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Food Nutrition Security

Total Diet Study training using the MCRA software

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Contribution from BfR, University of Ghent, Wageningen Research and Premotec

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Food Nutrition Security

- Standardisation of TDS input data of three countries NL, DE and BE to ensure applicability in several countries
- Harmonized approach using codes and standard formats agreed by the European Food Safety Authority (EFSA) and EU Member States for food safety
- MCRA TDS Demonstrator available in the Azure cloud
- Training materials for users (community of practice)

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Content

Lecture 1: international interest in Total Diet Studies (TDS)

Lecture 2: risk assessment based on TDS data

Lecture 3: TDS applied in Belgium for training courses of students (community of practice)

Hands-on training: how MCRA is used in a harmonized TDS approach

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Lecture 1: international interest in Total Diet Studies

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Ministry of Health, Welfare and Sport

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Content lecture 1

- What is a Total Diet Study?
- Why is it important at the international level?
- EU project TDS-exposure
- FNS-Cloud project

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EFSA – FAO – WHO guidance TDS

Materials

European Food Safety Authority

World Health Organization

EFSA Journal 2011; 9(11):2450

JOINT GUIDANCE OF EFSA, FAO AND WHO

Towards a harmonised Total Diet Study approach: a guidance document[1]

European Food Safety Authority (EFSA), Parma, Italy[2, 3]

Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

World Health Organization (WHO), Geneva, Switzerland

https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2011.2450

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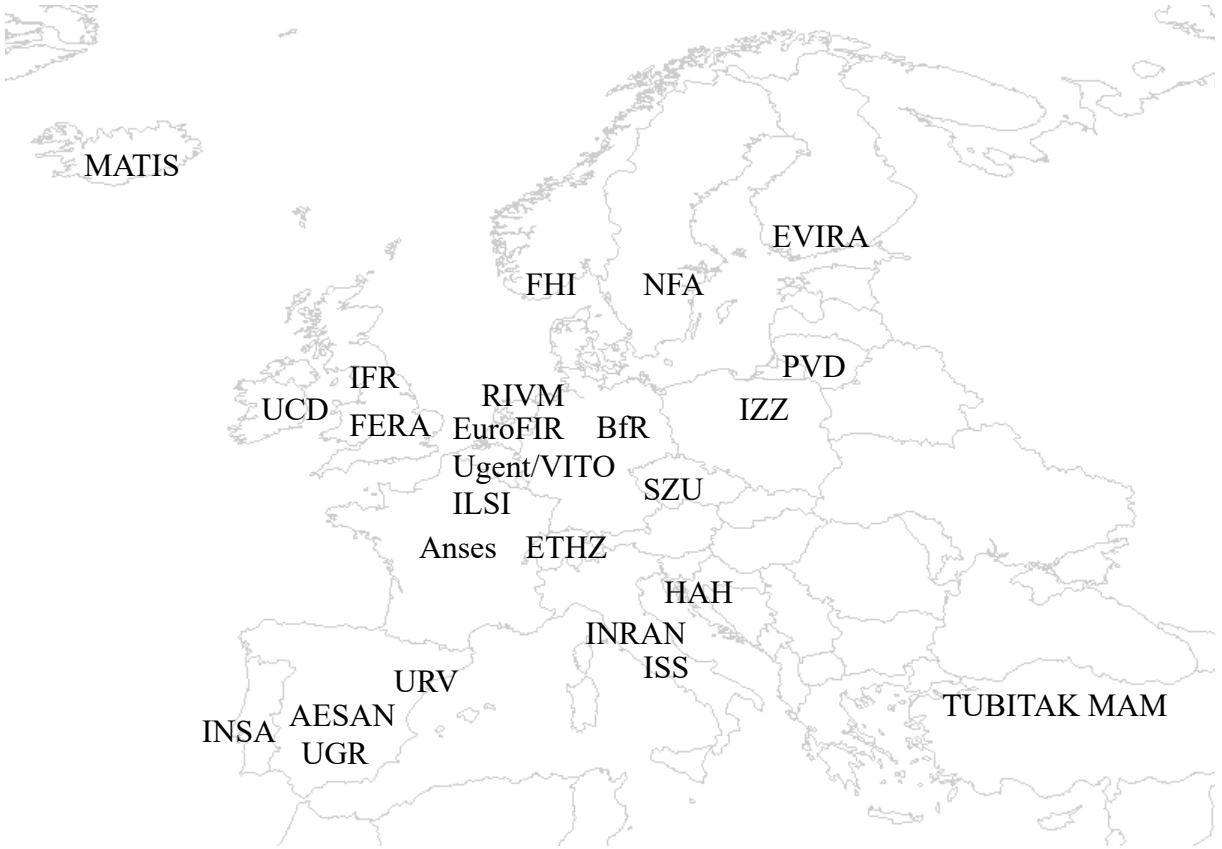
EU funded project TDS-exposure

- Collaborative 4–year research project
- Funded by European Commission within 7th Framework programme
- Conducted from 2012 – 2016
- Coordinator:

  French Agency for Food, Environmental and Occupational Health & Safety (ANSES)
- http://www.tds-exposure.eu/

Partners



- 26 beneficiaries

- 19 European countries: Belgium, Czech Republic, Finland, France, Germany, Ireland, Italy, Latvia, The Netherlands, Poland, Portugal, Spain, Sweden, UK, Croatia, Iceland, Turkey, Norway and Switzerland.

- Different structures:
10 research centres
6 food safety agencies
5 universities
4 national institutes for public health
1 SME

Features of TDS study

Concentrations of chemicals are analysed in pooled homogenised food samples:

- Average levels per sample ⇒ long-term exposure

  Variation in concentrations between foods may not be fully covered

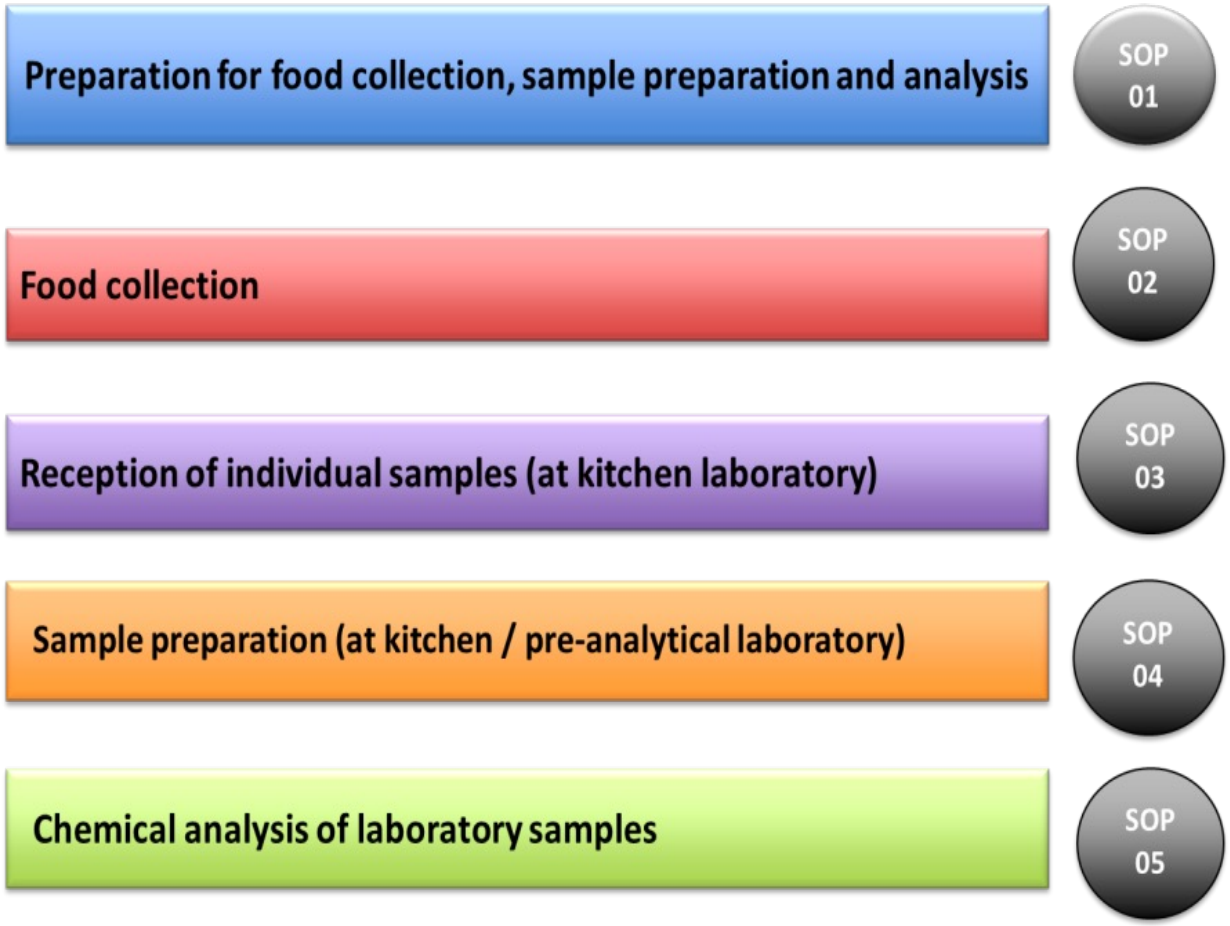
- Analysed as consumed

Objective: harmonisation

Harmonization of TDS method

1. Preparation of Standard Operating Procedures (SOPs) to assure quality and consistency of TDS
2. Testing feasibility of SOPs in practice via a pilot study
3. Use of the same exposure assessment software to assess the exposure to several contaminants

Standard Operating Procedures



Objective: harmonisation

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3. Use of the same exposure assessment software

Exposure

Food classification

- Mapping of food consumption data to analytical data obtained in TDS
- Use of FoodEx
  - International coding system, EFSA
  - Loss of detail compared to national codes
  - International standards data formats

Total Diet Studies - 6th International Workshop in Berlin

Worldwide exchange on planning, implementation and experiences with TDS

The German Federal Institute for Risk Assessment (BfR) and the World Health Organization (WHO) hosted the "6th International Workshop on Total Diet Studies (TDS)" on 10 and 11 October 2022. At the conference, countries from all over the world presented results and latest developments in the field of TDS.
The event was preceded by a four-day online tutorial on planning and conducting these studies, organised by 20 representatives of countries, planning to conduct their own TDS in the future took part.

