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A nationwide prospective cohort study on return to gainful occupation after stroke in Denmark 1996 – 2006

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ABSTRACT

Background: Return to work is an important outcome factor for working-age post stroke patients. Previous epidemiologic studies on this topic have been small (on average 125 patients per study). Their estimated effects are therefore associated with a tremendous statistical uncertainty. The present study estimates the effect of various predictors on the odds of returning to work after stroke in the total population of 20-57 year-old previously employed hospital treated stroke patients in Denmark 1996 – 2006 (N = 19985).

Methods and Results: The patients were followed through national registers; 62% were gainfully occupied two years after stroke. Patients with intracerebral infarction (reference group) had significantly higher chance of returning to work than those with subarachnoid hemorrhage, OR = 0.79 (95% CI: 0.71 – 0.88), and intracerebral hemorrhage, OR = 0.39 (0.35 – 0.43). Unskilled workers (reference group) had a worse prognosis than skilled workers, OR = 1.50 (1.38 – 1.64), technicians and associate professionals, OR = 2.33 (2.05 – 2.65), and professionals, OR = 3.04 (2.70 – 3.43). Being a woman, OR = 0.79 (0.74 – 0.84), self-employed, OR = 0.87 (0.78 – 0.96), or >= 50 years, OR = 0.61 (0.57 – 0.65), was also associated with a worse prognosis. Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities, OR = 0.91 (0.78 – 1.06).

Conclusion: Further research is needed to explain the gender inequality, which suggests either a potential to improve return-to-work rates among the females or a tendency among the males to return too early.

KEY WORDS: cerebral infarct; intracerebral hemorrhage; subarachnoid hemorrhage; rehabilitation; work ability.

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ARTICLE SUMMARY

Article focus

- The present study estimates odds ratios for return to gainful occupation ca. two years after stroke.
- It focuses on clinical, demographic and occupational factors which are potentially useful in predicting return to work.
- The study includes the total population of 20-57 year-old previously employed hospital treated stroke patients in Denmark 1996 – 2006.

Key messages

- 62% of the studied patients were gainfully occupied during the second calendar year after the stroke.
- The odds of returning to work depend on age, gender, occupation, self-employment and type of stroke.
- Women had a much lower chance of returning to work than men and to our knowledge there are no known physiologic factors which can justify this difference.
- Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities.

Strengths and limitations of this study

- The follow-up was done through registers and all people in the target population were included. Hence, the study is free from sampling bias, recall bias and non-response bias.
- The statistical model was completely defined and a detailed study protocol was published before we looked at any relation between the concerned exposure and response variables in our data material. Since we adhered to the protocol, the study is free from hindsight bias.
- The study is further strengthened by its size.
- The major weakness of the study is that it does not contain any stroke severity measures.

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INTRODUCTION

Return to work (RTW) plays a crucial role in the rehabilitation process of working age post-stroke patients. It provides a social identity and it is associated with increased self-esteem and life satisfaction.[1-3] It is also important, from a societal perspective, that as many as possible of the stroke patients who are economically active at the time of the onset, returns to work after stroke; in the European Union, the annual cost of lost productivity due to disability or death as a consequence of stroke was estimated at €8.5 billion in 2008.[4]

A recent review of articles dealing with return to work among stroke patients identified 70 studies, which in total comprised 8810 patients working before the stroke.[5] The review concluded that the analytic strategies that were used were inappropriate in all but three of the 70 studies.[6-8] The rest of the studies were associated either with selection bias or non-interpretable results due to highly variable follow-up periods or ill-defined criteria of work before stroke and at follow-up.[5] There are also limitations associated with the three appropriately performed studies. All of them were small (the included number of patients ranged from 109 to 173) and two of them [6;8] deal with data that are too old to afford results that can be used as proxies for present time RTW probabilities. The most recent of the three studies [7] reported that 55% of previously employed stroke patients in New Zealand returned to paid employment within six months. That study is, however, associated with selection bias; it only included cognitively competent patients.

The present study investigates return to work frequencies among nearly twenty thousand 20 – 57 year-old stroke patients in Denmark who were gainfully occupied prior to the stroke. The study covers stroke that occurred in the time period 1996 – 2006.

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MATERIAL AND METHODS

The study utilizes the Danish Occupational Hospitalization Register (OHR), a database obtained through a record-linkage between three national registers—the central person register, the hospital register, and the employment classification module. Currently, the OHR includes every person who has been economically active and an inhabitant of Denmark sometime after 1980.

The national hospital register has existed since 1977 and contains data from all public hospitals in Denmark (more than 99% of all admissions). From 1977 to 1994, the register only included inpatients but from 1995 it also covers outpatients and emergency ward visits.[9] The diagnoses have been coded according to international classification of diseases version ten (ICD-10) since 1994.

