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# Prevalence of smoking in the adult population of Germany

## Results of the German Health Interview and Examination Survey for Adults (DEGS1)

## Introduction

Smoking is the most significant single health risk factor and is the leading cause of premature mortality in the industrialised countries. The diseases which frequently occur among smokers include cardiovascular and respiratory diseases and cancers [1, 2]. Only in Germany, between 100,000 and 120,000 people die every year as a result of smoking [3, 4]. Diseases, health complaints and premature deaths caused by regular exposure to passive smoke must also be taken into account [5]. According to some estimates, the costs of treating diseases and health problems caused by smoking amount to 7.5 billion € a year. If occupational disability, early retirement and deaths are included, it can be assumed that the costs involved for the economy as a whole amount to 21 billion € per year [6].

In recent years, the national government of Germany has taken various measures to reduce tobacco consumption in the population in general and to protect non-smokers from the effects of passive smoke. These measures include the multi-staged tobacco tax increases from 2002–2005, the amendment of the workplaces ordinance in 2002, the raising of the age limit for the purchase and consumption of tobacco products in 2008, the restriction or the complete ban on tobacco advertising in line with established EU law, and the non-smoker protection laws of the national and regional governments, which were passed in 2007 and which refer to public buildings and transport, schools, hospitals and gastronomy businesses. These measures are supported by nationwide information campaigns by the Federal Centre for Health Education (BZgA) and setting-specific preventive measures implemented in many places, including schools, businesses and hospitals [3, 7].

On the basis of the data from the German Health Interview and Examination Survey for Adults (DEGS1), this study deals with the following issues: (1) How widespread is smoking among the 18- to 79-year-old population of Germany? (2) To what extent are age and gender-specific differences to be observed in smoking behaviour? (3) Is there a connection between social status and smoking and if so, how distinct is it? After inclusion of data from earlier health surveys, the question is also asked: (4) How has smoking behaviour developed in the last 20 years?

## Methods

The German Health Interview and Examination Survey for Adults ("Studie zur Gesundheit Erwachsener in Deutschland", DEGS) is part of the health monitoring system at the Robert Koch Institute (RKI). The concept and design of DEGS are described in detail elsewhere [8, 9, 10, 11, 12]. The first wave (DEGS1) was conducted from 2008–2011 and comprised interviews, examinations and tests [13, 14]. The target population comprises the residents of Germany aged 18–79 years. DEGS1 has a mixed design which permits both cross-sectional and longitudinal analyses. For this purpose, a random sample from local population registries was drawn to complete the participants of the German National Health Interview and Examination Survey 1998 (GNHIES98), who re-participated. A total of 8,152 persons participated, including 4,193 first-time participants (response rate 42%) and 3,959 revisiting participants of GNHIES98 (response rate 62%). In all 7,238 persons attended one of the 180 examination centres, and 914 were interviewed only. The net sample permits representative cross-sectional and time trend analyses statements for the age range of 18–79 years in comparisons with GNHIES98 (n=7,124) [12]. The data of the revisiting participants can be used for longitudinal analyses.

