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Cohort Profile

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Cohort Profile Update: The Danish Nurse Cohort

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Key Features

- The Danish Nurse Cohort was established in 1993 and included 19 898 female nurses aged >44 years. The aim of the cohort was to investigate the associations between hormone replacement therapy and the risk of breast cancer, heart diseases and osteoporotic fractures.
- Given the advanced age of the original cohort (mean age 85 years in 2023) and the emerging research interest in studying the working environment during a period of nursing shortages, all members of the Danish Nursing Organization were invited to participate in 2021 and 2024.
- Both the 2021 and 2024 survey waves included responses from male and female nurses. The response rate was 49% in 2021 and 39% in 2024. In both years, male nurses constituted 4% of respondents and female nurses made up 96%. The age range spanned from 19 to 95 years in 2021, with an average age of 49.6 years. In 2024, the ages ranged from 18 to 95 years, with a mean age of 52.2 years.
- In 2021, the survey introduced new topics such as working conditions, sleep patterns, COVID-19, stress and men's sexual health. By 2024, the scope was broadened to include traumatic brain injury and additional questions regarding the severity of menopausal symptoms.
- The Danish Nurse Cohort maintains several ongoing collaborations that are focused on themes such as the working environment, air and noise pollution, menopause and overall nurse health. For new collaborative projects and enquiries about data sharing, please contact Dr Mette Kildevæld Simonsen at mette.kildevaeld.simonsen@regionh.dk.

The original cohort

The Danish Nurse Cohort is a longitudinal study that focuses on nurses' health. Inspired by the US Nurses' Health Study,[1] the Danish Nurse Cohort was initiated to examine the benefits and risks associated with hormone replacement therapy (HRT) in a European population. Thus, the original cohort outlined aims to further investigate the association between HRT use and the risk of (i) breast cancer, (ii) heart diseases and (iii) osteoporotic fractures.[2] In 1990, the Danish Nurse Organization (DNO) authorized access to their membership register, enabling contact with Danish nurses. The register comprises active, inactive and retired nurses, as well as nursing students. As of 1 January 2024, it possesses a membership rate of >80% in the Danish Nurses Organization, encompassing >75% of currently employed Danish nurses. In 1993, a questionnaire was mailed to 23 170 female Danish nurses aged ≥44 years and 86.9% responded. In 1999, all DNO members age >44 years were reinvited. Of the 31 642 female nurses who were contacted, 76% responded. Since HRT was the focus of the baseline study, participation was limited to women who were aged ≥44 years. The cohort has had five waves of data collection: 1993, 1999, 2009, 2021 and 2024. Of the 15 322 female nurses who replied in both 1993 and 1999, a total of 12 955 nurses were still alive and residing in Denmark in 2009 and, of these, 11 114 (85.8%) completed the questionnaire (Table 1). In 2021 and 2024, all DNO members (including males) were invited to participate, with 36 658 (46%) responding in 2021 and 28 359 (39%) in 2024. Notably, 897 female nurses have participated in every wave from 1993 to 2024, whereas 1103 took part in the first four waves.

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Table 1. Characteristics of the Danish Nurse Cohort in each survey wave

	Year of data collection				
	First wave, 1993	Second wave, 1999	Third wave, 2009	Fourth wave, 2021	Fifth wave, 2024
Invited (*n*)	23 170	31 642	12 955	80 134	72 629
Non-responders (*n*)	3272	9487	1841	43 476	44 274
Responders (*n*)	19 898	24 155	11 114	36 658	28 359
Response rate (%)	85.9	76.0	85.8	46.0	39.0
Sex of nurses (%)	Female (100)	Female (100)	Female (100)	Male (4) Female (96)	Male (3) Female (97)
Mean age in years (SD)	56.3 (8.7)	56.1 (9.4)	70.6 (6.7)	49.6 (14.5)	52.2 (14.7)
Age range (years)	45–86	45–92	62–98	19–97	18–95

Data from the first three waves have been linked with administrative data from the Danish National Patient Register, which includes data on all public and private hospital admissions, the Danish Civil Registration System for vital statistics, the Danish Cancer Registry for incident cancer diseases diagnosed before and during follow-up, and the Danish National Prescription Database for all medications redeemed in Danish pharmacies by the individual. The Danish registries are nearly complete, minimizing selection and recall bias in the available information.[3,4] The 2021 and 2024 data have not been linked to these registries yet. It is expected that this linkage to various Danish registers will be completed before 2025.