The central person register contains information on gender, addresses and dates of birth, death and migrations for every person who is or has been an inhabitant of Denmark sometime between 1968 and present time. A person's occupation and social status are, since 1975, registered annually in the employment classification module.[9] The occupations are, since 1994, coded in accordance with Statistics Denmark's Standard Classification of Occupations (DISCO-88),[10] which is a national version of the International Standard Classification of Occupations (ISCO-88). Socio-economic status is coded in accordance with Statistics Denmark's official socio-economic classification.[11] At the one- and two-digit level, the classification contains the following social groups:

1. Gainfully occupied people
    1.1. Self-employed people
    1.2. Assisting spouses
    1.3. Employees
2. People on unemployment benefits

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3. Not economically active

    3.1. People in training/education

    3.2. Pensioners

    3.3. Other not economically active

Inclusion criteria

A person would be included in the study if he/she

1. on at least one occasion in the time period 1996 – 2006, was registered in the hospital patient registry with one of the following ICD-10 codes as principal diagnosis:
    - I60 subarachnoid hemorrhage
    - I61 intracerebral hemorrhage
    - I63 cerebral infarction
    - I64 stroke, not specified as hemorrhage or infarction
2. belonged to the age interval 20 – 57 years at the time of the hospital contact
3. was gainfully occupied the year preceding the hospital contact

Ethical approval

The study has been notified to and registered by Datatilsynet (the Danish Data Protection Agency). According to Danish law, questionnaire and register based studies do not need approval by ethical and scientific committees, nor informed consent.

Statistical analysis

The study consists of two parts, one is descriptive while the other utilizes statistical inference techniques to test hypotheses and estimate odds ratios for RTW (return to work).

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In the descriptive part we followed the stroke patients for five calendar years after the stroke for their main social status in each of these years. This part of the study only included people who were less than 55 years at the time of the stroke. For any given patient, the calendar year of the stroke was defined as year 0, the next calendar year was defined as year 1 etc.

In the regression analysis, we looked at the odds of having a socio-economic code, which indicates gainful occupation in year 2 after stroke. The outcome variable was set to 1 if the person was self-employed, assisting spouse or employee in that particular year. It was set to 0 if the person was unemployed, not economically active or dead.

As explanatory variables we used gender, age, diagnosis, calendar year, occupational class, self-employment, and type of municipality.

Age at the time of the stroke was divided into the categories 20 – 49 years and 50 – 57 years. In Denmark it is possible to retire at the age of 60, regardless of health condition. Therefore we excluded people being older than 60 years at follow-up. The cut-point 50 years conforms to OECD's definition of older workers,[12] who are known to have a more insecure labor market attachment than the younger ones.

The variable 'Diagnosis' contains the four stroke categories given in the section 'inclusion criteria'.

The variable 'Self-employment' was set to 1 if the person was self-employed or assisting spouse and 0 if he/she was an employee, the year preceding the stroke.

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The variable 'Occupational class' was based on the first digit of the DISCO-88 classification the year preceding the stroke. It contains the following categories:

- Legislators, senior officials and managers (DISCO-88 group 1)
- professionals (DISCO-88 group 2)
- technicians and associate professionals (DISCO-88 group 3)
- workers in occupations that require skills at a basic level (DISCO-88 group 4 – 8)
- workers in elementary occupations (DISCO-88 group 9)
- gainfully occupied people with an unknown occupation (missing DISCO-88 code)

The variable 'Type of municipality' was set to 1 if the person lived in a municipality which had a brain injury rehabilitation centre at the time of the stroke. Otherwise it was set to 0. The following municipalities had a brain injury rehabilitation centre throughout the study period: Copenhagen, Odense, Aarhus, Roskilde, Aalborg and Vejle.

There are at least two reasons for believing that the RTW probabilities depended on which calendar year the stroke occurred. Firstly, quality of stroke treatment and rehabilitation has a tendency to improve with time.[13-15] Secondly, a series of political initiatives and legislative changes, aimed at improving return to work rates in Denmark, occurred during the study period.[16]. We incorporated calendar year into the model as a class variable to deal with this possible time dependency.

It is also reasonable to believe that RTW probabilities depend on place of residence. In Denmark, municipalities play an important role in the return to work process. According to the law, it is the

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municipal officer and not the physician who has the formal right to decide whether or not a person qualifies for sickness benefit, disability pension, or vocational rehabilitation. The law also stipulates that the municipality should perform regular follow-up evaluations and draw up detailed reintegration plans for each sick-listed citizen at risk of long-tem sickness absence.[17] RTW initiatives are often launched at the municipality level and some municipalities might be more active than others. The unemployment situations may also differ between municipalities. In the present study, we used a multi-level analysis to deal with intra-municipality correlations — the municipalities were treated as the subjects while the individual observations within the municipalities were treated as correlated repeated measurements.

The logistic regression was performed by use of the GENMOD procedure in SAS version 9.1. Only main effects were considered. We assumed an exchangeable correlation structure and we used the empiric standard error estimates.

RESULTS

In total, 19985 patients fulfilled the inclusion criteria. Due to emigration, we missed follow-up data on 82 of them. The remaining 19903 patients were included in the analysis and 12375 (62.1%) of these were gainfully occupied during the second calendar year after the stroke. At baseline, 49.9% of the included patients were less than 50 years old and 39.1% were women.

The variable ‘municipality type’ did not reach statistical significance but all other examined factors proved to be significant predictors of return to work. Patients with intracerebral infarction had a significantly higher chance of returning to work than patients with subarachnoid hemorrhage, who in turn had a significantly better prognosis than those with intracerebral hemorrhage. Patients who

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were employed before the stroke had a better prognosis than those who were self-employed; younger patients had a better prognosis than the older ones and men had a better prognosis than women.