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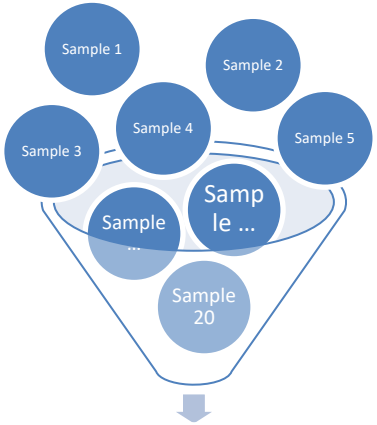
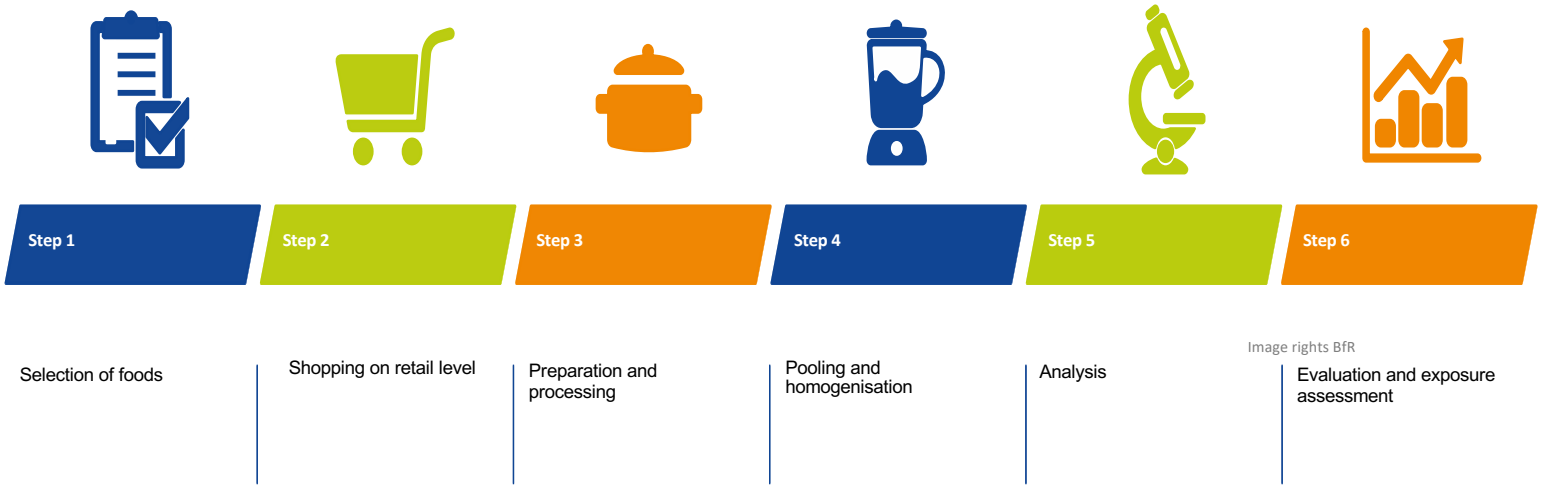
Explanation and practical steps of a TDS





Lecture 2: risk assessment based on TDS data

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Exposure is essential in risk assessment

Phillip(pus Theophrastus Aureolus Bombastus) von Hohenheim (Paracelsus), 1493 - 1541
Founder of toxicology

"dosis sola facit venenum"

(the dose determines whether a substances is a poison)

"All things are poison and nothing is without poison, only the dose permits something not to be poisonous"

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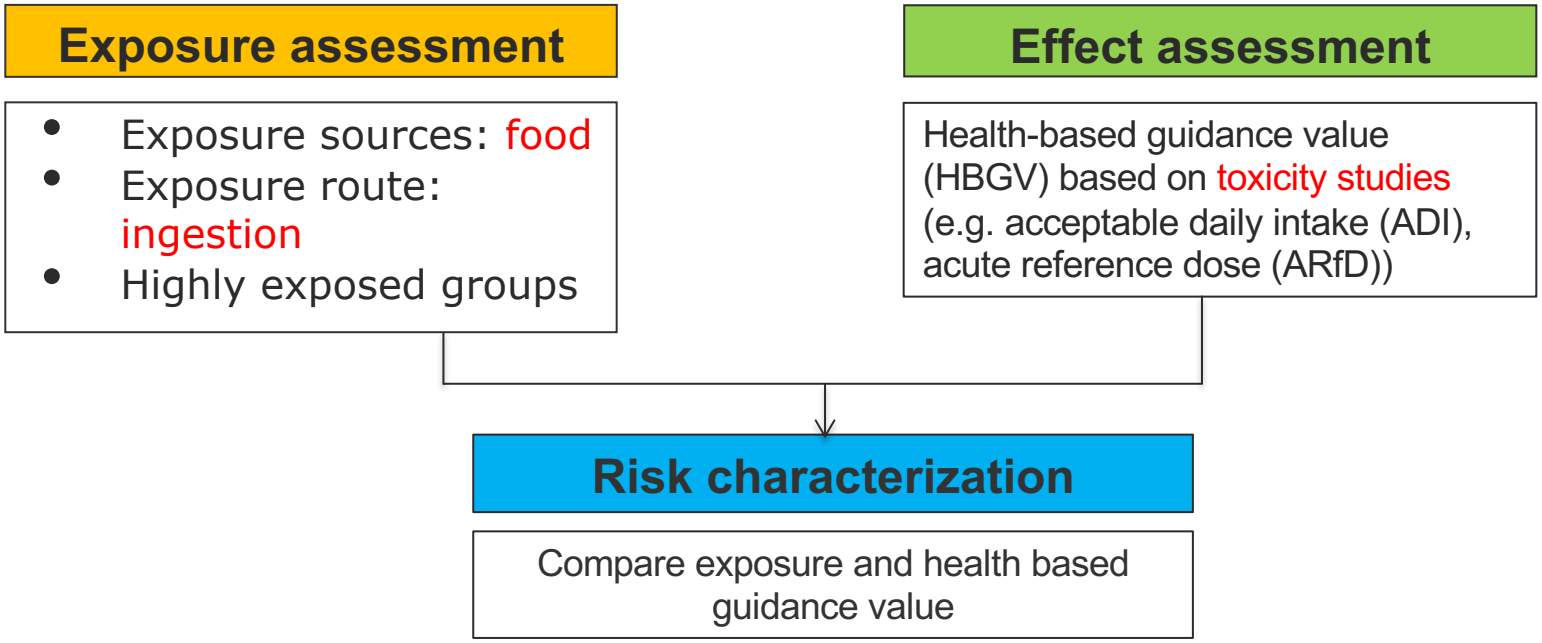
Risk assessment



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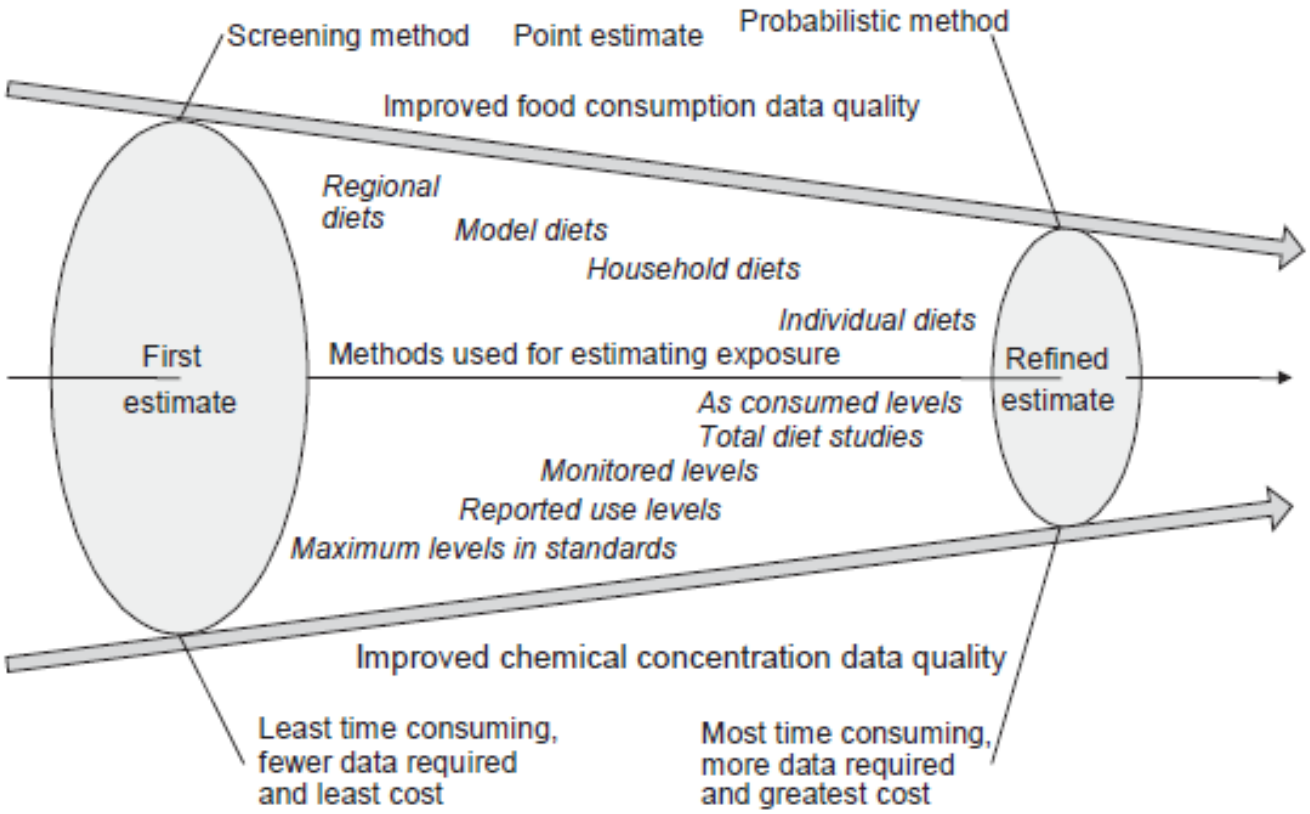
Stepwise (tiered) approach



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Which tier to use?

