Jobs encompassing prolonged sitting in cramped positions and risk of venous thromboembolism: cohort study

Poul Suadicani[1] • Harald Hannerz[2] • Elsa Bach[2] • Finn Gyntelberg[1]

[1]Epidemiological Research Unit, Department of Occupational and Environmental Medicine, Bispebjerg University Hospital, Copenhagen, Denmark

[2]National Research Centre for the Working Environment, Copenhagen, Denmark

Correspondence to: Poul Suadicani. Email: PSUA0001@bbh.regionh.dk

DECLARATIONS

Competing interests
None declared

Funding
None

Ethical approval
Not applicable

Guarantor
PS

Contributorship
All authors contributed equally

Acknowledgements
None

Reviewer
Richard Beasley

Summary

Objectives There is mounting evidence that prolonged cramped sitting in connection with long-lasting air travel increases the risk of deep vein thrombosis of the legs and pulmonary embolism, i.e. venous thromboembolism (VTE). Prolonged cramped sitting may occur even in various jobs unrelated to air travel, and, theoretically, be associated with an increased risk of VTE. The issue is unsettled.

Design A dynamic cohort study (open for both entry and departure) in Danish national registers 1997–2006.

Participants 20–59-year-old manual workers. The cohort consisted of an exposed group with job functions basically characterised as sedentary ($n = 105{,}564$) and a control group with more dynamic work ($n = 283{,}966$).

Setting Denmark.

Main outcome measures Deaths and hospital contacts due to pulmonary embolism and deep vein thrombosis.

Results Compared with occupations characterized by dynamic physical activity, the group encompassing those who would potentially be exposed to prolonged sitting in ergonomically adverse positions, had a significantly higher risk of pulmonary embolism ($n = 77$, relative risk 1.28; 95% CI 0.97–1.67, $P = 0.04$ in one-sided test). With respect to deep vein thrombosis they had a slightly but not significantly higher risk ($n = 256$, relative risk 1.09; 95% CI 0.94–1.26, $P = 0.12$).

Conclusion Despite the crude method used allowing for no control of individual risk factors, occupations encompassing longer and shorter periods of sitting in potentially adverse ergonomic positions, i.e. cramped sitting, had a higher risk of VTE, than a socioeconomically comparable group with more dynamic physical work demands.

Introduction

There is mounting evidence that prolonged cramped sitting in connection with long-lasting air travel increases the risk of deep vein thrombosis (DVT) of the legs and its frequent outcome, pulmonary embolism (PE) – in concert known as venous thromboembolism (VTE). The evidence has been gathered from case-control studies[1–8] and prospective studies.[9–23]

Although prolonged cramped sitting may occur even in various jobs unrelated to travel or transport, and, theoretically, be associated with an increased risk of VTE, only one methodologically sufficient study has reported on the association of non-travel-related prolonged seated immobility and DVT.[24,25] In a case-control study by West,[24] the authors included 97 cases, i.e. subjects with a discharge diagnosis of either DVT or PE, and subjects from the same coronary clinic with no such diagnoses. The period consisting of a prolonged period of seated immobility should have occurred within 4 weeks prior to the event. Although the sample size of the study was quite limited, cases had significantly more often been exposed to prolonged seated immobility compared to controls; the odds ratio (95% CI) was 2.2 (1.0–5.0). In a more recent case-control study from the same research institute, Healy *et al.*[25] included twice the number of cases and controls, 197 in each group, and confirmed the results of the first study, finding in multivariate analysis, that prolonged work- and computer-related seated immobility was associated with an increased risk of VTE, odds ratio 2.8 (95% CI 1.2–6.1, $P = 0.013$).

Thus, a review of the literature suggests that prolonged seated immobility may be a genuine problem also in the work environment. To further explore the likelihood of the existence of an underestimated occupational risk factor for VTE we tested among two groups of socioeconomically homogenous manual workers the hypothesis, that those who due to their job demands would occasionally or regularly be exposed to periods of uncomfortable, cramped sitting would have a higher risk of VTE than a group of workers where this would rarely be the case.

Material and methods

The present study used information in the Danish Occupational Hospitalisation Register (OHR), a database obtained through a record-linkage between four national registers – the central person register, the hospital register, the cause of death register and the employment classification module. Currently, the OHR includes every person who has been economically active and an inhabitant of Denmark sometime between 1981 and 2006.

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. Age and gender are part of the personal identification number, which is recorded practically without errors.

The national hospital patient register has existed since 1977 and contains data from all public hospitals in Denmark (more than 99% of all admissions). In the time period 1977–1994, the register only included inpatients but from 1995 it also covers the conclusion of outpatient courses and emergency ward visits.[26] The diagnoses are, since 1994, coded according to international classification of diseases version ten (ICD-10).[27] The national cause of death register[28] has existed since 1970 and contains information on causes and time of death.

Every adult person in Denmark is, since 1975, classified annually according to industry, occupation and socioeconomic status in the employment classification module (ECM).[26] The occupations in the ECM are coded in accordance with Statistics Denmark's Standard Classification of Occupations (DISCO-88),[29] which is a national version of the International Standard Classification of Occupations (ISCO-88).