There was a clear relationship between the educational requirements of the job and the chance of returning to work after stroke. Professionals had a significantly better prognosis than technicians and associate professionals who in turn had a significantly better prognosis than workers in occupations that only require skills at a basic level. The latter group had a significantly better prognosis than workers employed in elementary occupations, where no education is required.

Odds ratios for gainful occupation during the second calendar year after stroke are given in Table 1. Table 2 gives the social group distribution of the post-stroke patients by time passed since onset of illness.

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Table 1. Odds ratios (OR), with 95% confidence interval (CI) for return to gainful occupation two year after stroke

Parameter	Level	N	Returns	OR	95% CI
Gender (P < 0.0001)	Men	12114	7698	1.00	-
	Women	7789	4677	0.79	0.74-0.84
Age (P < 0.0001)	< 50 years	9930	6608	1.00	-
	50 - 57 years	9973	5767	0.61	0.57-0.65
Diagnosis (P < 0.0001)	Subarachnoid hemorrhage	3449	2070	0.79	0.71-0.88
	Intracerebral hemorrhage	2272	976	0.39	0.35-0.43
	Cerebral infarction	5952	3820	1.00	-
	Stroke, not specified as hemorrhage or infarction	8230	5509	1.14	1.06-1.23
Self-employment (P = 0.0083)	No	17916	11180	1.00	-
	Yes	1987	1195	0.87	0.78-0.96
Occupational class (P < 0.0001)	Legislators, senior officials and managers	1231	822	2.31	2.00-2.68
	Professionals	2190	1624	3.04	2.70-3.43
	Technicians and associate professionals	2980	2084	2.33	2.05-2.65
	Workers in occupations that require skills at a basic level	9129	5478	1.50	1.38-1.64
	Workers in elementary occupations	2475	1254	1.00	-
	Gainfully occupied people NOS	1898	1113	1.28	1.15-1.43
Municipality type (P = 0.2662)	Municipality without brain injury centre	15861	9908	1.00	-
	Municipality with brain injury centre	4042	2467	0.91	0.78-1.06

Table 2. Social group distribution (%) by time passed since onset of illness, among stroke patients in Denmark 1996-2006 who were 20-54 year of age and gainfully occupied at the time of the stroke

Social status	Year after stroke				
	1	2	3	4	5
Self-employed people	6.1	5.3	4.9	4.7	4.7
Assisting spouses	0.3	0.2	0.2	0.2	0.2
Employees	64.9	58.8	55.7	53.6	51.4
People on unemployment benefits	1.9	2.3	2.1	2.3	2.3
People in training/education	0.4	0.4	0.4	0.2	0.2
Pensioners	8.9	16.2	19.7	21.6	23.2
Other not economically active	7.9	6.4	5.5	4.7	4.2
Deceased	9.5	10.4	11.6	12.7	14.0
Total	100.0	100.0	100.0	100.0	100.0

DISCUSSION

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In the present study we have shown to what extent the odds for return to work after stroke depend on age, gender, occupational status, self–employment and type of stroke, and due to the size of the study we have done so with an extraordinary precision. The study did not require the participants to fill in a questionnaire; it was based solely on national registers. Recall bias and non-response bias were thereby eliminated. We also eliminated sampling bias by including the entire target population. Since the studied diagnoses require hospital treatment, referral bias should be minimal. Bias due to emigration should also be negligible since only 0.4% of the subjects emigrated during the ca. two-year follow-up period. The study is, moreover, free from hindsight bias; the statistical model was completely specified and a study protocol was published [18] before we looked at any relation between the exposure and response variables in our data material.

We had calendar day specific information on deaths, migrations and hospitalizations but, since the occupational data only were given per calendar year, we did not have exact dates of return to work. Moreover, only the main occupation and social group during a calendar year is recorded in the register. A person could, in other words, return to work in a given calendar year and still be counted as a non-returner if he, for example, was sickness absent or unemployed during the major part of that year. Another consequence of not having a calendar day specific occupational history was that we had to resort to logistic regression instead of time-to-event analysis, which is regarded as the choice method in modeling return to work.[5] That the participants had to return to a quite stable gainful occupation before they were categorized as having returned to work can, however, also be regarded as a strength. Many people with brain injury return to work too soon and subsequently find that they are unable to continue their employment.[1]

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In the present study we showed that people whose stroke was due to intracerebral hemorrhage, on average, had a worse prognosis than those with an intracerebral infarction. This finding is in agreement with previous research, which indicates that people with a stroke caused by hemorrhage tend to have more severe impairments at admission compared with those whose stroke is caused by an infarction.[19-21] Stroke types, as given by the ICD-10 codes are, however, quite crude proxies for stroke severity; it is obvious that a person with a miniscule intracerebral hemorrhage might have a far better prognosis than someone with a massive cerebral infarction. In a prospective study on 1000 unselected stroke patients in Denmark,[19] stroke severity was the all important prognostic factor; stroke type had no influence on neurologic outcome when stroke severity was controlled for. Overall stroke severity is also the most consistent predictive factor for RTW.[17] The major weakness of the present register study is that it lacks a direct severity measure, such as the American Heart Association Stroke Outcome Classification,[22] the modified Rankin scale [23] or the Barthel ADL Index.[24] Our chances of correctly estimating whether or not an individual patient would return to work would have been considerable enhanced by such measures. The results of the present study are therefore more useful when viewed from a public health perspective than they are from a clinical perspective. At the group level, the results can be used to estimate the proportion of patients that is expected to return to work. The study thereby provides a comparison material, which can be used by, for example, hospitals or municipalities to evaluate return to work programs.