What is the reason for the new data collection?

Over the last three decades, the initial 1993 cohort has aged, with an average age of 85 (76–95) years in 2024. This has led to a rise in health issues such as frailty, physical limits, cognitive decline and mortality. In the follow-up period, most original cohort members shifted from work to retirement—a significant life change that impacted multiple aspects of their lives, potentially affecting their health. To sustain the vitality of the cohort and continuously generate new research questions, new waves were carried out in 2021 and 2024. The 2021 data collection included all members of the DNO, covering nurses and nursing students aged 19–97 years. The 2024 data collection included all members, with ages ranging from 18 to 95 years. Table 1 shows the decline of 7505 invited nurses from 2021 to 2024. The decline in members of the DNO follows a turbulent 2021 that was marked by a widespread nurses' strike and reports of poor working conditions.

What will be the new areas of research?

The primary objective of the data collection in 2021 was to examine the working environment during a period of nursing shortages, exploring the relationship between chronotype, sleep patterns and the health risks of shift work, associations between time for and duration of menopause and the development of diseases, as well as studying men's sexual health and fertility. Studies on noise and air pollution will continue as an ongoing area of research. In 2021, data collection was aimed at a thorough investigation of vital areas, including lifestyle and health details that were not available from registries. This approach allowed the examination of changes in outcomes, as well as risks and protective factors, across the entire adult lifespan. In this paper, we describe the health behaviours and work environments of the population that was included in the fourth wave of the Danish Nurse Cohort data collection in 2021 by using a comparison to the general Danish population according to health behaviour and work environment.

Who is in the cohort?

The 2021 data collection occurred from December 2020 to March 2021. The target population for the data collection was all male and female members of the DNO, including students and employed, non-employed and retired nurses. Thus, a total of 80 134 nurses (mean age 49.5 years) were invited to participate, of whom 36 658 (46%) completed the self-administered questionnaire. The 2021 sample size consisted of 1 253 male (mean age 49.6) and 35 405 female nurses (mean age 49.6 years). The non-responders were, on average, younger (mean age 47.5 years) than responders.

In 2021, for the first time, male nurses were invited to participate. The main reason for this was that the research focus had changed from women's post-menopausal health to nurses' health and work environment in general. Furthermore, we wanted to know more about health, working environment and sexual health among male nurses. The questionnaires in the fourth and fifth waves were e-mailed by using the secured electronic communication service 'Digital Post' (an electronic mailbox for communication between public authorities and residents in Denmark).

What has been measured?

In 1993, we obtained information from participants concerning their parents' educational level and nurses' house income, working conditions, weight and height (including weight at birth), lifestyle (diet habits, smoking habits, alcohol consumption, and leisure time and physical activity), self-reported health, work environment, self-reported history of various diseases, family history of cardiovascular and cancer disease, and fractures diagnosed among cohort members. For information on self-rated general health, we used a single question: 'In general, would you say that your health is excellent, very good, good, fair, or poor?' To gather data on stress, we inquired about individuals' experiences by using the question: 'In the last two weeks, how frequently have you encountered stress?' Options included always, often, sometimes, rarely or never. Those who acknowledged experiencing stress were further asked to identify whether the primary source of stress was work, personal life or a combination of both. Quality of life was measured by using an 11-point Likert scale from 0 to 10. This method of assessing quality of life

was introduced to the nurses for the first time due to its simplicity and alignment with the standards employed by Statistics Denmark, enabling meaningful comparisons. To measure work satisfaction, we used the validated Utrecht Work Engagement Scale.[5]

