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A multifactorial approach to explaining the stagnation in national smoking rates

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ABSTRACT

INTRODUCTION: The aim of this paper was to investigate if a multifactorial approach may be used to explain why national smoking rates have levelled off in Denmark after 60 years of decline.

METHODS: Seven hypothetical explanations for stagnation in smoking rate were explored. A period of five years with a declining smoking prevalence (2007-2011) was compared with four years of stalled smoking prevalence (2012-2015). We used individual and national level information sources, mostly cross-sectional data that were collected repeatedly, including large nationally representative surveys, sales statistics, nation-wide news and smoking cessation databases and legal information, among others.

RESULTS: Most theories were rejected, leaving some that might have contributed to the stagnation: substantially fewer smokers had tried to quit in the stagnation period. Furthermore, the price of tobacco had remained almost unchanged, tobacco control legislation and anti-smoking campaigns had not been very intensive, assistance to quit and the Health Authority's manpower allocated to tobacco control had decreased temporarily while the use of e-cigarettes had increased in the stagnation period.

CONCLUSIONS: Important components to focus on in future tobacco control in Denmark were identified. The study suggests that, in future, we need to focus on exploring why Danish smokers have an increasing wish to quit while fewer and fewer, nevertheless, actually attempt to quit. Neither the authors nor the Danish Health Authority were aware of this paradox.

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TRIAL REGISTRATION: not relevant.

For the first time in more than 60 years the smoking rates have levelled off in Denmark. Almost 80% of the Danish men were smokers in the 1950s, and Danish women held the world record in smoking prevalence in the 1960s. Owing to tobacco control, we have recorded a steady, approx. 1% point annual decrease in smoking prevalence since the 1970s for both sexes. Therefore it is very disturbing that the decline in smoking has now (January 2018) stalled for six years because smoking remains the most important preventable factor of disease and premature death in Denmark [1]; causing approx. 13,600 deaths annually.

We believe that a single explanation rarely provides the full answer. Rather it seems likely that a series of factors in combination cause the observed stagnation in smoking prevalence. Nevertheless, most studies have investigated associations between smoking prevalence and a single component, e.g. price or implementation of a smoking ban [2].

The aim of this paper was to investigate why national Danish smoking rates have levelled off in recent years using an exploratory multifactorial approach. Seven possible explanations were suggested by public health professionals during a work-shop hosted by The Danish Society of Public Health in 2015: 1. We have reached the lowest achievable level of smoking and should not expect a further decline; 2. The smokers left are hard-core heavy smokers unable and/or unwilling to quit; 3. More young people have taken up smoking; 4. National tobacco control has decreased in intensity in recent years; 5. The media has focused less on quitting smoking, 6. Professional assistance to smokers who want to quit has decreased; and 7. Use of other nicotine-containing products, such as smokeless tobacco or e-cigarettes, has influenced smoking rates negatively. All seven hypotheses were investigated.

METHODS

We chose to investigate a five-year period with a declining smoking prevalence (the 2007-2011 period), and compare it with the more recent four-year period of stalled smoking prevalence (the 2012-2015 period, most recent data available at that time). We used information sources both from the individual and the national level, mostly repeated cross-sectional data from a nationally representative sample of the general population.

"Daily smoking prevalence", "Heavy smoking" (≥ 15 cigarettes/day), "Smokers wish to quit", "Tried to quit in the past year", "Perceive myself as dependent on smoking", "Use of e-cigarettes" and "Smokeless tobacco" (snuff etc.) are registered annually in the nationally representative survey coined "The Danes' Smoking" [3]. With respect to "Youths' daily smoking rates", two nationally representative surveys with at least one registration in both periods were found: the National Health

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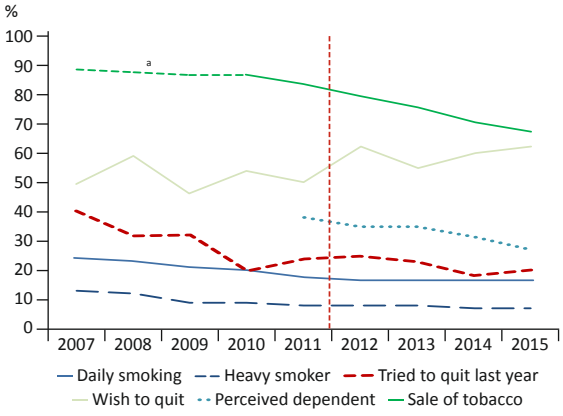
FIGURE 1