The prognosis among people with the ICD-10 code I64 (stroke, not specified as hemorrhage or infarction) is somewhat paradoxical. Stroke that is caused by either hemorrhage or infarction should not be associated with a better prognosis than both stroke specified as hemorrhage and stroke specified as infarction. The elevated odds for returning to work in this ill-defined patient group

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suggest that many of the people who were given the diagnosis I64 did not have a stroke in the first place.

The fact that men had a better chance of returning to work than women and the large difference between them is another paradoxical finding. Previous research does not indicate that female stroke patients have a worse functional recovery than the male patients.[25;26] It has, moreover, been shown that age-specific life expectancy after stroke is far better among women than men.[27] It is therefore reasonable to believe that at least a part of the gender difference observed in the present study is due to cultural rather than physiologic factors. For example, in many cultures, a part of the male identity is to be responsible for providing for the household (being the breadwinner). In such cultures, a man who returns to work would not only regain his employment and stable income but also his male identity.[28] Although Denmark is considered a modern country where men and women in many respects are treated as equals, attitudes and behavior might still be influenced by the more traditional gender roles with regard to being a provider versus allowing oneself to be provided for. It is possible that these ancient gender roles influenced not only the patient but also the municipality official who is to decide whether or not a person qualifies for sickness benefit, disability pension, or vocational rehabilitation. Since stress is believed to be an important risk factor for stroke,[29] it is also possible that a part of the observed gender difference in RTW rates was due to a higher health and safety awareness and a lower propensity to take risks among women[30;31]

Previous research on the relationship between occupational class and return to work after stroke was performed on patient samples that were too small to subdivide further than into white versus blue-collar workers. The observed white versus blue-collar odds-ratios for return to work were 4.72 (USA, 1968-73), 1.19 (USA, 1980's), 1.43 (Japan, 1986-90) and 2.99 (Sweden, 1990's).[2;6;8;32] In the present study, we have shown that it is not only the physical requirements of the work

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(manual versus non-manual) that matters but that inequalities also exist between occupational classes within the blue and white-collar categories. Although stroke is highly associated with cognitive impairments,[33] we found that the probability of returning to work increased with the educational requirements of the job. This may sound counter intuitive at first. The investigated socio-occupational classes differ, however, not only in cognitive demands but also in respect to other psychosocial factors. There is, for example, a positive relationship between the educational requirements of the job and the possibilities to influence the volume as well as the content of ones work [34] and this is a factor which can play an important role in the return to work process.[1] Educational requirements are also positively correlated with 'meaning of work'.[34]

Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities. This null-finding might be due to factors that have nothing to do with the centres. As only a minority of the patients is treated at a brain rehabilitation centre, our study can not determine the effectiveness of the centres. It stresses, however, the importance of testing the workability of the centres in a randomized controlled trial before it is decided whether or not they should be recommended as an efficient RTW strategy.

In conclusion, RTW strategies for post-stroke patients ought to focus especially on the inequalities between the genders and socioeconomic groups. Further research is needed to explain the gender inequality, which suggests either a potential to improve return-to-work rates among the females or a tendency among the males to return too early.

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DISCLOSURES

Frank Humle, one of the authors, is Director of the Centre for Rehabilitation of Brain Injury (CRBI) in Copenhagen, Denmark. CRBI is a self-owned fund which is financially supported by grants from the Danish municipalities and, to a lesser degree, by a collectively bargained framework agreement under the Danish Health Law that covers 20% of the funds' operation costs. Since the study could tell us whether or not stroke patients in municipalities with brain injury rehabilitation centres have a better prognosis than those in other municipalities, there was a potential conflict of interest. We believe, however, that any potential bias due to competing interests was eliminated by the publication of our detailed study protocol,[18] which implied a commitment to adhere to the methods chosen and to publish the results regardless of the outcome.

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, explain how loss to follow-up was addressed
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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A nationwide prospective cohort study on return to gainful occupation after stroke in Denmark 1996 – 2006

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A nationwide prospective cohort study on return to gainful occupation after stroke in Denmark 1996 – 2006

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ABSTRACT

Background: Return to work is an important outcome factor for working-age post stroke patients. Previous epidemiologic studies on this topic have been small (on average 125 patients per study). Their estimated effects are therefore associated with a tremendous statistical uncertainty. The present study estimates the effect of various predictors on the odds of returning to work after stroke in the total population of 20-57 year-old previously employed hospital treated stroke patients in Denmark 1996 – 2006 (N = 19985).

