil)", "smoking tobacco (t)" and "cigars and cigarillos (mil)" [5, 6].

The number of cigarettes, cigars and cigarillos were converted to tonnes assuming that one cigarette weighs 1 g, and that cigars and cigarillos weigh 3 g per piece. These assumptions have previously been used [5].

Smoking habit surveys

The inclusion criteria for smoking habit surveys were that they included adults in Denmark. The exclusion criteria were: 1) surveys carried out on a limited population, e.g. doctors or pregnant women or, 2) surveys carried out in a limited geographical area.

Smoking habit surveys were found in the grey-zone literature on the webpages of the National Board of Health and the National Institute of Public Health, via a PubMed search and in the report *The Danes' Smoking Habits* [5].

PubMed

The PubMed search criteria were as follows: "Denmark" (Mesh) AND ("Smoking/epidemiology" (Majr) OR "Smoking/prevention and control" (Majr) OR "Smoking/statistics and numerical data" (Majr) OR "Smoking/trends" (Majr)), limited to include only adults (19+). The search was performed on 12 March 2011.

The search gave 94 hits. It was possible to get the abstract from 76 articles of which 60 were excluded based on the abstract. The method sections of the remaining 16 hits led to exclusion of 14 articles. Of the 18 articles with no abstract, it was possible to exclude ten based on the title, and based on the method sections

five could be excluded. Consequently, five articles were included [8-12].

The report *The Danes' Smoking Habits* included an overview of smoking habit surveys undertaken before 1990 [5]. Among these 18 surveys of adults smoking habits, 13 were not nationwide and/or carried out on a subpopulation. Of the remaining five, two were identified through grey-zone literature, and one was identified via the PubMed search. It was possible to locate the article [13] for one of the remaining two surveys, and the other survey is referred to in this work based on the information from the report *The Danes' Smoking Habits*.

The surveys

The Morbidity Survey of 1950 [8, 14] was carried out in 1951-54, and approximately 100,000 adults participated.

Gallup A/S collected data on the Danes' smoking habits for the tobacco industry in 1963 and annually from 1969 to 1993 [8-11, 15]. Data were collected annually through personal interviews with 15,000-30,000 Danes older than 15 years. Smokers were identified with the question: Did you smoke yesterday? – yes/no. This means that daily smokers and non-daily smokers could not be separated in these data, and that non-daily smokers could be classified as non-smokers or daily smokers. The data used in this paper were for 1963 and 1969 from *Ugeskrift for Læger* [8], while the data from 1970-1993 were from a National Board of Health report [15].

The Bonnevie survey from 1964 was originally carried out for the newspaper *Politiken*, which later gave Bonnevie access to publish the data in *Ugeskrift for Læger* [13].

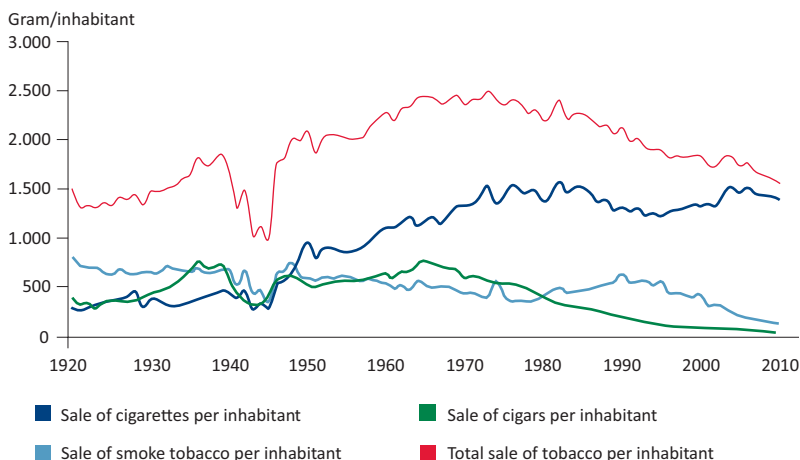
The Danish Health Study was carried out in 1982 and comprised 3,419 participants. It was not possible to locate the original publication [5].