Tier to choose depends on:

- **Purpose** of the food safety assessment:
  - Realistic vs. screening
  - Refinement needed
- **Availability** of information
  - Data and models

General: higher tier assessments may be used when lower tiers show a possible safety concern or your aim is a realistic exposure estimate

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Dietary exposure assessment

$$\text{Dietary exposure} = \frac{\Sigma\ (\text{Concentration of chemical in food} \times \text{Food consumption})}{\text{Body weight (kg)}}$$

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Food consumption data

- National food consumption surveys
  - 2-7 days of food recalling (or recording)
  - EFSA comprehensive food consumption database (privacy sensitive data needs permission from data owner)
  - FAO/WHO Chronic individual food consumption database – Summary statistics (CIFOCOss)
  - FAO/WHO GIFT | Global Individual Food consumption data Tool
- Others
  - Food balance sheet data (GEMS/Food)
  - Household budget surveys
  - Food frequency information

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Individual data

- Body weight
  - Express exposure per kg body weight
  - Mean of a population
  - Body weight of an individual
- Age
  - Children vs adults
  - Women of child-bearing age
  - Elderly
- Other relevant variables:
  - Gender, socio-economic status, etc.

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Concentration data

- Monitoring data
  - EU directives to monitor for many chemicals
  - Ad hoc surveys
  - Initiatives from sector or retailers
  - EFSA Data lake data published on Zenodo
- Use levels for additives
  - From industry
- Data from Total Diet Studies (TDS)
  - Food as eaten
  - Representativeness depending on the sample size

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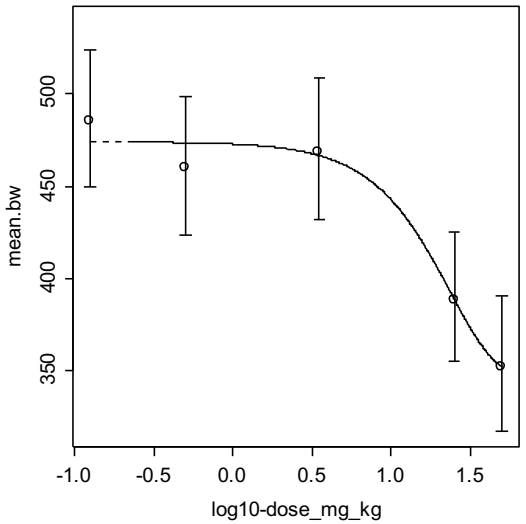
Hazard characterisation

- Derived for adverse effects for which no intake level can be defined below which there is a negligible effect (NO(A)EL) as point of departure for risk assessment (PODI)

  E.g. loss in IQ (lead), cancer (arsenic)

- Or PODI Intake level at which there is a predefined x% change (e.g. 5%) in an effect which is not deemed adverse:
  - Animal / epidemiological studies
  - Dose-response modelling



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Lecture 3. TDS applied in Belgium for understanding exposure to Nickel

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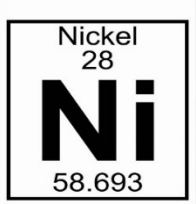
NICKEL ?



Relevance of Nickel as potential food safety hazard **?**

- A risk assessment of EFSA in 2015 stated that the occurrence of nickel in the diet is worrying for the general European population and for Ni-sensitive individuals (EFSA, 2015)

efsa
European Food Safety Authority

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Chemical food safety: substance: Single Hazard (Nickel)

Plant-based foods

Foods of animal origin

Drinks

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Data for Nickel study

- Nickel concentration in foods➔ investigation conducted at Ugent➔ Available in EFSA format (data owner)

- Belgian Food consumption data 2014 (BNFCS)➔Sciensano➔ purchased by University of Gent for INNIBEL project and for FNS CLOUD project (no data owner)

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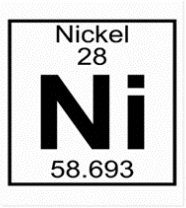
Food samples, sampling plan and analysis of the samples

- Risk-based sampling plan

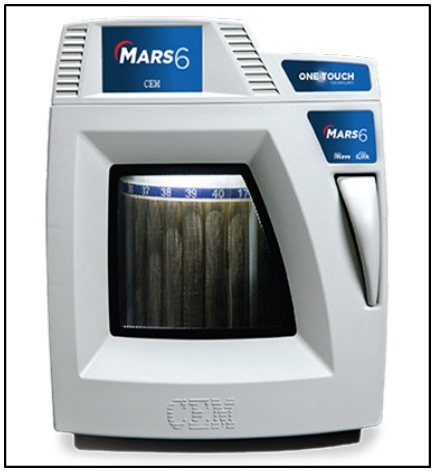
❖ In total 708 samples

❖ Three major food categories:

- Plant-based foods (N = 406)
- Foods of animal origin (N = 113)
- Drinks (N = 189)



- Microwave-assisted acid digestion, ICP-MS analysis



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Individual data (consumption)

- Body weight
  - Express exposure per kg body weight
  - Body weight of an individual
- Age
  - Children, adolescents and adults

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Aggregated Dietary exposure assessment

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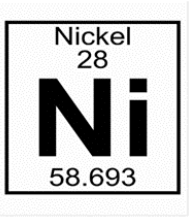
Exposure assessment (method)



- Ni screening data (main focus on foods and drinks)➔ every food was analyzed separately
- Belgian food consumption data 2014
- Chronic exposure (two days consumers)
    - Pooling : Food category or Food type
    - Aggregated exposure assessment
    - Simple distribution approach

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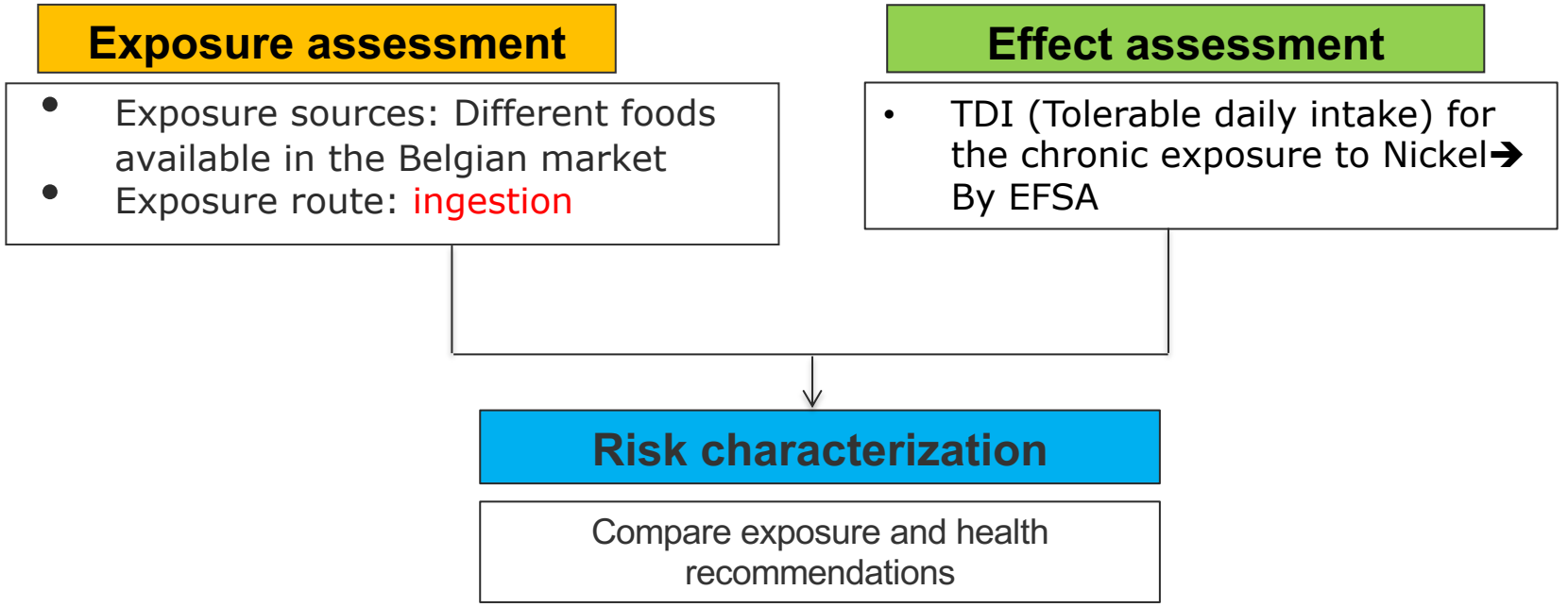
Risk assessment



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Risk assessment

- Comparison of calculated exposure with TDI of 13 µg/kg bw/day

- For children, adolescents and adults➔ no exceeding from the aforementioned reference value was observed.