Methods and Results: The patients were followed through national registers; 62% were gainfully occupied two years after stroke. The odds of returning to work were higher among people with intracerebral infarction, OR = 1.0 (the reference group), than they were among people with subarachnoid haemorrhage, OR = 0.79 (95% CI: 0.71 – 0.88), and intracerebral haemorrhage, OR = 0.39 (0.35 – 0.43). The odds of returning to work were lower among workers in elementary occupations OR = 1.0 (reference group) than they were among workers in occupations that require skills at a basic level, OR = 1.50 (1.38 – 1.64), technicians and associate professionals, OR = 2.33 (2.05 – 2.65), and professionals, OR = 3.04 (2.70 – 3.43). Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities, OR = 0.91 (0.78 – 1.06). Being a woman, OR = 0.79 (0.74 – 0.84), self-employed, OR = 0.87 (0.78 – 0.96), or >= 50 years, OR = 0.61 (0.57 – 0.65), was associated with an adverse prognosis.

Conclusion: Further research is needed to explain the gender inequality, which suggests either a potential to improve return-to-work rates among the females or a tendency among the males to return too early.

KEY WORDS: cerebral infarct; intracerebral haemorrhage; subarachnoid haemorrhage; rehabilitation; work ability.

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ARTICLE SUMMARY

Article focus

- The present study estimates odds ratios for return to gainful occupation ca. two years after stroke.
- It focuses on clinical, demographic and occupational factors which are potentially useful in predicting return to work.
- The study includes the total population of 20-57 year-old previously employed hospital treated stroke patients in Denmark 1996 – 2006.

Key messages

- 62% of the studied patients were gainfully occupied during the second calendar year after the stroke.
- The odds of returning to work depend on age, gender, occupation, self-employment and type of stroke.
- Women had a much lower chance of returning to work than men and to our knowledge there are no known physiologic factors which can justify this difference.
- Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities.

Strengths and limitations of this study

- The follow-up was done through registers and all people in the target population were included. Hence, the study is free from sampling bias, recall bias and non-response bias.
- The statistical model was completely defined and a detailed study protocol was published before we looked at any relation between the concerned exposure and response variables in our data material. Since we adhered to the protocol, the study is free from hindsight bias.
- The study is further strengthened by its size.
- The major weakness of the study is that it does not contain any stroke severity measures.

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INTRODUCTION

Return to work (RTW) plays a crucial role in the rehabilitation process of working age post-stroke patients. It provides a social identity and it is associated with increased self-esteem and life satisfaction.[1-3] It is also important, from a societal perspective, that as many as possible of the stroke patients who are economically active at the time of the onset, return to work after stroke; in the European Union, the annual cost of lost productivity due to disability or death as a consequence of stroke was estimated at €8.5 billion in 2008.[4]

A recent review of articles dealing with return to work among stroke patients identified 70 studies, which in total comprised 8810 patients working before the stroke.[5] The review concluded that the analytic strategies that were used were inappropriate in all but three of the 70 studies.[6-8] The rest of the studies were associated either with selection bias or non-interpretable results due to highly variable follow-up periods or ill-defined criteria of work before stroke and at follow-up.[5] There are also limitations associated with the three appropriately performed studies. All of them were small (the included number of patients ranged from 109 to 173) and two of them [6;8] deal with data that are too old to afford results that can be used as proxies for present time RTW probabilities. The most recent of the three studies [7] reported that 55% of previously employed stroke patients in New Zealand returned to paid employment within six months. That study is, however, associated with selection bias; it only included cognitively competent patients.

The present study estimates the effect of various predictors on the odds of returning to work after stroke. It covers the total population of 20-57 year-old previously employed hospital treated stroke patients in Denmark 1996 – 2006.

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MATERIAL AND METHODS

The study utilizes the Danish Occupational Hospitalisation Register (OHR), a database obtained through a record-linkage between three national registers—the central person register, the hospital patient register, and the employment classification module. Currently, the OHR includes every person who has been economically active and an inhabitant of Denmark sometime after 1980.

The national hospital patient register has existed since 1977 and contains data from all public hospitals in Denmark (more than 99% of all admissions). From 1977 to 1994, the register only included inpatients but from 1995 it also covers outpatients and emergency ward visits.[9] The diagnoses have been coded according to international classification of diseases version ten (ICD-10) since 1994.

The central person register contains information on gender, addresses and dates of birth, death and migrations for every person who is or has been an inhabitant of Denmark sometime between 1968 and present time. A person's occupation and social status are, since 1975, registered annually in the employment classification module.[9] A person is classified according to his/her main income during the year. The occupations are, since 1994, coded in accordance with Statistics Denmark's Standard Classification of Occupations (DISCO-88),[10] which is a national version of the International Standard Classification of Occupations (ISCO-88). Socio-economic status is coded in accordance with Statistics Denmark's official socio-economic classification.[11] At the one- and two-digit level, the classification contains the following social groups:

1. Gainfully occupied people
    1.1. Self-employed people
    1.2. Assisting spouses
    1.3. Employees

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2. People on unemployment benefits
3. Not economically active
   3.1. People in training/education
   3.2. Pensioners
   3.3. Other not economically active

Inclusion criteria

A person would be included in the study if he/she

1. on at least one occasion in the time period 1996 – 2006, was registered in the hospital patient registry with one of the following ICD-10 codes as principal diagnosis:
   - I60 subarachnoid haemorrhage
   - I61 intracerebral haemorrhage
   - I63 cerebral infarction
   - I64 stroke, not specified as haemorrhage or infarction
2. belonged to the age interval 20 – 57 years at the time of the hospital contact
3. was gainfully occupied the year preceding the hospital contact

Accuracy of the databases

Age and gender are part of the personal identification number of the central person register, which is recorded almost without errors. The completeness and accuracy of the data were confirmed in the matching process where we had a 100% match of the files. A person is classified according to his/her main income during the year. The socio-economic categories given above are based on incomes, which are declared to the Danish tax authority. This information should be correct among people who declare their income correctly. The occupational code, which is provided by the

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employer, is less reliable and is missing for almost 10% of the employees. For circulatory disease, the ICD-10 code of the principal diagnosis given in the hospital patient register has been estimated to be accurate in 73.4% of the records.[12].

