

NCU – Summative report for 2014

Report submission date: March 2015

Principal investigator: Eero Pukkala

Project title: Work and cancer: in-depth studies initiated by the NOCCA project

NCU grant received (€): 55 000

Project commencement and completion dates: 2012-2014

1. Briefly describe the project in a language understandable to non-scientists (max. 100 words)

The aim of this project was to identify work-related factors that are associated with increased (or decreased) cancer incidence.

2. Summarize the major findings of the project (max. 400 words)

Each of the numerous studies published from this project reports important findings. As an example, the study “Cancer incidence among firefighters – 45 years of follow-up in five Nordic countries” describes the cancer incidence pattern among over 16,000 firefighters with more than 2500 cancer cases. There was only a small excess in the overall cancer incidence, but quite high and statistically significant excesses e.g. for prostate cancer in younger ages; and for multiple myeloma, adenocarcinoma of the lung, and mesothelioma in older ages. After publication of these findings in 2014, further studies on cancer risk were initiated in numerous countries.

Another study used the NOCCA data base to elucidate a cluster of cholangiocarcinoma among workers in a small printing shop reported from Japan. There was 2.3 fold risk intrahepatic cholangiocarcinoma among printers in the Nordic countries. This is a good example of using massive NOCCA data to confirm alarming findings from small studies.

A study on cancer risk among Nordic waiters published in 2015 observed many-fold relative risks of alcohol-related cancers among male waiters, but still the absolute number of excess cases was in lung cancer in women. This article is important as a

background information in future studies on effects of smoking ban in the Nordic restaurants.

3. Describe how the project has increased our knowledge of the prevention, cause and/or cure for cancer (max. 150 words)

Because the NOCCA data set is larger than any earlier study on work and cancer incidence, it has increased knowledge of associations of rare exposures and rare cancers which did not exist at all before. The findings of NOCCA studies are systematically requested for instance for the IARC monograph evaluations, and institutes of occupational health. NOCCA expertise is repeatedly asked by related EU bodies, labour unions etc., and NOCCA findings are now regularly listed as a central element in any international review or survey on work and cancer.

4. Outline how Nordic cooperation has added value to this project (max. 100 words)

Most of the findings could not have been in a study in one Nordic country alone. The international collaboration also brings wide scope of expertise in the research team.

5. Publications resulting from the NCU research grant

Eighteen published articles and three more submitted peer-reviewed articles. About twenty more articles expected to be ready for submission in 2015-6.

Two book chapters.

Two international courses, related teaching materials.

Numerous presentations in scientific congresses.

For details, see pages 3-9

Published/accepted/preliminarily accepted articles

1. **Occupation and scrotal cancer: Results of the NOCCA study.** Verhoeven, R.H.A., Kiemeny, L.A.L.M., Coebergh, J.W.W., Weiderpass, E., Kjaerheim, K., Martinsen, J.I., Lynge, E., Pukkala, E. (Acta Oncol. 2011; 50: 1244-1246).
2. **Occupation and risk of primary Fallopian tube carcinoma in Nordic countries.** Riska, A., Martinsen, J.I., Kjaerheim, K., Lynge, E., Sparen, P., Tryggvadottir, L., Weiderpass, E., Pukkala, E. (Int. J. Cancer 2012; 131: 186–192).
3. **Cancer incidence among priests – 45 years of follow-up in four Nordic countries.** Stang, A., Martinsen, J.I., Kjaerheim, K., Weiderpass, E., Sparén, P., Tryggvadóttir, L., Pukkala, E. (Eur. J. Epidemiol. 2012; 27: 101-108).
4. **Incidence of uterine leiomyosarcoma and endometrial stromal sarcoma in Nordic countries: Results from NordCAN and NOCCA databases.** Koivisto-Korander R., Martinsen J.I., Weiderpass E., Leminen A., Pukkala, E. (Maturitas 2012; 72: 56-60).
5. **Occupational exposure to wood dust and formaldehyde and risk of nasal, nasopharyngeal, and lung cancer among Finnish men.** Siew SS, Kauppinen T, Kyyrönen P, Heikkilä P, Pukkala E. (Cancer Manag. Res. 2012;4:223-232).
6. **Occupation and leukaemia in Nordic countries.** Talibov, M., Kautiainen, S., Martinsen, J.I., Kjaerheim, K., Lynge, E., Sparen, P., Tryggvadottir, L., Weiderpass, E., Pukkala, E. J. Occup. (Environ. Med. 2012; 54: 1527-1532).
7. **Cholangiocarcinoma among workers in the printing industry: Using the NOCCA database to elucidate the generalisability of a cluster report from Japan.** Vlaanderen, J., Straif, K., Martinsen, J.I., Kauppinen, T., Pukkala, E., Sparen, P., Tryggvadottir, L., Weiderpass, E., Kjaerheim, K. (Occup. Environ. Med. 2013; 70: 828-30. doi: 10.1136/oemed-2013-101500).
8. **Occupational exposure to trichloroethylene and perchloroethylene and the risk of lymphoma, liver, and kidney cancer in four Nordic countries.** Vlaanderen, J., Straif, K., Pukkala, E., Kauppinen, T., Kyyrönen, P., Martinsen, J.I., Kjaerheim, K., Tryggvadottir, L., Hansen, J., Sparen, P., Weiderpass, E. (Occup. Environ. Med. 2013; 70: 393-401).
9. **Suontelosityövän ammattiryhmittäisten suhteellisten ilmaantuvuuksien estimointi epäsuoran vakioinnin ja bayesiläisten hierarkkisten mallien avulla.** [Incidence of cancer of the oral cavity by occupational group: Estimation of relative incidences by indirect standardization and Bayesian hierarchical models (in Finnish).] Karhunen, V. Master's thesis in Statistics. University of Oulu, Finland 2013 (56 pages).

