

Benzene exposure and risk of colorectal cancer in the Norwegian Offshore Petroleum Workers cohort

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WCE

WORLD CONGRESS OF EPIDEMIOLOGY 2024



Outline

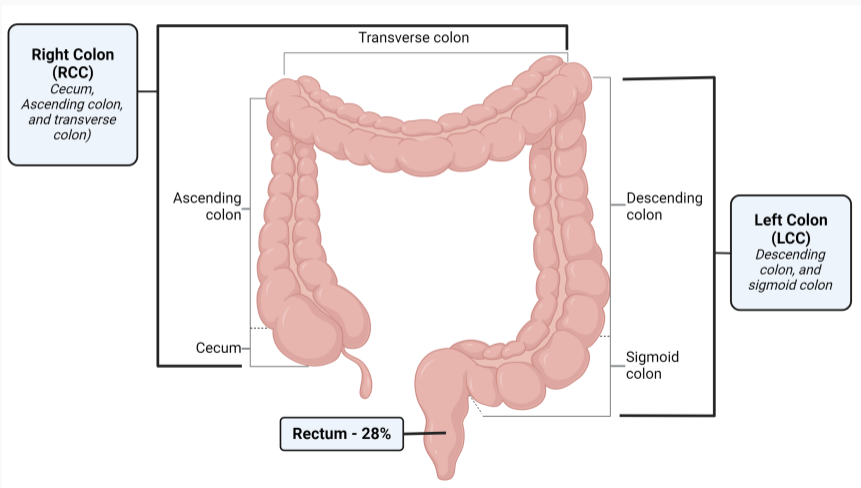
Introduction

Methods

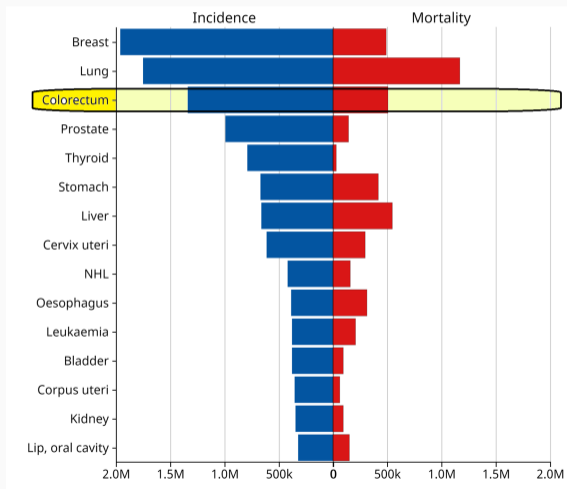
Results

Discussion and conclusion

Colorectal cancer: side matters



Global cancer incidence and mortality, both sexes.



Colorectal cancer - industrial vs non-industrial gap

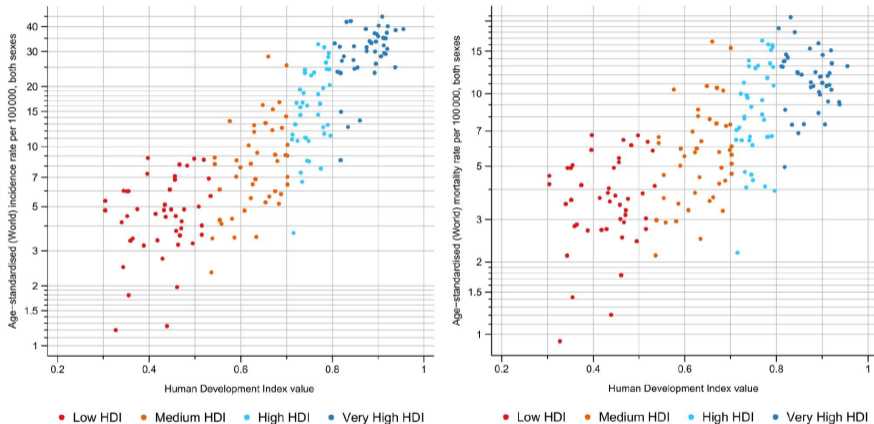
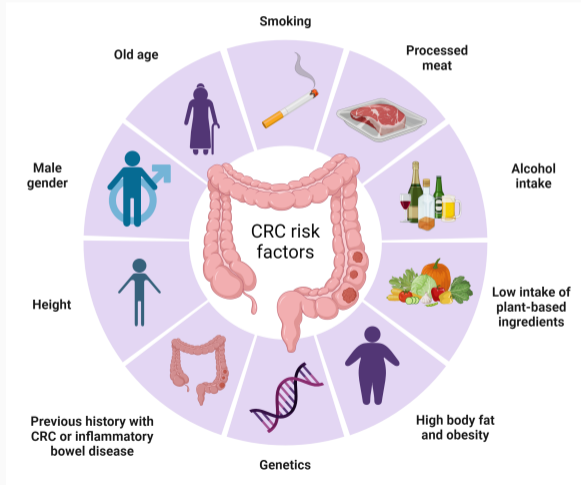