The Annual Smoking Habit Survey (ASHS) [15, 16] from 1994, *Tobaksskaderådet* (until 2001, subsequently the National Board of Health), the Danish Cancer Society, the Danish Heart Association, and the Danish Lung Association (since 1998) have carried out an annual survey of the Danes' smoking habits. The use of opinion-research institutes and administration methods have changed over time (from telephone to web-based, in 2007 both methods were used). Data for 1994-2003 were from a report [15] and for 2004-2010 from the National Board of Health's web page [16].

The National Health Interview Surveys (SUSY) were carried out by the National Institute of Public Health in 1987, 1994, 2000, 2005 (and in 2010, but data were not published when the present article was prepared) [17]. Data were retrieved from the National Institute of Public Health's web page and directly from the Institute [17]. In 1991, the Danish Institute for Clinical Epidemiology carried out a survey that included smoking habits [12].

FIGURE 1

Sale of tobacco in Denmark, 1920-2010 in gram per inhabitant (all age groups included).



The KRAM survey was carried out in 2007-2008. It is not included in this study because of a low participation rate (14.2%) and limited geographical coverage [18].

The National Health Profile [19] survey was undertaken in 2010.

The surveys of smoking habits are not directly comparable due to differences in questions and methods of data collection.

Smoking status can be reported as smokers versus non-smokers, but can also be subdivided in other ways, e.g. heavy smokers and light smokers [17]. Smokers can be subdivided on the basis of what they smoke, e.g. pipe and cigarettes. Furthermore, they can be subdivided based on the frequency of smoking, e.g. daily smoker and non-daily smokers. In this paper, data are reported for the total proportion of smokers, daily smokers and heavy smokers (≥ 15 cigarettes/day), but not all surveys had all numbers.

Data processing

The data were processed in Excel.

The sale of tobacco per inhabitant was calculated for every year on the basis of population numbers and the total amount of tobacco sold. The population numbers were from Statistics Denmark's Statbank table HISB3 [6].

Gram tobacco per smoker (1994 and 2010) was calculated using the number of people over 15 years of age in Denmark from Statistics Denmark's table BEF5 [6], the proportion of smokers in Denmark from the annual smoking habit survey [15, 16] and the sale of tobacco in Denmark [6].

Confidence intervals for the proportion of smokers

The proportion of smokers was calculated from the sources stated above; some of these were weighted numbers. According to Altman [20], it can be assumed that the distribution of sample means will be nearly normal in large samples like the smoking habit surveys, and the confidence intervals were calculated under this assumption.

Trial registration: not relevant.

RESULTS

Sale of tobacco goods 1920-2010

The sale of tobacco goods increased from the mid-1930s until 1940 and again from 1945 to 1950, then stagnated until 1957 and increased again until 1975, **Figure 1**.

There was a declining total sale of tobacco per inhabitant from the mid-1980s onwards. The decline was mostly in smoking tobacco, cigars and cigarillos. The sale of cigarettes decreased from the mid-1980s to 1995, followed by a slight increase up to 2005.

FIGURE 2

The proportion of smokers among Danish men in nine smoking habit surveys. Heavy smokers in three smoking habit surveys (1953-2010).