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Hands-on training: how MCRA is used in a harmonized TDS approach

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Learning goals

- Get familiair with MCRA
  - Create and run a standard action: TDS Belgium Nickel
  - Run a standard action: TDS Netherlands DON
  - Run a standard action: TDS Germany methylmercury
  - Understand seasonal and regional variation
  - Understand the output
  - Upload your own data
  - Documentation

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MCRA

- mcra-training.rivm.nl
- MCRA training

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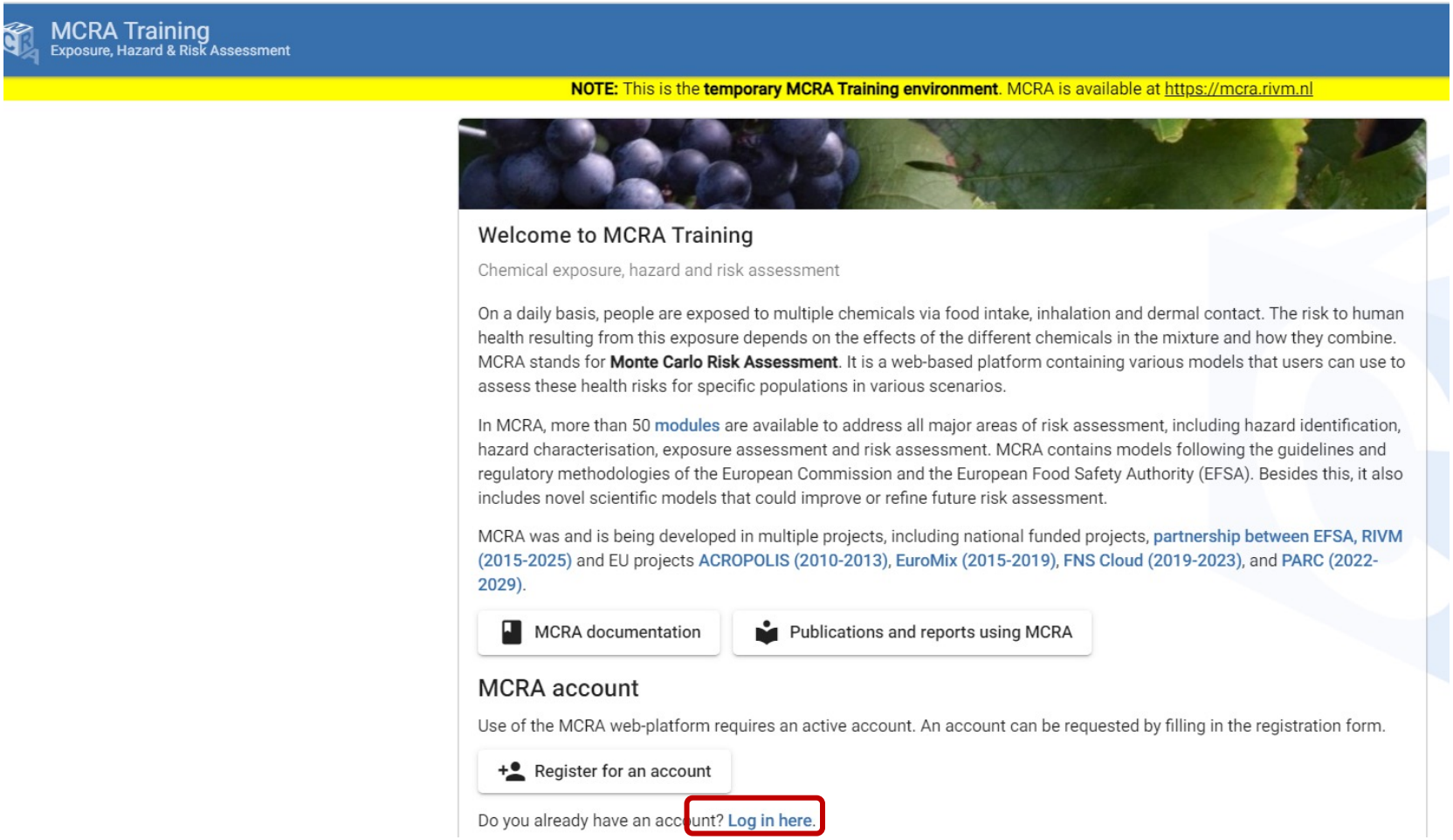
Opening page with short explanation



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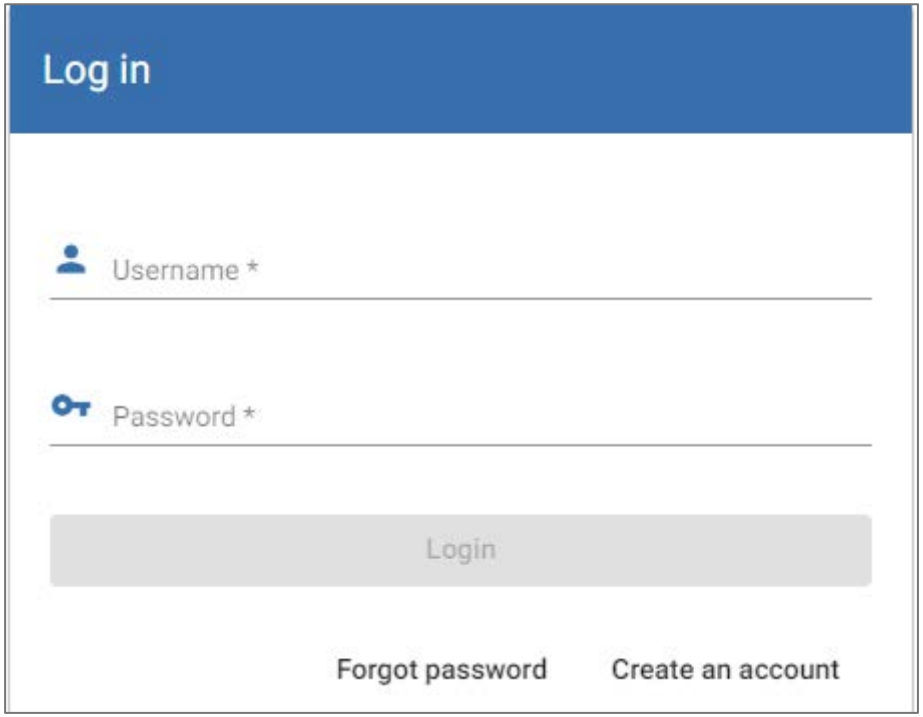
Login



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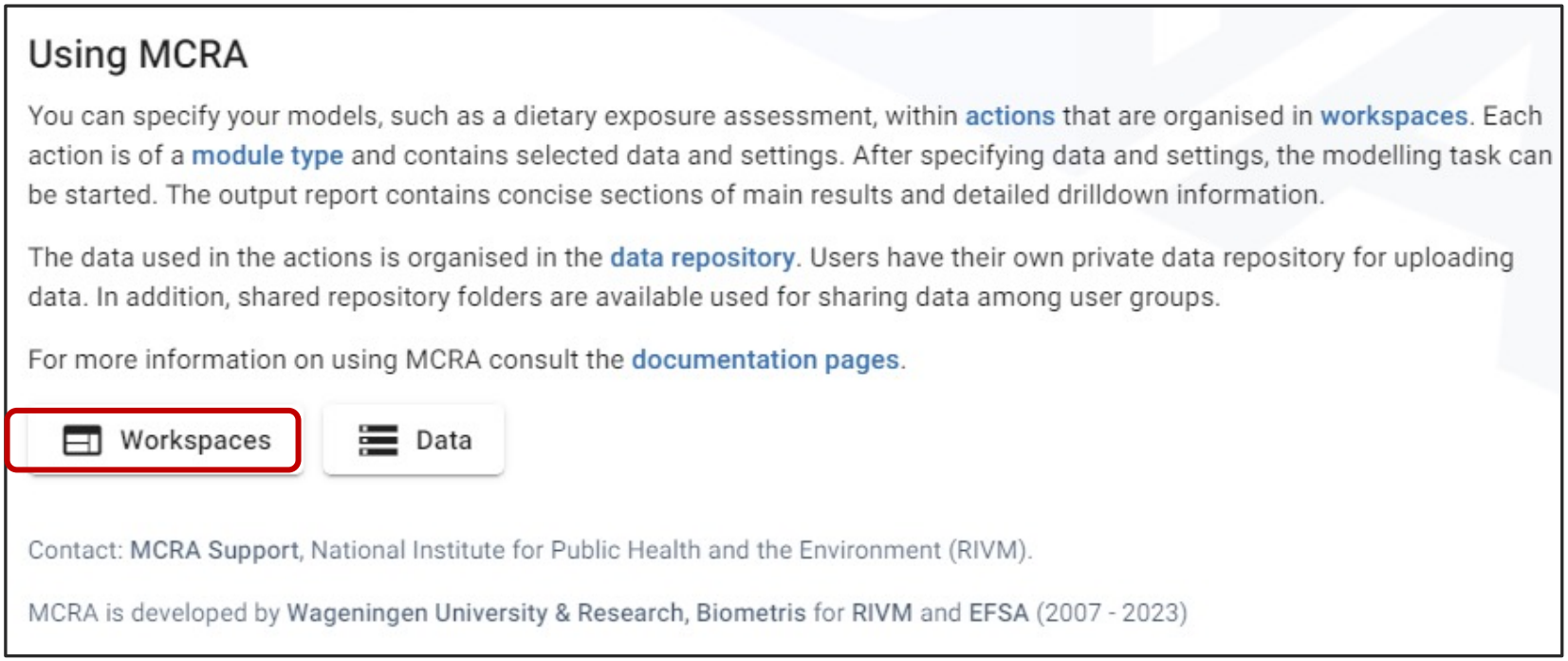
Create workspace (1)

