Probabilistic Dietary Exposure Assessment of the Italian Population to 3-monochloropropane-1,2-diol, 2-monochloropropane-1,3-diol and glycidol

Oral presentation at ISES Europe 2024 Workshop

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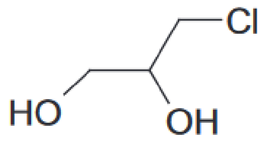
Istituto di Ricerche Farmacologiche Mario Negri

Milan, Italy

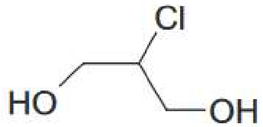
ISTITUTO DI RICERCHE FARMACOLOGICHE MARIO NEGRI · IRCCS

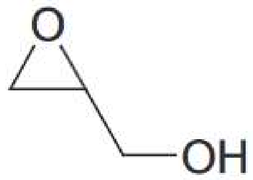
Background



3-MCPD

2-MCPD





Glycidol

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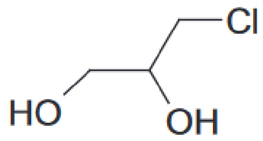

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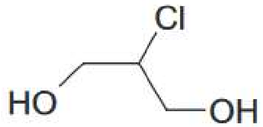

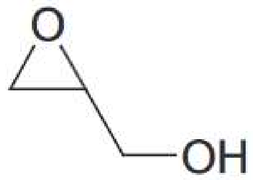

Glycidol

…and their respective mono- and diesters

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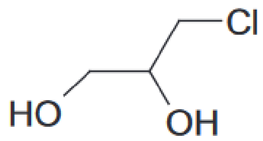

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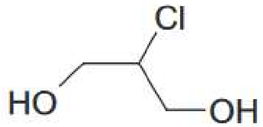

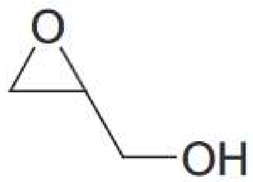

Glycidol

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Occurrence

- Refinement of vegetable oils (ex.: refined palm oil)

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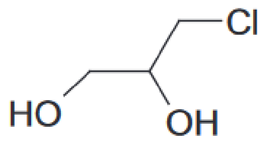

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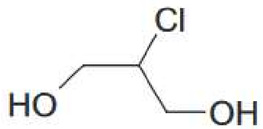

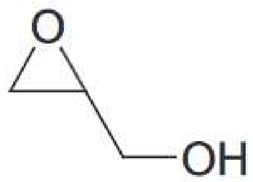

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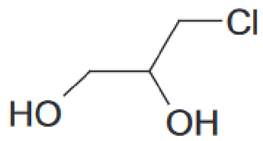

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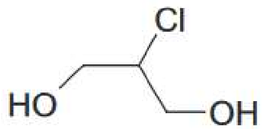

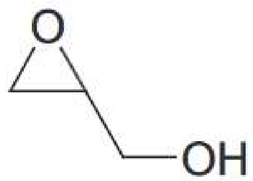

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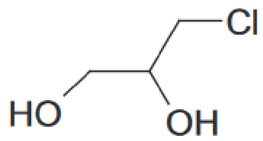

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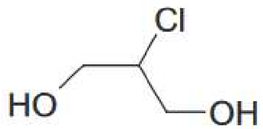

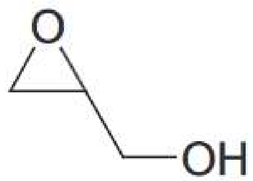

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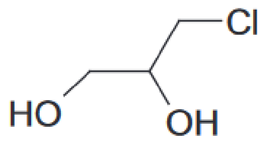

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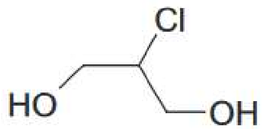

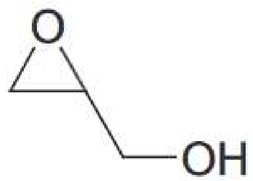

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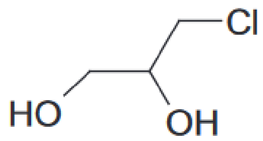

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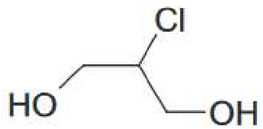

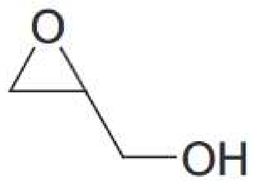

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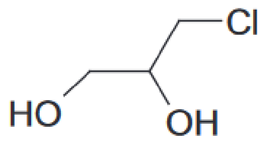

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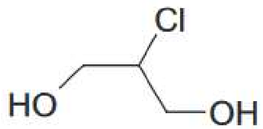

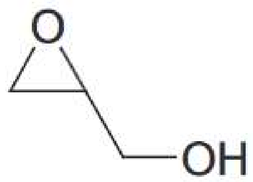

Glycidol

…and their respective mono- and diesters

Occurrence

- Refinement of vegetable oils

Mechanism of formation

- Acylglycerols and chlorine
- Key factors: temperature and time

Background

Toxicological effects

- 3-MCPD: IARC group 2B. Male antifertility agent. Male repro- and nephrotoxicity
- Glycidol: IARC group 2A. Carcinogenicity and genotoxicity

Background

Toxicological effects

- 3-MCPD: IARC group 2B. Male antifertility agent. Male repro- and nephrotoxicity
- 2-MCPD: two *in vivo* studies. Muscoloskeletal- and nephrotoxicity
- Glycidol: IARC group 2A. Carcinogenicity and genotoxicity

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Toxicological effects

- 3-MCPD: IARC group 2B. Male antifertility agent. Male repro- and nephrotoxicity
- 2-MCPD: two *in vivo* studies. Muscoloskeletal- and nephrotoxicity
- Glycidol: IARC group 2A. Carcinogenicity and genotoxicity

EFSA Health-Based Guidance Values (HBGVs)

- Two guidances
- 3-MCPD: Tolerable Daily Intake (TDI) = 2 µg/kg bw/day
- Glycidol: Margin Of Exposure (MOE) ≥ 25.000, then low concern

Motivation and aims

Concern for exposure to 3-MCPD and glycidol among infants

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Provide up-to-date exposure estimates for the Italian population to 3-MCPD, 2-MCPD and glycidol

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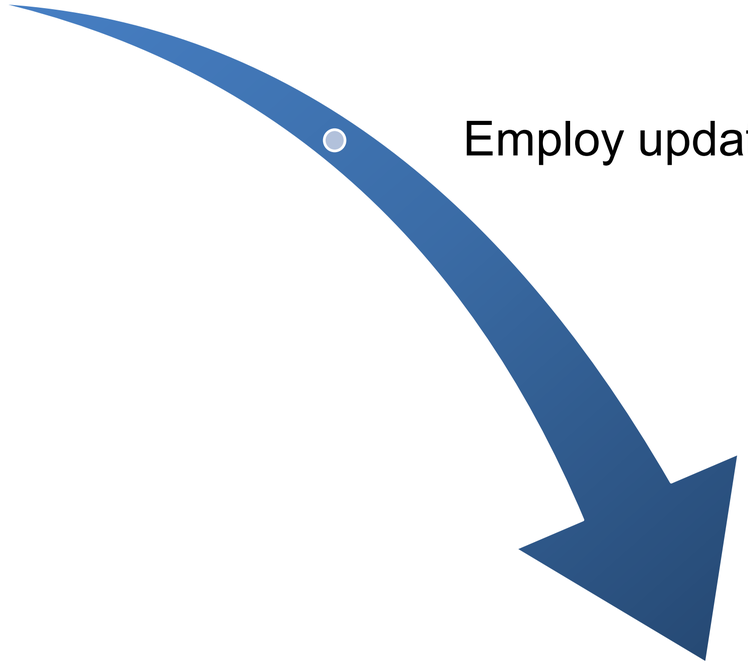
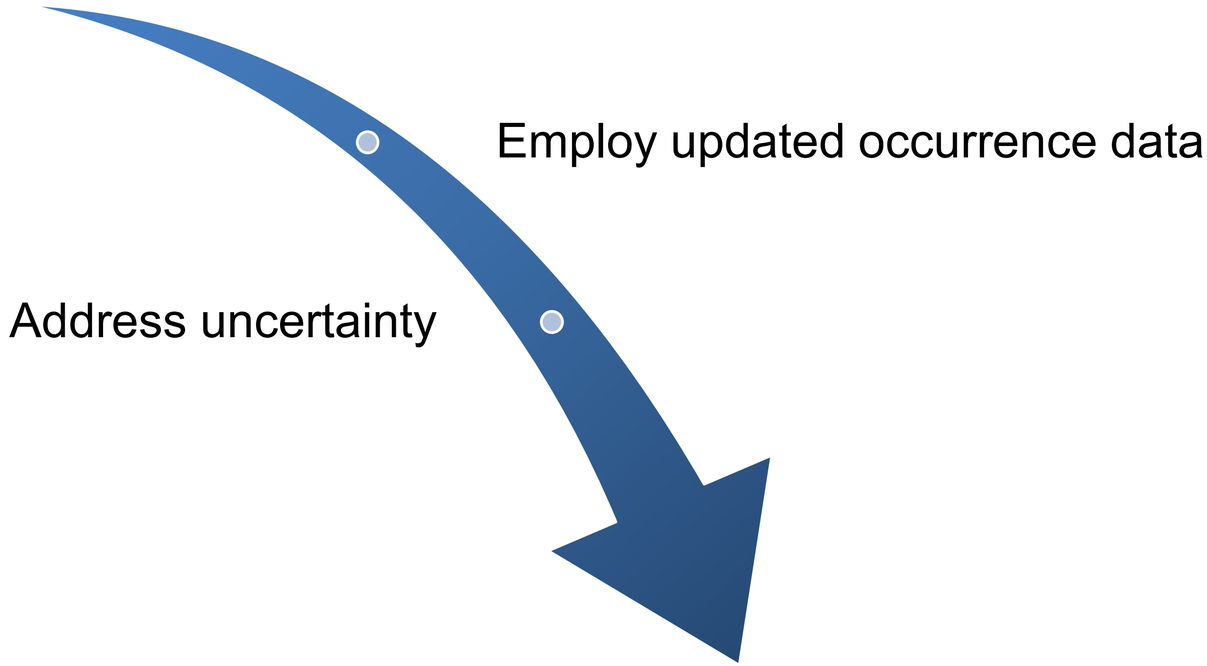