Figure 2 Correlation between age-standardised colorectal cancer incidence (left panel) and mortality rates (right panel) and human development index (HDI) in both sexes combined (GLOBOCAN 2012¹).

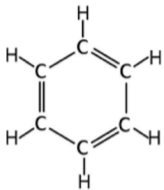
Risk factors



Occupational risk factors?




Benzene



- natural component of crude oil, the main source of benzene produced today.
- Used in many industries.

Benzene carcinogenicity

- 
- 1920s • First reports in humans
 - 1979 • IARC: Group 1: Leukemia
 - 2009 • IARC: Acute non-lymphocytic leukaemia incl AML in adults
 - 2012 • IARC: AML in children, +ve assoc with CML, lung
 - 2023/4 • New studies, Solid tumors (lung, bladder)

Benzene and solid tumors (2023-2024)

www.nature.com/bjc

British Journal of Cancer

ARTICLE OPEN

Check for updates

Exposure to benzene and other hydrocarbons and risk of bladder cancer among male offshore petroleum workers

Nita K. Shala^{1,2,50}, Jo S. Stenehjem¹, Ronnie Babigumira^{1,2}, Fei-Chih Liu¹, Leon A. M. Berge^{1,2}, Debra T. Silverman³, Melissa C. Friesen³, Nathaniel Rothman³, Qing Lan³, H. Dean Hosgood⁴, Sven O. Samuelsen⁵, Magne Bråtveit⁶, Jorunn Kirkeleit^{6,7}, Bettina K. Andreassen¹, Marit B. Veierød² and Tom K. Grimsrud¹

ORIGINAL ARTICLE

Occupational Benzene Exposure and Lung Cancer Risk

A Pooled Analysis of 14 Case-Control Studies

Wenxin Wan¹, Susan Peters¹, Lützen Portengen¹, Ann Olsson², Joachim Schüz², Wolfgang Ahrens^{3,4}, Miriam Schejbalova⁵, Paolo Boffetta^{6,7}, Thomas Behrens⁸, Thomas Brüning⁸, Benjamin Kendzia⁸, Dario Consonni⁹, Paul A. Demers¹⁰, Eleonóra Fabiánová^{11,12}, Guillermo Fernández-Tardón^{13,14}, John K. Field¹⁵, Francesco Forastiere¹⁶, Lenka Foretova¹⁷, Pascal Guénel¹⁸, Per Gustavsson¹⁹, Karl-Heinz Jöckel²⁰, Stefan Karrasch^{21,23,24}, Maria Teresa Landi²⁵, Jolanta Lissowska²⁶, Christine Baru²⁷, Dana Mates²⁸, John R. McLaughlin²⁹, Franco Merletti³⁰, Enrica Migliore³⁰, Lorenzo Richiardi³⁰, Tamás Pándics³¹, Hermann Pohlabeln³, Jack Siemiatycki³², Beata Świątkowska³³, Heinz-Erich Wichmann^{22,23}, David Zaridze³⁴, Calvin Ge³⁵, Kurt Straif^{26,37}, Hans Kromhout¹, and Roel Vermeulen¹

www.nature.com/jes

Journal of Exposure Science & Environmental Epidemiology

ARTICLE OPEN

Check for updates

Occupational exposure to organic solvents and risk of bladder cancer

Shuai Xie¹, Melissa C. Friesen¹, Dalsu Baris¹, Molly Schwenn², Nathaniel Rothman¹, Alison Johnson³, Margaret R. Karagas⁴, Debra T. Silverman¹ and Stella Koutros^{1,52}

Research question

Is there a relationship between low-level benzene exposure and CRC risk in offshore petroleum workers?