10. **New risks and trends in the safety and health of women at work.** European Risk Observatory. A report prepared for the European Agency for Safety and Health at Work by the Topic Centre Occupational Safety and Health (task leader Gervais, R., HSL, UK). Luxembourg: Publications Office of the European Union, 2013, doi: 10.2802/69206 (382 pages).
11. **Performance of the Finnish Information System on Occupational Exposure (FINJEM) in epidemiologic, surveillance and other applications.** Kauppinen, T., Uuksulainen, S., Saalo, A., Mäkinen, I., Pukkala, E. (Ann. Occup. Hyg. 2014; 58: 380-396; doi:10.1093/annhyg/met074).
12. **Tetrachloroethylene exposure and bladder cancer risk: A meta-analysis of dry cleaning worker studies.** Vlaanderen, J., Straif, K., Ruder, A., Blair, A., Hansen, J., Lynge, E., Charbotel, B., Loomis, D., Kauppinen, T., Kyrrönen, P., Martinsen, J.I., Pukkala, E., Weiderpass, E., Guha, N. (Environ. Hlth Perspect. 2014; 122: 661-666).
13. **Cancer incidence among firefighters – 45 years of follow-up in five Nordic countries.** Pukkala, E., Martinsen, J.I., Weiderpass, E., Kjaerheim, K., Lynge, E., Tryggvadottir, L., Sparén, P., Demers, P. (Occup. Environ. Med. 2014; 71: 398-404; doi:10.1136/oemed-2013-101803).
14. **Occupational exposure to solvents and acute myeloid leukemia: a population-based case-control study in Nordic countries.** Talibov, M., Kautiainen, S., Martinsen, J.I., Kjaerheim, K., Lynge, E., Sørensen, P., Weiderpass, E., Tryggvadottir, L., Kauppinen, T., Kyrrönen, P., Pukkala, E. (Scand. J. Work Environ. Health 2014; 40: 511-517; doi: 10.5271/sjweh.3436).
15. **Occupation and risk of oesophageal adenocarcinoma and squamous-cell carcinoma: the Nordic Occupational Cancer study.** Jansson, C., Oh, J.-K., Martinsen, J.I., Lagergren, J., Plato, N., Kjaerheim, K., Pukkala, E., Sparén, P., Tryggvadottir, L., Weiderpass, E. (Int. J. Cancer in press, accepted November 2014).
16. **Cancer incidence in a cohort with high fish consumption.** Turunen, A.W., Suominen, A.L., Kiviranta, H., Verkasalo, P.K., Pukkala, E. (Cancer Causes Control 2014; 25: 1595-1602; doi 10.1007/s10552-014-0464-5).
17. **Exposure to carcinogens and work-related cancer: A review of assessment methods.** Lißner, L., Kuhl, K., Kauppinen, T., Uuksulainen, S.: European Risk Observatory Report, European Agency for Safety and Health at Work. Publications Office of the European Union, Luxembourg 2014.
18. **Cancer incidence among waiters – 45 years of follow-up in five Nordic countries.** Reijula, J., Kjaerheim, K., Lynge, E., Martinsen, J.I., Reijula, K., Sparén, P., Tryggvadottir, L. Weiderpass, E., Pukkala, E. (Scand. J. Public Health 2015; 43: 204–211).