Employ updated occurrence data

Provide up-to-date exposure estimates for the Italian population to 3-MCPD, 2-MCPD and glycidol

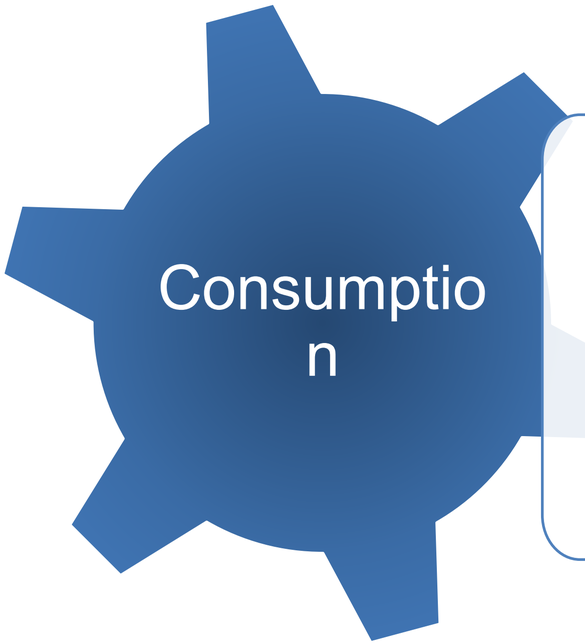
Motivation and aims

Concern for exposure to 3-MCPD and glycidol among infants



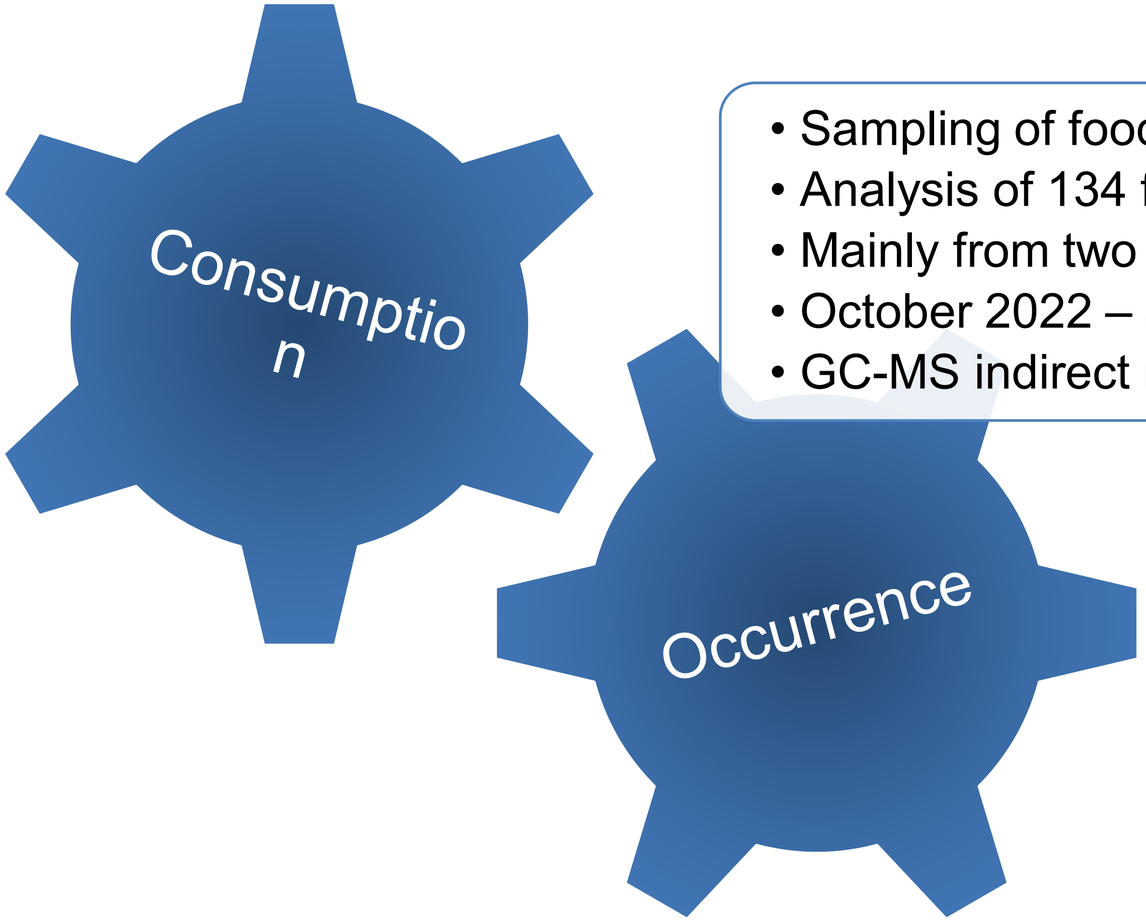
Provide up-to-date exposure estimates for the Italian population to 3-MCPD, 2-MCPD and glycidol

Methods



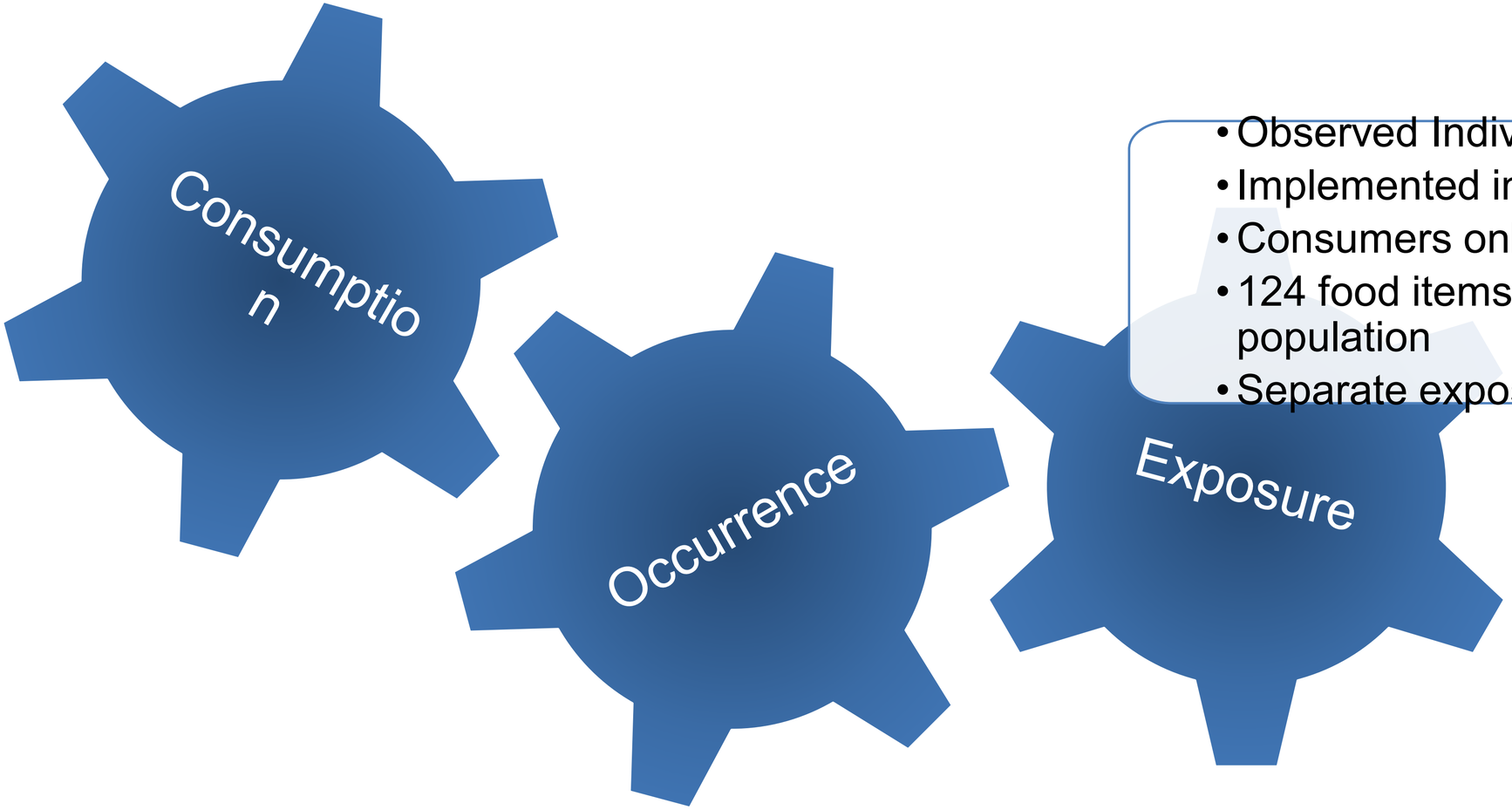
- Individual dietary consumption data
- *FAO/WHO Global Individual Food consumption data Tool*
- *INRAN SCAI 2005-2006* dietary survey
- Most recent open access data on dietary consumption
- 3323 individuals
- Detailed information about features/brands of consumed food

Methods



- Sampling of food items based on dietary data
- Analysis of 134 food items
- Mainly from two mass-market retailers in Lombardy
- October 2022 – July 2023
- GC-MS indirect method: hydrolysis of esters

Methods



- Observed Individual Means methodology
- Implemented in R
- Consumers only
- 124 food items relevant for the Italian population
- Separate exposure assessments

Methods

Observed Individual Means methodology

- Estimate Confidence Interval for 95th percentile
- Bootstrap: resampling with replacement