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Ethics approval

The study has been notified to and registered by Datatilsynet (the Danish Data Protection Agency). According to Danish law, questionnaire and register based studies do not need approval by ethical and scientific committees, nor informed consent.

Statistical analysis

The study consists of two parts, one is descriptive while the other utilizes statistical inference techniques to test hypotheses and estimate odds ratios for RTW (return to work).

In the descriptive part we followed the stroke patients for five calendar years after the stroke for their main social status in each of these years. This part of the study only included people who were less than 55 years at the time of the stroke. For any given patient, the calendar year of the stroke was defined as year 0, the next calendar year was defined as year 1 etc.

In the regression analysis, we looked at the odds of having a socio-economic code, which indicates gainful occupation in year 2 after stroke. The outcome variable was set to 1 if the person was self-employed, assisting spouse or employee in that particular year. It was set to 0 if the person was unemployed, not economically active or dead.

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As explanatory variables we used gender, age, diagnosis, calendar year, occupational class, self-employment, and type of municipality.

Age at the time of the stroke was divided into the categories 20 – 49 years and 50 – 57 years. In Denmark it is possible to retire at the age of 60, regardless of health condition. Therefore we excluded people being older than 60 years at follow-up. The cut-point 50 years conforms to OECD's definition of older workers,[13] who are known to have a more insecure labour market attachment than the younger ones.

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The variable 'Diagnosis' contains the four stroke categories given in the section 'inclusion criteria'.

The variable 'Self-employment' was set to 1 if the person was self-employed or assisting spouse and 0 if he/she was an employee, the year preceding the stroke.

The variable 'Occupational class' was based on the first digit of the DISCO-88 classification the year preceding the stroke. It contains the following categories:

- Legislators, senior officials and managers (DISCO-88 group 1)
- professionals (DISCO-88 group 2)
- technicians and associate professionals (DISCO-88 group 3)
- workers in occupations that require skills at a basic level (DISCO-88 group 4 – 8)
- workers in elementary occupations (DISCO-88 group 9)
- gainfully occupied people with an unknown occupation (missing DISCO-88 code)

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The variable 'Type of municipality' was set to 1 if the person lived in a municipality which had a brain injury rehabilitation centre at the time of the stroke. Otherwise it was set to 0. The following municipalities had a brain injury rehabilitation centre throughout the study period: Copenhagen, Odense, Aarhus, Roskilde, Aalborg and Vejle.

There are at least two reasons for believing that the RTW probabilities depended on which calendar year the stroke occurred. Firstly, quality of stroke treatment and rehabilitation has a tendency to improve with time.[14-16] Secondly, a series of political initiatives and legislative changes, aimed at improving return to work rates in Denmark, occurred during the study period.[17]. We incorporated calendar year into the model as a class variable to deal with this possible time dependency.

It is also reasonable to believe that RTW probabilities depend on place of residence. In Denmark, municipalities play an important role in the return to work process. According to the law, it is the municipal officer and not the physician who has the formal right to decide whether or not a person qualifies for sickness benefit, disability pension, or vocational rehabilitation. The law also stipulates that the municipality should perform regular follow-up evaluations and draw up detailed reintegration plans for each sick-listed citizen at risk of long-tem sickness absence.[18] RTW initiatives are often launched at the municipality level and some municipalities might be more active than others. The unemployment situations may also differ between municipalities. In the present study, we used a multi-level analysis to deal with intra-municipality correlations — the municipalities were treated as the subjects while the individual observations within the municipalities were treated as correlated repeated measurements.

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The logistic regression was performed by use of the GENMOD procedure in SAS version 9.1. Only main effects were considered. We assumed an exchangeable correlation structure and we used the empiric standard error estimates. The reference groups were chosen more or less arbitrarily, before we looked at any results. An odds ratio which is higher than one indicates that the odds of returning to work are higher than they are in the reference group.

RESULTS

In total, 19985 patients fulfilled the inclusion criteria. Due to emigration, we missed follow-up data on 82 of them. The remaining 19903 patients were included in the analysis and 12375 (62.1%) of these were gainfully occupied during the second calendar year after the stroke. At baseline, 49.9% of the included patients were less than 50 years old and 39.1% were women.

The variable 'municipality type' did not reach statistical significance but all other examined factors proved to be significant predictors of return to work. Patients with intracerebral infarction had a significantly higher chance of returning to work than patients with subarachnoid haemorrhage, who in turn had a significantly better prognosis than those with intracerebral haemorrhage. Patients who were employed before the stroke had a better prognosis than those who were self-employed; younger patients had a better prognosis than the older ones and men had a better prognosis than women.

