

# **Dermal, inhalation and internal exposure to 1,6-HDI and its oligomers in car body repair shop workers and industrial spray painters**

Anjoeka Pronk, Fang Yu, Jelle Vlaanderen, Erik Tielemans, Liesbeth Preller, Ivana Bobeldijk, James A Deddens, Ute Latza, Xaver Baur, Dick Heederik



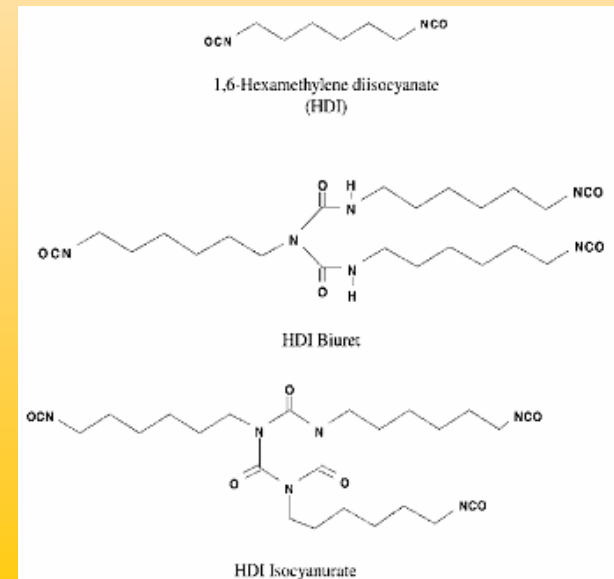
# Introduction

- Highly reactive  $\text{N}=\text{C}=\text{O}$  group
- Present in polyurethane products
- Low molecular weight allergens
- Important cause of occupational asthma
- Uncertainties exposure – response
  - Relevant exposure
  - Mechanisms
  - Health endpoints



# Epidemiological study

- Population (n=600-800)
  - Car body repair shops
    - Spray painters: HDI + oligomers
    - Welders: Thermal degradation products
  - Industrial painting companies
    - Spray painters: HDI + oligomers



# Exposure assessment

- Compound:
  - Monomers, oligomers, thermal degradation products
  - Vapor - aerosol
  - Several analytical methods
- Route:
  - Inhalatory
  - Dermal (no quantitative methods)
- Pattern:
  - Variability high
  - PPE use

➤ Actual total exposure received unknown



# Study aims

- Develop method for dermal exposure
- Compare task based exposure with urinary metabolites in spray painting environments



# Study design

	Car body repair shops	Industrial painting companies
Companies	6	5
<u>External exposure</u>		
Inhalation - dermal	68	27
Tasks	Mixing, spraying, cleaning spray gun, welding	Mixing, spraying, rolling/brushing, assisting
<u>Biomonitoring</u>		
Workers	47	12
Urine samples	243	56



# Exposure assessment

## Inhalation exposure

- Sampling: Impinger
- Reagent: Di-n-butylamine (DBA) in toluene
- Analysis: LC-MS