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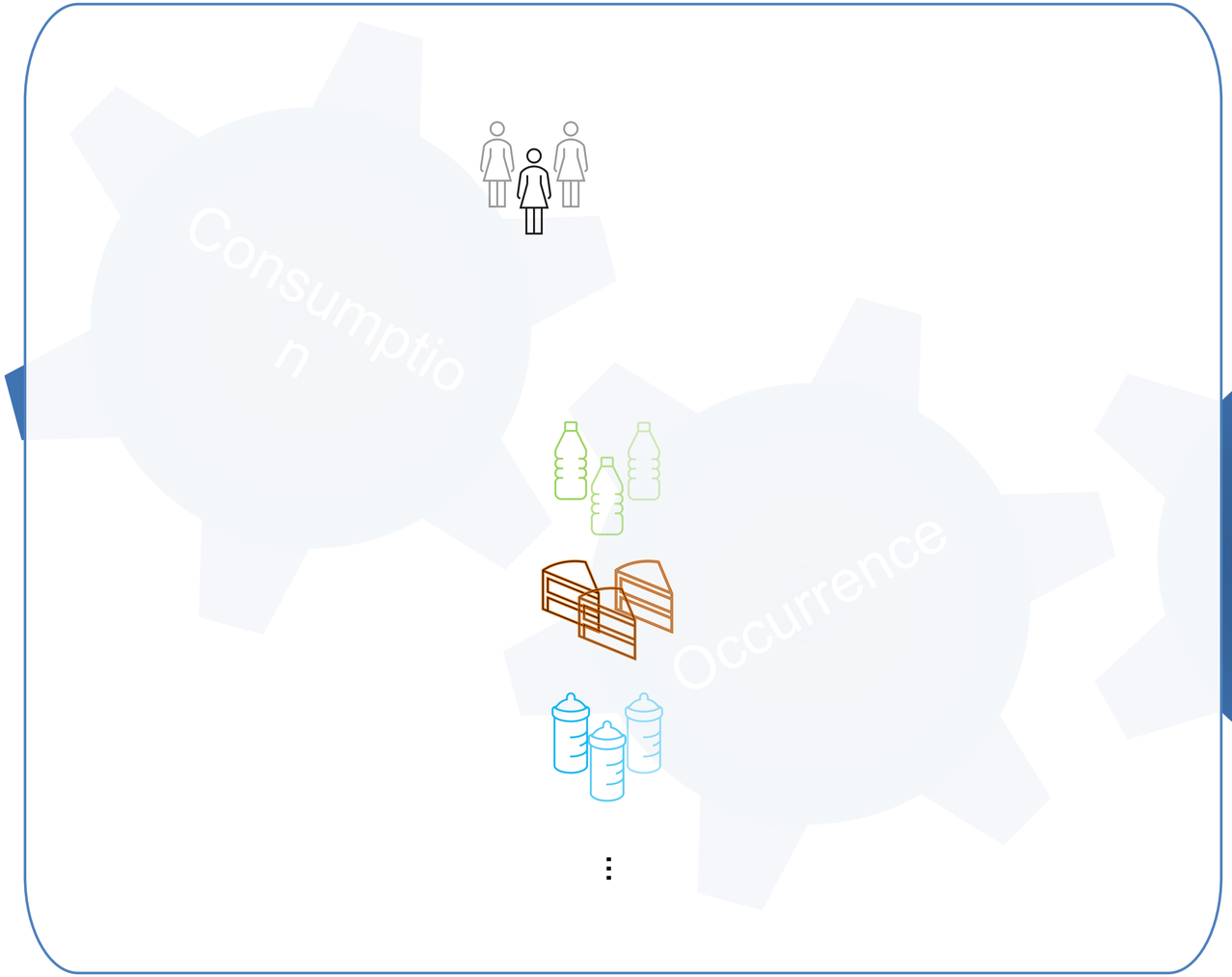

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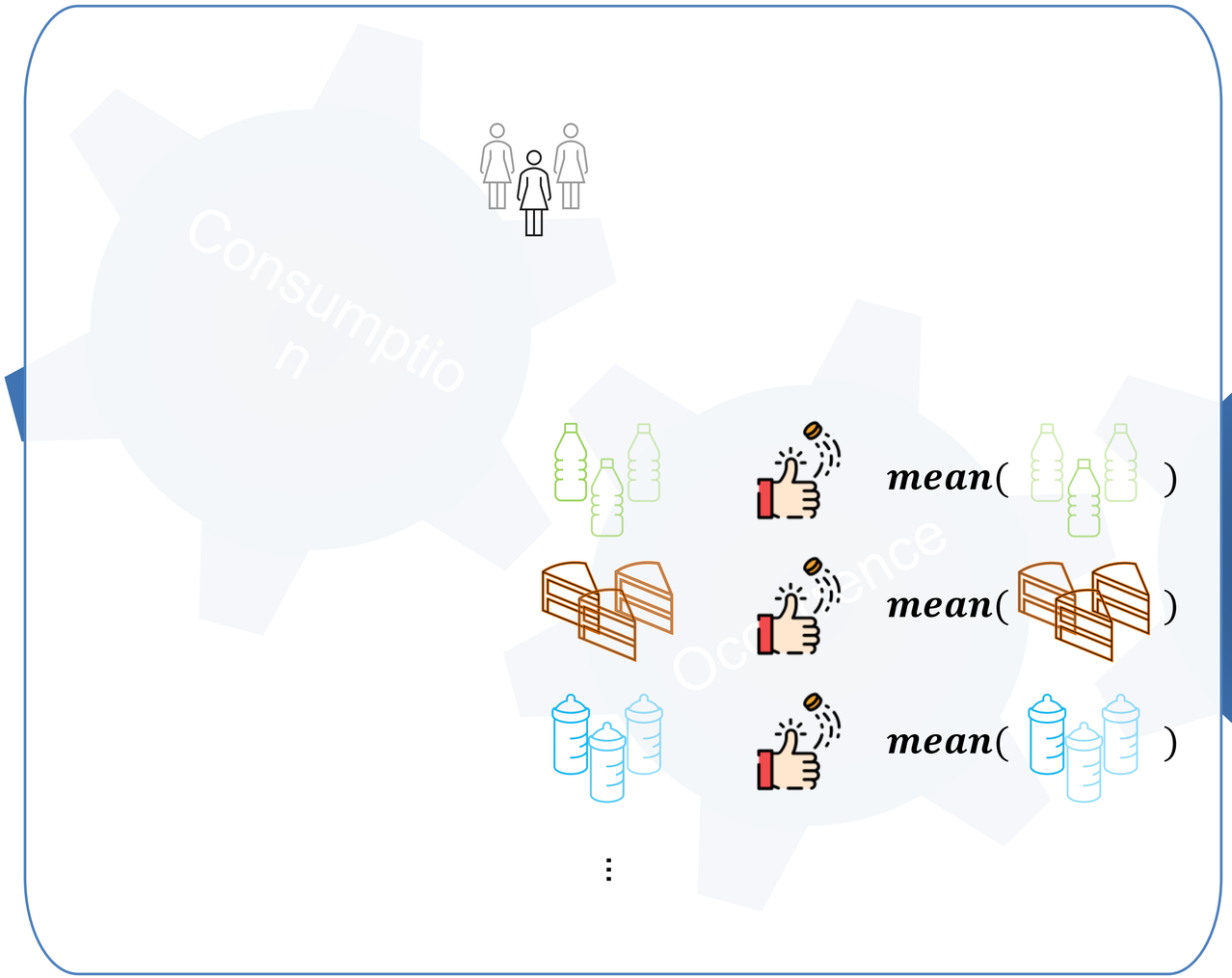

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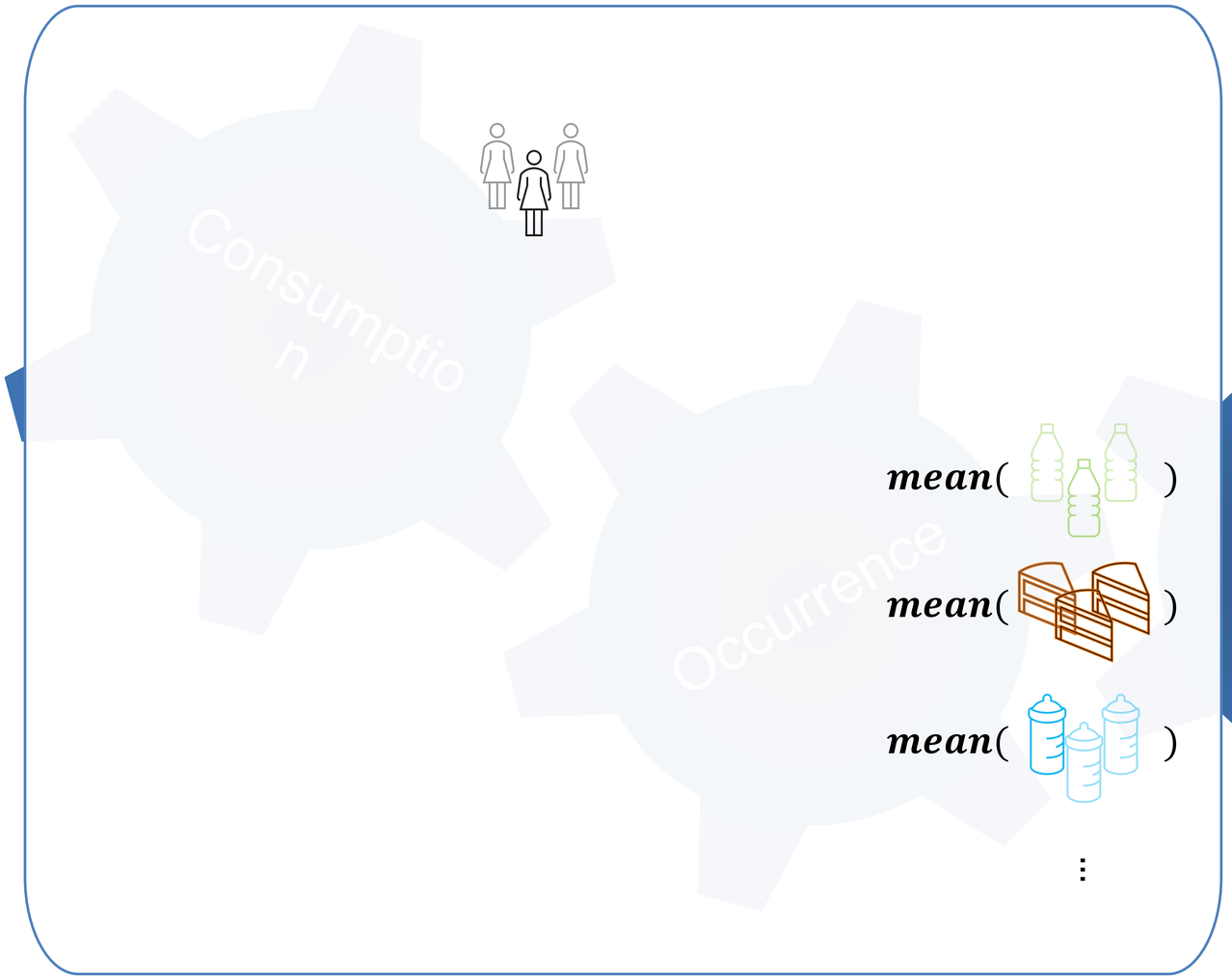

