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STUDY DESIGN ARTICLE

The Danish National Health Survey 2010. Study design and respondent characteristics

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Abstract

Aims: In 2010 the five Danish regions and the National Institute of Public Health at the University of Southern Denmark conducted a national representative health survey among the adult population in Denmark. This paper describes the study design and the sample and study population as well as the content of the questionnaire. *Methods*: The survey was based on five regional stratified random samples and one national random sample. The samples were mutually exclusive. A total of 298,550 individuals (16 years or older) were invited to participate. Information was collected using a mixed mode approach (paper and web questionnaires). A questionnaire with a minimum of 52 core questions was used in all six subsamples. Calibrated weights were computed in order to take account of the complex survey design and reduce non-response bias. *Results*: In all, 177,639 individuals completed the questionnaire (59.5%). The response rate varied from 52.3% in the Capital Region of Denmark sample to 65.5% in the North Denmark Region sample. The response rate was particularly low among young men, unmarried *people* and among individuals with a different ethnic background than Danish. **Conclusions: The survey was a result of extensive national cooperation across sectors, which makes it unique in its field of application, e.g. health surveillance, planning and prioritizing public health initiatives and research. However, the low response rate in some subgroups of the study population can pose problems in generalizing data, and efforts to increase the response rate will be important in the forthcoming surveys.**

Key Words: *Cross-sectional studies, study design, data collection, health surveys, health surveillance*

Introduction

Health surveys are essential components of a comprehensive health surveillance system. Much of the information collected in these surveys cannot be gathered by means of official statistical registers, e.g. information on self-rated health, health behaviour (e.g. smoking and physical activity) and quality and quantity of social relations. In addition, register data on contact with the healthcare system only give information on the most serious aspects of morbidity and health conditions, whereas problems that the population copes with in daily life can only be revealed by surveys [1]. Furthermore, in many countries, the only way to gain information about the health of the population is through surveys because adequate registers are not available. In Denmark, there is a long tradition of monitoring the health of the population through surveys. For example, the National Institute of Public Health (NIPH) at the University of Southern Denmark has conducted health surveys regularly since 1987 [2].

Following a large governmental reform in 2007, Danish municipalities took over the responsibility for

disease prevention and health promotion. This has lead many municipalities to conduct health surveys in order to identify local health problems and to plan and prioritize public health initiatives. However, the local health surveys differ greatly according to methodology, period and questionnaire content. To enable harmonized and comparable data across municipalities and regions and to ensure comparability with data at the national level, a task force with representatives from the National Board of Health, Danish Regions, Local Government Denmark, NIPH, the five Danish regions, two municipalities and a consultancy (COWI A/S) was established in 2007. The task force developed a framework for the Danish National Health Survey 2010 and a standard questionnaire. Hence, the survey is a result of extensive national cooperation across sectors, which make the survey unique in its field of application, e.g. health surveillance, planning and prioritizing public health initiatives and research. The aims of this paper are to give a description of the study design and of the sample and study population as well as the content of the questionnaire.

Material and methods

The subsamples

The Danish National Health Survey 2010 was based on six mutually exclusive random subsamples; one in each of the five Danish regions and one national sample. NIPH was responsible for the national sample and the five regions were responsible for the sample in their region. It was decided that the regional samples should have a minimum sample size of 2,000 individuals in each municipality or half of the adult population in municipalities with less than 4,000 citizens eligible for study participation. Denmark consists of 98 municipalities in total. The capital municipality has about 437,000 eligible citizens and was divided into 10 neighbourhoods. Each neighbourhood was treated as a municipality in the sampling process and in the data analysis. Hence, the municipal sample sizes varied from 900 to 20,000 individuals. In all, 25,000 individuals were invited in the national sample. The samples were drawn from the adult population in Denmark (including institutionalized persons) using the Danish Civil Registration System (each individual has a unique personal identification number). The register contains information on, for example, sex, age, address, marital status, citizenship and place of birth for all individuals with a permanent residence in Denmark. Ethnic background is defined on the basis of information on the respondent citizenship and place of birth and information about parents' birthplace is extracted from the Danish Civil Registration System. Based on this information three groups were defined: Danish background, other Western background and non-Western background. The total sample included 298,850 individuals aged 16 years or older resident in Denmark on 1 January 2010. The sample sizes were; 95,150 in the Capital Region of Denmark (7.0% of the population aged 16 years or older), 34,000 in Region Zealand (5.2%), 56,300 in the Region of Southern Denmark (5.9%), 52,400 in the Central Denmark Region (5.3%), 35,700 in the North Denmark Region (7.6%) and 25,000 in the national sample (0.6%). Figure 1 shows the number of municipalities and the size of the population age 16 years or older in each region.