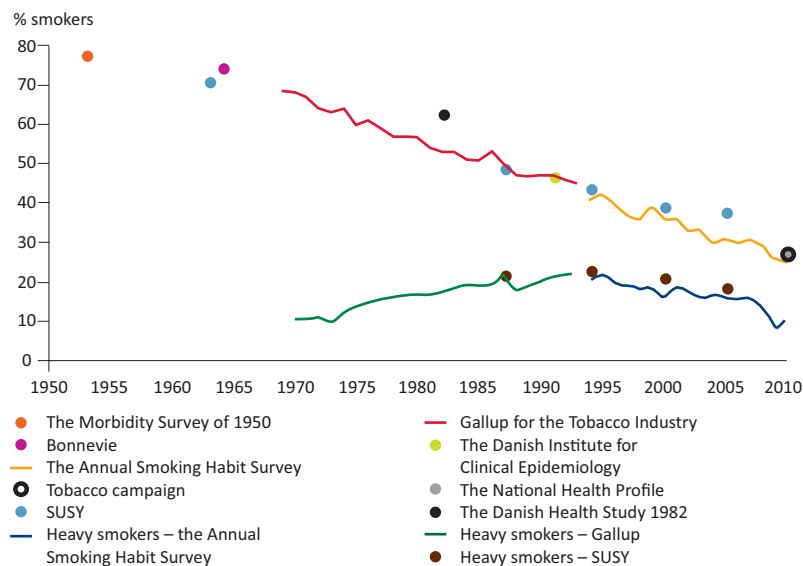
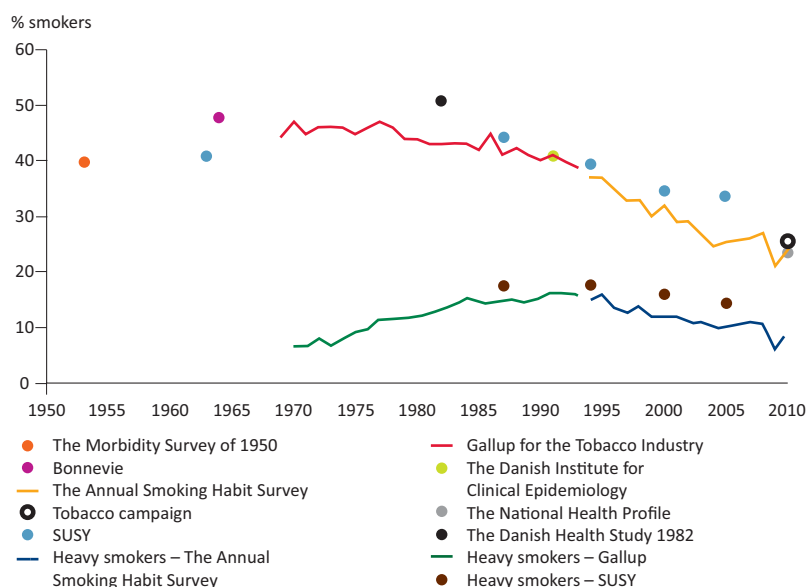


FIGURE 3

The proportion of smokers among Danish women in nine smoking habit surveys. Heavy smokers in three smoking habit surveys (1953-2010).



Smoking habits in Denmark

Figure 2 shows that there has been a decrease in the proportion of Danish male smokers. The surveys from the 1950s and 1960s found that more than 70% of males smoked. In 2010, this proportion had declined to under 30%.

The proportion of female smokers peaked in the

1970s and thereafter decreased from the late 1970s with a stronger decline as from the 1990s; in 2010, it was under 30%, **Figure 3**. From 1970 until the mid-1990s, there has been an increase in the proportion of heavy smokers; hereafter, the proportions of heavy smokers have declined.

Sold tobacco per smoker per day in 1994 was around 16 g, and in 2010 it had increased to 22 g per day per smoker. This is an average for all smokers including those with non-daily tobacco use.

Differences between surveys from the same year

In some years, multiple surveys have been conducted. For some of these surveys, it was possible to construct a confidence interval for the proportion of smokers. The limiting factor has been access to the number of participants divided into men and women.

Table 1 shows that there was a significant difference (except for all female smokers in 2000) between the ASHS and the SUSY in 2000 and 2005. The SUSY have higher proportions of all smokers, daily smokers and heavy smokers.

The response rate was different in the different surveys. For SUSY, the response rates were from 80% to 52% [17], the National Health Profile had a response rate of 60% [19] and the ASHS had response rates between 30% and 70%.

DISCUSSION

According to the surveys, tobacco consumption showed

a marked decrease with more than a 50% decline in the proportion of Danes who smoke from 1970 until today, while the total sale of tobacco by weight decreased by less than 30%. Part of the explanation for this discrepancy may be that the taxed tobacco sale accounted for only part of the total Danish consumption. According to an estimation of cross-border trade made by the Danish Ministry of Taxation, there has been an increase in the amount of tobacco sold to foreigners and a decrease in how much tobacco the Danes buy abroad, but it is still estimated that more cigarettes are taken into Denmark than are taken out as a result of cross-border trade [7]. Other factors that can have changed over time are the registration practices and the tobacco content (weight) per cigarette. The weight of cigarettes both shows increases and decreases over time and between brands.