19. **Occupational exposure to extremely low frequency magnetic fields and electrical shocks and acute myeloid leukemia in four Nordic countries.** Talibov, M., Guxens, M., Pukkala, E., Huss, A., Kromhout, H., Slottje, P., Martinsen, J.I., Kjaerheim, K., Sparén, P., Weiderpass, E., Tryggvadottir, L., Uuksulainen, S., Vermeulen, R. (Submitted to Cancer Cause Control, January 2015).
20. **Testicular germ cell tumours and parental occupational exposure to pesticides: a register-based case-control study in Denmark, Finland, Norway and Sweden (NORD-TEST study).** Le Cornet, C., Fervers, B., Dalton, S.O., Feychting, M., Pukkala, E., Tynes, T., Hansen, J., Beranger, R., Kauppinen, T., Uuksulainen, S., Wiebert, P., Woldbæk, T., Skakkebak, N.E., Olsson, A., Schüz, J. (Submitted to Occup. Environ. Med., January 2015).
21. **Breast cancer among night shift workers.** Sigstad, J.-A., Kjaerheim, K., Tynes, T. (Submitted to Scand. J. Work. Environ. Health, March 2015).

Analyses / manuscript finalisation ongoing

22. **Occupation and mesothelioma of the peritoneum and pleura in Sweden – updated incidence for men and women, 1961-2009.** Nils Plato, <other NOCCA co-authors>, Elisabete Weiderpass. Scand J Environ Health, to be submitted in March 2015.
23. **Mesothelioma in Sweden; dose-response analysis for 29 different carcinogenic agents.** Nils Plato, <other NOCCA co-authors>, Elisabete Weiderpass. Occup. Environ. Med., to be submitted in June 2015.
24. **Mesothelioma incidence and occupation in the Nordic countries – a follow up during four decades.** Nils Plato, <other NOCCA co-authors>, Elisabete Weiderpass. Occup. Environ. Medicine, to be submitted in May 2015,
25. **Formaldehyde exposure and risk of cancer at selected sites.** Tom Grimrud, Norway; manuscript soon ready for submission.
26. **Cancer among veterinarians.** Laura Laakso, Finland, in collaboration with veterinarians from other Nordic countries; manuscript for Vet. Rec. drafted, estimated to be ready for submission in May 2015.
27. **Opposite cancer patterns among fishermen and sea workers.** Linda Kærlev and Johnni Hansen, Denmark; Submission planned in Summer 2015.
28. **Does occupational variation explain the difference in colorectal cancer risk between Denmark and Norway.** Elsebeth Lynge, Denmark; Jan Ivar Martinsen, Norway; manuscript soon ready for submission.
29. **Changes in socioeconomic variation in incidence in cancers over time and region.** Susanne Dalton, Denmark; manuscript expected during 2015.

30. **Physical activity at work and colorectal cancer risk in men** (doctoral student Jorma Sormunen supervised by Eero Pukkala); manuscript drafted, planned submission in May 2015.
31. **Physical activity at work and prostate cancer risk in men** (doctoral student Jorma Sormunen supervised by Eero Pukkala); manuscript expected during 2015.
32. **Nordic study on dose-response analyses on wood dust and adenocarcinoma of nose** (doctoral student Angelica Siew, Malaysia, supervised by Eero Pukkala; article drafted, planned submission in May 2015).
33. **Does alcohol consumption explain the large occupational variation in risk of oral cavity and pharynx** (doctoral student Laura Tarvainen, the occupation-specific part supervised by Eero Pukkala).
34. **Occupation, smoking and bladder cancer phenotype: an investigation of the link between different carcinogens and tumour biology** (James Catto, UK). Article under preparation for submission to the Urology Journal (March 2015).
35. **Cancer risk related to exposure to electromagnetic fields at work** (doctoral student Mònica Guxens, Spain, supervised by Roel Vermeulen); two articles drafted.
36. **Occupational variation in incidence of granulosa cell tumours** (doctoral student Saara Bryk, Finland, supervised by Annika Riska); article planned to be ready for submission in April 2015.
37. **Occupational variation in young-age prostate cancer risk** (Kathryn Hughes Barry, NIH/NCI); manuscript ready for distribution in April 2015.
38. **Shift work and risk of non-breast cancers** (Johnni Hansen, Denmark); article will be written in April 2015.
39. **Asbestos exposure and cholangiocarcinoma** (doctoral students supervised by Stefano Mattioli, Italy); manuscript promised in Spring 2015.
40. **Occupational variation in cancer patient survival** (original author moved to Canada, new researcher to take over the project to be confirmed)
41. **Bladder cancer occupational variation and dose-response association with solvents**. Kishor Hadkhale, Nepal, has received the raw data in March 2015 and has started the analyses as his PhD thesis study project.

Book chapters

1. **Biobanks and registers in epidemiological research on cancer.** by Pukkala, E. In: Dillner, J. (ed.): Methods in Biobanking. Methods in Molecular Biology, 2011, Volume 675. Totowa, Humana Press 2011, pp. 127-164. DOI: 10.1007/978-1-59745-423-0_3 {includes 8 pages of description of NOCCA project as an example of sophisticated use of Nordic data registers}.
2. **Role of registers in occupational cancer control** by Grimsrud, T.K. and Weiderpass, E. In: Anttila, S., Boffetta, P. (eds): Occupational cancer. London, Springer 2014, pp. 583-590.