The cross-sectional and trend analyses are conducted with a weighting factor which corrects deviations in the sample from the population structure (as of 31 Dec 2010) with regard to age, sex, region and nationality, as well as community type and education [12]. A separate weighting factor was prepared for the examination part. Calculation of the
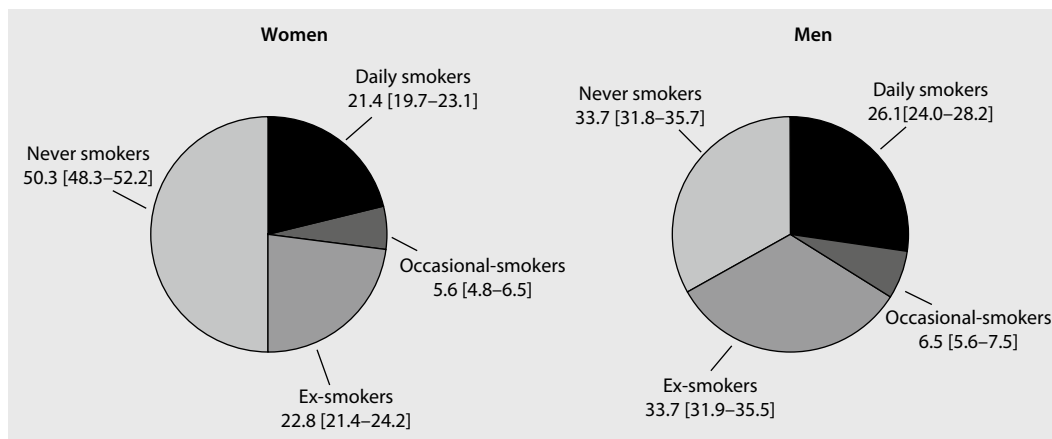
**Fig. 1 ◄** Distribution of smoking among 18- to 79-year-old women and men. The prevalences (in %) and 95% confidence intervals (n=7,899)
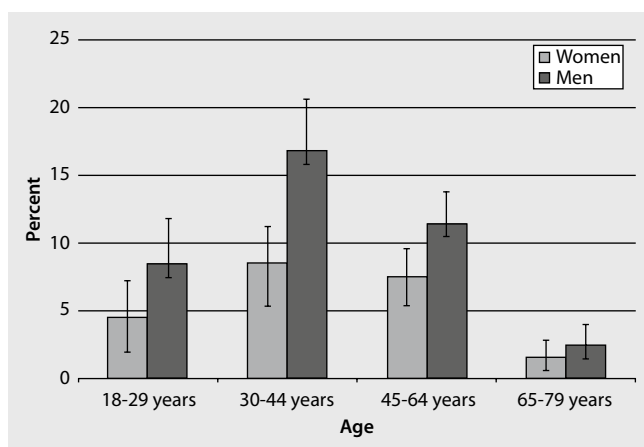


**Fig. 2 ▲** Distribution of heavy smoking among 18- to 79-year-old women and men. The prevalences (in %) with 95% confidence intervals (n=7,755)
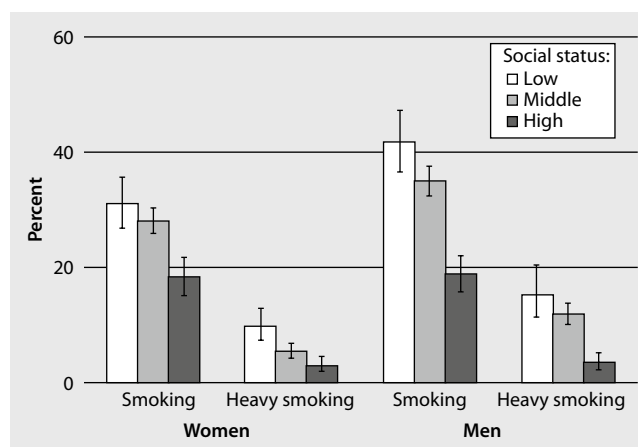


**Fig. 3 ▲** Distribution of smoking and heavy smoking by social status among 18- to 79-year-old women and men. The prevalences (in %) with 95% confidence intervals (n=7,858 for smoking, n=7,717 for heavy smoking)

weighting factor also considered re-participation probability of GNHIES98 participants, based on a logistic regression model. For the purpose of conducting trend analyses, the data from the GN-HIES98 were age-adjusted to the population level as of 31 Dec 2010. A non-response analysis and a comparison of selected indicators with data from census statistics indicate a high level of representativity of the net sample for the residential population aged 18–79 years of Germany [12].

Above all, prevalences with 95% confidence intervals are reported below. In addition to age and gender-specific differences, differences by social status are also examined. Social status was determined using an index which includes information on education and vocational training, occupational status and net equivalent income and which enables a classification into low, middle and high

status groups [15, 16]. To take into account the weighting as well as the correlation of the participants within a community, the confidence intervals were determined with the SPSS-20 procedures for complex samples. Differences are regarded as statistically significant if the respective 95% confidence intervals do not overlap. To enable the evaluation of changes in the course of time, additional p values are established which were calculated with the help of regression analyses in which the change in the age structure is taken into account as an explanatory variable. The p values, which state whether a change in smoking behaviour independent of this age effect took place, were also determined with the SPSS-20 method for complex random samples.