- Select workspaces



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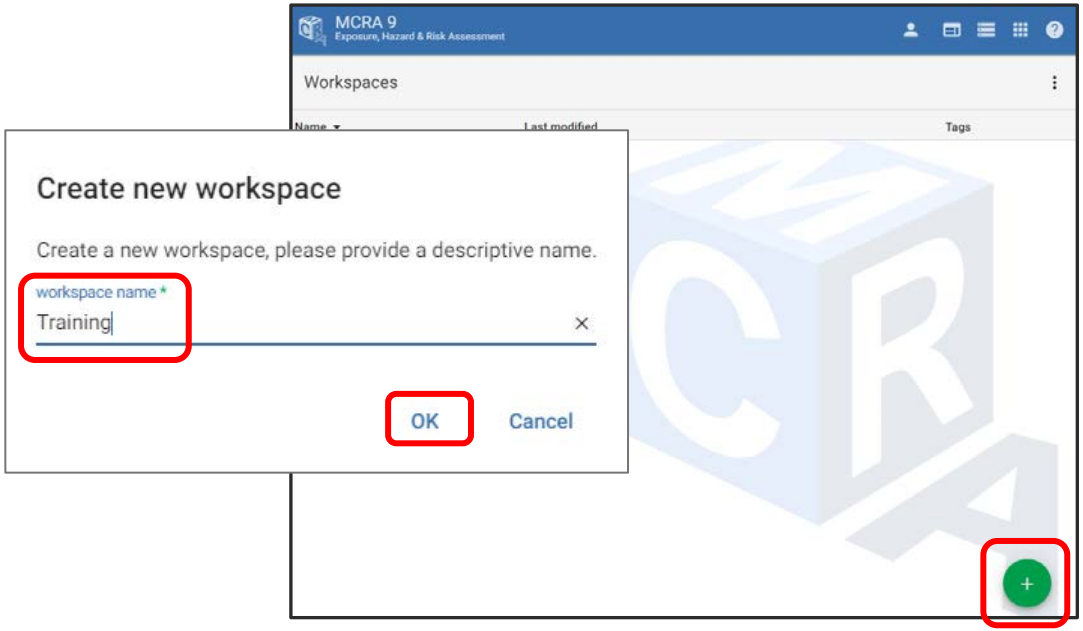
Create workspace (2)

- Create workspace by clicking +
- Give the workspace a name and click on ‘OK’



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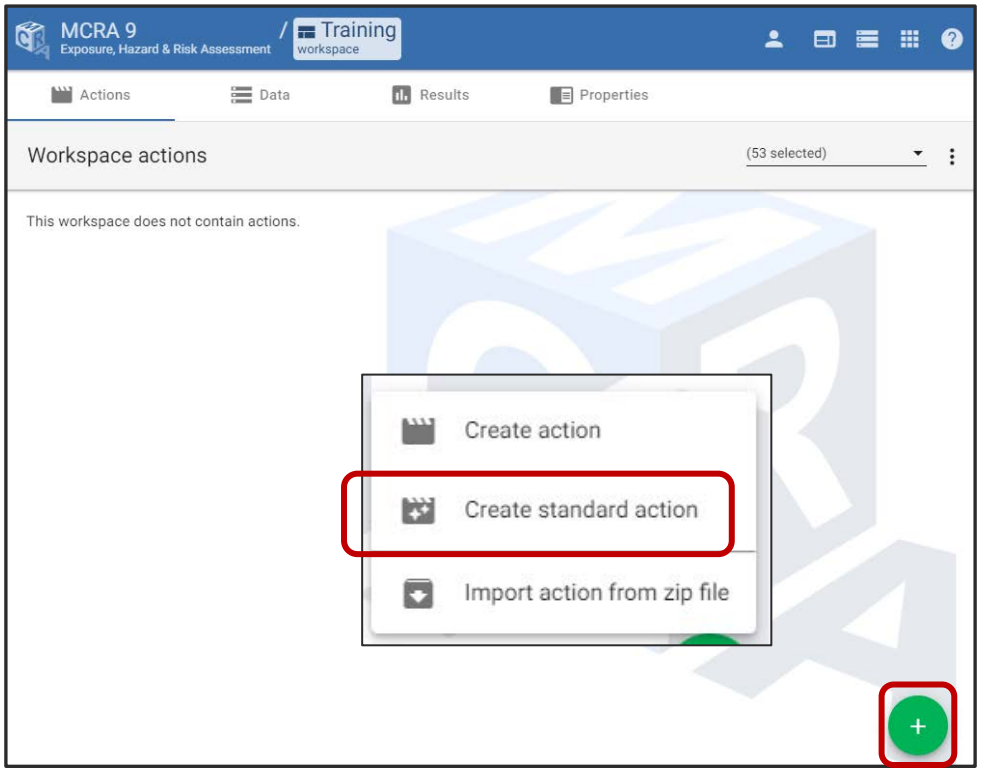
Create standard action (1)

Create a standard action by clicking +

Select create standard action



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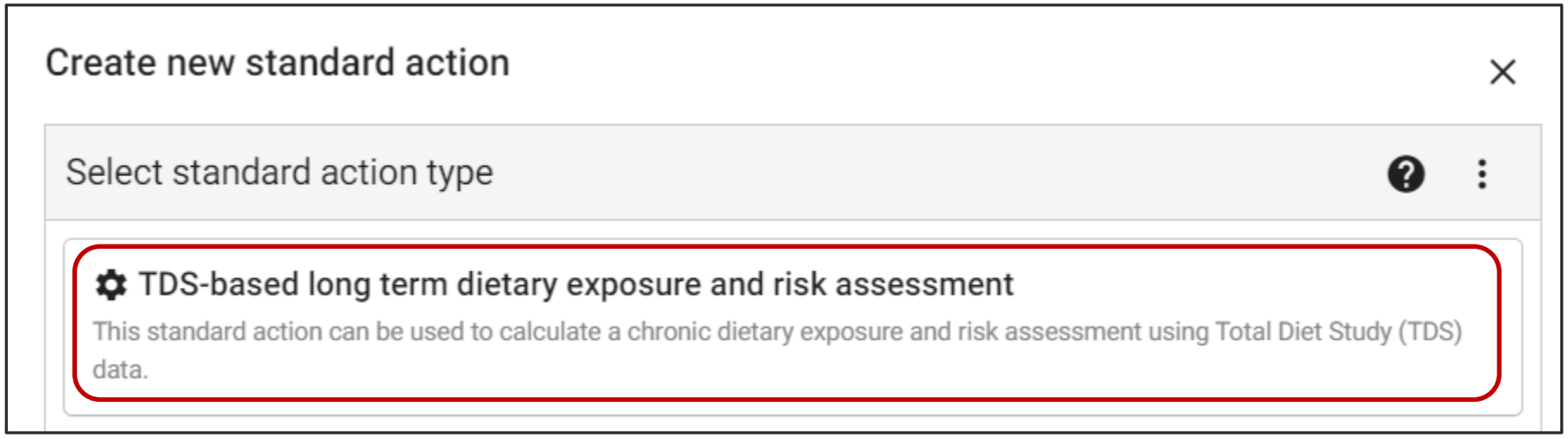
Create standard action (2)

Select ‘TDS-based long term dietary exposure and risk assessment’



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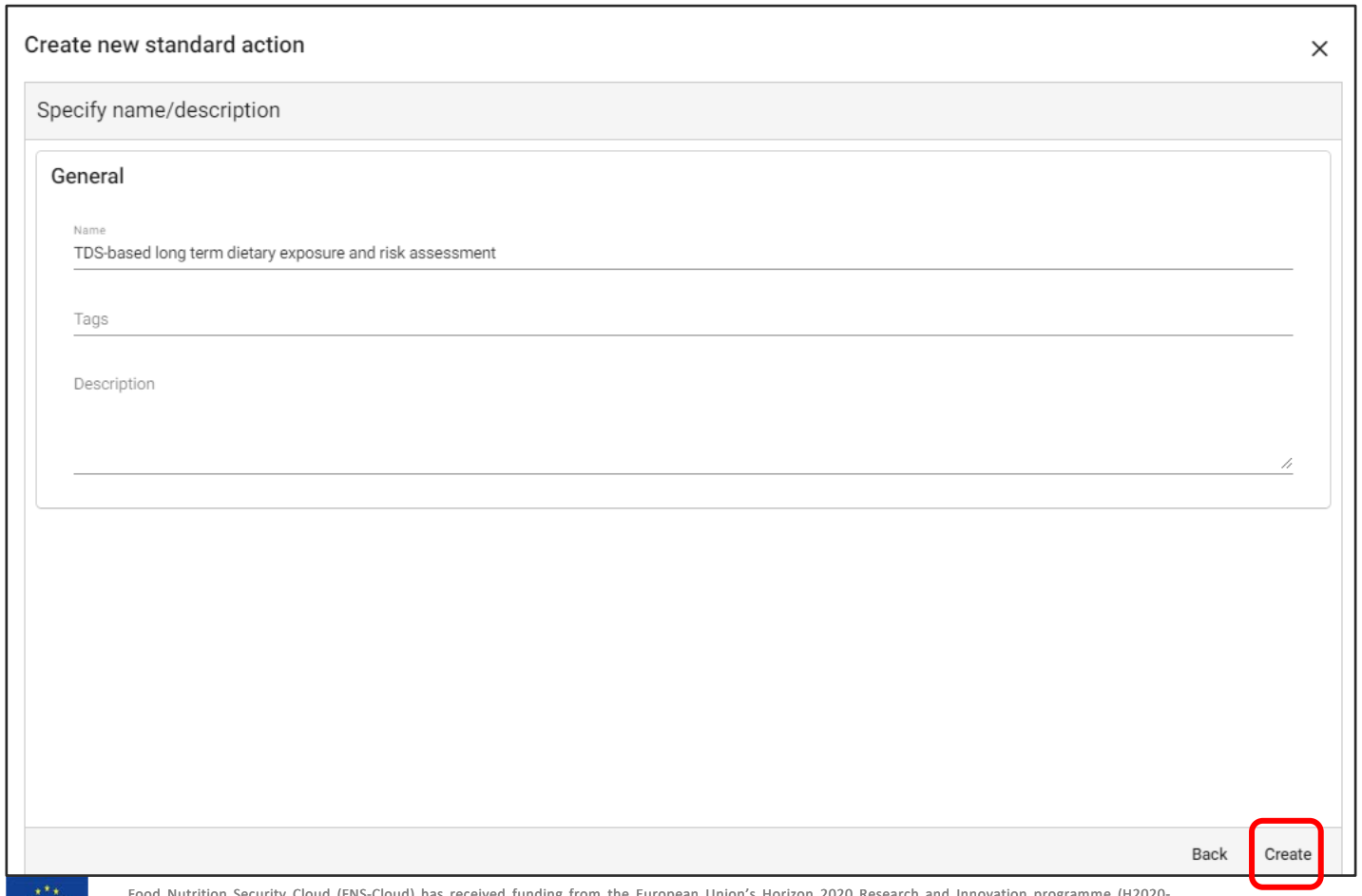
Create standard action (3)