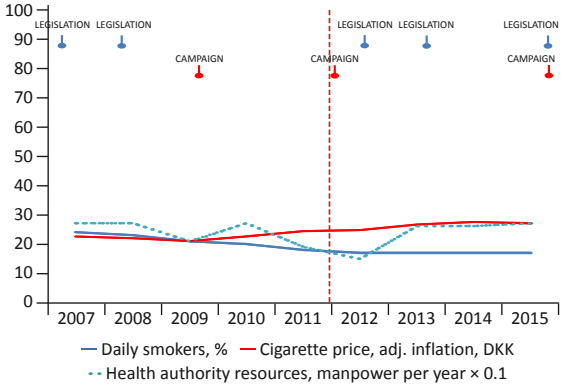
Hypothesis 2: "The smokers left are hard-core heavy smokers unable and/or unwilling to quit".



a) The dotted line illustrates that the first three years are not fully comparable with the rest of the period as border sale was not included for the years 2007-2009.

FIGURE 2

Hypothesis 4: "The national tobacco control has decreased in intensity in past years".



Profiles (16-24-year-olds) and the School Children Survey (15-year-olds) [4]. "Tobacco consumption" was retrieved from the national Tax Authority register, Bordersale Status 2016 [5].

"Lowest achievable national level of smoking"

We searched for the prevalence of daily smoking in countries that are known to have a strong tobacco control: Norway [6] , Sweden [7], Canada [8], Brazil [9], Hong Kong [10] and California [11].

"Tobacco control legislation"

We searched the database Legal Information (retsinformation.dk). Statistics Denmark's database was used to calculate the inflation-adjusted "Tobacco price". We searched the Danish Health Authority's websites for "Anti-smoking media campaigns" [12] and retrieved approximate estimates of the "Danish Health Authority's manpower allocated to tobacco control" from the Danish Health Authority.

"Media's focus on smoking cessation"

We used InfoMedia and supplemented with a raw Google search (a combination of the search terms "Smoking cessation" + "Newspaper" for each year).

"Smoking cessation services"

In municipalities, pharmacies, etc., these are registered annually in the Danish Smoking Cessation Database [13]. We supplemented these data with activities recorded by the "National Quitline" [14].

We were unable to achieve information on the sale of e-cigarettes during the nine years in question.

Analyses

Findings were plotted in figures for a visual overview of time trends. The smoking prevalence was the core of each figure. No statistical analyses were performed.

Trial registration: not relevant.

RESULTS

The "Lowest achievable national level of daily smoking" in nations with a strong tobacco control was: 9% in Canada, 10% in Sweden, 10.4% in Brazil, 10.5% Hong Kong, 11.7% in California (occasional smokers included) and 12% in Norway, compared with 17% in Denmark.

The prevalence of "Heavy smoking" decreased from 8% to 7% in the stagnation period. "Tobacco consumption" declined steadily by approx. 25% from 2010 to 2015 (**Figure 1**). "Perceive myself to be dependent of smoking" was assessed from 2011 and showed a continuous decrease (from 38% to 27% in 2015) in smokers perceiving themselves as being very dependent. "Smokers wish to quit" increased. 62% answered "Yes, I want to quit", in 2015 compared with 49.5% in 2007. On the other hand, the proportion who had "Tried to quit in the past year" decreased in both periods; the proportion being halved from 2007 to 2015.

"Youths' daily smoking rates" decreased from 17.5% in the first period to 14% in the stagnation period among 16-24-year-olds, and from 10% to 5% among the 15-year-olds.