Smoking behaviour was surveyed by means of several questions relating to current and previous smoking habits and smoking intensity. The first question was

"Do you currently smoke—even if only occasionally" (Answer categories: "Yes, every day", "Yes, occasionally", "No longer" and "Have never smoked"). Based on the answers to this question, a difference is made between "daily smokers", "occasional smokers", "ex-smokers" and "never smokers". When current smokers are defined, the categories of daily and occasional smokers are combined. Moreover, information is given on "ever smokers" (daily, occasional and former smokers) and on the "quit rate" (percentage of former smokers among ever smokers). To enable accurate statements on smoking intensity, the respondents were asked to state the average quantities smoked per day (daily smokers) or per week (occasional smokers) with differentiation between ready-made, hand-rolled or home-made cigarettes, cigars/cigarillos, pipes and water pipes. In the following analysis, the group of heavy cigarette

smokers is studied. According to an estimation made by the World Health Organization (WHO), heavy smokers are defined as people who smoke 20 or more cigarettes a day [17].

For the time developments and trend analysis of smoking behaviour, data from the pooled data records for the national health surveys 1990–91 and the Health Examination Survey EAST 1991–92 (NUS90–92, n=7,407), the German National Health Interview and Examination Survey 1998 (GNHIES98, n=7,124), the Telephone Health Survey 2003 (GS-Tel03, n=8,318) and the German Health Update 2009 (GEDA09, n=21.262) were additionally used. In these health surveys, all of which were conducted by the Robert Koch Institute, smoking behaviour was surveyed in a manner comparable to DEGS1. However for the trend analysis, which extends back to the early 1990s, the population has to be limited to the 25–69 year olds as the NUST2 and SURVEY OST were restricted to this age range. When comparing the results of DEGS1 with those of GNHIES98, GS-Tel03 and GEDA09, the age groups from 18–79 can be analysed.

It should also be taken into account that the health surveys differ with regard to the study design, participation rate and random sample composition. GS-Tel03 and GEDA09 were telephone surveys with a response rate of 31 and 29% respectively [18], whereas the other surveys were conducted on the spot as combined interview and examination surveys at study centres with response rates varying between 62% in GNHIES98 and 42% in DEGS1. Although special weighting factors were calculated for the trend analyses, they can only partially compensate the heterogeneity of the surveys [19].

## Results

According to the data of the DEGS study, 29.7% of 18–79 year olds smoke daily or occasionally. A total of 26.9% of the women smoke, which is less than with men, 32.6% of whom reach at least occasionally for a cigarette or one of the other considered tobacco products. Furthermore 22.8% of the women and 33.7% of

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## Prevalence of smoking in the adult population of Germany. Results of the German Health Interview and Examination Survey for Adults (DEGS1)

### Abstract

Although various tobacco control measures have been implemented in Germany in the recent years, smoking is still widespread and constitutes a considerable health risk for the population. According to the data of the German Health Interview and Examination Survey for Adults (DEGS1), which was conducted by Robert Koch Institute from 2008–2011, 29.7% of the 18- to 79-year-old population smokes (women =26.9%, men =32.6%). The proportion of women and men who smoke 20 or more cigarettes a day amounts to 6.0 and 10.6% respectively. Smoking is mostly widespread among young adults, as well as among persons with low social status who are also overrepresented among the heavy smokers. Comparison with data from previous health surveys indicates that the proportion of smokers has reduced slightly over the last 10 years.

### Keywords
Tobacco consumption · Smoking · Health behaviour · Social inequality · Health survey

## Verbreitung des Rauchens in der Erwachsenenbevölkerung in Deutschland. Ergebnisse der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1)

### Zusammenfassung

Obwohl in Deutschland in den letzten Jahren verschiedene Maßnahmen zur Eindämmung des Tabakkonsums umgesetzt wurden, ist das Rauchen nach wie vor stark verbreitet und stellt ein erhebliches Risiko für die Gesundheit der Bevölkerung dar. Nach den Daten der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1), die vom Robert Koch-Institut in den Jahren 2008 bis 2011 durchgeführt wurde, rauchen 29,7% der 18- bis 79-jährigen Erwachsenen (Frauen =26,9%, Männer =32,6%). Der Anteil der Frauen und Männer, die 20 oder mehr Zigaretten am Tag rauchen, beträgt 6,0 bzw. 10,6%. Am stärksten verbreitet ist das Rauchen bei jungen Erwachsenen, außerdem bei Personen mit niedrigem Sozialstatus, die auch überproportional zu den starken Raucherinnen bzw. Rauchern zu zählen sind. Der Vergleich mit den Daten früherer Gesundheitssurveys deutet darauf hin, dass der Anteil der Raucherinnen und Raucher im Verlauf der letzten 10 Jahre etwas zurückgegangen ist.