The questionnaire also comprised an extensive reproductive history including questions on age of menarche, age of menopause, use of oral contraceptives and removal of uterus and/or ovaries. In 1999, this questionnaire-based information was repeatedly obtained. Due to growing concerns about overweight and obesity, a new section was added to collect data on weight history, self-measured waist circumference and parental overweight status. In 2009, this section was expanded with additional questions on weight loss methods and the intentionality of weight loss. In 2021, we also included questions on COVID-19 infection and longer-lasting COVID symptoms. The inquiries that were related to COVID-19 comprised three key questions: 'Have you undergone testing for COVID-19? If so, did the test yield a positive result (indicating infection with the coronavirus)? Additionally, have you exhibited any symptoms associated with COVID-19?' Additionally, participants were asked about the severity and duration of their COVID symptoms, with a specific question: 'Following a positive test result, how many days did you continue to experience symptoms?' Other themes in the questionnaire were sleep and chronotype, work-related bodily pain, work environment and men's sexual health and reproduction. In 2024, we introduced questions about traumatic brain injury, caregiving and added supplementary questions to assess the severity of menopausal symptoms. Aside from these additions, the questionnaire remained largely unchanged from the 2021 version. An outline of the main areas of information obtained may be seen in Table 2.

Table 2. Main categories of data collected in the Danish Nurse Cohort survey waves

	Year of survey wave				
Variables	**1993**	**1999**	**2009**	**2021**	**2024**
Background					
Cohabitation/children	X	X	X	X	X
Parents' education		X		X	
Socio-economic factors					
Family income in the past year	X	X			
Parent's occupation		X		X	
Lifestyle					
Smoking	X	X	X	X	X
Alcohol	X	X	X	X	X
Diet	X	X	X	X	X
Physical activity	X	X	X	X	X
Sleep and chronotype				X	X
Body weight and management					
Weight	X	X	X	X	X
Height	X	X	X	X	
Waist circumference		X	X	X	X
Intentional weight loss		X	X		X
Slimming diets			X		X
Parents' body shape (pictogram)		X		X	X
Hormone therapy					
Oral contraceptive	X	X			
Hormone replacement therapy	X	X			
Menopausal symptoms	X	X			X
Gynaecological history	X	X			
Age of menarche	X	X			X
Age of menopause	X	X		X	X
Removal of uterus		X			
Removal ovaries		X			
Mens' fertility				X	
Health perception					
Self-rated health	X	X	X	X	X
Health-related quality of life			X	X	X
Cohen's perceived stress scale			X		X
Physical function			X	X	X
Stress				X	X
Mens' sexual health				X	
Psychosocial work environment					
Work pressure	X	X	X	X	X
Work tempo	X	X	X	X	X
Work influence	X	X	X	X	X
Type of work	X	X		X	X
Work shifts	X	X	X	X	X
Work and leisure time				X	X
Stress from work	X	X		X	X
Work satisfaction and pride				X	X
Family health history	X	X			
Caregiver					X
COVID-19				X	X
Traumatic brain injury					X

What has it found? Key findings and publications

The healthcare workforce experienced substantial pressure during the COVID-19 pandemic. The 2021 questionnaire was administered at the height of stress within the healthcare sector in December 2020, amid the peak of the coronavirus crisis, to examine working conditions during the crisis. A surprisingly high percentage (85.1%) of nurses were often, very often or always proud of the task they performed at work. The nurses reported a significant rise in workload, a faster pace and diminished influence compared with previous rounds. Since 1993, the Danish nurses have been asked the following questions:

- How frequently do you find yourself occupied to the extent that completing your tasks becomes challenging?
- What is the level of working pace or job pressure in your current position?
- How much control or influence do you typically have on your daily tasks?
- How frequently do you receive assistance and support from your supervisors?

The data in Figure 1 demonstrate that working conditions have changed significantly over the past 30 years.

Nurses are now busier and report a faster work pace. However, their influence on work organization has improved. All measures—workload, pace and influence—appear to have improved following the COVID-19 pandemic.