Data collection

A concurrent mixed-mode approach was used to collect the survey data. All selected individuals received a letter of introduction that briefly described the purpose and content of the survey and it was emphasized that participation was voluntary. The letter invited the selected individuals either to complete a web questionnaire or to fill out the enclosed paper questionnaire. The letter contained a unique user name which gave access to the web questionnaire. In the Central Denmark Region sample, however, it was only possible to complete a paper questionnaire. The data were collected from February to April 2010. A reminder procedure with a minimum of two postal reminders was used in all samples with the latter containing a new paper questionnaire.

Weighting

Since all individuals living in Denmark have a unique personal identification number both respondents and non-respondents in the survey can be linked on an individual level to different central registers. Hence, to a certain extent it is possible to statistically allow for the differential non-response by using auxiliary information from Statistics Denmark's registers. Calibrated weights were computed based on register information on sex, age, municipality of residence, highest completed educational level, income, marital status, ethnic background, number of visits to the general practitioner in 2007, a hospitalization in 2007 (yes or no), occupational status, owner/tenant status and protection from inquiries during statistical and scientific surveys for all individuals living in Denmark on 1 January 2010 [3]. The calibrated weights also take account of the complex sample design described previously. The weights were computed by Statistics Denmark.
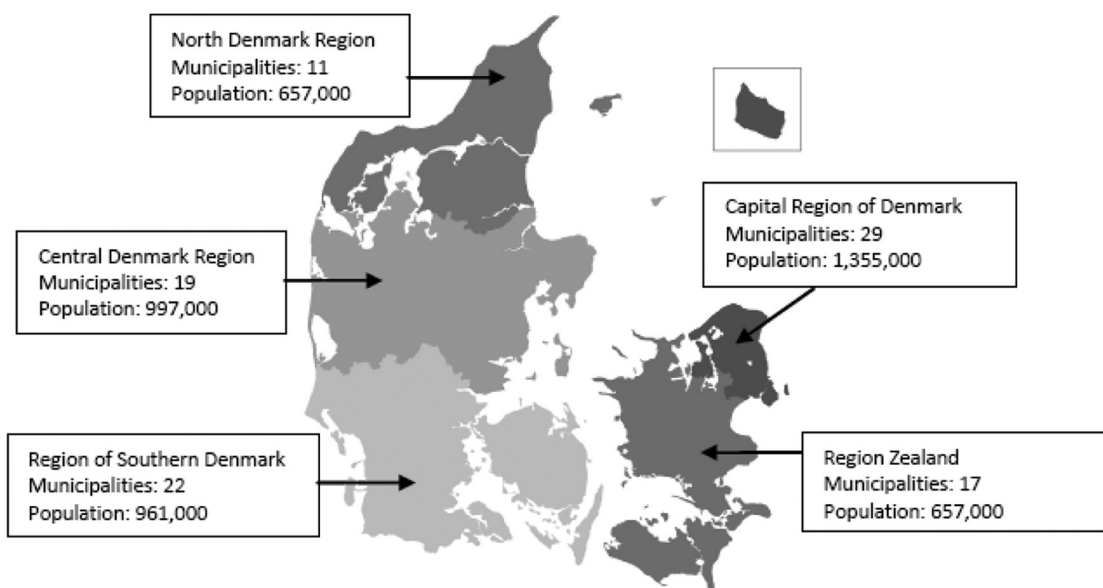
Figure 1.   Map of Denmark with the number of municipalities and the size of the population (16 years or older) in each region

The questionnaire

The standard questionnaire included 52 core questions and was used in all six samples. The questionnaire included questions on sociodemographic characteristics, health-related quality of life, health behaviour, morbidity, consequences of illness and social relations. The questions have all been used in previous Danish health surveys. In addition, the standard questionnaire included international validated questionnaire scales such as the 12-Item Short-Form Health Survey version 2 (SF-12 v2) and a screening tool for alcohol abuse (the CAGE-C test). SF-12 v2 consists of 12 items and is designed to assess general self-rated health, physical and psychological symptoms and limitations in everyday activities due to physical and mental health problems during the previous four weeks. By multiplying each indicator variable by its respective regression weight and summing the products it is possible to compute a Mental Component Summary (MCS-12) scale and a Physical Component Summary (PCS-12) scale. Higher scores indicate better health [4]. The CAGE-C test is a short, six-question test that diagnoses alcohol problems over a lifetime [5]. In addition to the 52 standard questions, each region and NIPH could add questions on topics of specific interest to the standard questionnaire. The detailed contents of the standard questionnaire are listed in Table I. The standard questionnaire is available on request.