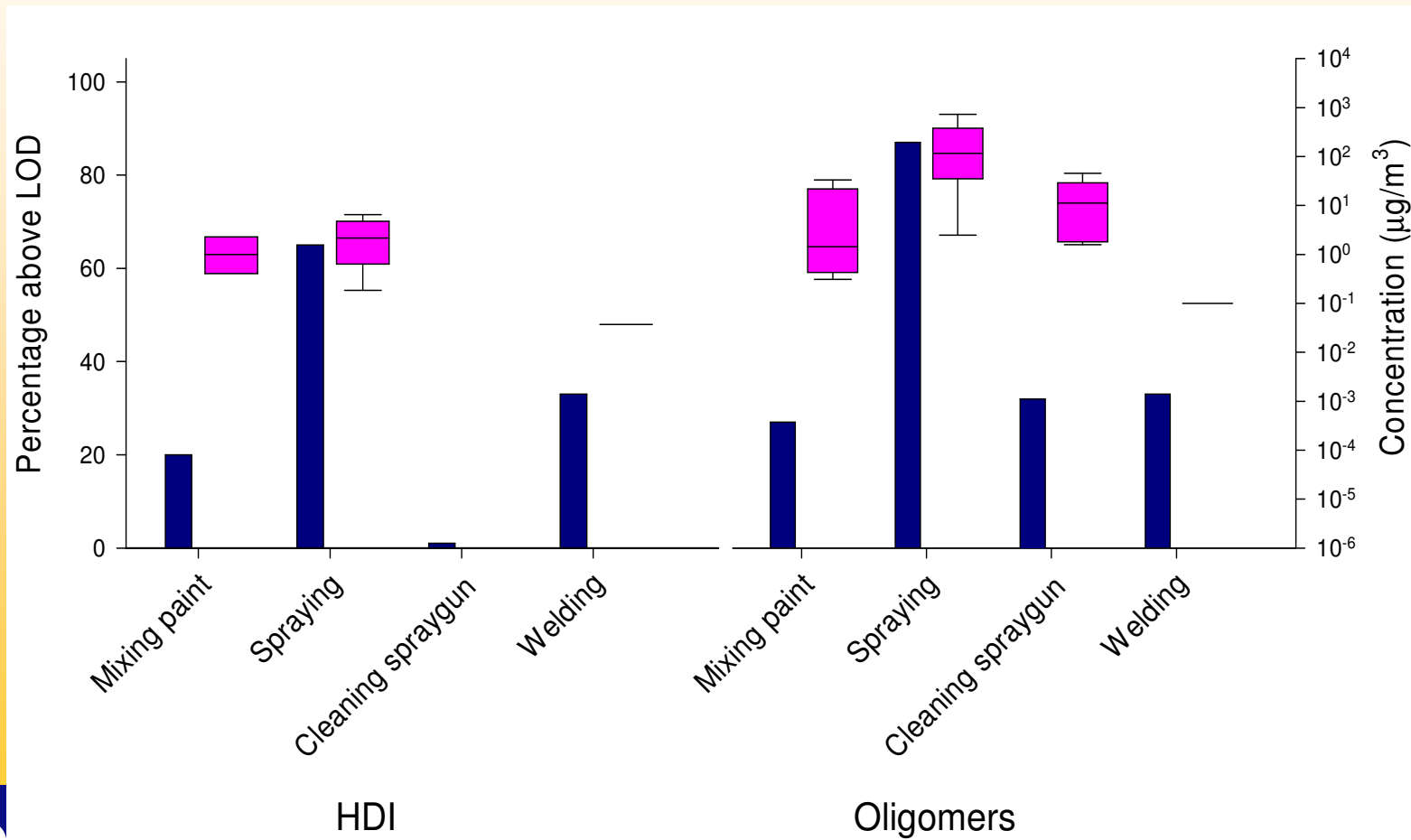
## Dermal exposure

- Sampling: Nitril rubber gloves submerged into reagent after sampling
- Reagent: DBA in toluene
- Analysis: LC-MS