Outline

Introduction

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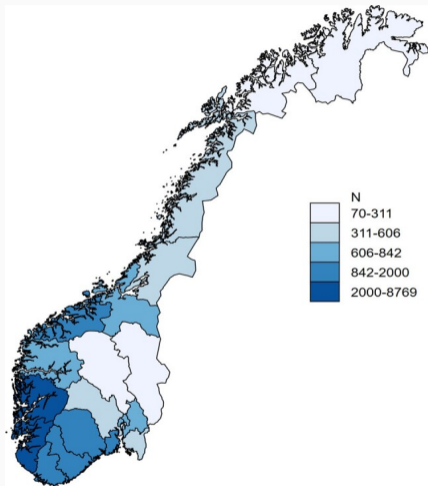
Oil in Norway



Drilling at Ekofisk (1989). Photo/Copyright: ConocoPhillips.

250,000 jobs are linked to the oil and gas industry. Oil and gas account for half of all Norwegian exports and make up a third of the government's income

Norwegian Offshore Petroleum Workers Cohort (1998)



N=27914

Survey on working environment, lifestyle, and cancer risk among Norwegian offshore workers

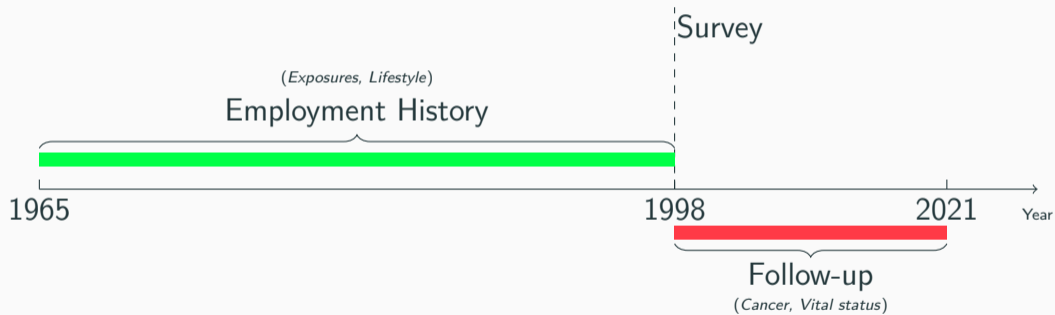
Questionnaire translated from Norwegian

BACKGROUND QUESTIONS

Have you been working 20 days or more on a stationary or moveable platform (installation) on the Norwegian continental shelf?

- Yes. Please answer all questions and return the questionnaire
- No. Please answer question 1 *only* and return the questionnaire

Timeline



Exposure: job exposure matrix (JEM) - benzene

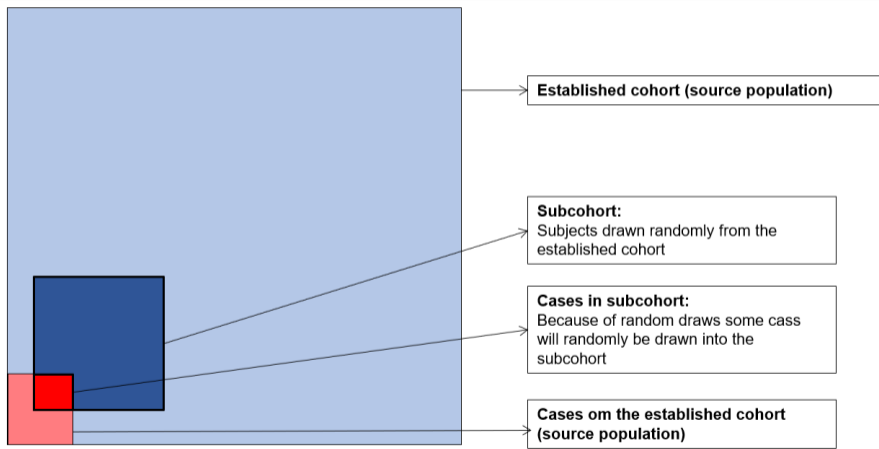
Table 2.3 Rating of the job categories relative to each other according to exposure burden (exposure intensity x duration x frequency) of performed tasks in four time periods.