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There was a clear relationship between the educational requirements of the job and the chance of returning to work after stroke. Professionals had a significantly better prognosis than technicians and associate professionals who in turn had a significantly better prognosis than workers in

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occupations that only require skills at a basic level. The latter group had a significantly better prognosis than workers employed in elementary occupations, where no education is required.

Odds ratios for gainful occupation during the second calendar year after stroke are given in Table 1. Table 2 gives the social group distribution of the post-stroke patients by time passed since onset of illness. The category 'gainfully occupied' includes self-employed people, assisting spouses and employees. From Table 2, the percentages in these categories are 5.3, 0.2 and 58.8 respectively. The sum of these percentages is not 62.1% but 64.3%. The reason for the discrepancy is that table 2 only includes people in the age bracket 20-54 years while the main analysis includes people in the age bracket 20 – 57 years.

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Table 1. Odds ratios (OR), with 95% confidence interval (CI) for return to gainful occupation two year after stroke

Parameter	Level	N	Returns	OR	95% CI
Gender	Men	12114	7698	1.00	-
	Women	7789	4677	0.79	0.74-0.84
Age	< 50 years	9930	6608	1.00	-
	50 - 57 years	9973	5767	0.61	0.57-0.65
Diagnosis	Subarachnoid haemorrhage	3449	2070	0.79	0.71-0.88
	Intracerebral haemorrhage	2272	976	0.39	0.35-0.43
	Cerebral infarction	5952	3820	1.00	-
	Stroke, not specified as haemorrhage or infarction	8230	5509	1.14	1.06-1.23
Self-employment	No	17916	11180	1.00	-
	Yes	1987	1195	0.87	0.78-0.96
Occupational class	Legislators, senior officials and managers	1231	822	2.31	2.00-2.68
	Professionals	2190	1624	3.04	2.70-3.43
	Technicians and associate professionals	2980	2084	2.33	2.05-2.65
	Workers in occupations that require skills at a basic level	9129	5478	1.50	1.38-1.64
	Workers in elementary occupations	2475	1254	1.00	-
	Gainfully occupied people NOS	1898	1113	1.28	1.15-1.43
Municipality type	Municipality without brain injury centre	15861	9908	1.00	-
	Municipality with brain injury centre	4042	2467	0.91	0.78-1.06

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Table 2. Social group distribution (%) by time passed since onset of illness, among stroke patients in Denmark 1996-2006 who were 20-54 year of age and gainfully occupied at the time of the stroke

Social status	Year after stroke				
	1	2	3	4	5
Self-employed people	6.1	5.3	4.9	4.7	4.7
Assisting spouses	0.3	0.2	0.2	0.2	0.2
Employees	64.9	58.8	55.7	53.6	51.4
People on unemployment benefits	1.9	2.3	2.1	2.3	2.3
People in training/education	0.4	0.4	0.4	0.2	0.2
Disability pensioners	8.9	16.2	19.7	21.6	23.2
Other not economically active	7.9	6.4	5.5	4.7	4.2
Deceased	9.5	10.4	11.6	12.7	14.0
Total	100.0	100.0	100.0	100.0	100.0

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DISCUSSION

In the present study we have shown to what extent the odds for return to work after stroke depend on age, gender, occupational status, self–employment and type of stroke, and due to the size of the study we have done so with an extraordinary precision. The study did not require the participants to

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fill in a questionnaire; it was based solely on national registers. Recall bias and non-response bias were thereby eliminated. We also eliminated sampling bias by including the entire target population. Since the studied diagnoses require hospital treatment, referral bias should be minimal. Bias due to emigration should also be negligible since only 0.4% of the subjects emigrated during the ca. two-year follow-up period. The study is, moreover, free from hindsight bias; the statistical model was completely specified and a study protocol was published [19] before we looked at any relation between the exposure and response variables in our data material.

We had calendar day specific information on deaths, migrations and hospitalisations but, since the occupational data only were given per calendar year, we did not have exact dates of return to work. Moreover, only the main occupation and social group during a calendar year is recorded in the register. A person could, in other words, return to work in a given calendar year and still be counted as a non-returner if he, for example, was sickness absent or unemployed during the major part of that year. Another consequence of not having a calendar day specific occupational history was that we had to resort to logistic regression instead of time-to-event analysis, which is regarded as the choice method in modelling return to work.[5] Since RTW is not a rare event, the odds ratio can not be used as a proxy for the rate ratio, which makes it difficult to compare the effects obtained in the present study with those obtained in studies that uses time-to-event analysis. That the participants had to return to a quite stable gainful occupation before they were categorized as having returned to work can, however, also be regarded as a strength. Studies show that many people with brain injury return to work too soon and subsequently find that they are unable to continue their employment.[1] Table 2 suggests that this is the case also for some of the people in the present study.