### Schlüsselwörter
Tabakkonsum · Rauchen · Gesundheitsverhalten · Soziale Ungleichheit · Gesundheitssurvey

the men used to smoke but have given it up in the meanwhile. Half of 18- to 79-year-old women and a third of the men of the same age have never smoked ( ▣ **Fig. 1**).

Smoking is most common among young adults. With 18- to 29-year-old women, the prevalence for current smoking (daily or occasionally) is 40.0 and 47.0% for men of the same age. In middle age groups, prevalences lie around 30% with women and between 30 and 40% with men. The proportion of women and men aged 65–79 who smoke is 8.9 and 11.6% respectively, which is a lower percentage than in early and middle adulthood.

Roughly a quarter of the women and men who smoke consume 20 or more cigarettes a day. In relation to the total population aged 18–79, the prevalence of heavy smoking is 8.3% with the value of 6.0% for women lying below the equivalent value for men (10.6%).

The proportion of heavy smokers is highest in the 30–44 age group ( ▣ **Fig. 2**). The share of women and men in this age group who are heavy smokers is 8.5 and 16.8% respectively. The lowest proportion of heavy smokers is to be found among the 65–79 year olds with 1.5% of women and 2.4% of men.

Furthermore, differences in smoking behaviour by social status can also be

**Tab. 1** Distribution of smoking among women and men in different age groups. Prevalences (in %) and 95% confidence intervals (n=7,899)

| | Smoking behaviour | | | |
|---|---|---|---|---|
| | **Daily** | **Occasionally** | **Previously** | **Never** |
| **Women** | | | | |
| 18–29 years | 29.7 [25.7–34.1] | 10.3 [7.8–13.5] | 14.5 [11.5–18.0] | 45.5 [41.0–50.1] |
| 30–44 years | 24.6 [21.2–28.3] | 6.6 [5.0–8.6] | 20.4 [17.5–23.5] | 48.5 [44.4–52.5] |
| 45–64 years | 23.2 [20.4–26.2] | 4.7 [3.6–6.1] | 30.3 [27.7–32.9] | 41.9 [38.9–44.9] |
| 65–79 years | 7.1 [5.5–9.3] | 1.8 [1.1–3.1] | 20.0 [16.7–23.7] | 71.1 [67.0–74.8] |
| **Men** | | | | |
| 18–29 years | 34.2 [29.6–39.2] | 12.8 [10.0–16.2] | 12.6 [9.5–16.4] | 40.4 [35.4–45.7] |
| 30–44 years | 32.1 [28.0–36.5] | 7.7 [5.8–10.3] | 24.1 [20.4–28.4] | 36.0 [31.9–40.4] |
| 45–64 years | 25.6 [22.5–29.0] | 4.6 [3.5–6.2] | 43.0 [40.0–46.1] | 26.7 [24.0–29.6] |
| 65–79 years | 9.8 [7.7–12.3] | 1.8 [1.0–3.1] | 50.8 [47.2–54.5] | 37.6 [34.1–41.3] |

**Tab. 2** Quit rate by age, sex and social status. Prevalences (in %) with 95% confidence intervals (n=4,510)

| | **Total** | **Low social status** | **Middle social status** | **High social status** |
|---|---|---|---|---|
| **Women** | | | | |
| 18–29 years | 26.5 [21.4–32.4] | 26.5 [16.8–39.3] | 25.1 [18.8–32.6] | 35.4 [20.2–54.1] |
| 30–44 years | 39.5 [34.1–43.5] | 29.8 [19.3–42.9] | 36.2 [30.0–42.9] | 57.8 [45.8–68.9] |
| 45–64 years | 52.1 [48.0–56.1] | 36.9 [27.4–47.6] | 51.2 [46.3–56.1] | 67.7 [59.8–74.7] |
| 65–79 years | 69.0 [62.2–75.1] | 59.9 [41.7–75.7] | 70.8 [62.6–77.8] | 78.5 [64.0–88.3] |
| Total | 45.8 [43.2–48.5] | 35.8 [30.2–41.8] | 44.6 [41.5–47.8] | 61.8 [56.0–67.0] |
| **Men** | | | | |
| 18–29 years | 21.1 [16.1–27.1] | 17.0 [8.9–29.8] | 19.8 [14.0–27.2] | 41.5 [23.3–62.4] |
| 30–44 years | 37.7 [32.3–43.5] | 28.9 [18.5–42.0] | 33.3 [26.6–40.6] | 56.6 [45.6–67.0] |
| 45–64 years | 58.7 [54.8–62.5] | 49.4 [40.2–58.6] | 58.2 [53.4–62.9] | 69.9 [63.0–75.5] |
| 65–79 years | 81.5 [77.5–84.9] | 75.4 [63.2–84.6] | 83.0 [77.9–87.1] | 85.6 [78.2–90.7] |
| Total | 50.8 [48.2–53.5] | 42.8 [36.8–49.0] | 49.2 [45.8–52.6] | 65.6 [60.7–70.2] |