Data from the Danish Nurse Cohort were compared with those of the general population using data from the Danish Health and Morbidity Survey in 2021 (Table 3). As the 2024 data have not yet been linked to other databases, we present the 2021 data in this paper. In addition, comparisons were conducted on individuals in the general population with similar educational levels (i.e. medium-cycle higher education). Data on alcohol consumption in the general population derive from the wave in 2017 due to comparability issues. The Danish Health and Morbidity Surveys have been conducted regularly since 1987 to describe the status and trends in health in the adult Danish population.[6]

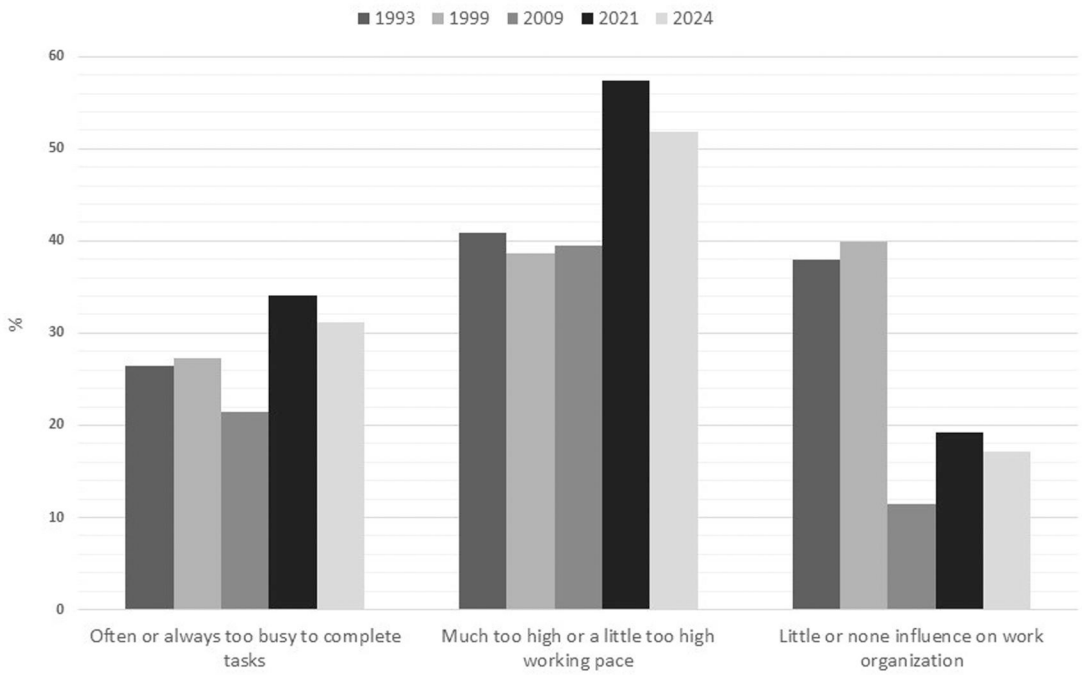

Figure 1. Development in the working environment from 1993 to 2024 among female nurses aged >44 years

Table 3. Comparison of health, lifestyle and working environment between Danish nurses and the general Danish population in 2021 by sex

	Age- standardized risk ratios with 95% CIs			
	Danish nurses compared with the general population		Danish nurses (≥25 years) compared with the general population with medium-cycle higher education[a]	
Variable	Female nurses ($n = 35\,405$)	Male nurses ($n = 1253$)	Female nurses ($n = 33\,981$)	Male nurses (1208)
Self-rated health				
Excellent, very good or good self-rated health	1.07 (1.05–1.08)	1.02 (0.99–1.05)	1.00 (0.97–1.02)	0.99 (0.95–1.02)
Smoking				
Daily smoker	0.52 (0.48–0.56)	0.74 (0.61–0.89)	0.66 (0.55–0.79)	1.08 (0.81–1.44)
Daily or occasional smoker	0.63 (0.59–0.67)	0.94 (0.82–1.08)	0.76 (0.66–0.88)	1.42 (1.13–1.79)
Alcohol				
Alcohol ≥4 days per week	1.25 (1.16–1.34)	0.97 (0.86–1.10)	1.01 (0.86–1.10)	0.93 (0.79–1.10)
Felt you should cut down on your drinking within the past 12 months	1.56 (1.43–1.69)	1.25 (1.10–1.42)	1.27 (1.08–1.50)	1.17 (0.97–1.42)
Physical activity				
Heavy exercise ≥4 h per week	1.57 (1.47–1.68)	1.14 (1.04–1.26)	1.28 (1.14–1.44)	0.99 (0.87–1.13)
Sedentary	0.55 (0.52–0.59)	0.66 (0.56–0.78)	0.88 (0.75–1.04)	0.94 (0.74–1.20)
Body mass index (BMI)				
Overweight (BMI ≥ 25 kg/m^2)	0.97 (0.94–1.00)	0.99 (0.94–1.04)	1.05 (0.99–1.13)	1.01 (0.94–1.09)
Obesity (BMI ≥ 30 kg/m^2)	0.91 (0.85–0.97)	0.92 (0.80–1.07)	1.06 (0.92–1.21)	1.06 (0.87–1.30)
Working environment				
Rarely or never receive help and support from supervisors	1.53 (1.40–1.68)	1.67 (1.46–1.91)	1.67 (1.41–1.98)	1.60 (1.28–2.01)
Often or almost always have insufficient time to complete tasks at work	2.01(1.84–2.18)	1.93 (1.70–2.20)	1.71 (1.49–1.97)	1.76 (1.42–2.19)