# Inhalation exposure

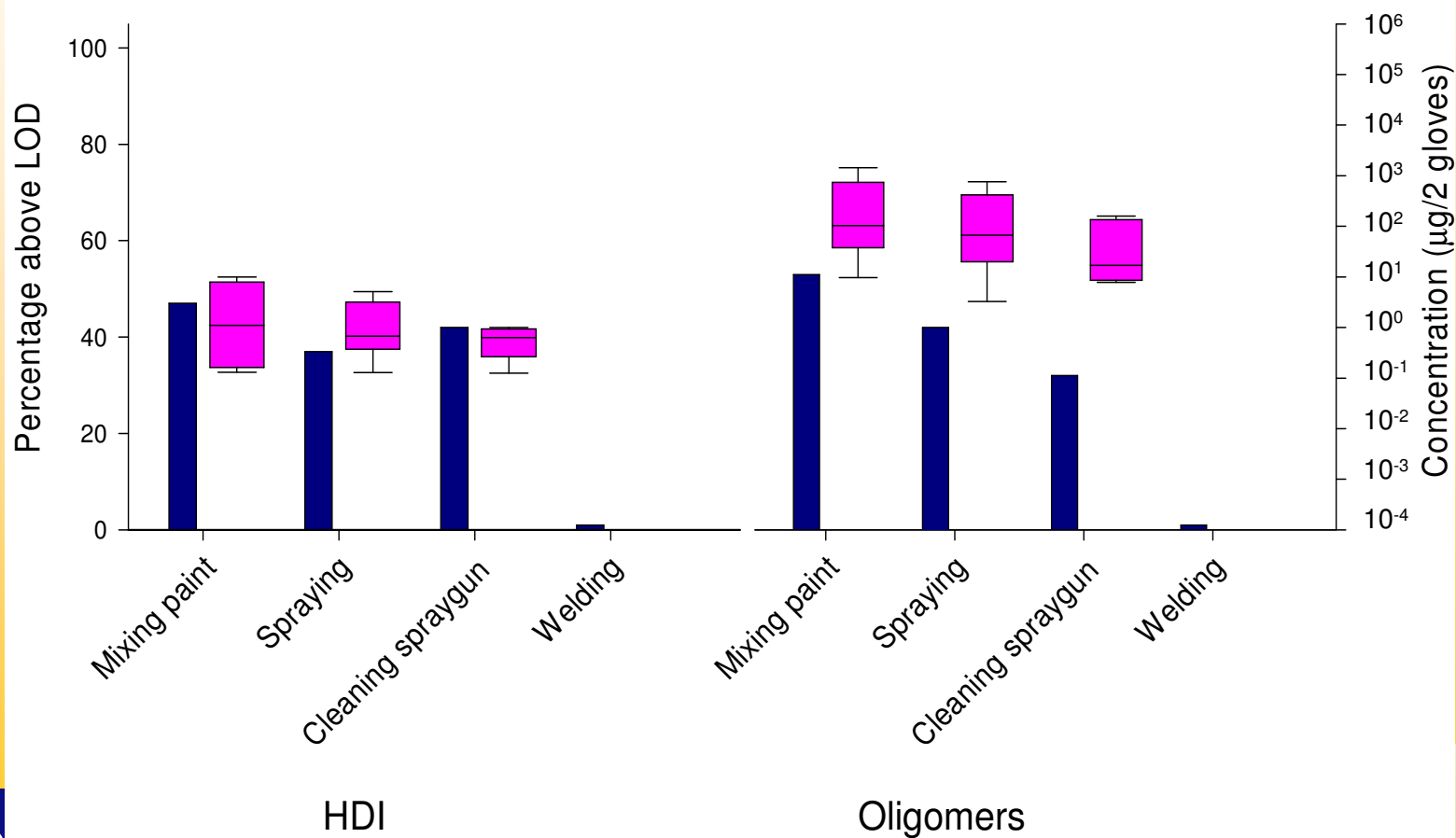
## car body repair shops





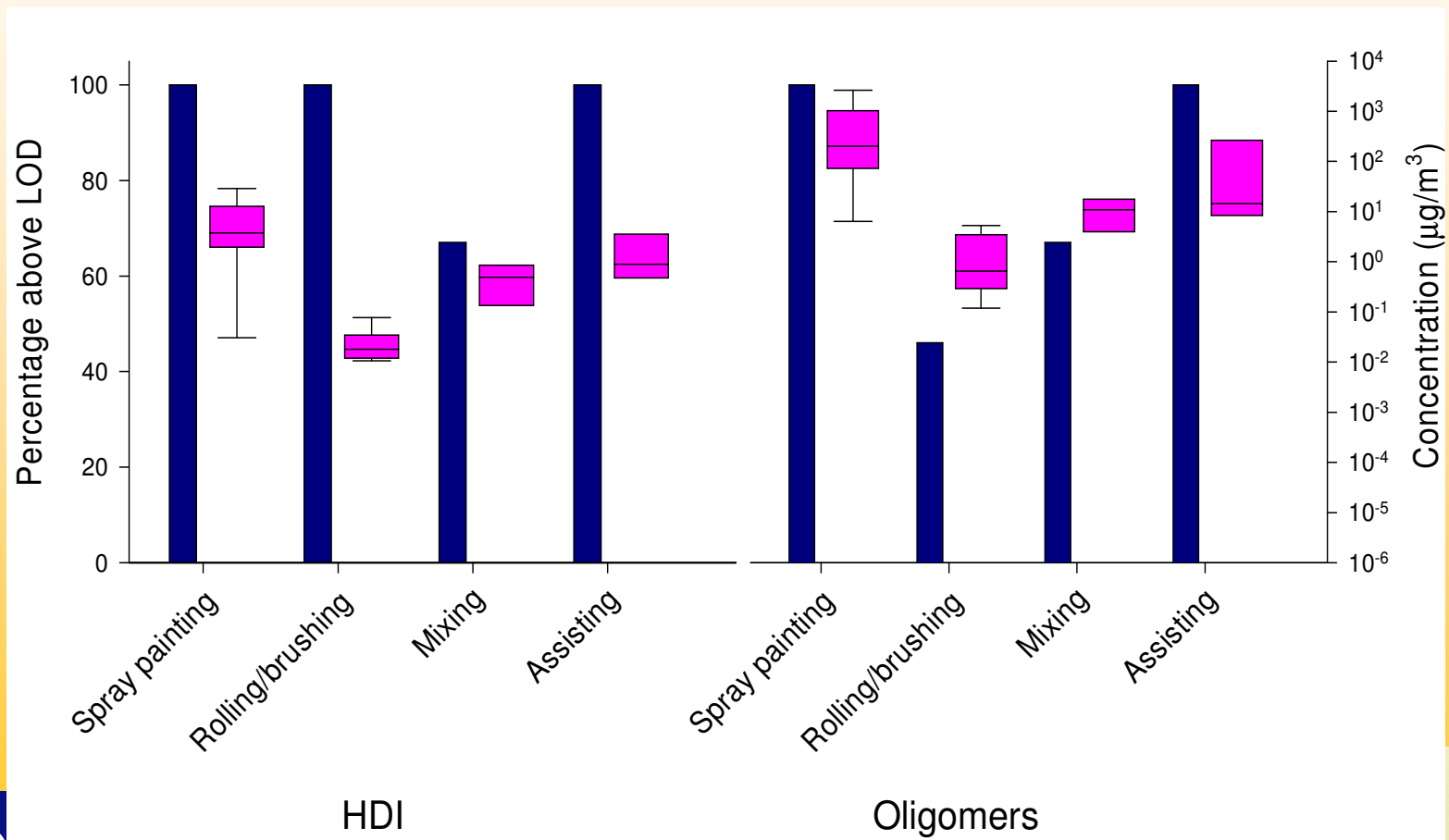
# Dermal exposure

## car body repair shops



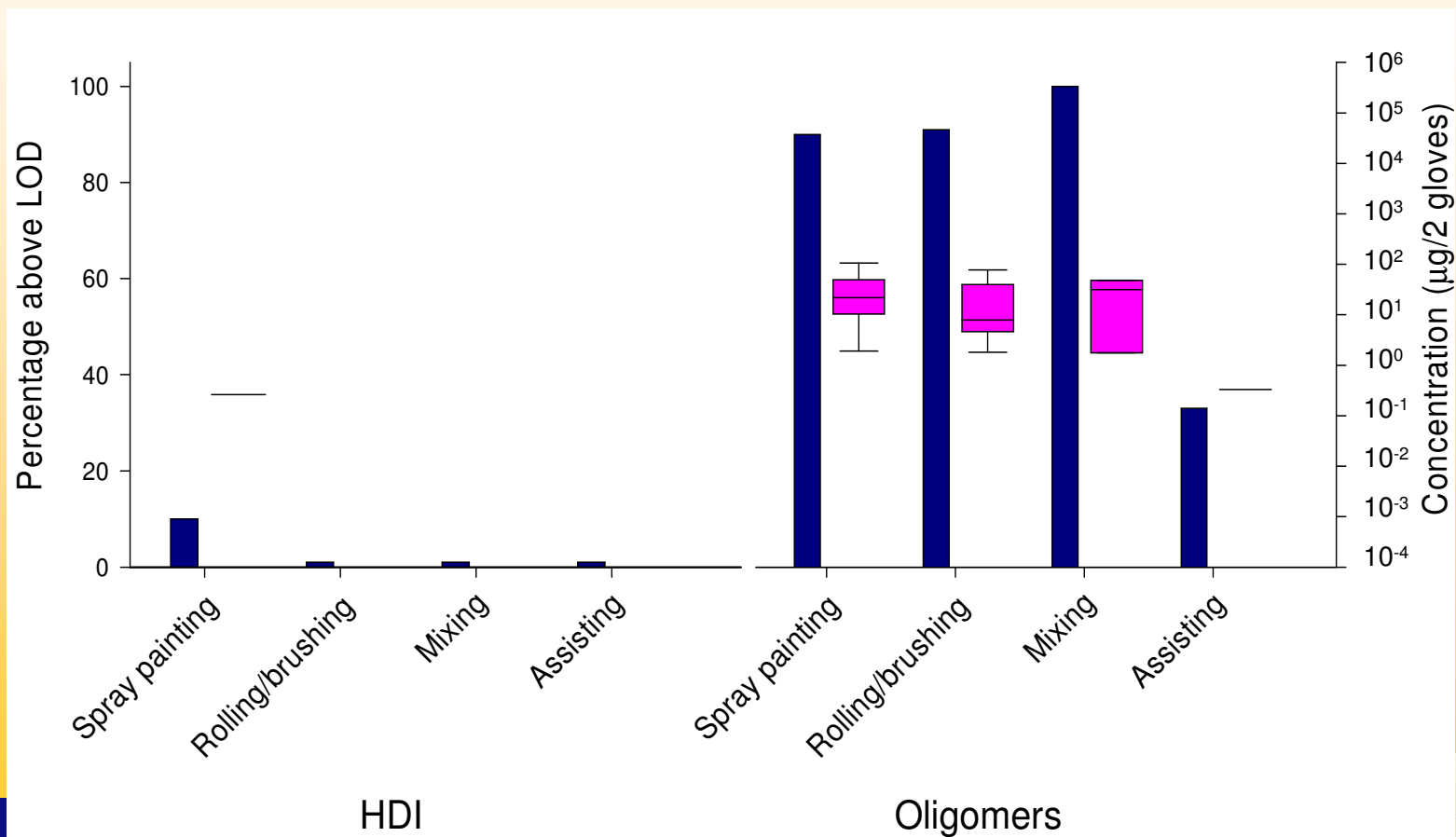
# Inhalation exposure

## industrial painting companies



# Dermal exposure

## industrial painting companies



# Determinants dermal exposure

Odds ratio's for the presence of detectable dermal exposure

	<b>Car body repair shops (n=6)</b>	<b>Industrial painting companies (n=5)</b>
<b>Gloves vs no gloves</b>	<b>0.22 (0.09-0.57)</b>	<b>-*</b>
<b>Inhalation exposure level (<math>\mu\text{g}/\text{m}^3</math> NCO)**</b>	<b>1.34 (0.97-1.84)</b>	<b>0.97 (0.68-1.38)</b>