Select ‘Create’



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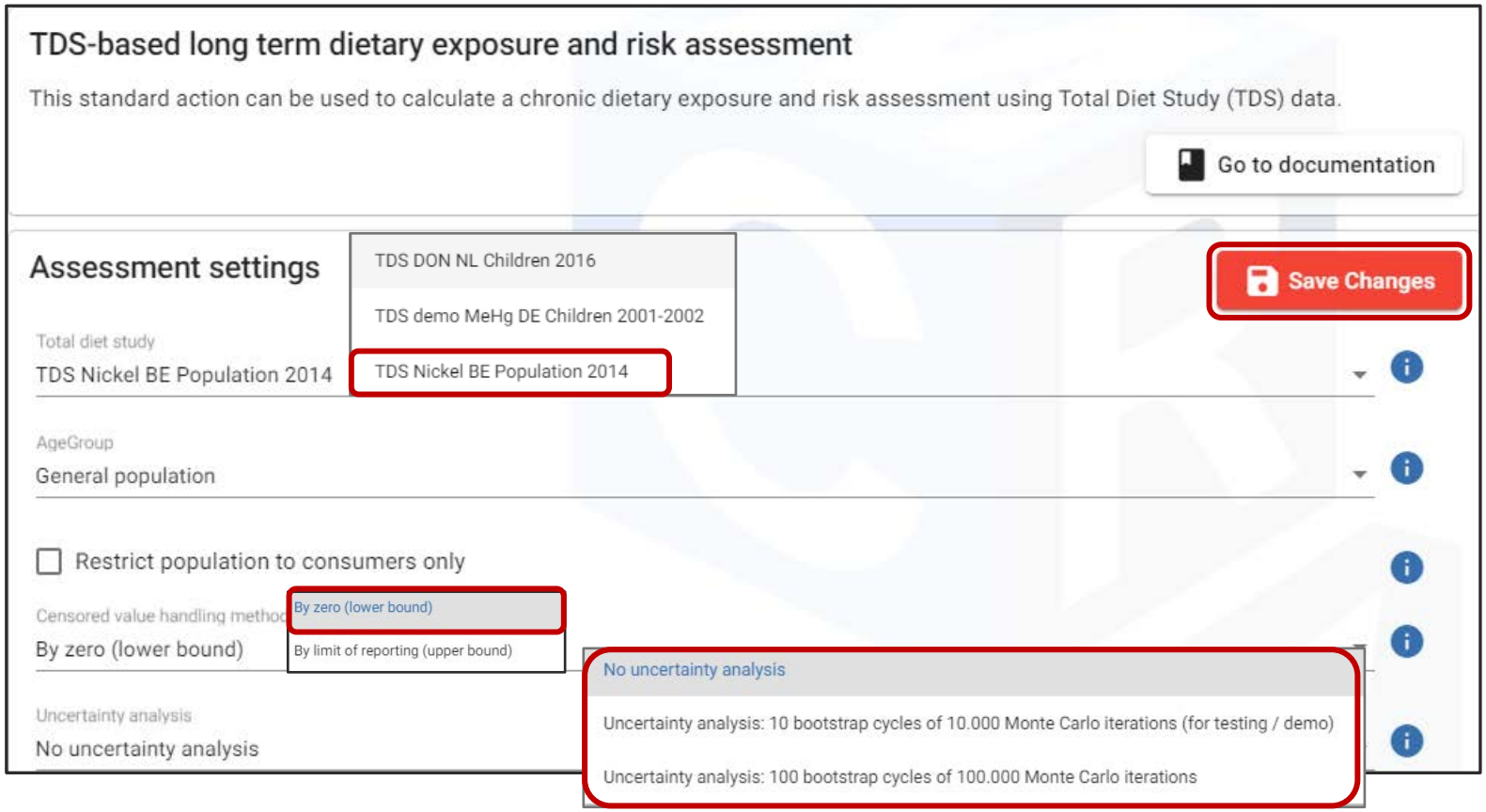
Inspect settings

- Select TDS Nickel BE Population 2014
- Press **Save Changes**



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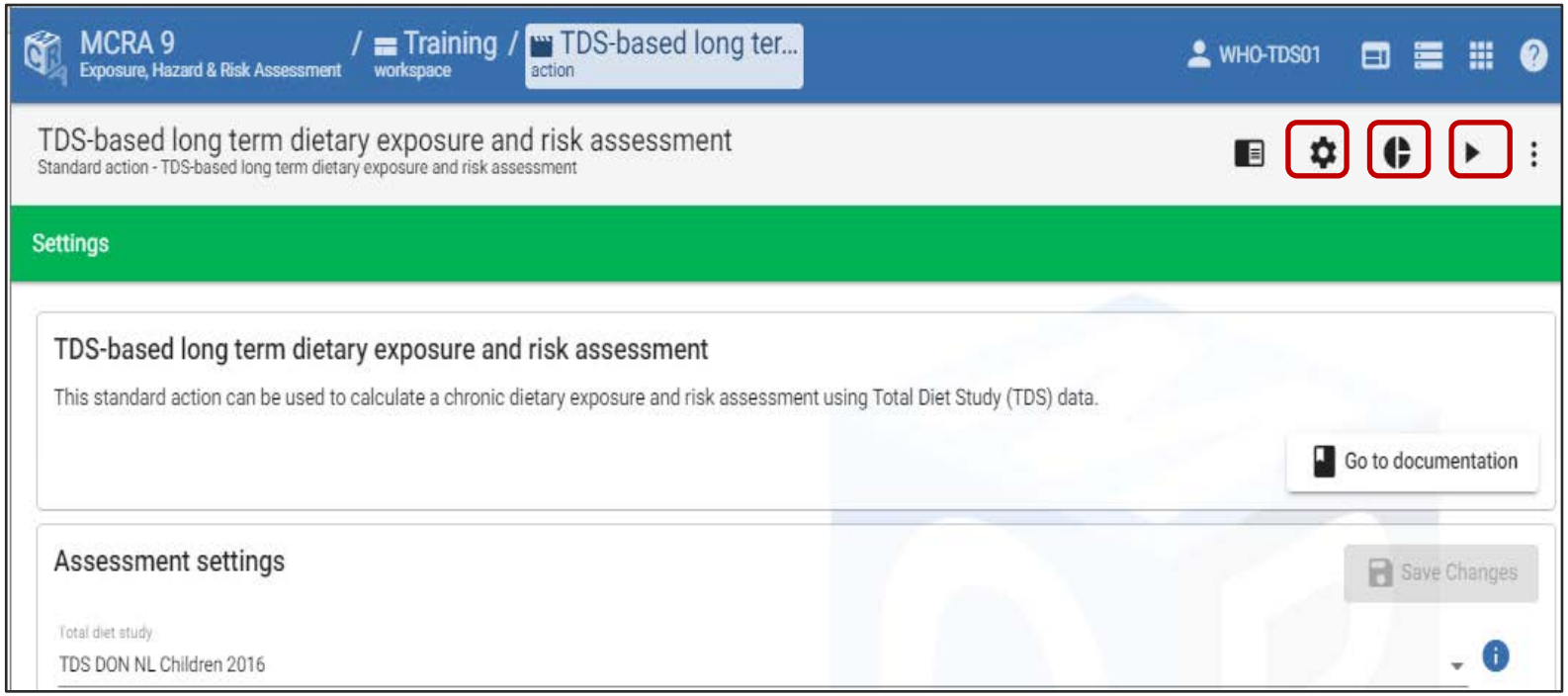
Navigation pane exercise