**Tab. 3** Change in smoking behaviour in women and men in various age groups during the period 2003–2011. The prevalences are shown as percentages and the difference between the 2 years observed as percentage points, along with the p value for the indicated difference (n=8,163 for GSTel03, n=7,899 for DEGS1)

| | **2003 (%)** | **2011 (%)** | **Difference** | **p value** |
|---|---|---|---|---|
| **Women** | | | | |
| 18–29 years | 46.2 | 40.0 | −6.2 | 0.068 |
| 30–44 years | 39.6 | 31.2 | −8.4 | 0.001 |
| 45–64 years | 27.8 | 27.8 | ±0.0 | 0.747 |
| 65–79 years | 7.0 | 9.0 | +2.0 | 0.150 |
| Total | 29.8 | 26.9 | −2.9 | 0.019 |
| **Men** | | | | |
| 18–29 years | 54.5 | 47.0 | −7.5 | 0.032 |
| 30–44 years | 45.9 | 39.8 | −6.1 | 0.033 |
| 45–64 years | 33.4 | 30.3 | −3.1 | 0.056 |
| 65–79 years | 17.1 | 11.5 | −5.6 | 0.011 |
| Total | 38.8 | 32.6 | −6.2 | 0.000 |

identified (● **Fig. 3**). Women and men with a low social status smoke roughly twice as often as women and men with a high social status. The status-specific differences are even more pronounced where heavy smoking is concerned, especially among men. It can also be seen that members of the middle status group tend to smoke more often and more heavily than those in the high status group. There are also differences over the low status group, but they are not statistically significant.

The status-specific differences in smoking behaviour appear because members of the low status group start smoking more frequently and stop less frequently. This at least applies to men, whereas the differences in quitting behaviour would appear to be decisive with women. From the 18- to 79-year-old men with a low social status, 72.9% have started to smoke, as opposed to 68.9% with a middle and 54.3% with a high social status. The comparable values for women are 48.3, 50.7 and 47.7% which does not indicate any statistically significant difference between the social groups where starting smoking is concerned.

Contrary to this, differences in quitting behaviour are to be observed with both women and men. The quit rate, which describes the percentage of ex-smokers among all persons who ever started smoking, is 35.8% in women with low social status aged 18–79, compared to 61.8% in women of the same age with high social status. With values of 42.8% in the low and 65.6% in the high status group, these differences are similarly distinct among men. An age-differentiated observation shows the status-specific variations of the quit rate in middle age to be statistically significant (● **Tab. 2**).

Statements on long-term developments and trends in smoking are possible for the 25- to 69-year-old population (● **Fig. 4**). From the 1990s, the data indicate an increase in prevalence among women of more than five percentage points to 32.0% in 2003 while no significant changes were observed for men. For the period 2003–2009, on the other hand, a decline in the smoking rate of roughly two percentage points was observed for both men and women. Since then, the
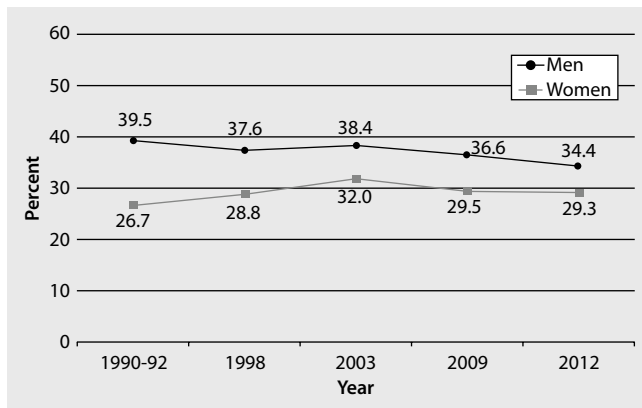
**Fig. 4** ◄ Chronological development of the percentage of smokers in the 25- to 69-year-old population. Prevalences (in %) (n=7,466 for NUS90–92, n=5,825 for GNHIES98, n=6,890 for GSTel03, n=16.418 for GEDA09, n=7,272 for DEGS1)

smoking rate among women has stagnated and reached a level of 29.3% in the 25–69 age group in 2011. With men, the decline continued, with prevalence falling by a further two percentage points to 34.4% in 2011.