\* No OR calculated since all workers used gloves

\*\* OR for a 10-fold increase in inhalation exposure levels



# External exposure

- Inhalation exposure
  - Oligomers >>HDI
  - Spray painting >> mixing, cleaning spray gun
- Dermal exposure
  - Oligomers>>HDI
  - Spray painting ~ mixing, cleaning spray gun

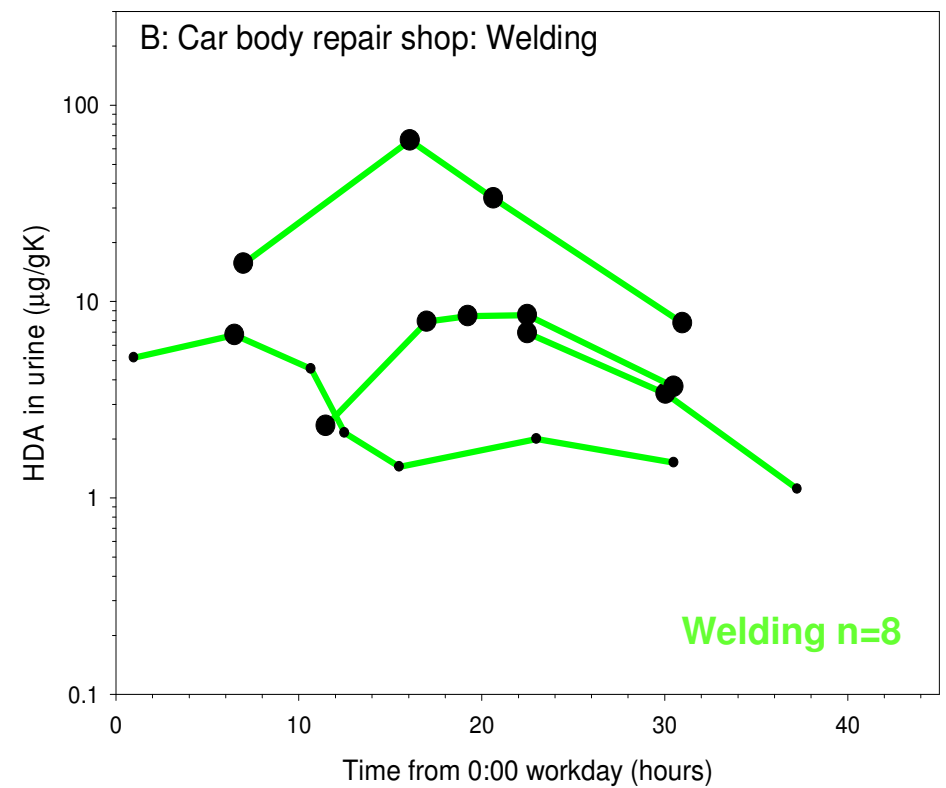
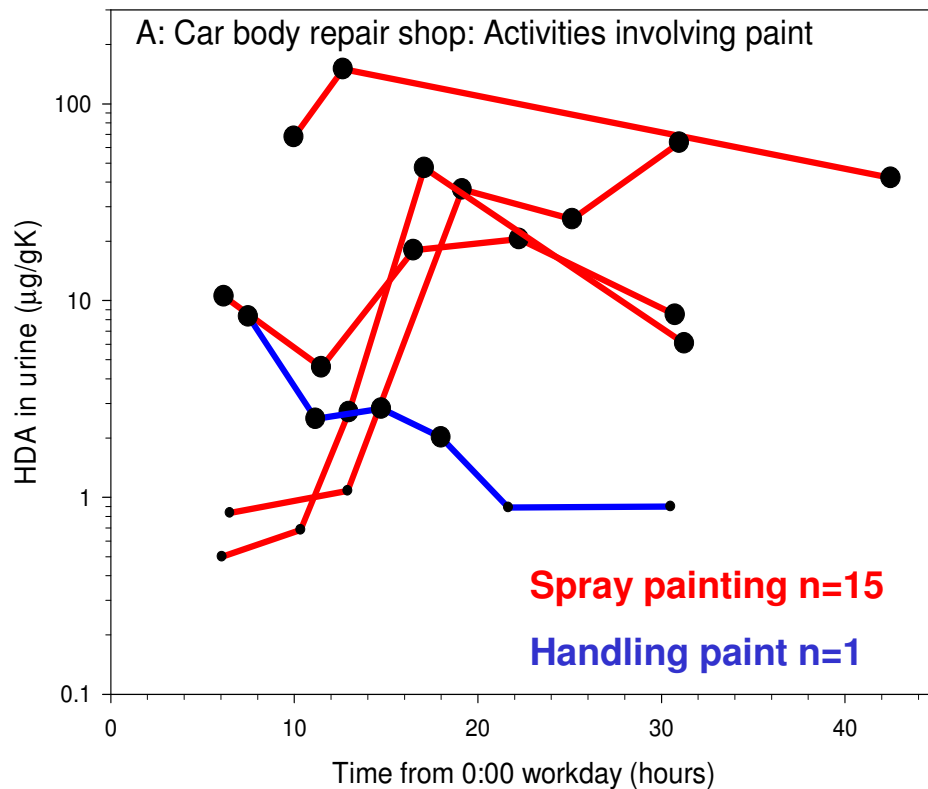