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In the present study we showed that people whose stroke was due to intracerebral haemorrhage, on average, had a worse prognosis than those with an intracerebral infarction. This finding is in agreement with previous research, which indicates that people with a stroke caused by haemorrhage tend to have more severe impairments at admission compared with those whose stroke is caused by an infarction.[20-22] Stroke types, as given by the ICD-10 codes are, however, quite crude proxies for stroke severity; it is obvious that a person with a miniscule intracerebral haemorrhage might have a far better prognosis than someone with a massive cerebral infarction. In a prospective study on 1000 unselected stroke patients in Denmark,[20] stroke severity was the all important prognostic factor; stroke type had no influence on neurologic outcome when stroke severity was controlled for. Overall stroke severity is also the most consistent predictive factor for RTW.[18] The major weakness of the present register study is that it lacks a direct severity measure, such as the American Heart Association Stroke Outcome Classification,[23] the modified Rankin scale [24] or the Barthel ADL Index.[25] Our chances of correctly estimating whether or not an individual patient would return to work would have been considerable enhanced by such measures. The results of the present study are therefore more useful when viewed from a public health perspective than they are from a clinical perspective. At the group level, the results can be used to estimate the proportion of patients that is expected to return to work. The study thereby provides a comparison material, which can be used by, for example, hospitals or municipalities to evaluate return to work programs.

The prognosis among people with the ICD-10 code I64 (stroke, not specified as haemorrhage or infarction) is somewhat paradoxical. Stroke that is caused by either haemorrhage or infarction should not be associated with a better prognosis than both stroke specified as haemorrhage and stroke specified as infarction. The elevated odds for returning to work in this ill-defined patient

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group suggest that many of the people who were given the diagnosis I64 did not have a stroke in the first place.

The fact that men had a better chance of returning to work than women and the large difference between them is another paradoxical finding. Previous research does not indicate that female stroke patients have a worse functional recovery than the male patients.[26;27] It has, moreover, been shown that age-specific life expectancy after stroke is far better among women than men.[28] It is therefore reasonable to believe that at least a part of the gender difference observed in the present study is due to cultural rather than physiologic factors. For example, in many cultures, a part of the male identity is to be responsible for providing for the household (being the breadwinner). In such cultures, a man who returns to work would not only regain his employment and stable income but also his male identity.[29] Although Denmark is considered a modern country where men and women in many respects are treated as equals, attitudes and behaviour might still be influenced by the more traditional gender roles with regard to being a provider versus allowing oneself to be provided for. It is possible that these ancient gender roles influenced not only the patient but also the municipality official who is to decide whether or not a person qualifies for sickness benefit, disability pension, or vocational rehabilitation. Since stress is believed to be an important risk factor for stroke,[30] it is also possible that a part of the observed gender difference in RTW rates was due to a higher health and safety awareness and a lower propensity to take risks among women[31;32]

Previous research on the relationship between occupational class and return to work after stroke was performed on patient samples that were too small to subdivide further than into white versus blue-collar workers. The observed white versus blue-collar odds-ratios for return to work were 4.72 (USA, 1968-73), 1.19 (USA, 1980's), 1.43 (Japan, 1986-90) and 2.99 (Sweden, 1990's).[2;6;8;33] In

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the present study, we have shown that it is not only the physical requirements of the work (manual versus non-manual) that matters but that inequalities also exist between occupational classes within the blue and white-collar categories. Although stroke is highly associated with cognitive impairments,[34] we found that the probability of returning to work increased with the educational requirements of the job. This may sound counter intuitive at first. The investigated socio-occupational classes differ, however, not only in cognitive demands but also in respect to other psychosocial factors. There is, for example, a positive relationship between the educational requirements of the job and the possibilities to influence the volume as well as the content of ones work [35] and this is a factor which can play an important role in the return to work process.[1] Educational requirements are also positively correlated with 'meaning of work'.[35]

Patients in municipalities with a brain injury rehabilitation centre did not have a better prognosis than patients in other municipalities. This null-finding might be due to factors that have nothing to do with the centres. As only a minority of the patients is treated at a brain rehabilitation centre, our study can not determine the effectiveness of the centres. It stresses, however, the importance of testing the workability of the centres in a randomized controlled trial before it is decided whether or not they should be recommended as an efficient RTW strategy.

It should finally be noted that the present study gives the situation in the Danish population and that the Danish system, where the eligibility for sickness benefit, vocational training and disability pension is determined by a municipal official, differ from that in many other countries where this is determined by a medical practitioner.

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In conclusion, RTW strategies for post-stroke patients ought to focus especially on the inequalities between the genders and socioeconomic groups. Further research is needed to explain the gender inequality, which suggests either a potential to improve return-to-work rates among the females or a tendency among the males to return too early.

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ACKNOWLEDGEMENTS

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DISCLOSURES

Frank Humle, one of the authors, is Director of the Centre for Rehabilitation of Brain Injury (CRBI) in Copenhagen, Denmark. CRBI is a self-owned fund which is financially supported by grants from the Danish municipalities and, to a lesser degree, by a collectively bargained framework agreement under the Danish Health Law that covers 20% of the funds' operation costs. Since the study could tell us whether or not stroke patients in municipalities with brain injury rehabilitation centres have a better prognosis than those in other municipalities, there was a potential conflict of interest. We believe, however, that any potential bias due to competing interests was eliminated by the publication of our detailed study protocol,[19] which implied a commitment to adhere to the methods chosen and to publish the results regardless of the outcome.

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, explain how loss to follow-up was addressed
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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