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95th percentile

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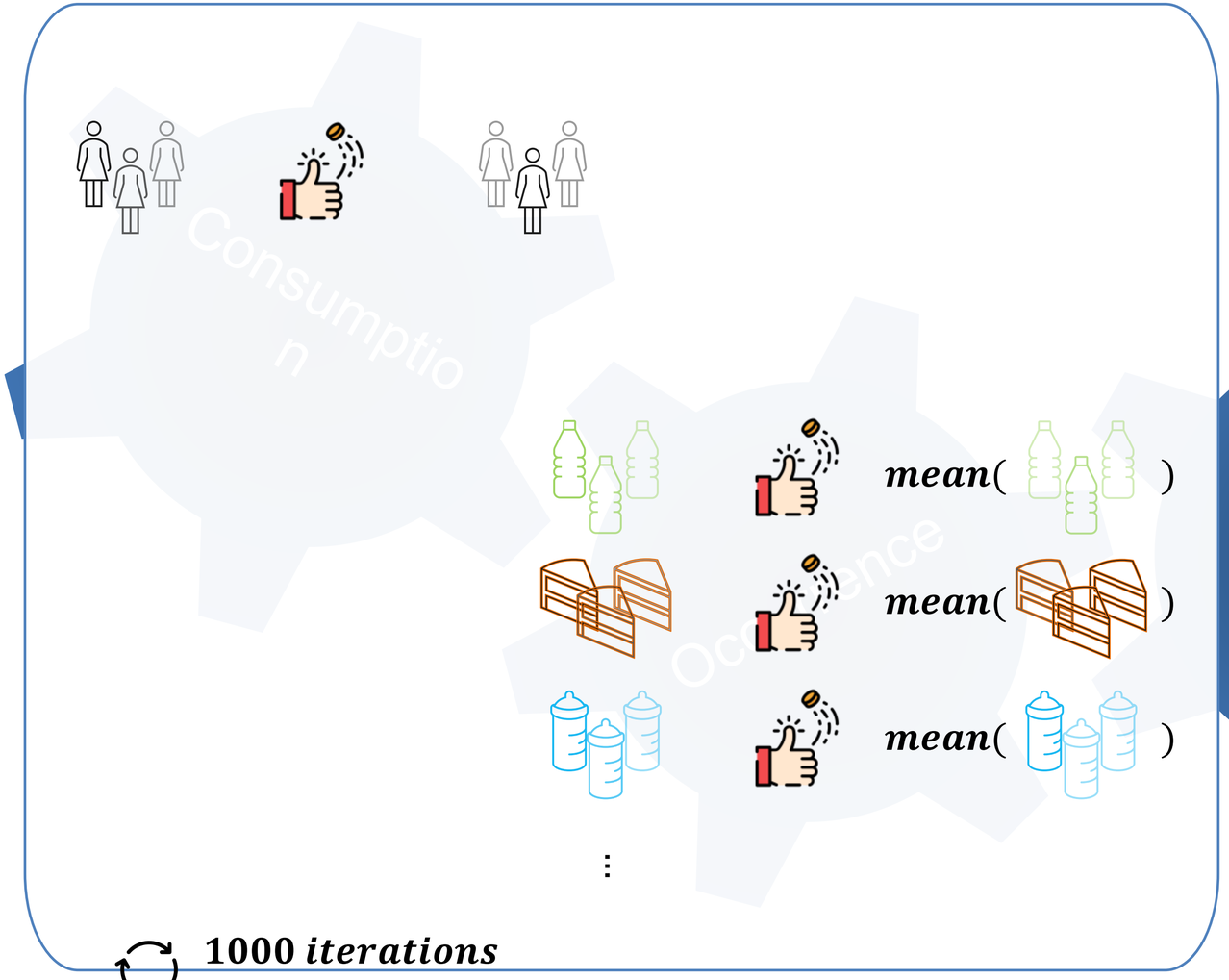

Exposure

Observed Individual Means methodology

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Distribution of 95th percentiles

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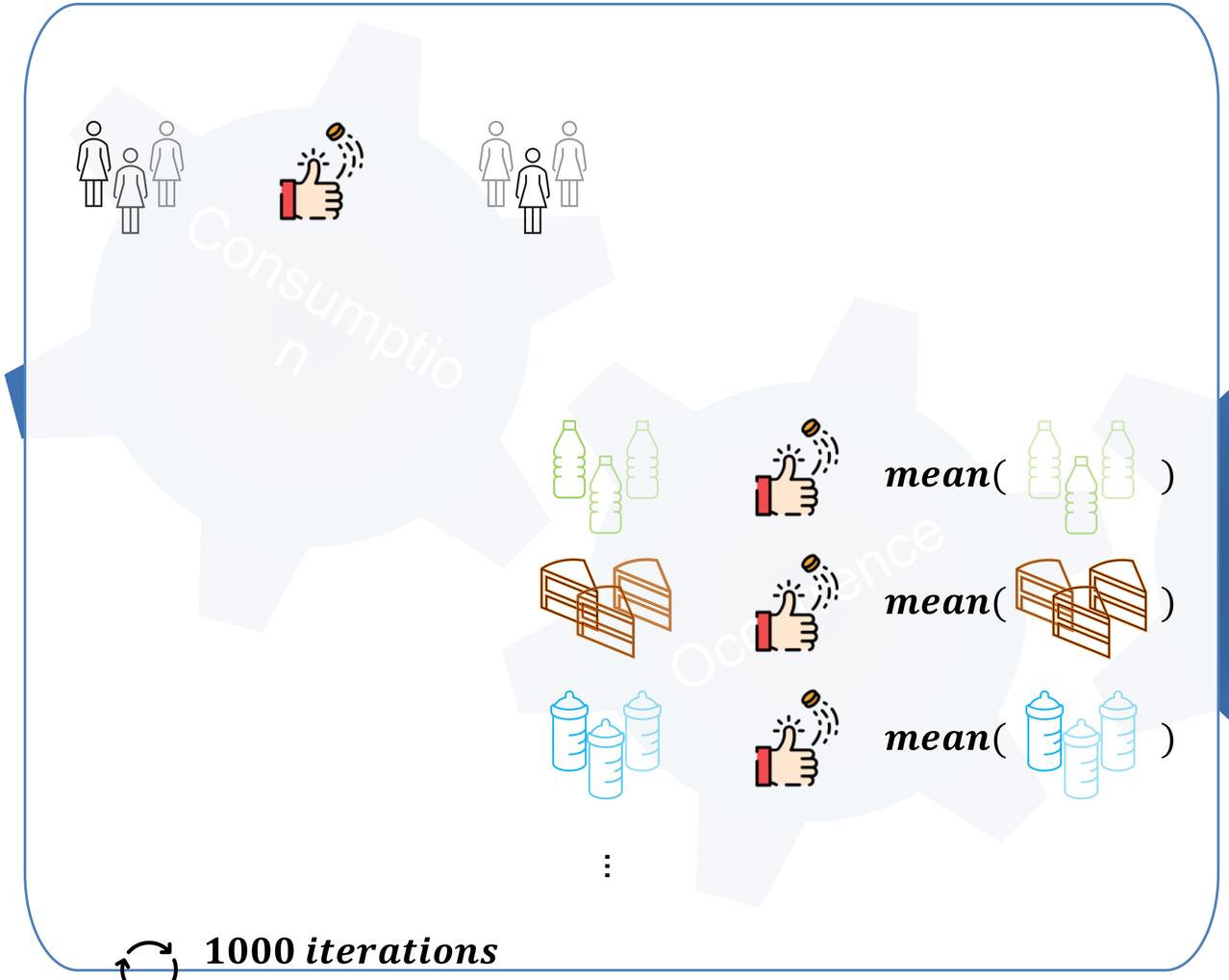

Observed Individual Means methodology

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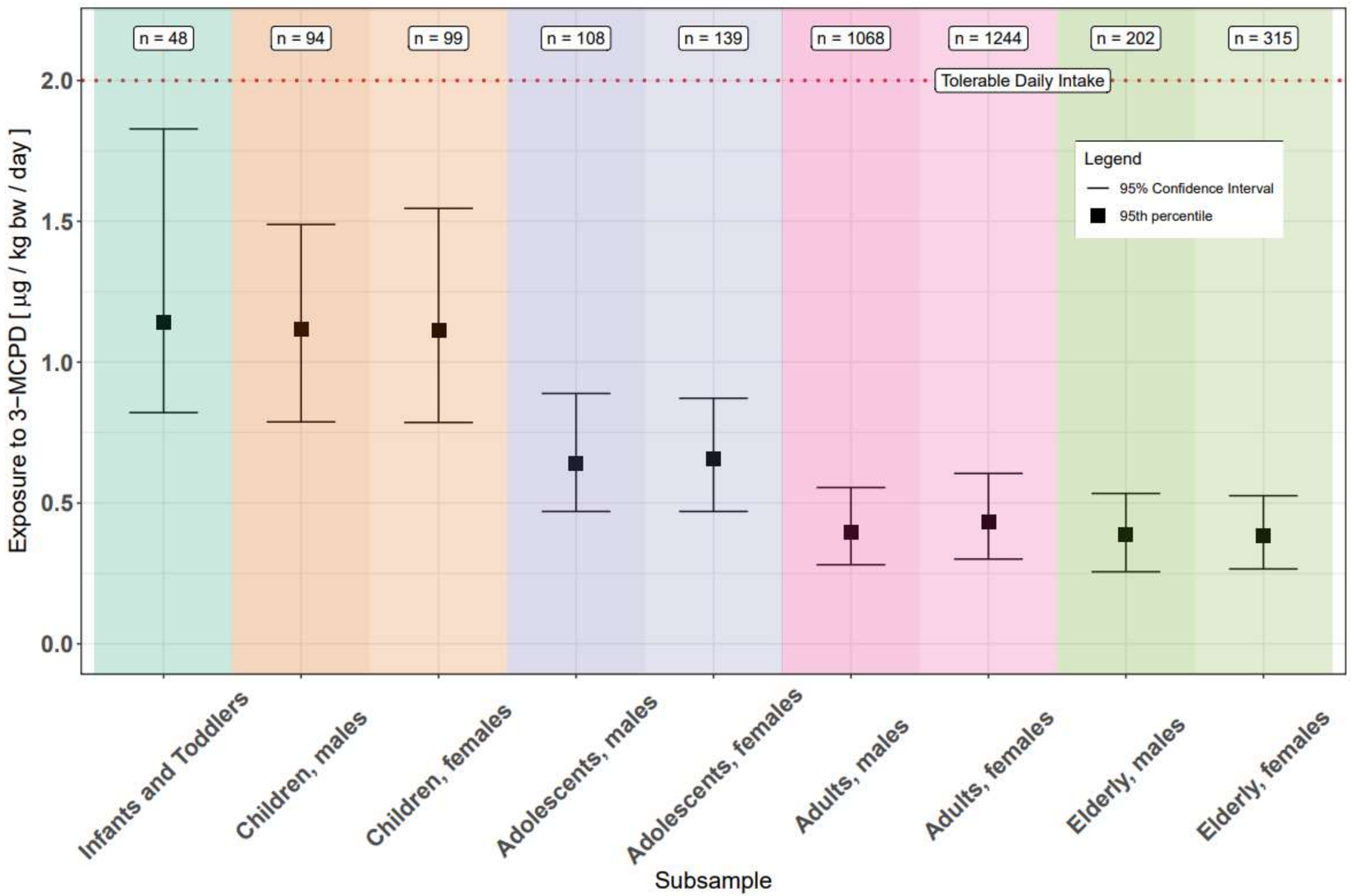
Exposure