# Biomonitoring HDA

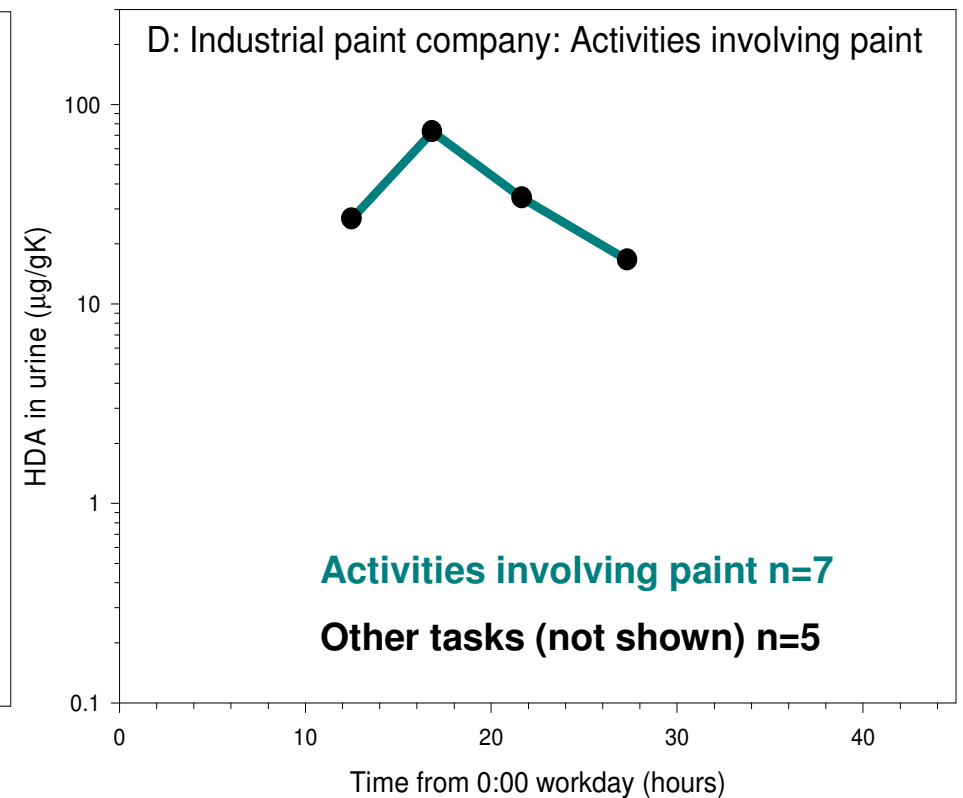
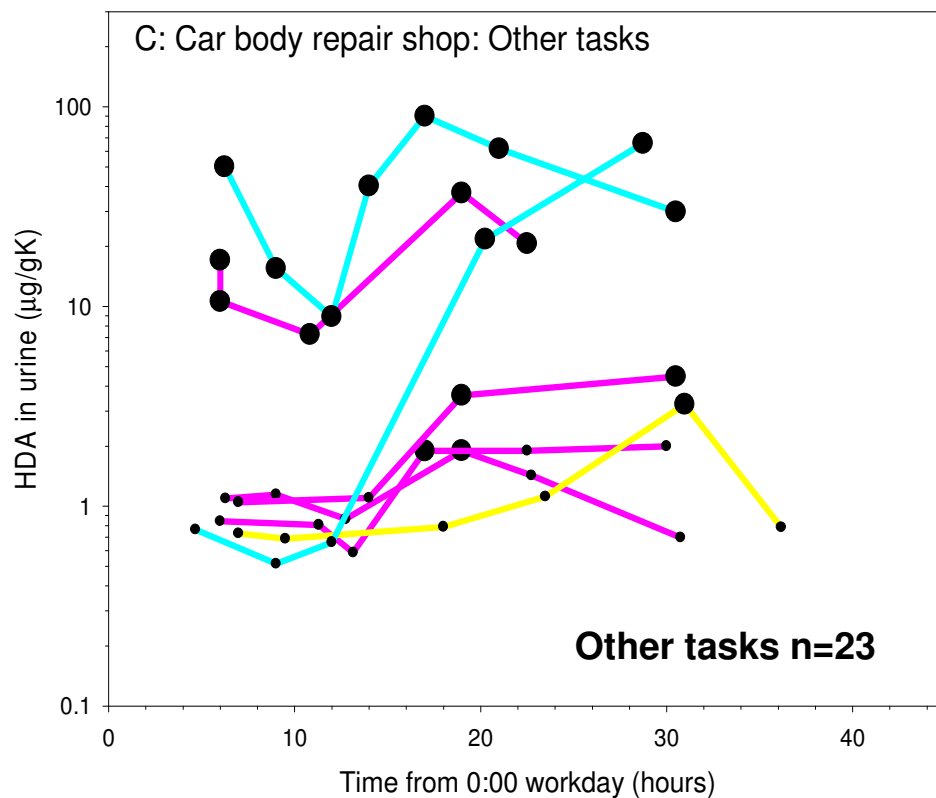
- Urinary metabolite of HDI
- Exposure through all routes
- Method:
  - Sampling: 24h Urine spot samples
  - Metabolite: Hexamethylene di-amine (HDA)
  - Analysis: GC-MS



# Biomonitoring



# Biomonitoring





# HDA over the measurement day

Time interval	% above LOD	OR (95% CI) detectable samples
0-8 AM	18	-
8-12 AM	17	1.06
0-3 PM	11	1.03
3-6 PM	23	2.06*
6-12 PM	27	1.92
0-8 AM next day	24	1.97

\*  $p < 0.05$

→ Fraction of detectable HDA significantly raised during the day



# Internal exposure (HDA)

- 25% of spray painters
  - Inter person variability
  - No clear association with PPE use
- Also other workers
  - Different source HDA
  - Earlier exposure (longer half life oligomers)
  - Bystander exposure



# Conclusions

- Exposure
  - Dermal exposure successfully measured
  - Dermal and inhalation exposure present
  - Mainly (spray) painters
- Internal exposure
  - Non spray painters may receive considerable doses