Statistical analysis

Multiple logistic regression analyses were used to analyse the association between overall non-response and the potential explanatory factors of interest (sex, age, marital status and ethnic background). The results are presented as percentages and odds ratios (OR) with 95% confidence intervals (CI). In addition, multiple logistic regression analysis was used to test for potential interactions between the explanatory variables because the literature indicated that there might be an interaction between these variables.

Results

The standard questionnaire was fully or partially completed by 177,639 individuals, corresponding to 59.5% of the total sample (Table II). The response rate varied from 52.3% in the Capital Region of Denmark sample to 65.5% in the North Denmark Region sample. The majority (85.3%) completed the questionnaire by paper. The response rate was lower among men (55.5%) than among women (63.4%) and particularly low among men aged 16–24 years (42.4%) and 25–34 years (44.9%) and among women aged 75 years or older (49.4%) (Table III). In addition, the response rate was low among unmarried people (49.2%) and among individuals with an ethnic background other than Danish. The results of the regression analysis confirmed these findings. Furthermore, the analysis revealed an interaction between sex and age. Odds ratios for non-response were higher for men than women in all age groups with the exception of the oldest age group (75 years or older) where the opposite held true. The analysis also showed an interaction between sex and marital

Table I.   Content of questionnaire.

Topics	Indicators
Sociodemography	Marital status, cohabiting status, number of children in the household, education and occupation
Quality of life and health	Stress (three questions from the Perceived Stress Scale) and the 12-Item Short-Form Health Survey v2 (SF-12 v2)
Anthropometry	Self-reported weight and height
Diet	Food frequency and self-rated dietary habits
Smoking	Smoking frequency and smoking quantity
Alcohol	Alcohol consumption – quantity and frequency, type of alcoholic beverage, binge drinking and CAGE-C
Physical activity	Leisuretime physical activity and self-rated physical condition
Health promotion and prevention	Readiness of health behaviour change (physical activity, weight, diet, smoking, alcohol), help and support for smoking cessation
Social relations	Contact with family, friends, colleagues or fellow students in leisure time, neighbours, people from the internet, social support, help with practical problems, loneliness
Morbidity, symptoms and contact with health services	Longstanding illness, specific diseases (asthma, allergy, diabetes, hypertension, heart attack, angina pectoris, stroke, chronic obstructive pulmonary disease, osteoarthritis, rheumatoid arthritis, osteoporosis, cancer, migraine, transient mental disorder, persistent mental illness or disorder, back disorder, cataract, tinnitus), pain or discomfort (pain or discomfort in the shoulder or neck, pain or discomfort in the back or lower back, pain or discomfort in the arms, hands, legs, knees, hips or joints, fatigue, headache, sleeping problems or insomnia, melancholy/depression or unhappiness, anxiety/nervousness/restlessness or apprehension) and contact with the general practitioner
Absence from work	Absence due to illness, discomfort or injury

status. Odds ratios for non-response were higher for men than for women among married, divorced and unmarried people, but lower among people who were widowed. Other significant two-way interactions were detected and these are shown in Table IV (sex and ethnic background, age and ethnic background, marital status and ethnic background). Table III also shows the crude relative distribution among the respondents and among the total sample. It shows that women in general, but especially women in the age group 45–64 years, were over-represented among the respondents compared with the total sample, whereas young men and elderly women were under-represented. Furthermore, unmarried people and individuals with a non-Western ethnic background were under-represented. The last column in Table III shows the relative distribution among the respondents after applying the weights computed by Statistics Denmark and corresponds to the relative distribution in the adult population in Denmark. The mean weight was 24.98 (ranging from 1.25 to 147.14). Thus, one respondent represents, on average, 24.98 persons in the population. The weights were normalized to a mean weight of 1 in order to yield appropriate standard errors. Hence, the sum of the normalized weights equals the actual size of the study population (177,639 individuals).

Discussion

The Danish National Health Survey 2010 is a result of extensive national cooperation across sectors, which makes the survey unique in its field of application. For the municipalities and the regions the data constitute a powerful tool for local health surveillance, planning and prioritizing. Because of the national coordination of questionnaire content, time period and methodology it is possible for municipalities to compare

Table II.   Overview of the different subsamples of the Danish National Health Survey 2010.