Distribution of 95th percentiles

CI for 95% percentile

Results: exposure to 3-MCPD



Middle bound

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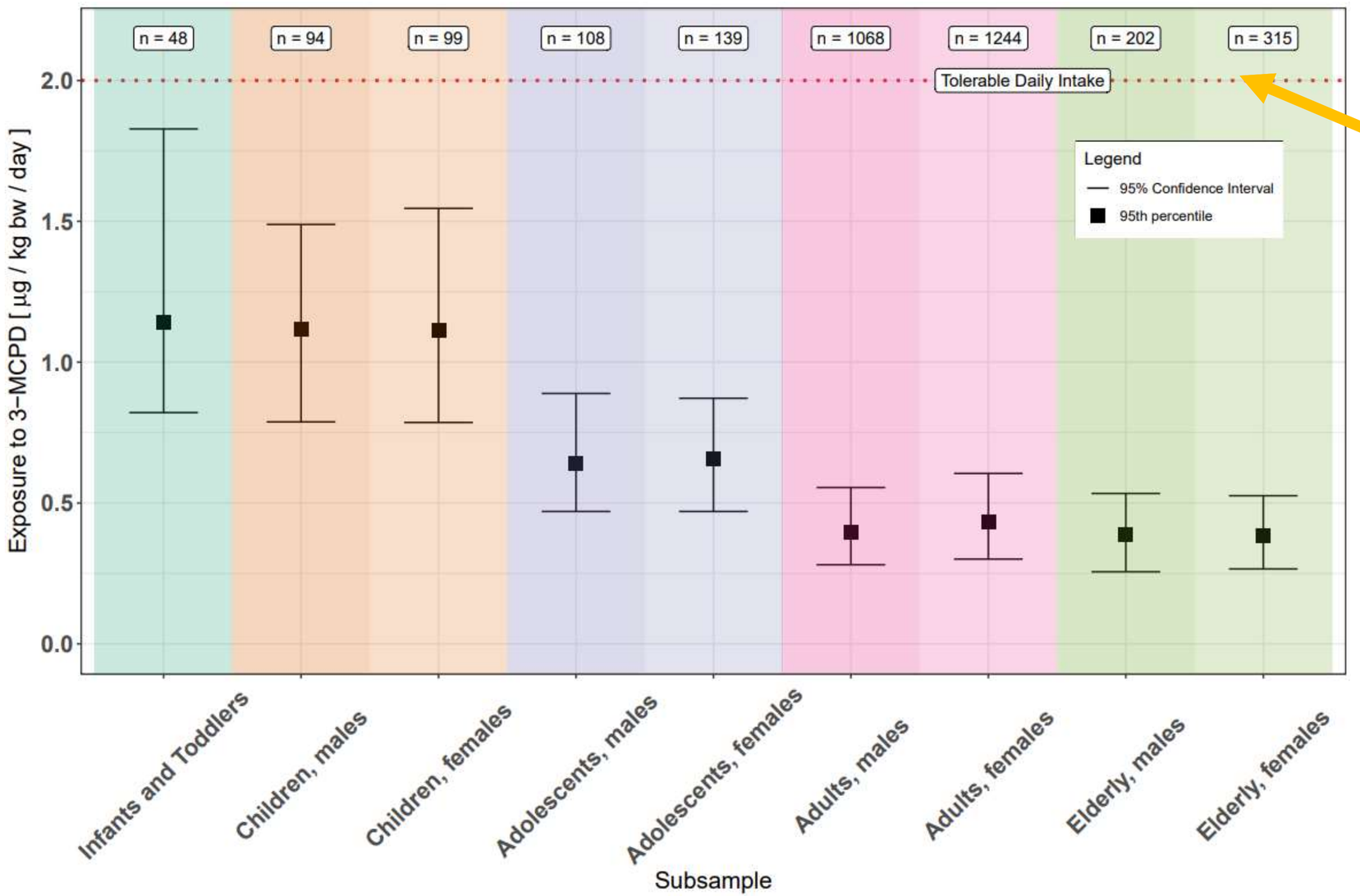
Results: exposure to 3-MCPD

Lower exposure



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TDI = 2 µg/kg bw/day

No exceedance of HBGV

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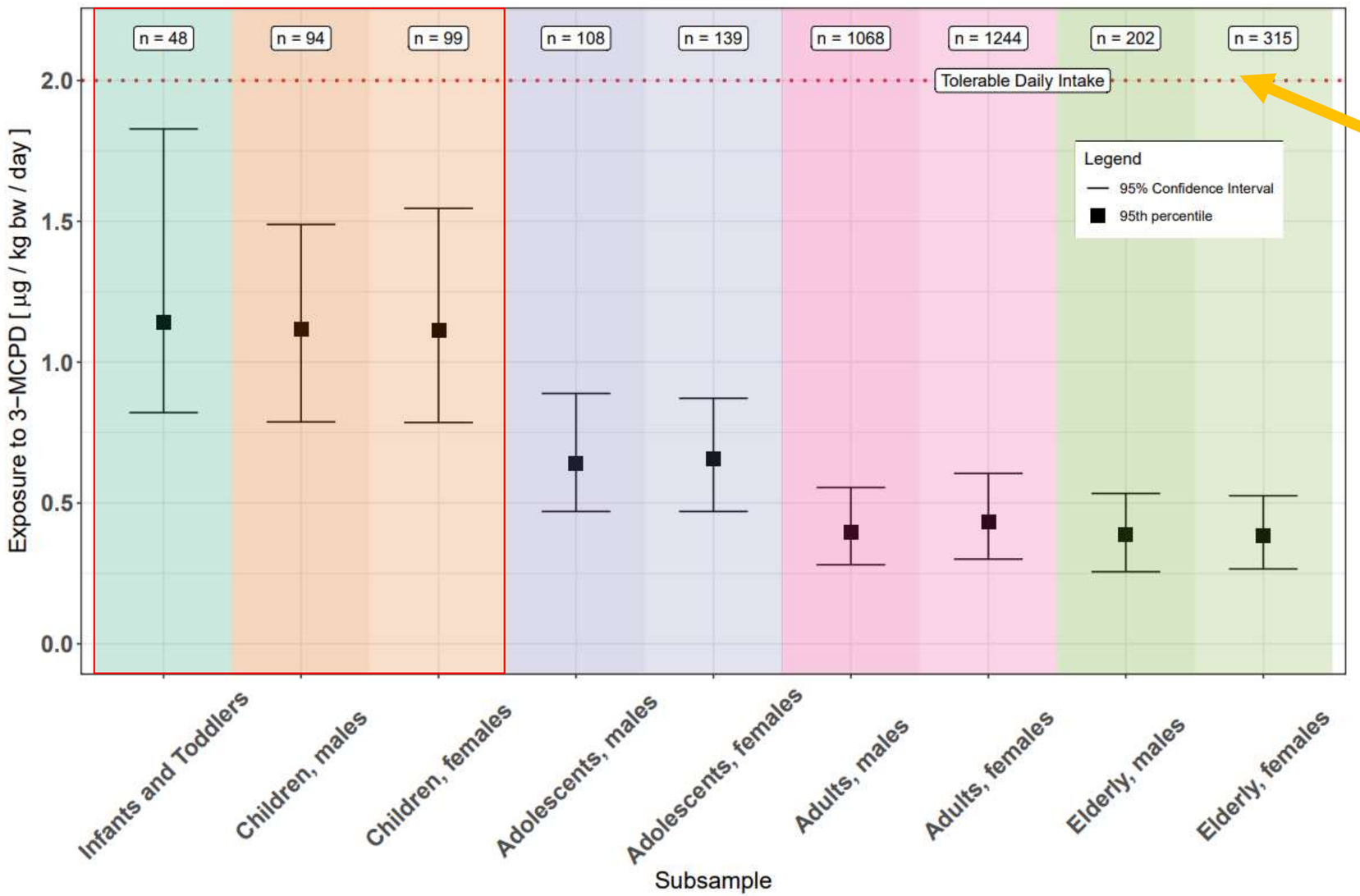