The occupational code in the Employment Classification Module was used to identify manual workers with job functions basically characterized as sedentary and a reference group consisting of men and women of comparable socioeconomic background who had work of a more dynamic nature. Seven different codes were used to select men and women in the following occupations: Train engine drivers (DISCO-88 = 8311), bus drivers (DISCO-88 = 8323), lorry drivers (DISCO-88 = 8324), tractor

drivers (DISCO-88 = 8331), construction vehicle drivers (DISCO-88 = 8332), crane drivers (DISCO-88 = 8333), and forklift drivers (DISCO-88 = 8334) – all sedentary jobs. Three codes were used to identify socioeconomically comparable occupational groups characterized by being physically active at work: Skilled construction workers (basic) (DISCO-88 = 712), skilled construction workers (finish) (DISCO-88 = 713), and unskilled construction workers (DISCO-88 = 913).

A dynamic cohort (open for both entry and departure), consisting of all 20–59-year-old employees in the selected occupations, was followed in the time period 1995–2006 for hospital treatment or death due to pulmonary embolism (ICD-10: I26) and phlebitis and thrombophlebitis of lower extremities (ICD-10: I80.0–I80.3). Only the principal diagnoses were regarded. A person would depart from the cohort if any of the following events occurred: he/she became 60 years old, he/she changed to an occupation, which did not belong to the selected ones, he emigrated or he died. A person was censored at the time of dying, emigrating or when contracting the outcome in question. The data were analysed using Poisson regression estimating the rate ratio (RR) between the exposed and the controls adjusting for calendar year, gender, age (10-year age groups) and gender*age. Proc genmod in SAS version 9.1 was used to implement the analysis.

Results

In total, 105,564 persons belonged to the exposed group at some time point during the 10-year follow-up. Approximately 3.6% of the exposed workers were train engine drivers, 16.1% were bus drivers, 54.4% were lorry drivers, 7.2% were drivers of construction vehicles, 15.5% were forklift drivers and 3.3% were drivers of other vehicles. Their mean follow-up time was 3.7 years and their mean age during the follow-up was 42.3 years. A total of 283,966 persons belonged to the control group at some time point. Their mean follow-up time was 4.3 years and their mean age was 39.1 years. The proportion of women was 5.4% among the exposed and 5.5% among the controls. Among the exposed, we found 77 cases of pulmonary embolism and 256 cases of phlebitis and thrombophlebitis of lower extremities. The corresponding numbers among the controls were 167 and 642.

Compared with occupations characterized by dynamic physical activity, the group encompassing those who would potentially be exposed to prolonged sitting in ergonomically adverse positions, had a significantly higher risk of death or hospital treatment due pulmonary embolism (relative risk 1.28; 95% CI 0.97–1.67, $P = 0.04$) in one-sided test; with respect to death or hospital treatment due to deep vein thrombosis they had a slightly but not significantly higher risk (relative risk 1.09; 95% CI 0.94–1.26, $P = 0.12$). Considering that the two endpoints studied are different manifestations of the same disease, in a *post hoc* analysis we combined the two endpoints. In two-sided test the relative risk was 1.13 (0.99–1.29).

Discussion

The hypothesis tested was based on the assumption that the men and women in the group with jobs requiring sitting for long periods may have been seated in cramped positions now and then. Our data do not provide information on this. However, we find this likely because the group exposed to sitting for long hours encompassed many drivers of various vehicles. A common problem for drivers is unpleasant ergonomic conditions due to lack of space comparable to air travel. Also the sitting position itself may be inadequate for a given person if the seating is not sufficiently adjustable. So the sitting position may prohibit movement of the legs, and may compromise blood flow in the leg veins due to compression.

Interestingly, the group selected as having sedentary jobs, did have an increased risk of VTE, in particular with respect to pulmonary embolism. Considering the many potential confounding factors inherent in a register-based study like the present, the results support the hypothesis tested. One established strong risk factor for VTE is smoking. From another available database at the National Research Centre for the Working Environment (NRCWE) information on smoking habits among similar job categories as those included in our study was achieved. No differences in smoking habits between the two

groups were found with approximately 38% smokers in both groups.

Considering the fact that the exposed group were all employed in transport jobs, the possibility exists that they may have been involved in traffic accidents resulting in fractures or other traumatic events requiring surgical treatment. Such forms of bodily harm may *per se* increase the risk of DVT and could explain an overall higher risk of DVT or PE among such workers. However, in the analyses performed in this study only primary diagnoses of DVT were used. Accordingly, traumatic events are very unlikely explanations for the excess risk found among the exposed group. In contrast, an under-estimation of the risk of VTE among individuals having a job encompassing prolonged seated position, may have been underestimated. Many Danish truck drivers drive long distances abroad. They may have been admitted to hospitals in other predominantly European countries, and for this reason their DVT or PE event will not have been recorded in Danish hospital registers. Among controls only few will have jobs abroad meaning that under-reporting of DVT or PE events in this group is much less likely.

A community-based population-study from 2002 by Heit *et al.*[30] estimated which factors appeared to have the greatest impact on risk of deep vein thrombosis among 625 Minnesota residents with a definite first lifetime deep vein thrombosis or pulmonary embolism diagnosed during the 15-year period 1976–1990 and 625 unaffected residents. The study participants were matched according to age and sex. The authors concluded that, factors associated with institutionalization independently account for more than 50% of all cases of venous thromboembolism in the community. Greater emphasis should be placed on prophylaxis for hospitalized medical patients. Other risk factors account for about 25% of all cases of venous thromboembolism, while the remaining 25% of cases were considered idiopathic. Maybe the results of this study, may offer some of the explanation for this rather large proportion of idiopathic VTE.

Conclusion

Despite the crude method used allowing for no control of individual risk factors, occupations encompassing longer and shorter periods of sitting in potentially adverse ergonomic positions, i.e. cramped sitting, had a higher risk of VTE, than a socioeconomically comparable group with more dynamic physical work demands.

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