Courses on occupational cancer

1. NIVA (Nordic Institute for Advanced Training in Occupational Health) workshop **"Nordic Occupational Cancer (NOCCA) Studies"** in Mariehamn, Finland in August 2011 (course director Eero Pukkala, main lecturers from NOCCA team).
2. NIVA course **"Seeking Causes for Occupational Cancer"** in Sannäs, Finland, on 17-20 September 2013 (<http://www.niva.org/start/#/view-54553-38>; course director Eero Pukkala, main lecturers from NOCCA team).

NOCCA-related lectures (selected examples)

Feb 2012 Workshop on "Roadblocks and remedies for use of cancer registries in translational research" at IARC, Lyon, France (Eero Pukkala invited expert)

Apr 2012 Finnish Cancer Registry 60 years Symposium", Helsinki (Eero Pukkala, invited speaker: "Miracle of Register-based research")

Apr 2012 Symposium of Belgian Research Society, Antwerp, Belgium (Eero Pukkala, invited speaker)

Aug 2012 ANCR Meeting, Oslo (Laufey Tryggvadottir, invited speaker: "Flagships of Nordic collaboration")

Sep 2012 European Epidemiology Congress, Porto, Portugal (Eero Pukkala session organiser and invited plenary speaker: "Paradise of epidemiology")

Sep 2012 Workshop on carcinogens and work-related cancer, Berlin, Germany (Elsebeth Lyng: "Social inequalities and their impact on exposures to carcinogens and occupational cancer")

Jan 2013 Danish Parliament (Johnni Hansen, invited speaker: "Firefighters and risk of cancer")

Mar 2013 National Board of Industrial Injuries in Denmark (Johnni Hansen, invited speaker: "IARC classification of occupational carcinogens")

Jun 2013 ANCR Meeting, Reykjavik (Kristina Kjærheim: "Cholangiocarcinoma in printing industry: using NOCCA to elucidate a cluster report from Japan")

Jun 2013 ANCR Meeting, Reykjavik (Elisabete Weiderpass: "Occupation and mesothelioma in Sweden")

Jun 2013 First international Blue light symposium, Tokyo, Japan (Johnni Hansen, invited speaker: "Night work and circadian disruption")

Jun 2013 EPICOH meeting, Utrecht, the Netherlands (Johnni Hansen: "A comprehensive Danish Data linkage")

Jun 2013 Center of Chronobiology, Ludwig Maximilian University of Munich, Germany (Johnni Hansen, invited speaker: "Shift-work and risk of cancer")

Aug 2013 Combined European and Nordic Epidemiology Congress, Aarhus (Eero Pukkala, plenary lecture: "Best examples of Nordic collaboration")

Nov 2013 Seminar at University of Utrecht, the Netherlands (Eero Pukkala, invited lecture: "NOCCA as a tool of research on work and cancer")

Dec 2013 Seminar series on registers as a data source for effectiveness and patient safety research, Research Centre for Comparative Effectiveness and Patient Safety (RECEPS), University of Eastern Finland, Kuopio (Eero Pukkala, invited lecture: "Nordic countries - Paradise of register-based cancer epidemiology?")

Dec 2013 Nordic School for Public Health, Gothenburg (Eero Pukkala, invited lecture: "Methods for sophisticated register-based epidemiological research")

Jan 2014 Direction de l'Evaluation de Risques, Paris, France (Eero Pukkala, invited expert lecture: "Atypical working schedules")

Mar 2014 Kolloquium of the German Region of the International Biometric Society, Bremen, Germany (Eero Pukkala, invited expert lecture: "Analysis of epidemiological mega studies")

Jun 2014 ANCR, Malmö, Sweden (Kristina Kjærheim: "Cancer risk among Nordic firefighters")

Jun 2014 Bioelectromagnetics Society and the European BioElectromagnetics Association annual joint meeting, Cape Town, South Africa (Monica Guxens, platform presentation: "Occupational exposure to extremely low frequency magnetic fields and risk of electric shocks and cancer risk in four Nordic countries")

Aug 2014 International Fire Safety seminar, Bergen, Norway (Kristina Kjaerheim: "Cancer risk among Nordic firefighters")

Mar 2015 Conference "Women, Health and Work", European Trade Union Institute, Brussels, Belgium (Eero Pukkala, invited expert lecture)

Mar 2015 EU Members of Parliament against Cancer Brussels (Kristina Kjaerheim, invited expert lecture: "Cancer among Nordic firefighters - study results and future plans")