	Capital Region of Denmark	Region Zealand	Region of Southern Denmark	Central Denmark Region	North Denmark Region	Denmark	Total
Data collection mode	Paper and web	Paper and web	Paper and web	Paper	Paper and web	Paper and web	Paper and web
Sample size	95,150	34,000	56,300	52,400	35,700	25,000	298,550
Response rate (%)	52.3	55.0	64.7	65.2	65.5	60.7	59.5
Response mode distribution							
– Paper (%)	82.5	88.2	70.3	100.0	90.1	68.3	85.3
–Web (%)	17.5	11.8	29.7	0.0	9.9	31.7	14.7
Number of respondents	49,806	18,712	36,396	34,168	23,392	15,165	177,639

Table III. Response rate and relative distribution according to sex, age, marital status and ethnic background among the sample and the respondents. Percentages.

				Relative distribution		
		Response rate	Sample size	Sample (crude) (%)	Respondents (crude) (%)	Respondent (weighted) (%)
Total		59.5	298,550	100.0	100.0	100.0
Men	16–24 years	42.4	19,594	6.6	4.7	6.9
	25–34 years	44.9	17,560	5.9	4.4	7.4
	35–44 years	51.1	25,474	8.5	7.3	9.1
	45–54 years	56.3	26,898	9.0	8.5	8.7
	55–64 years	63.5	26,964	9.0	9.6	8.1
	65–74 years	69.9	18,704	6.3	7.4	5.6
	≥75 years	60.1	11,597	3.9	3.9	3.4
	All men	55.5	146,791	49.2	45.9	49.1
Women	16–24 years	57.0	17,995	6.0	5.8	6.6
	25–34 years	59.2	17,557	5.9	5.9	7.4
	35–44 years	64.6	25,529	8.6	9.3	8.9
	45–54 years	67.2	26,635	8.9	10.1	8.5
	55–64 years	70.3	26,246	8.8	10.4	8.2
	65–74 years	69.3	20,023	6.7	7.8	6.1
	≥75 years	49.4	17,774	6.0	4.9	5.3
	All women	63.4	151,759	50.8	54.1	50.9
Marital status	Married	67.0	156,441	52.4	59.0	51.8
	Divorced	55.6	27,828	9.3	8.7	9.0
	Widowed	54.3	23,104	7.7	7.1	7.5
	Unmarried	49.2	91,177	30.5	25.3	31.6
Ethnic background	Danish	62.1	269,246	90.2	94.1	90.1
	Western	43.0	11,112	3.7	2.7	4.3
	Non-Western	31.8	18,192	6.1	3.3	5.6

Table IV. Overview of interactions between sex, age, marital status and ethnic background in relation to non-response. Odds ratios.

		Ethnic background			Sex	
		Danish	Western	Non-Western	Men	Women
Sex	Men	1.43*	3.25*	4.95*	–	–
	Women	1	1.95*	3.76*	–	–
Age	16–24 years	1.14*	4.11*	3.64*	1.09*	0.60*
	25–34 years	1.17*	4.36*	5.93*	1.14*	0.67*
	35–44 years	1.29*	2.65*	4.51*	1.17*	0.67*
	45–54 years	1.17*	2.02*	3.78*	1	0.64*
	55–64 years	1	1.48*	3.50*	0.81*	0.59*
	65–74 years	0.89*	1.10	3.17*	0.62*	0.61*
	≥75 years	1.60*	1.77*	4.63*	0.94*	1.24*
Marital status	Married	1	1.94*	3.98*	1	0.76*
	Divorced	1.77*	2.41*	5.61*	1.80*	1.25*
	Widowed	1.82*	2.01*	5.81*	1.25*	1.46*
	Unmarried	1.96*	5.64*	6.11*	2.26*	1.25*

*95% CI does not include the value 1

themselves with the national and regional average and with municipalities across regions that resemble them according to size and sociodemographic composition. In addition, the advantage of local ownership and results at the local level should not be underestimated. It will probably make health politics more sound and make politicians more sympathetic to health issues.