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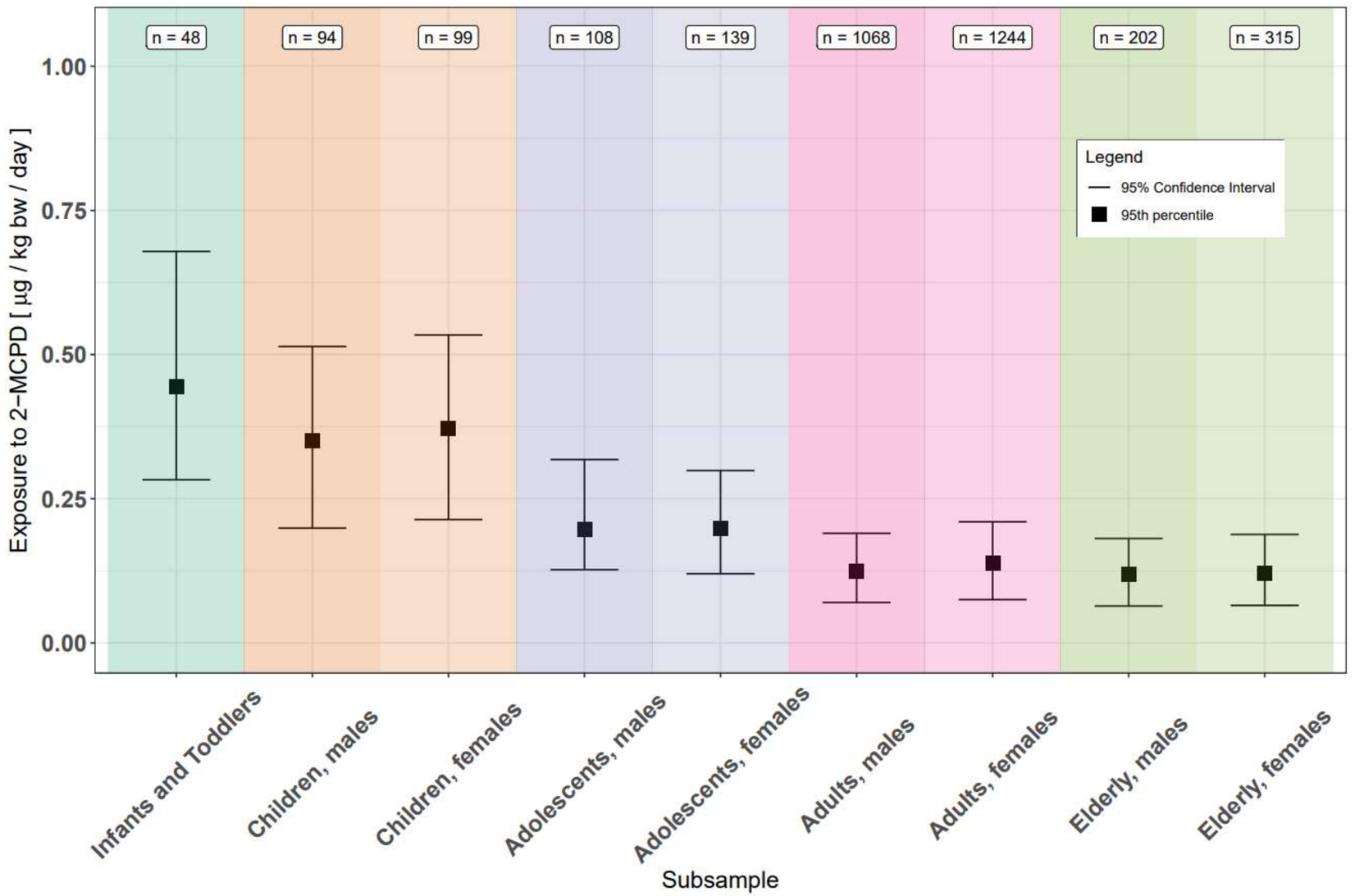
Results: exposure to 2-MCPD



Lower bound

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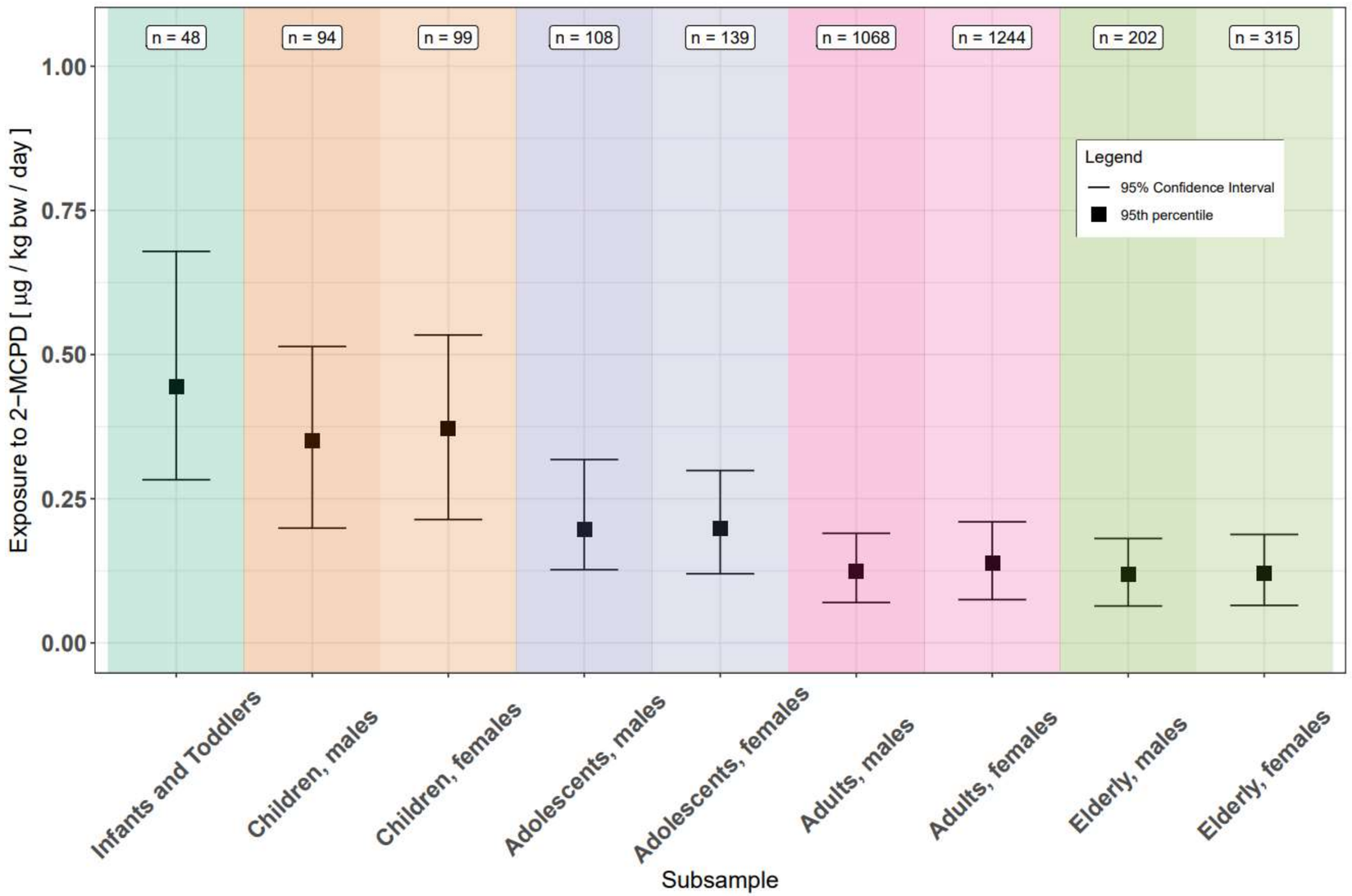
Results: exposure to 2-MCPD

Lower exposure



Lower bound

No HBGV

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Results: exposure to 2-MCPD

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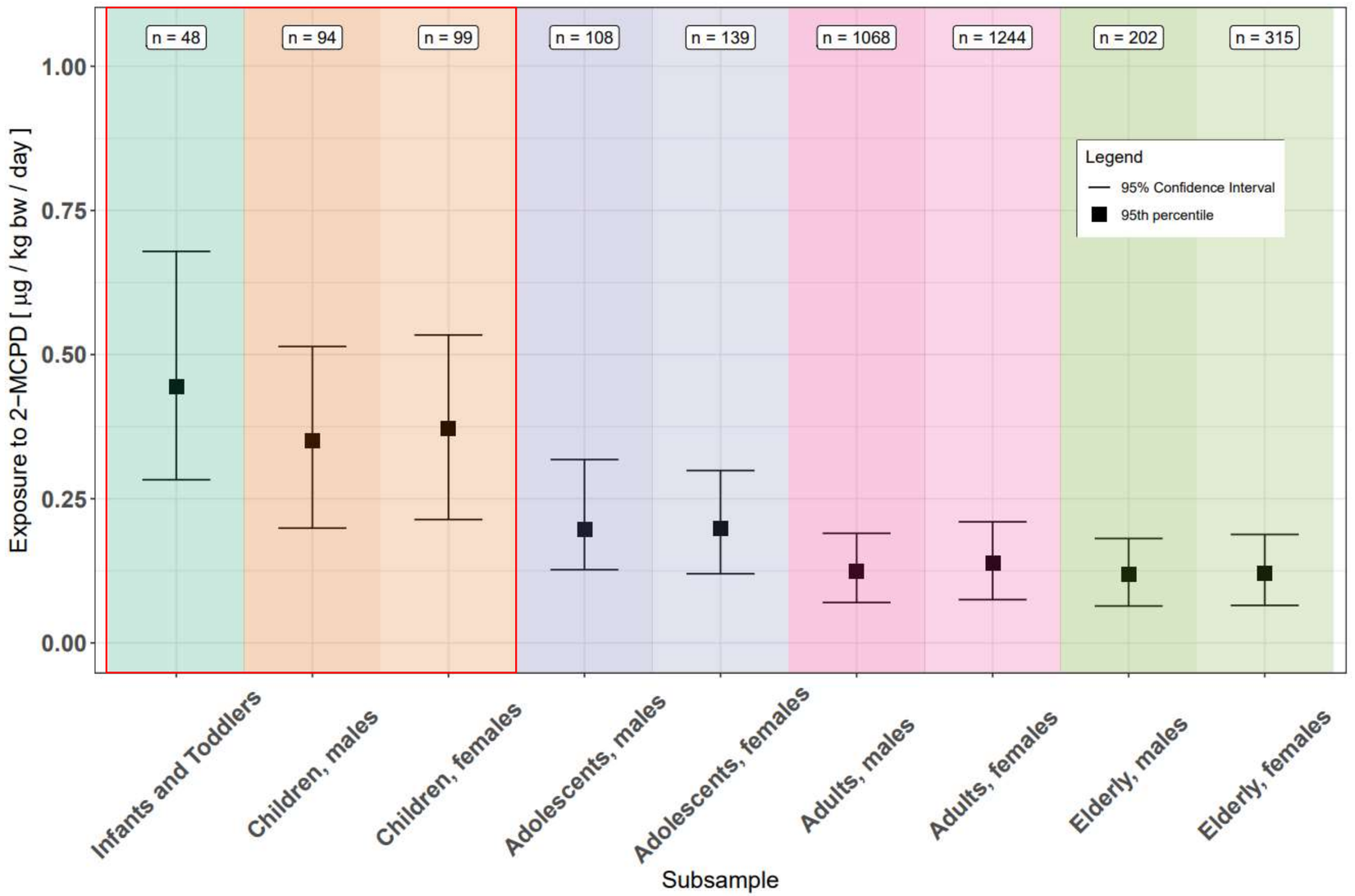