A decline in smoking among women can only be observed in the younger age groups and among men in the higher age groups. This becomes clear when the figures for the years 2003 and 2011 are compared for which the under 25 and 70–79 age groups can also be included (☐ **Tab. 3**). The development among women aged 30–44 is statistically significant. A statistically significant decline in the smoking rate was determined among men in all age groups with the exception of the 45–64 year olds.

## Discussion

The data from the DEGS1 survey indicate that many adults in Germany still smoke. Among the 18- to 79-year-old population, 26.9% of women and 32.6% of men smoke daily or occasionally. Smoking is most widespread among young adults aged 18–29. It is also very popular between the ages of 30 and 64 years and only decreases significantly after the age of 65. It is unlikely that this decline is due solely to changes in living conditions and lifestyle after retirement and it should be regarded as a consequence of the increase in the occurrence of tobacco-associated illnesses and premature deaths [20].

Where heavy smoking is concerned, which is considered as consumption of 20 or more cigarettes per day, there is a different distribution over the observed age groups. The highest prevalences with

men and women are to be found in middle age. The reason for the increase in the percentage of heavy smokers from early to middle adulthood is due to the addiction where the longer a person smokes, the higher the nicotine intake has to be in order to achieve the desired psychotropic effect [21]. The decline in heavy smoking after the age of 65 is due among other factors to the increased risk of illness and premature death among heavy smokers [22].

In addition to this, the data from the DEGS1 survey show a connection between social status and smoking behaviour. The differences, which are to the disadvantage of the low and middle groups compared to the high status group, have already been reported in numerous other studies. Except for analyses done on the basis of the previous health surveys conducted by the Robert Koch Institute [23, 24], other studies based on the data of the microcensus of the Federal Statistical Office [25] and Socioeconomic Panel of the German Institute for Economic Research [26] are also meant. The results of the DEGS1 survey, which apply to ever smoking and the quit rate, indicate that among the studied age groups, the status-specific differences in smoking behaviour are attributable above all to the fact that people with a low social status are less likely to quit smoking (cf. [20]). With men, but not with women, an additional aspect is that a larger proportion from the low status group start to smoke.

Comparison with earlier health surveys indicates that the percentage of smokers has decreased slightly in the last 10 years. The changes in the period from 2003–2011 can be regarded as statistically

significant for the 25- to 79-year-old population. A more precise examination according to age and sex shows that the decline in men in all age groups is statistically significant with the exception of the 45–64 year olds. With women, only the decline in the 30–44 age group is proved to be statistically significant.

When analysing the changes in smoking behaviour over time, the differences in the study designs and random sample compositions mentioned in the Methods section have to be taken into account. That is why, the decline in smoking should be interpreted with caution, especially as it can only be seen in recent years. Subsequent health surveys will show whether this development continues further. The available results do not permit a direct conclusion with regard to the extent to which the political tobacco control measures have been successful. It is noticeable, however, that this decline came only when smoking in public became increasingly a topic of controversial discussions and various political measures, such as several tobacco tax increases and expanded non-smoker protection laws, were implemented.

It will probably only be possible to achieve a long-lasting reduction in smoking, however, if the measures taken up to now are continued and further expanded. Above all, the greatest chance of success appears to have a combination of behavioural- and conditional-related measures which impede the start of smoking as well as helps people to quit [27, 28]. Emphasis should also be placed on the protection of non-smokers against passive smoking. The measures of tobacco prevention, the cessation of smoking and the protection of non-smokers should be developed and implemented specifically for each target group, with consideration paid to age and gender-specific, as well as social differences in smoking behaviour. In addition to the regular reports on the spread and development of smoking, of great importance are the national health targets, which are an instrument of the planning, regulating, and controlling the success of the measures and programmes, especially if these include the relevant players and are linked with concrete recommendations for action [29, 30].

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