Job category	Exposure burden (intensity x frequency x duration)			
	1970-79	1980-89	1990-99	2000 →
Process technicians ^a	2.4	2.4	2.1	1.8
Mechanics	1.9	1.9	1.6	1.4
Industrial cleaners	1.4	1.4	1.3	1.3
Process technicians ^b	1.4	1.4	1.1	0.9
Laboratory engineers	1.3	1.3	1.0	0.7
Deck crew	0.8	0.8	0.7	0.7
Plumbers and piping engineers	0.6	0.6	0.5	0.4
Non-destructive testing	0.5	0.5	0.4	0.4

Exposure: metrics

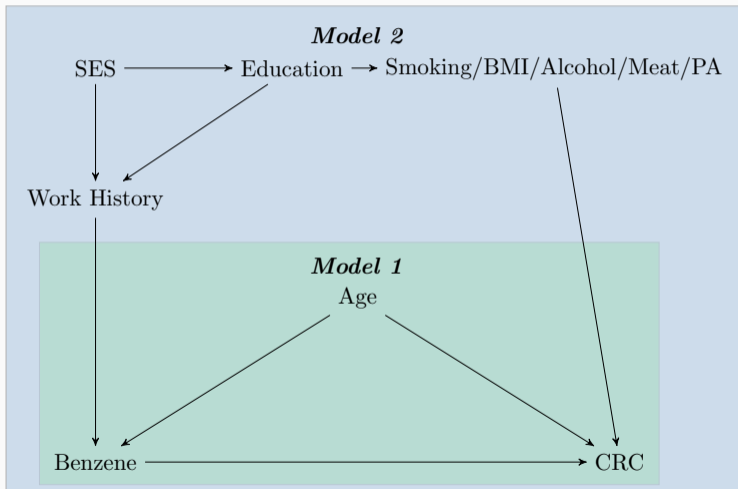
- Cumulative exposure (ppm-years)
- Duration of exposure (years)
- Intensity of exposure (ppm)

Study design: case-cohort



Efficient, Flexible, ↓Selection Bias, ↓Information Bias.

DAGs



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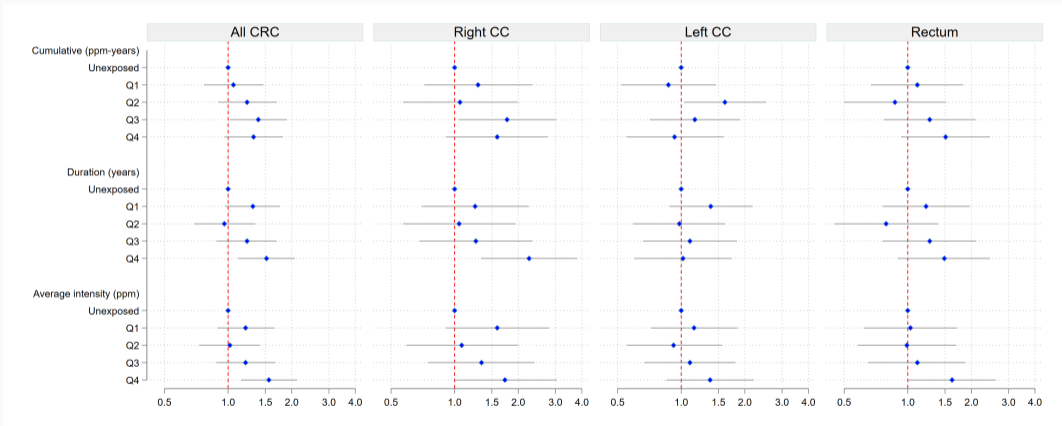
Discussion and conclusion

Cases vs non-cases

Compared to non-cases, cases

- ✚ were **younger**.
- ✚ were **heavier**
- ✚ had a higher proportion with high **ed**
- ✚ had a higher proportion of current and former **smokers**
- ✚ had a higher intake of **meat** and **alcohol**
- 📁 but differences were small

Benzene exposure and risk of CRC



Estimated HRs (with 95% C.I.s) for the association between benzene exposure metrics (in quartiles, Q) and risk of colorectal cancer (CRC)

Outline

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Discussion

- ✍️ Low-level benzene exposure is associated with CRC risk in petroleum workers
- ✍️ Strongest association found with exposure duration and RCC.
- ✍️ Side appears to matter.
- ✍️ Adds to emerging evidence on solid tumors, including lung and bladder.

Strengths and Limitations

Strengths

- ✓ Incidence data from a nationwide registry
- ✓ Large, prospective cohort, with good exposure data
- ✓ Industry-specific benzene JEM
- ✓ Adjusted for potential confounding factors.

Limitations

- ✗ No work history data during follow-up
- ✗ Selected cohort (alive to answer)

Conclusion

We found positive exposure-response associations between low-level benzene exposure and CRC risk among offshore petroleum workers. This may have important occupational and public health implications.

Thank you