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No HBGV

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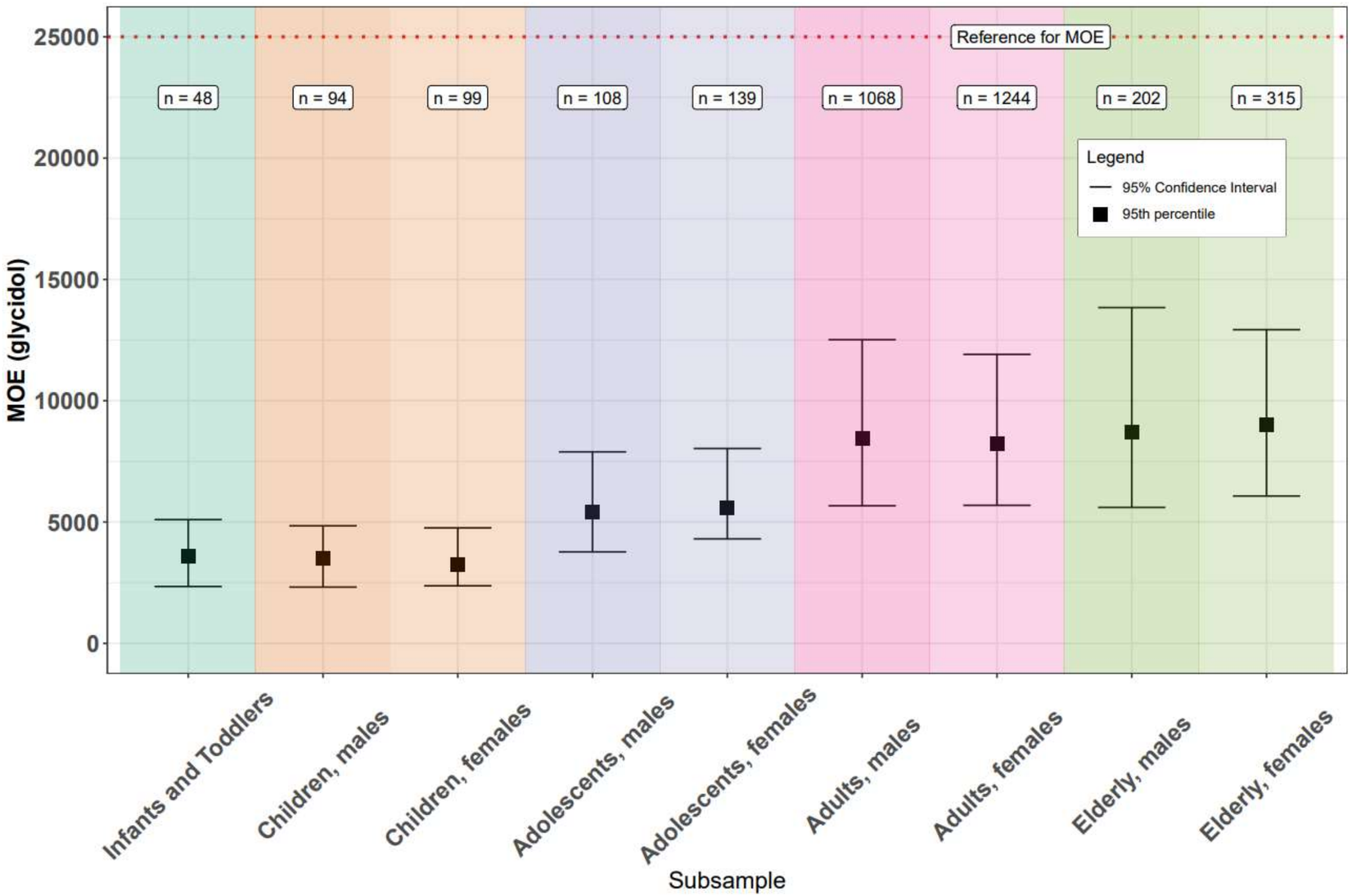
Results: exposure to glycidol



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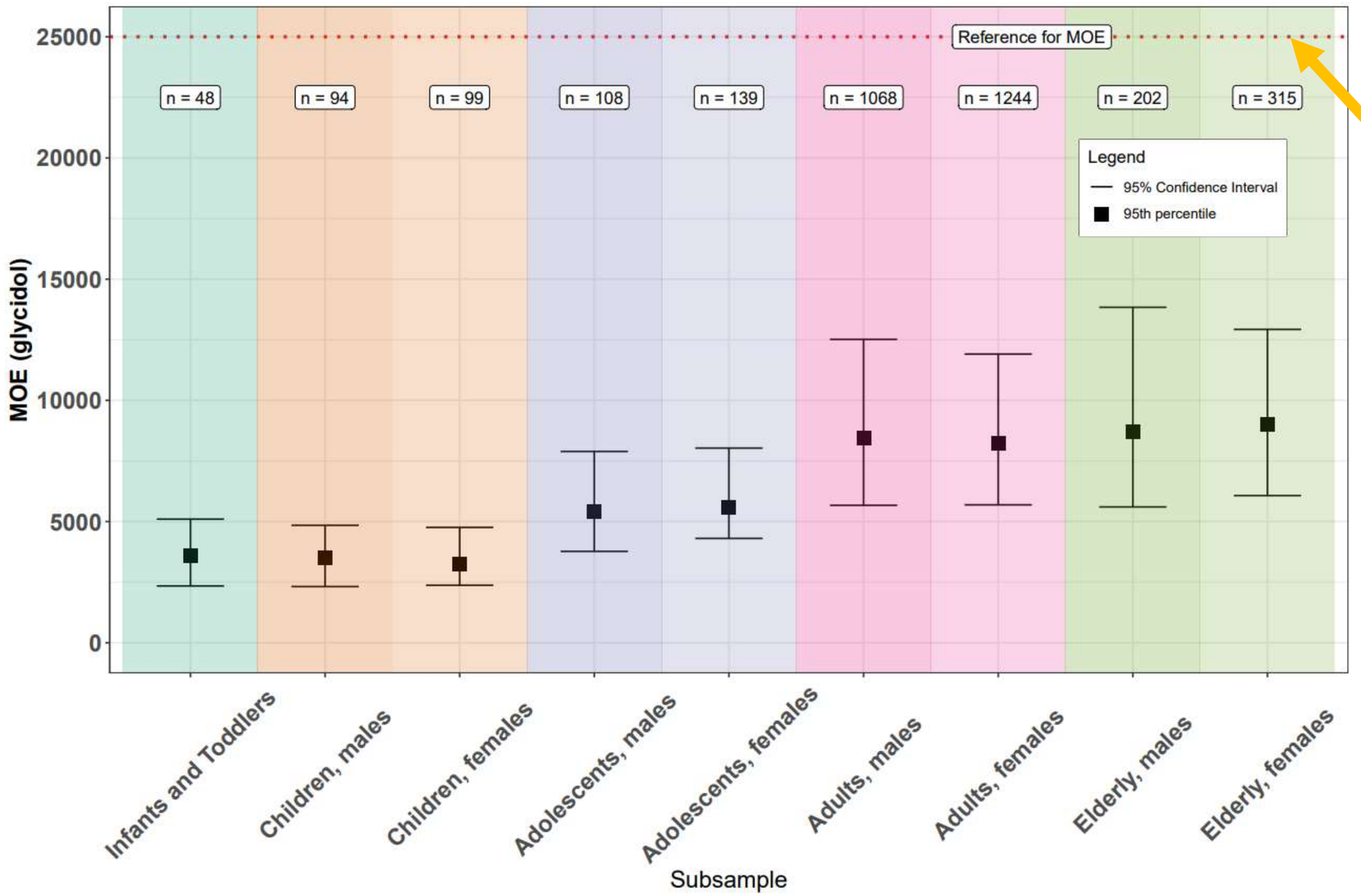
Results: exposure to glycidol

Higher exposure



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Reference MOE = 25000

Concern

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Results: exposure to glycidol

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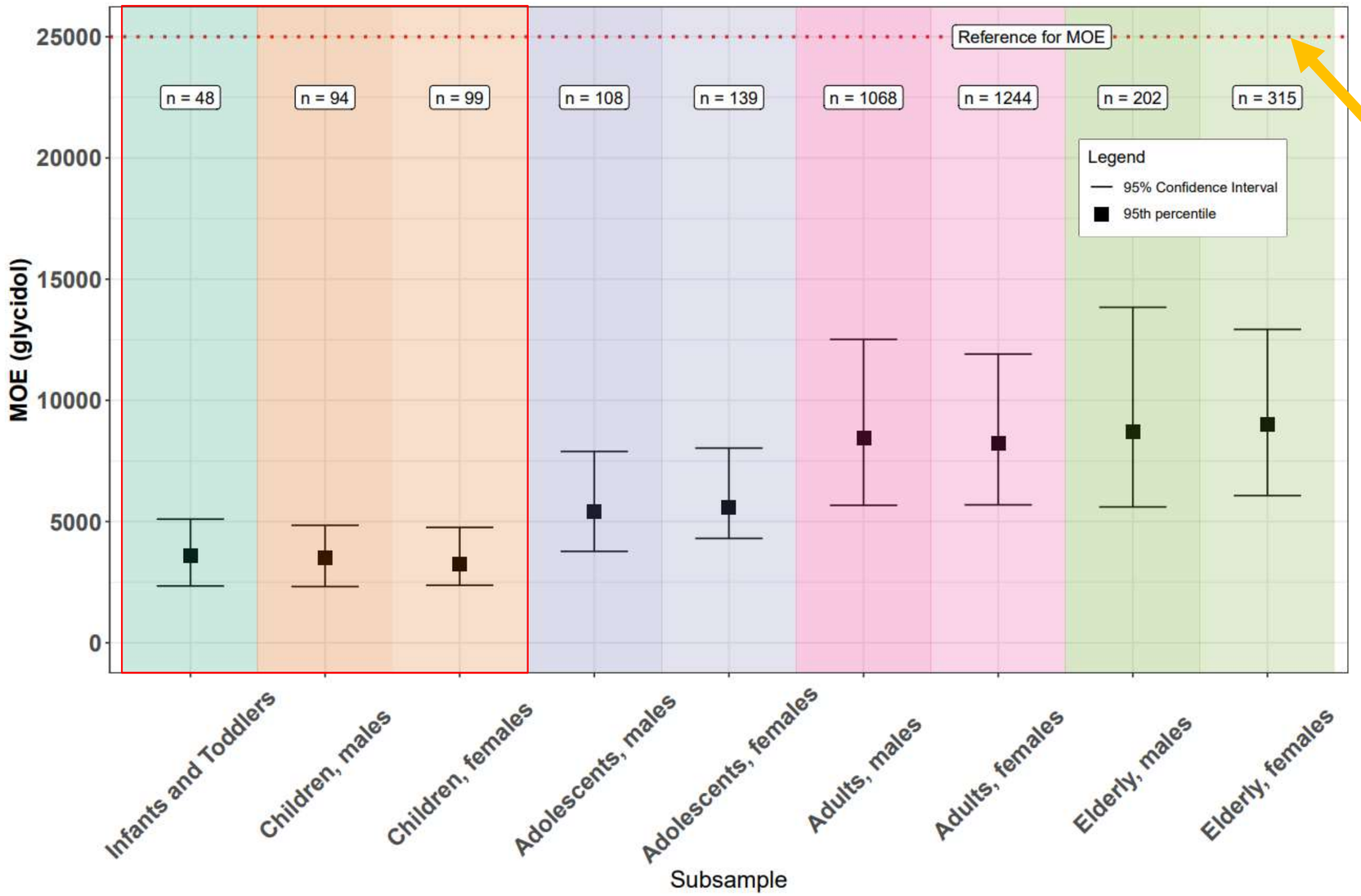