Furthermore the survey constitutes a unique research database. In this respect, the major strengths are the large number of respondents, the setting in a general population and the diversity of questionnaire content. Thus, relationships between lifestyle and morbidity in different subgroups of the population can be analyzed and relevant confounders can be included in the

statistical analyses. Due to the unique permanent registration number system in Denmark the respondents can be followed over time by linking to different Danish registers through the unique personal identification number (e.g. The Danish National Patient Register, The Danish Register of Causes of Death, The Danish National Health Service Register and The Danish National Prescription Registry). Hence, the research database may form the basis for important follow-up studies. Research projects can also be based on the cross-sectional data, although that usually precludes any strong conclusions on causality.

A drawback with survey data is the possible restrictions in generalizing data from surveys to the target population if the non-participation rate is high [6,7]. However, if the non-response is missing completely at random, the non-response is unlikely to affect the representativeness of the survey. Our survey had an acceptable response rate but non-respondents were more likely to be young men and elderly women, unmarried and with an ethnic background other than Danish. Our results are in line with other research, and thereby support the assumption that these population groups in general are under-represented in population health surveys [2,6,8–10]. We also found several two-way interactions between non-response and sociodemographic characteristics. This means that specific sociodemographic groups are under-represented, e.g. unmarried men and not only men in general. Finally, the response rate was low in the Capital Region of Denmark sample, which is in keeping with other studies that have also reported higher non-response rates in urbanized areas [11,12]. As in almost all surveys non-response bias cannot be ruled out, but the use of calibrated weights will most likely reduce non-response bias. The weights are included in the database and can be applied routinely in future data analyses to reduce non-response bias and ensure nationally/regionally representative estimates. As the data are self-reported they are prone to social desirability bias. However, social desirability bias is most profound in interview surveys as it involves a second person (the interviewer) and self-administered questionnaire surveys are generally considered to be suitable for sensitive questions about health status and health behaviour [13].

The results from the Danish National Health Survey 2010 have been published in regional reports [14–18]. Subsequently, all data were gathered in a national database and a national report was published by the National Board of Health [19]. As a part of the publishing process, the National Board of Health and NIPH developed an online database (www.sundhedsprofil2010.dk). The online database was launched in March 2011 and is available only in Danish. The database includes approximately 90 health indicators obtained from the survey. The database allows users to generate tables categorized by region, municipality, sex, age, cohabitation status, combined school and vocational education, employment status and ethnic background. Furthermore, users can generate interactive maps categorized by region, municipality and sex. It is possible to export the generated tables to EXCEL and users can view the generated tables and maps in PDF format. The online database facilitates the accessibility and the use of the data by practitioners, politicians, researchers and others that are interested in public health. The results can be used in national, regional and municipal planning and surveillance as well as in research and analysis.

A possible issue of concern is the mixed-mode design of the survey which can lead to internal measurement error due to mode effect. Consequently, in research using a mixed-mode approach to data collection it is important to consider the potential impact of mode on the data collected. Several evaluations have shown no statistically significant mode effects irrespective of target populations or disciplines in question [20–26]. Despite the methodological concerns associated with it, a mixed-mode approach has many benefits which are largely seen to outweigh its potential challenges [20,22,26]. For researchers, the benefits include a cheaper and faster data collection and a possibility to enhance representativeness and increase responsiveness by making the study more accessible to a larger group of respondents. For respondents, the benefits include convenience and ease of use [20–22,24].

The percentage of respondents who chose to answer the web questionnaire varied greatly between the six subsamples. This was probably due to differences in the introduction letter, the technical software used and layout of the web questionnaire.

Another problem for researchers in Denmark is the increasing number of individuals in Denmark that are protected from inquiries during statistical and scientific surveys. Since this protection became available in 2000 approximately 13% of the population has used this option [3]. The proportion is highest in the age group 20–29 years (25%). Protected individuals were not eligible for sampling to the Danish National Health Survey 2010. In 2007 the registration procedure was changed and now requires a more active decision. This has caused the proportion with protection to drop considerably, but it is still a problem in certain age groups. Individuals who are protected from inquiries during statistical and scientific surveys are also one of the main reasons for the difference

between the sample (sample, crude) and the relative distribution in the total population in Denmark (sample, weighted) (Table III). These individuals were not eligible for sampling but the weighting procedure uses auxiliary information to reduce the potential bias this may cause. In addition, random sampling error may also contribute to this discrepancy.

The next Danish National Health Survey is planned to be conducted in 2013. Working areas and areas of improvement include analysis on the effect of the mixed-mode design and initiatives to increase response rate among under-represented population groups (e.g. questionnaires in different languages, layout features of the questionnaire or use of attractive incentives).

Conflict of interest

None declared.

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