Another explanation may be that the proportion of Danes still smoking is to an ever larger extent heavy smokers. If it is assumed that the numbers are correct and representative, all smokers would need to smoke an average of 22 cigarettes a day in 2010 compared with 16 in 1994. However, if increased tobacco consumption per smoker is the explanation, one would have expected that the number of heavy smokers would have been increasing, which is not the case. But the proportion of daily smokers who are heavy smokers has increased in the study period; e.g. in 1987, 45% of the daily smokers in the SUSY were heavy smokers compared with 56% in 2005.

A third explanation may be that the surveys no

TABLE 1

Proportion of smokers, daily smokers and heavy smokers in four Danish smoking habit surveys from 2000 to 2010. The values are percentages (95% confidence intervals).

Year	Smoking habit surveys	All smokers		Daily smokers		Heavy smokers	
		male	female	male	female	male	female
1987	Gallup for the Tobacco Industry ^{a, b}	50	41	–	–	22	15
	SUSY	49 (47-51)	44 (42-46)	46 (44-48)	42 (40-44)	22 (20-24)	18 (16-19)
	Difference ^c	1	3	–	–	0	–3
1994	ASHS ^a	41	37	38	35	21	15
	SUSY	44 (42-46)	39 (37-41)	41 (39-43)	37 (35-39)	23 (21-25)	18 (16-19)
	Difference ^c	3	2	3	2	2	3
2000	ASHS	36 (34-38)	32 (30-34)	32 (30-34)	29 (27-31)	16 (14-18)	12 (10-14)
	SUSY	39 (38-40)	35 (34-36)	36 (35-37)	32 (31-33)	21 (20-22)	16 (15-17)
	Difference ^c	3 (1-6)	3 (0-5)	4 (1-7)	3 (1-5)	5 (3-7)	4 (2-6)
2005	ASHS	30 (28-32)	25 (23-27)	28 (26-30)	24 (22-26)	16 (14-18)	10 (9-11)
	SUSY	38 (37-39)	34 (33-35)	32 (31-33)	28 (27-29)	19 (18-20)	15 (14-16)
	Difference ^c	8 (6-10)	9 (7-11)	4 (2-6)	4 (2-6)	3 (1-5)	5 (4-6)
2010	ASHS	25 (23-27)	24 (22-26)	20 (18-22)	20 (18-22)	10 (9-11)	10 (9-11)
	The National Health Profile	28 (28-28)	23 (22-24)	23 (23-23)	19 (18-20)	13 (13-13)	9 (8-10)
	Difference ^c	3 (1-5)	–1 (–3-1)	3 (1-5)	–1 (–3-1)	3 (2-4)	–1 (–2-0)

ASHS = The Annual Smoking Habit Survey.

SUSY = The National Health Interview Survey.

a) Data on participants divided by sex were not available, so it was not possible to compute confidence intervals.

b) Smokers are identified by the question "Did you smoke yesterday?".

c) Percentage points.

longer cover as much of the tobacco consumption as they did earlier. Bonnevie showed that with the exception of cigars, there was good agreement between the amount of tobacco sold and the consumption in the survey in 1964 [13]. Osler et al also found good agreement between the cigarette consumption found in SUSY 1987 and the sale of cigarettes in the same year [12].

The past 20 years have seen a growing focus on how much smoking costs society, and on the fact that second-hand smoking may lead to lung cancer and other diseases. This may have led to decreasing social acceptance of smoking, which, again, may have had a negative influence on the degree to which smokers are willing to participate in health surveys causing more smokers to underestimate how much they actually smoke and, finally, some might not even acknowledge their own smoking. There has been an increase in the number of smokers who report that they do not smoke daily [2].

It may also be of importance which institution or agency performs the survey. In the Gallup surveys, it was the tobacco industry; whereas it is health organizations in the ASHS. In both cases, a desire to please the organizations performing the surveys may have been in play. This would seem to be supported by the downwards change observed in 1993/1994, when the surveys went from being paid by the tobacco industry to being paid by health organizations. However, this coincides with a change in the question posed to smokers.