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Conclusions

Summary

- Concerns for exposure to glycidol
- No sex-dependent difference in exposure

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- Concerns for exposure to glycidol
- No sex-dependent difference in exposure

Limitations

- Hydrolysis of esters in GIT and internal exposure
- Sample size of subgroups
- Lack of HBGV for 2-MCPD
- Other minor mechanisms of formation

Conclusions

Summary

- Concerns for exposure to glycidol
- No sex-dependent difference in exposure

Limitations

- Hydrolysis of esters in GIT and internal exposure
- Sample size of subgroups
- Lack of HBGV for 2-MCPD
- Other minor mechanisms of formation

Next steps

- Update exposure estimates with new dietary consumption data (not publicly available yet)
- Investigate risks related to 2-MCPD

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Thank you for your attention!

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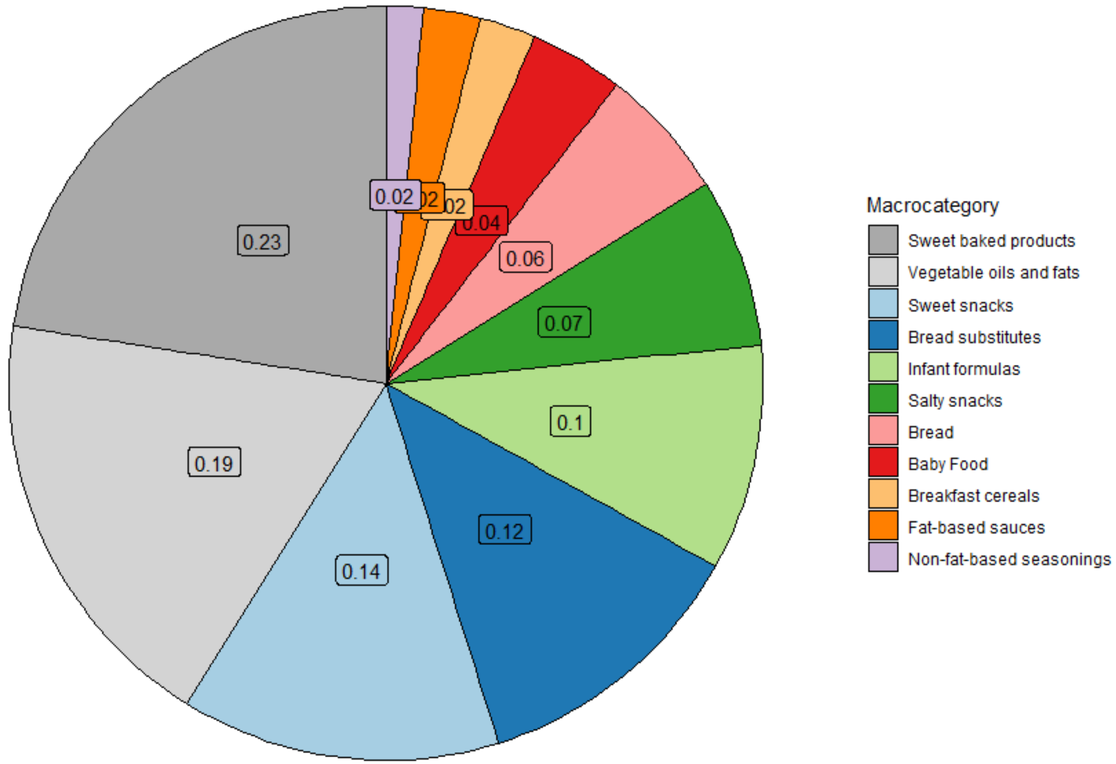
Results: age classes

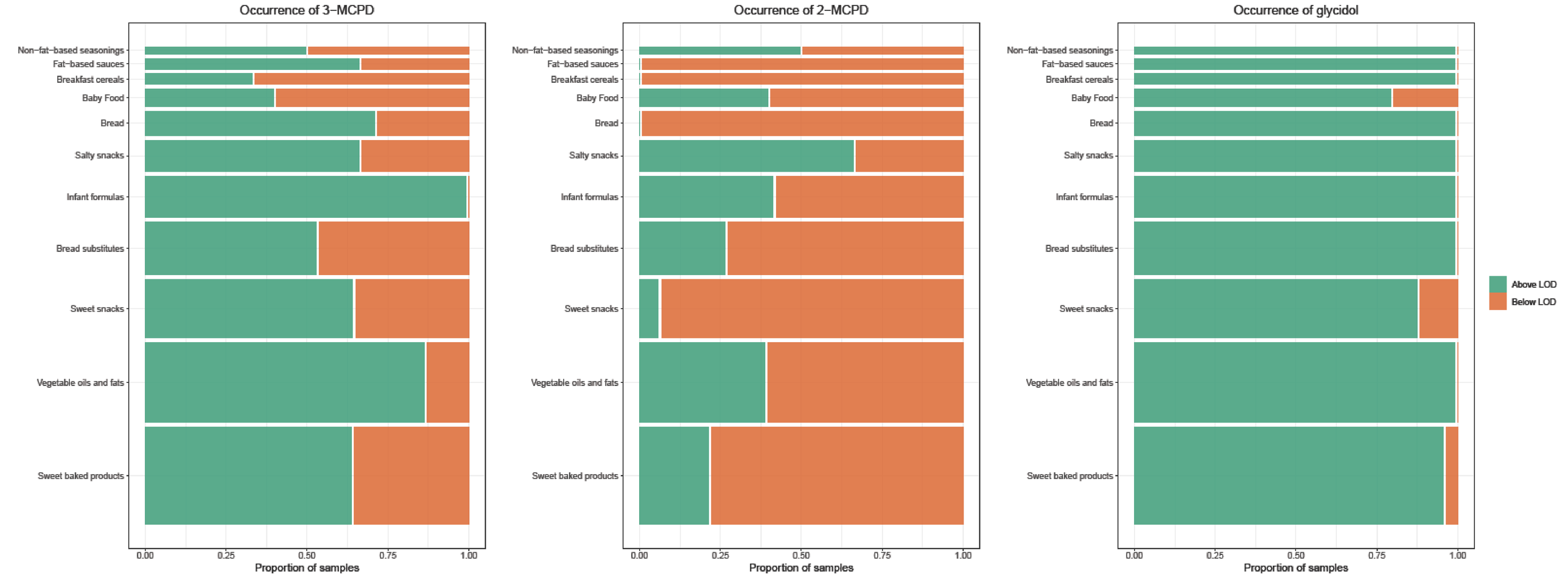
Age class	Age (years)
Infants and Toddlers	$0 \leq age < 3$
Children	$3 \leq age < 10$
Adolescents	$10 \leq age < 18$
Adults	$18 \leq age < 65$
Elderly	$age \geq 65$

Results: sampling

n = 124



Results: occurrence



Results: comparison with regulatory maximum levels

Reference: COMMISSION REGULATION (EU) 2020/1322 of 23 September 2020

Glycidol

Occurrence in refined vegetable oils and margarines above 1000 µg/kg for 5/21 samples.

Occurrence in infant formulas above 50 µg/kg for 8/12 samples.

3-MCPD

Occurrence in refined vegetable oils and margarines above 1250 µg/kg for 1/21 samples.

Occurrence in infant formulas above 125 µg/kg for 0/12 samples.

'Section 4: 3-monochloropropanediol (3-MCPD), 3-MCPD fatty acid esters and glycidyl fatty acid esters

	Foodstuffs (1)	Maximum level (µg/kg)
4.1	**3-monochloropropanediol (3-MCPD)**	
4.1.1	Hydrolysed vegetable protein (25)	20
4.1.2	Soy sauce (25)	20
4.2	**Glycidyl fatty acid esters, expressed as glycidol**	
4.2.1.	Vegetable oils and fats, fish oils and oils from other marine organisms placed on the market for the final consumer or for use as an ingredient in food, with the exception of the foods referred to in 4.2.2 and of virgin olive oils (*)	1 000 (***)
4.2.2.	Vegetable oils and fats, fish oils and oils from other marine organisms destined for the production of baby food and processed cereal-based food for infants and young children (2)	500 (***) (******)
4.2.3	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (2) (23) and young-child formula (23) (**) (powder)	50 (***)
4.2.4	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (2) (23) and young-child formula (23) (**) (liquid)	6,0 (***)
4.3	**Sum of 3-monochloropropanediol (3-MCPD) and 3-MCPD fatty acid esters, expressed as 3-MCPD** (****)	
4.3.1.	Vegetable oils and fats, fish oils and oils from other marine organisms placed on the market for the final consumer or for use as an ingredient in food falling within the following categories, with the exception of the foods referred to in 4.3.2 and of virgin olive oils (*):	
	— oils and fats from coconut, maize, rapeseed, sunflower, soybean, palm kernel and olive oils (composed of refined olive oil and virgin olive oil) (*) and mixtures of oils and fats with oils and fats only from this category,	1 250
	— other vegetable oils (including pomace olive oils (*)), fish oils and oils from other marine organisms and mixtures of oils and fats with oils and fats only from this category,	2 500
	— mixtures of oils and fats from the two abovementioned categories.	— (*****)
4.3.2.	Vegetable oils and fats, fish oils and oils from other marine organisms destined for the production of baby food and processed cereal-based food for infants and young children (2)	750 (******)
4.3.3	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (2) (23) and young-child formula (23) (**) (powder)	125 (*******)
4.3.4	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children (2) (23) and young-child formula (23) (**) (liquid)	15 (*******)

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