- Go to 'Settings'
- Go to 'Results'
- Run an action



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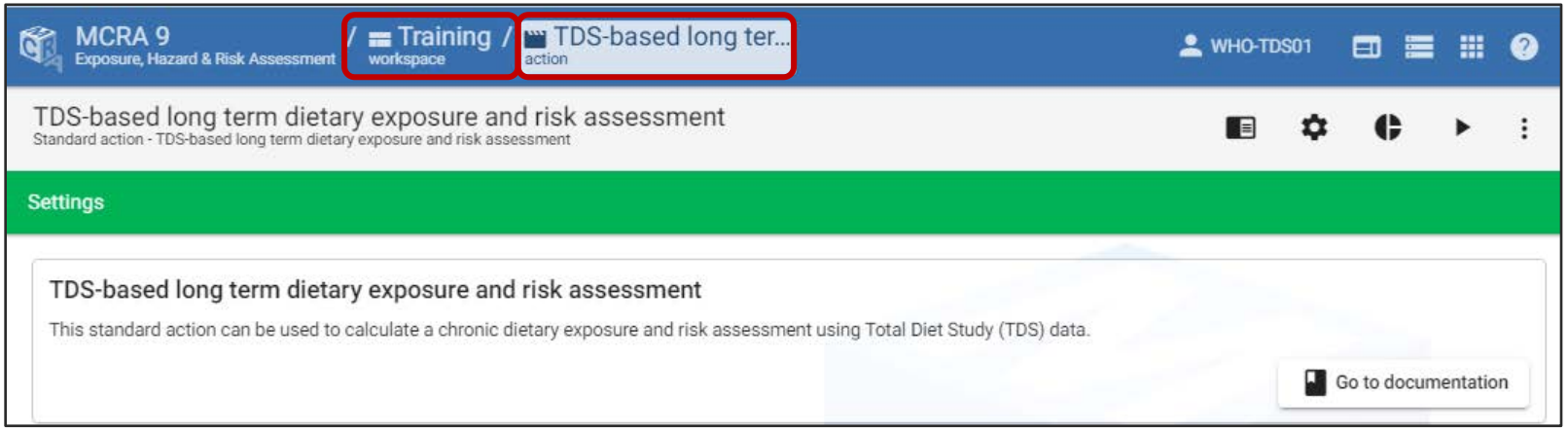
Navigation pane exercise

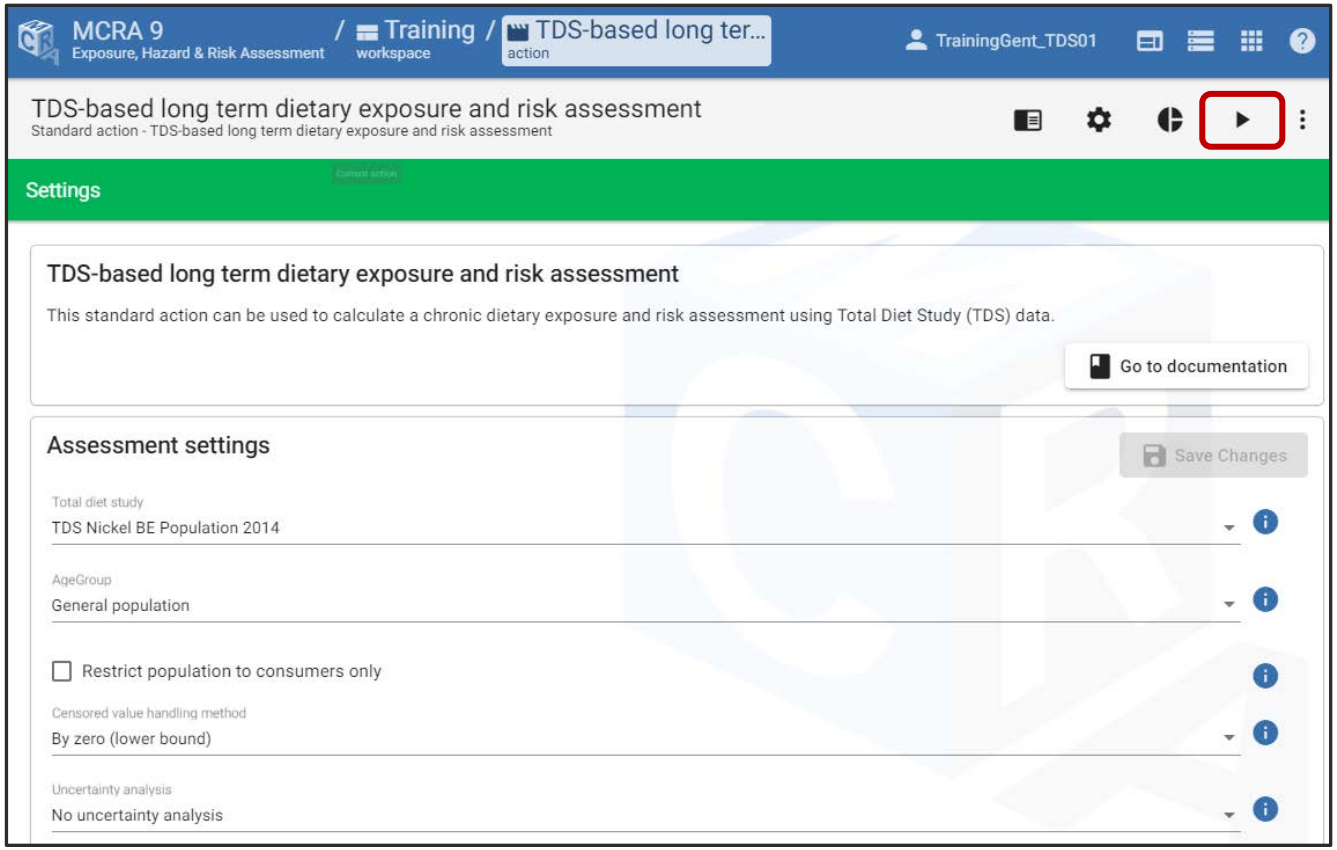
- Go to ‘action’
- Go to ‘Workspace’
- Go to action again



Food Nutrition Security Cloud (FNS-Cloud) has received funding from the European Union’s Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059 – www.fns-cloud.eu

Press run

Press run ▶



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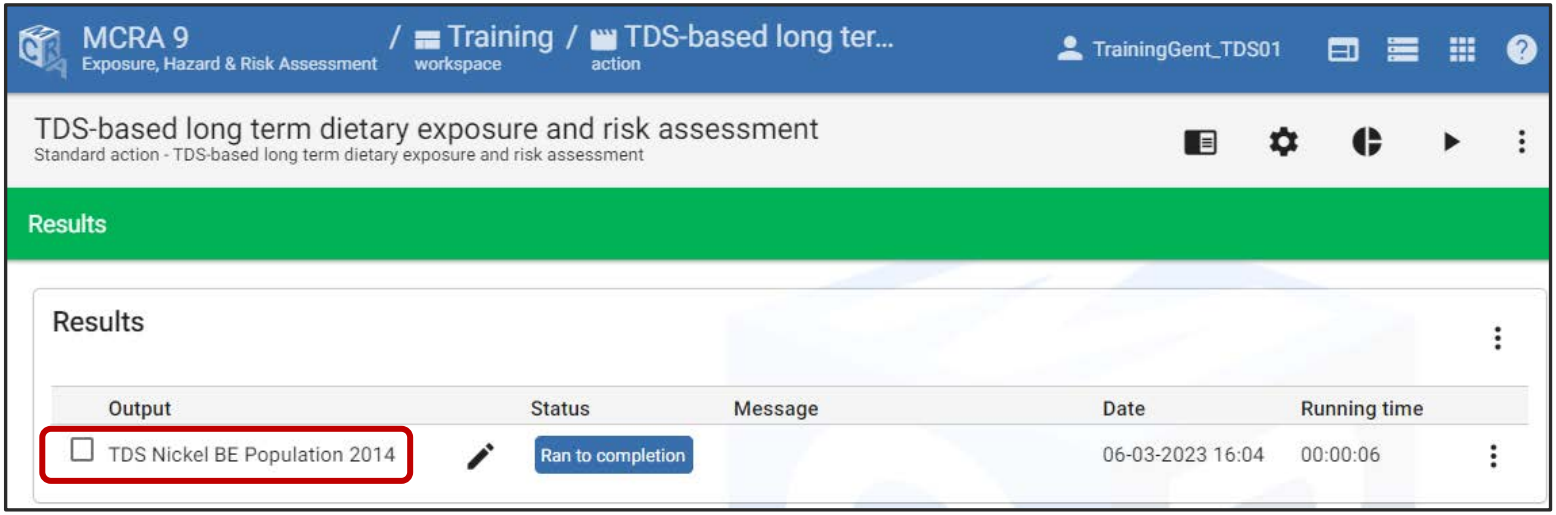
Wait for completion and open the report

