

SOME AROMATIC AMINES AND RELATED COMPOUNDS

VOLUME 127

This publication represents the views and expert opinions of an IARC Working Group on the Identification of Carcinogenic Hazards to Humans, which met remotely, 25 May–12 June 2020

LYON, FRANCE - 2021

IARC MONOGRAPHS
ON THE IDENTIFICATION
OF CARCINOGENIC HAZARDS
TO HUMANS

Table S1.9 Review of exposure assessment quality in cohort studies on exposure to aniline

Reference	What was the study design?	What methods were used for the assessment?	What was the definition of the exposure?	Was the exposure defined well?	What route of exposure was assessed?	Could there be exposed subjects in the reference group?	Was intensity assessed well?	Was the duration of exposure assessed well?	Was cumulative exposure assessed?	Was exposure assessed before outcome being ascertained?	What was the timing of exposure relative to the outcome?	Are there any known carcinogen co-exposures in the industry?
Case et al. (1954)	Cohort study of United Kingdom workers manufacturing or using dyestuff intermediates	Use of substance in processing	Companies reported all workers who were known to have had any contact with aniline, benzidine, 1-naphthylamine or 2-naphthylamine	No, very unclear	Not defined	No, general population used as reference	No	Not assessed	No, only ever/never	No, not in most recent analysis	Exposure preceded outcome (death)	Yes. Co-exposure with magenta is reported in 9 of 13 cases who were exposed to aniline but were not exposed to α - or β -naphthylamine [1- or 2-naphthylamine] or benzidine
Ott & Langner (1983)	Cohort study of US workers manufacturing organic dyes	Process review of raw products and intermediates produced, departments with aniline identified in two departments	Ever/never worked in area with potential exposure to aniline (acetanilide and indigo areas)	Moderately well-defined as to area	Not defined	No, USA white male population used as reference	Not assessed	Yes, total years in exposed department	By duration of exposure only	No, after cancers had occurred	Exposure preceded outcome	Yes: asbestos, arsenic and vinyl chloride. Workers may have been co-exposed to <i>ortho</i> -toluidine
Sorahan (2008)	Cohort study, extended follow-up in United Kingdom workers manufacturing chemicals for the rubber industry	JEM based on potential for exposure to aniline in each department	Ever/never worked in any of 6 departments with potential exposure to aniline	Moderately well-defined as to area	Not defined	No, general population used as reference	Not assessed	Yes, total years in exposed department	By duration of exposure only	No, not in most recent analysis	Exposure preceded outcome	Yes. Co-exposure to <i>ortho</i> -toluidine, PBN, MBT

Table S1.9 Review of exposure assessment quality in cohort studies on exposure to aniline

Reference	What was the study design?	What methods were used for the assessment?	What was the definition of the exposure?	Was the exposure defined well?	What route of exposure was assessed?	Could there be exposed subjects in the reference group?	Was intensity assessed well?	Was the duration of exposure assessed well?	Was cumulative exposure assessed?	Was exposure assessed before outcome being ascertained?	What was the timing of exposure relative to the outcome?	Are there any known carcinogen co-exposures in the industry?
Carreón et al. (2014), Hanley et al. (2012)	Cohort study, extended follow-up in USA workers manufacturing chemicals for the rubber industry	Review of work histories, process records, hygiene measurements to create a JEM. Details in Hanley et al. (2012)	Four exposure categories for combined exposure and duration of employment	Well-defined as exposure to combined three agents, not well-defined for aniline alone	Personal breathing zone and biological monitoring	No, general population used as reference	Combined exposure assessed as: PNE (probably not exposed); PEI (probably exposed low and irregularly /occasionally); PER (probably exposed low and regularly); DER (definitely exposed moderate/high and regularly). A ranking system was also used (see text)	Yes, days in each job	Yes, sum of all jobs with level of exposure by days worked in that job	No, not in most recent analysis	Exposure preceded outcome	Yes. Exposure was to any of <i>ortho</i> -toluidine, aniline, and nitrobenzene combined. No individual data for aniline provided. Patterns of exposure were very similar for both <i>ortho</i> -toluidine and aniline and co-exposures occurred in all departments

JEM, job-exposure matrix; MBT, 2-mercaptobenzothiazole; PBN, phenyl-2-naphthylamine.

References

- Alguacil J, Kauppinen T, Porta M, Partanen T, Malats N, Kogevinas M, et al.; PANKRAS II Study Group (2000). Risk of pancreatic cancer and occupational exposures in Spain. *Ann Occup Hyg.* 44(5):391–403. [https://doi.org/10.1016/S0003-4878\(99\)00119-2](https://doi.org/10.1016/S0003-4878(99)00119-2) PMID:10930502
- Carreón T, Hein MJ, Hanley KW, Viet SM, Ruder AM (2014). Bladder cancer incidence among workers exposed to *o*-toluidine, aniline and nitrobenzene at a rubber chemical manufacturing plant. *Occup Environ Med.* 71(3):175–82. <https://doi.org/10.1136/oemed-2013-101873> PMID:24368697
- Case RA, Hosker ME, McDonald DB, Pearson JT (1954). Tumours of the urinary bladder in workmen engaged in the manufacture and use of certain dyestuff intermediates in the British chemical industry. I. The role of aniline, benzidine, alpha-naphthylamine, and beta-naphthylamine. *Br J Ind Med.* 11(2):75–104. <https://doi.org/10.1136/oem.11.2.75> PMID:13149741
- Feingold L, Savitz DA, John EM (1992). Use of a job-exposure matrix to evaluate parental occupation and childhood cancer. *Cancer Causes Control.* 3(2):161–9. <https://doi.org/10.1007/BF00051656> PMID:1562706
- Hanley KW, Viet SM, Hein MJ, Carreón T, Ruder AM (2012). Exposure to *o*-toluidine, aniline, and nitrobenzene in a rubber chemical manufacturing plant: a retrospective exposure assessment update. *J Occup Environ Hyg.* 9(8):478–90. <https://doi.org/10.1080/15459624.2012.693836> PMID:22708702
- Nizamova RS (1991). [Occupational hazards and bladder cancer]. *Urol Nefrol (Mosk).* (5):35–8. PMID:1836689 [Russian]
- Ott MG, Langner RR (1983). A mortality survey of men engaged in the manufacture of organic dyes. *J Occup Med.* 25(10):763–8. <https://doi.org/10.1097/00043764-198310000-00018> PMID:6631562
- Preti G, Labows JN, Kostelc JG, Aldinger S, Daniele R (1988). Analysis of lung air from patients with bronchogenic carcinoma and controls using gas chromatography-mass spectrometry. *J Chromatogr A.* 432:1–11. [https://doi.org/10.1016/S0378-4347\(00\)80627-1](https://doi.org/10.1016/S0378-4347(00)80627-1) PMID:3220881
- Sorahan T (2008). Bladder cancer risks in workers manufacturing chemicals for the rubber industry. *Occup Med (Lond).* 58(7):496–501. <https://doi.org/10.1093/occmed/kqn104> PMID:18725381