

# **Health hazards and cancer in relation to occupational exposures among Swedish seafarers**

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligen försvaras i sal Europa, Wallenbergs konferenscentrum, Medicinaregatan 20A, den 11 december, klockan 13:00

av

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Fakultetsopponent:

Professor Bente Moen

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## **Avhandlingen baseras på följande delarbeten**

- I. Forsell K, Hagberg S, Nilsson R. Lung cancer and mesothelioma among engine room crew – case reports with risk assessment of previous and ongoing exposure to carcinogens. *Internat Marit Health* 2007;58:1-4
- II. Forsell K, Eriksson H, Järholm B, Lundh M, Andersson E, Nilsson R. Work environment and safety climate in the Swedish merchant fleet. *Int Arch Occup Environ Health* 2017;90:161-168
- III. Forsell K, Liljelind I, Ljungkvist G, Nordlinder R, Andersson E, Nilsson R. Benzene exposure and biomarkers in alveolar air and urine among deck crews on tankers transporting gasoline. In manuscript
- IV. Forsell K, Björ O, Järholm B, Nilsson R, Andersson E. Hematologic malignancy on tankers: A case-referent study among male Swedish seafarers. In manuscript

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR MEDICIN**



# Health hazards and cancer in relation to occupational exposures among Swedish seafarers

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## Abstract

This thesis explores health hazards for seafarers in the Swedish merchant fleet, and occupational risks for lung cancer, mesothelioma and hematologic malignancy (HM). A special focus has been exposure to benzene and biomarker levels for work on product or chemical tankers during the mid-1990'ies.

In a case report, we describe two cases of mesothelioma and two cases of lung cancer having worked in the engine room. Cumulative exposure to asbestos were up to 5 fibre-years. Other exposures were carcinogenic PAHs and nitroarenes. A web-based survey to active seafarers in the Swedish merchant fleet revealed noise, the risk of accidents, whole-body vibrations and ergonomic strain as main work environment problems. General health, work ability and safety climate were all rated high. Associations were found between lower airway symptoms and soot (PR 2.4, 95% CI 1.1-5.1) and between hearing impairment and noise exposure (PR 1.5; 95% CI 1.3–1.7). Iso-strain was especially common in the service department. Twenty-two percent of men and 45% of women had been subjected to harassments. The tanker study showed a geometric mean for benzene exposure of 0.45 mg/m<sup>3</sup> (4hTWA) during a work shift, with a wide range (0.02-143 mg/m<sup>3</sup>). Correlations were found between exposure and benzene in alveolar air ( $p < 0.0001$ ), unmetabolised benzene in urine ( $p < 0.0001$ ) and ttMA in urine ( $p = 0.0011$ ). All biomarkers increased significantly during work ( $p < 0.002$ ). In a case-referent study with the observation period 1985 to 2014, the OR for HM was 1.32 (95% CI 0.86-2.02) if work on tankers had started before 1985 and with a cumulated tanker service of at least five years. If work on tankers had started after 1985, the OR was 0.85 (95% CI 0.51-1.43).

In conclusion, health hazards in today's seafaring relate to physical, chemical and psychosocial factors. Work on tankers with mixed open and closed cargo systems might have led to important benzene up-take. Possibly, the risk for HM for seafarers on tankers has decreased during the last decades.

**Keywords:** seafarer, work environment, mesothelioma, lung cancer, hematologic malignancy, benzene

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