Nationwide "Anti-smoking media campaigns" were launched via TV in 2009, and also at the end of 2011/beginning of 2012 and in 2015 [12] (**Figure 2**). "Tobacco control legislation": In 2007, a smoking ban covering indoor public places was implemented. In 2008, a law was

passed that prohibited the sale of tobacco to minors and there was a tightening of the existing law on tobacco marketing. In 2012, the law on smoking bans in indoor public places underwent a minor revision. In 2013, the law that prohibited the sale of tobacco to minors was supplemented with a photo ID requirement, and there was a minor revision of the existing law on tobacco marketing. In 2015, a law was passed which prohibited the sale of snuff/snus. The "Tobacco price" increased slightly in both periods. The "Danish Health Authority's manpower allocated to tobacco control" started low in 2012, at less than half of the manpower used in 2007, but increased during the year after and, in the more recent years, reached the 2007 level.

"Media's focus on smoking cessation – Internet hits" and "– newspaper articles" were high in 2007. Fewer newspaper articles on smoking cessation were published in the stagnation period, which displayed a decreasing tendency. In contrast hereto, an increase was observed in the number of Internet hits in the stagnation period.

The national "Smoking cessation services": face-to-face counselling almost halved from 2007 to 2013 (**Figure 3**). However, in 2015 a dramatic increase was recorded in the number of smokers receiving assistance to quit smoking (funding of "heavy-smoker cessation projects" by the health authorities). "National Quitline": there was no clear difference in telephone counselling between the two periods.

The use of "Smokeless tobacco" remained very low throughout the two periods, without an increase in the stagnation period (**Figure 4**).

DISCUSSION

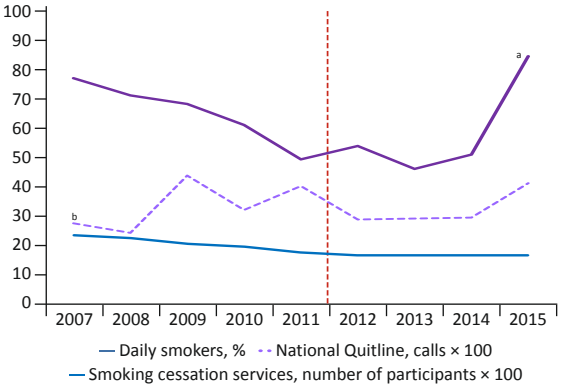
We used a multifactorial approach in our effort to identify factors of importance for the stagnation of the smoking prevalence in Denmark. Seven theories were tested by inclusion of 18 different components/variables. We were able to reject most of the theories, leaving a few for further study: substantially fewer smokers had tried to quit in the most recent years, the price of tobacco had remained almost unchanged, tobacco control legislation and anti-smoking campaigns had not been very intensive, assistance to quit had temporarily decreased, while use of e-cigarettes had increased.

A few studies have attempted to integrate the influence of several components on smoking rates simultaneously [15]. Even so, a single component approach is the most common although it does not reflect real life. Our multifactorial approach yielded an overview of changes in national and individual-level factors.

Several countries with a strong tobacco control have achieved lower smoking prevalence rates, so we may reject the theory that we have reached the lowest achievable level of smoking. A smoking prevalence of 10% or less seems realistic in Denmark, and some countries are even aiming at 5% or less [16]. The impact of anti-smoking interventions, e.g. price on tobacco, campaigns or marketing bans on smoking rates, has been summed up in international recommendations, the WHO's Framework Convention on Tobacco Control, which was signed by Denmark in 2004. In sum; we know what works. In California, it has been estimated that 59% of the reduction in smoking rates were due to price increases and 28% of the effect to media policies [17]. Snuff/snus use is frequently used to explain the low smoking prevalence in Sweden, but only men have used snuff, whereas women who have achieved the same de-

FIGURE 3

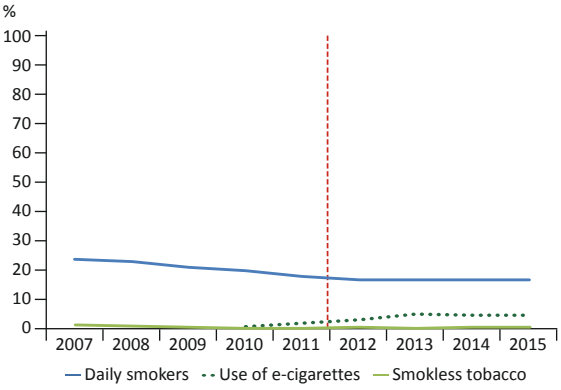
Hypothesis 6: "The professional assistance to smokers who want to quit has decreased".



a) Data from 2015 are not final and an increased number should be expected.
b) Due to problems with registration in 2007 data for this year is our best approximation.