[a] Medium-cycle higher education typically has a duration of 2–4 years and builds on an upper secondary education.

To examine whether nurses from the fourth wave resemble the general Danish population, age-standardized risk ratios with 95% CIs were calculated. Nurses from the fourth wave were selected for comparison because their data allow us to evaluate working conditions during the COVID-19 pandemic. The caparison between the general population and nurses reveals that female nurses were more likely to engage in heavy exercise than women from the general population, including those with a similar level of education (Table 3). More female and male nurses were daily smokers and reported less support from supervisors together with incomplete working tasks compared with the general population

and when compared with the general population with a similar educational level. However, female nurses were more likely to have consumed alcohol for ≥4 days per week and to have felt that they should cut down on drinking within the past 12 months.

What are the main strengths and weaknesses?

The main strengths of the Danish Nurse Cohort are the large sample size and the homogenous study population, especially with respect to socio-economic status. The extraordinarily high participation rate from 1993 to 2009 improved statistical power and external validity, and reduced the risk of selection bias. Moreover, the long follow-up period makes it possible to study slow-developing diseases such as cancer and neurogenerative diseases. The large range of self-reported data that has been merged with high-quality information from Danish health registers is extraordinary in health surveys. Additionally, the cohort contains self-reported data from nurses who, as professionals, have broad expert knowledge concerning health issues, which increases the accuracy of self-reported information such as use of HRT and medical conditions.[7,8] The variety of self-reported information allows researchers to adjust for important confounding variables. A cohort of nurses is a select group and findings may not apply to the general population. As the cohort is composed entirely of nurses, the findings may not be generalizable to the broader population. Nurses may have health behaviours, socio-economic status and access to healthcare that differ significantly from those of the general population, potentially skewing the results. Danish nurses are exceptionally healthy, especially when compared with similarly educated individuals in Denmark. Self-reporting may cause systematic or random errors. However, in such a large cohort as the Danish Nurse Cohort, a detailed clinical examination of all participants poses logistic and cost challenges. A sixth survey wave will be administered in February–March 2027. Hereafter, a new follow-up questionnaire will be sent to all members of the DNO every 3 years. The Danish Nurse Cohort partners with other cohorts that are using state-of-the-art methodologies and we are always interested in collaboration to improve public health in general.

Can I get hold of the data? Where can I find out more?

Data for specific research projects may be obtained by sending a short (one-page) project idea and hypothesis to the primary investigator of the Danish Nurse Cohort (mette.kildevaeld.simonsen@regionh.dk). Publications and details regarding the Danish Nurse Cohort: http://kostforskning.dk/en/kohorter/den-danske-sygeplejerskekohorte-2/.

Ethics approval

Ethics approval for the Danish Nurse Cohort was obtained from the Scientific and Ethical Committee of Copenhagen and Frederiksberg Municipalities [J. no. (KF) 01–103/93] and the Danish Data Protection Agency (J. no. 1993–1110–1151).

Data availability

See 'Can I get hold of the data?' above.

Author contributions

All authors contributed to the content and the design of the figures and tables.

Use of artificial intelligence

The text has been reviewed by AI, and minor adjustments proposed by ChatGPT OpenAI.

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Conflict of interest

None declared.

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