The surveys from the past ten years show considerable difference in the proportions of smokers found. Some of this difference was caused by statistic uncertainty, but the SUSY generally found a higher proportion of smokers than the ASHS. Part of the explanation may lie in differences between the methods used; thus, the SUSY is a personal interview in the home, whereas the ASHS is performed as a telephone interview.

How do we best monitor tobacco consumption? The disadvantage of using sales data is that such data hold no information on how many or who (age, sex etc.) smokes or how much they smoke. The use of sales data does not allow us to follow changes within different sub-populations. The disadvantages associated with using surveys are that we do not get answers from everyone and that the answers obtained may not be correct.

It is relevant to use both measures to illustrate the changes in the Danes' smoking habits, as both measures have advantages and disadvantages that do not overlap on all points; and the measures therefore supplement each other.

LITERATURE

1. The Health Consequences of Smoking. Washington, D.C: Office of the Surgeon General, 2004.
2. Centers for Disease Control and Prevention. Prevalence of current cigarette smoking among adults and changes in prevalence of current and some day smoking. *MMWR* 2003;11;52:303-7.
3. Laugesen M. Has smoking prevalence markedly decreased despite more cigarettes released for sale? *N Z Med J* 2009;122:76-82.
4. Gorber SC, Schofield-Hurwitz S, Hardt J et al. The accuracy of self-reported smoking. *Nicotine Tob Res* 2009;11:12-24.
5. Osler M. *Danskernes Rygevaner*. København: Hjerteforeningen, Kræftens Bekæmpelse og Tobaksskaderådet, 1992.
6. Danmarks Statistik. Statistikbanken. www.statistikbanken.dk (July 2011).
7. Status over grænsehandel 2010. Copenhagen: Skatteministeriet, 2010.
8. Nielsen PE, Krarup NB, Astrup J et al. Alterations in Danish smoking habits 1958-1976. *Ugeskr Læger* 1978;140:2528-32.
9. Nielsen PE, Krarup NB. Consumption of tobacco in Denmark in the period 1920-1975. *Ugeskr Læger* 1976;138:2511-6.
10. Nielsen PE, Zacho J, Olsen JA et al. Alterations in the Danish smoking habits in the period 1970-1987. *Ugeskr Læger* 1988;150:2229-33.
11. Nielsen PE, Sørensen JF. Changes in the smoking habits in the Danish population 1988-1993. *Ugeskr Læger* 1995;157:3451-6.
12. Osler M. Smoking habits in Denmark from 1953 to 1991. *Int J Epidemiol* 1992;21:862-71.
13. Bonnevie P. Befolkningens rygevaner. *Ugeskr Læger* 1964;126:1433-5.
14. Hamtoft. Morbiditetsundersøgelsen af 1950, Bilag 18: Komiteen til undersøgelse af den danske befolknings sundhedstilstand. Copenhagen: Fællesudvalgets Kommisorium Sundhedsstyrelsen Landsforeningen til Kræftens Bekæmpelse and Den Almindelige Danske Lægeforening, 1961.
15. Statistik 2003: alkohol, narkotika og tobak. Copenhagen: National Board of Health, 2004.
16. [www.sst.dk/Sundhed og forebyggelse/Tobak/Tal_og_undersogelser/Danskernes_rygevaner.aspx](http://www.sst.dk/Sundhed%20og%20forebyggelse/Tobak/Tal_og_undersogelser/Danskernes_rygevaner.aspx) (April 2011).
17. [www.si-folkesundhed.dk/Forskning/Befolkningens_sundhedstilstand/Sundhed og sygelighed SUSY.aspx](http://www.si-folkesundhed.dk/Forskning/Befolkningens_sundhedstilstand/Sundhed_og_sygelighed_SUSY.aspx) (April 2011).
18. Christensen AI, Severin M, Holmberg T et al. KRAM-undersøgelsen i tal og billeder. Copenhagen: Statens Institut for Folkesundhed, 2009.
19. Christensen AI, Davidsen M, Ekholm O et al. Den Nationale Sundhedsprofil 2010. Copenhagen: Statens Institut for Folkesundhed, 2011.
20. Altman D. *Practical statistics for medical research*. London: Chapman & Hall, 1991:152-78.

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