FIGURE 4

Hypothesis 7: "Use of other nicotine containing products, like smokeless tobacco or e-cigarettes, has had a negative influence on smoking rates".



crease in smoking prevalence have not used snuff/snus [18]. Sweden and Norway have had comprehensive tobacco control in place for decades.

The "hardening theory" was also rejected. There are fewer self-reported hard-core smokers, which corresponds to the decrease in the sale of tobacco. Smokers' self-perceived dependency of smoking has decreased, and their wish to quit has increased over time. Other studies have also shown that there has actually been a "softening" of smokers (less heavy smokers, less smokers with a strong dependency) in the most recent years [19]. Despite of this, the proportion of smokers who had tried to quit within the past year in 2015 was only half of the proportion of smokers who had tried to quit in 2007.

Data confirmed that young people record decreasing daily smoking rates in the stagnation period, so the theory that more young people have started smoking was rejected (but Danish high school students have increasing rates of occasional smoking).

It could not be rejected that national tobacco control had decreased in intensity. There had been no nationwide anti-smoking TV campaign for four years, and legislation in the stagnation period was primarily based on minor revisions of existing laws. The Health Authority's manpower allocated to tobacco control started very low in the first year of the stagnation period, but is now back to the 2007-level. The tobacco price increased in the stagnation period, but only by approx. 2 DKK (0.24 EUR/0.25 USD) per package of cigarettes (adjusted for purchasing power over time).

It should probably be rejected that the media focused less on quitting smoking. Fewer newspaper articles on smoking cessation were actually published in the stagnation period, but there was a simultaneous increase in number of Internet hits, probably reflecting a change in the use of media.

It could not be rejected that assistance to smokers who wanted to quit decreased. There was a steep fall in the number of smokers using national smoking cessation services. At the same time, the national quit-line activities were low in the first three years of the stagnation period. Fortunately, a recent steep increase has been recorded in phone-calls to these services.

It could not be rejected that use of e-cigarettes influenced the stagnation. Use of e-cigarettes was, indeed, higher in the stagnation period, but there were relatively few users overall. Use of e-cigarettes might undermine smokers' wish to quit, but evidence is lacking. Use of smokeless tobacco was very low and remained unchanged.

We found several components that might have caused the stagnation in smoking prevalence. It seems crucial that the proportion of smokers having tried to quit in the past year has halved over the nine years. Also, the more or less unchanged tobacco price, which we know to be one of the most potent components in tobacco control, might have been of importance [2]. Making small adjustments in tobacco control legislation has probably not have had sufficient impact [20] and anti-smoking campaigns have not been very intensive. Professional assistance to quitting was also markedly reduced in the stagnation period. However, as only a minority of smokers use assistance to quitting, we believe that the population level impact was limited. The potential impact of e-cigarette use is difficult to access.

A main strength of the present study is that we had access to data on both the individual level and the national level. Other strengths include that, in general, the validity of Danish register data is high; aggregate data can provide general trends; and we investigated two longer-term periods.

Certain weaknesses also have to be acknowledged. Our approach is capable of detecting trends and giving a hint of the components in play, but it does not allow us to detect causality or estimate the proportional impact that the components might have on smoking rates. There has been reporting of register data of low quality/validity, and we cannot rule out that there has been a general improvement in the second period due to the increased focus on this issue; moreover, surveys might not be adapted to take into account the changing socio-demographic distribution of smokers in a representative manner. Further, we were unable to assess the intensity of campaigns and legislation, and we have not been able to take tobacco industry activities into account. Also, we are unaware if the media's focus on smoking cessation was negative or positive. Finally, statistical analyses have not been performed as this was an exploratory study.

CONCLUSIONS

By combining individual and national-level data from various sources, we were able to identify important and unknown components that we need to focus on in future tobacco control in Denmark. Especially, we need to explore why Danish smokers have an increasing wish to quit and why they report to be less addicted to tobacco while ever fewer smokers try to quit smoking. Neither the authors nor the Danish Health Authority was aware of this paradox.

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CONFLICT OF INTEREST: none. Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk

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