Wait until the job has finished · Ran to completion

Open report by clicking on the name of the output



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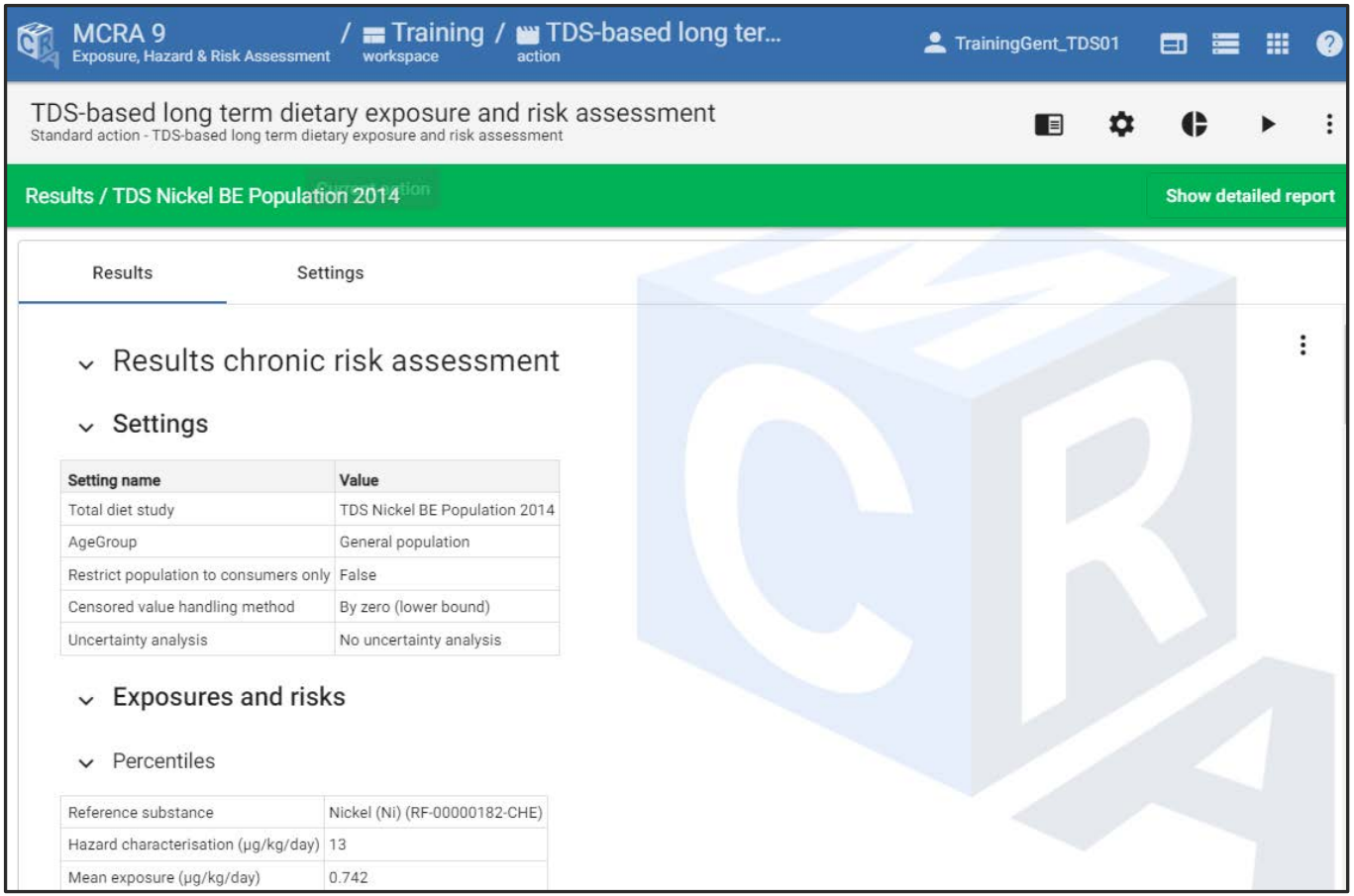
Browse through the report

- Browse through the report



FNS-Cloud
Food Nutrition Security

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Exercise E1

- Report the exposure at the 50- and 95-percentile.
- Which foods are contributing most to the dietary exposure?

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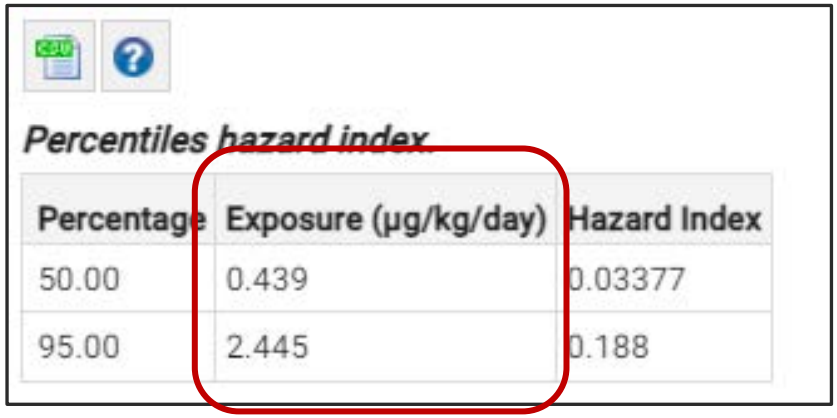
Exposure at p50- and p95



Percentiles hazard index

Percentage	Exposure (µg/kg/day)	Hazard Index
50.00	0.439	0.03377
95.00	2.445	0.188

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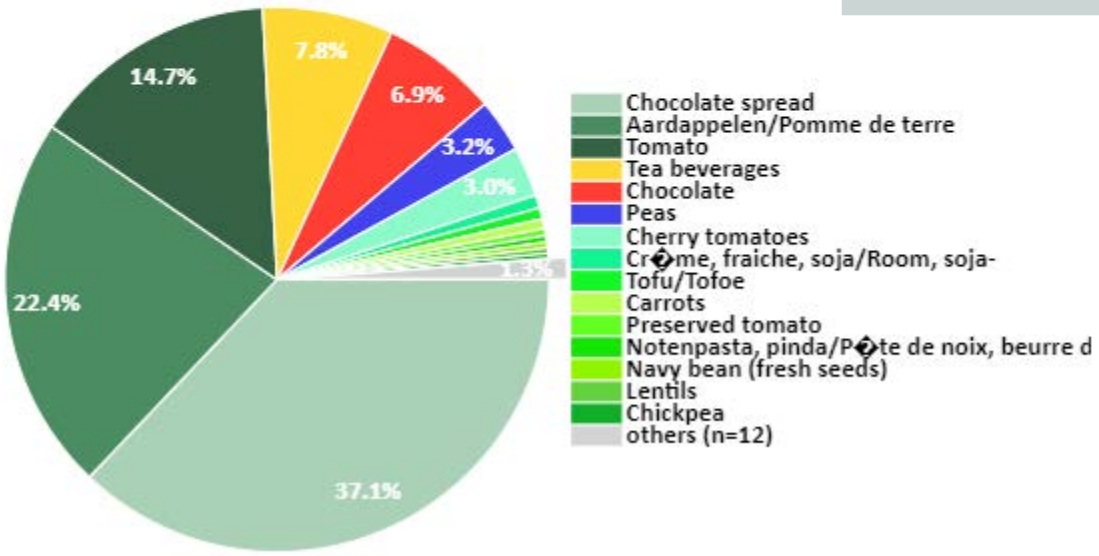
Foods contributing the most

Exposures by modelled food (total distribution)

Total 37 modelled foods.

Contribution to total exposure distribution for modelled foods.



Food	Contribution (%)
Chocolate spread	37.1
Aardappelen/pomme de terre	22.4
Tomato	14.7

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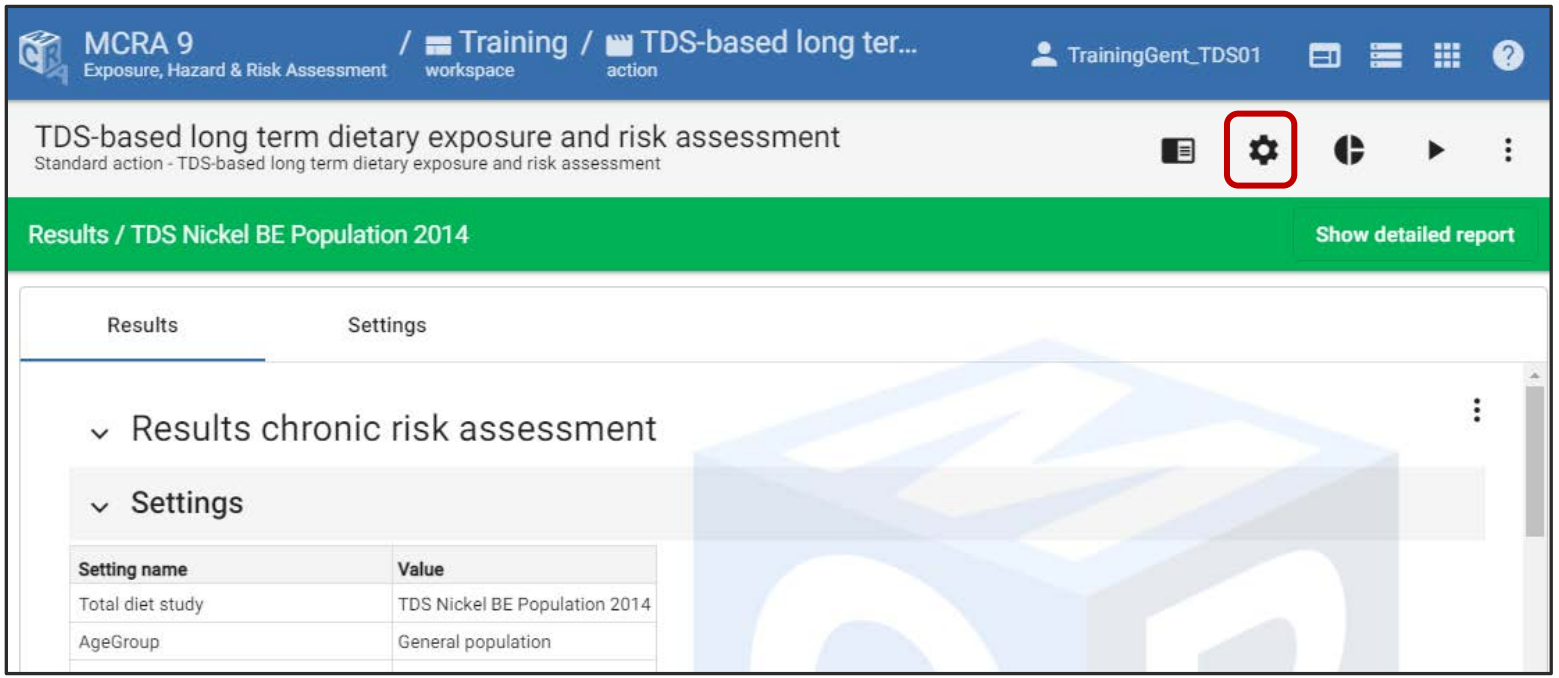
TDS Netherlands

- Go to Settings 



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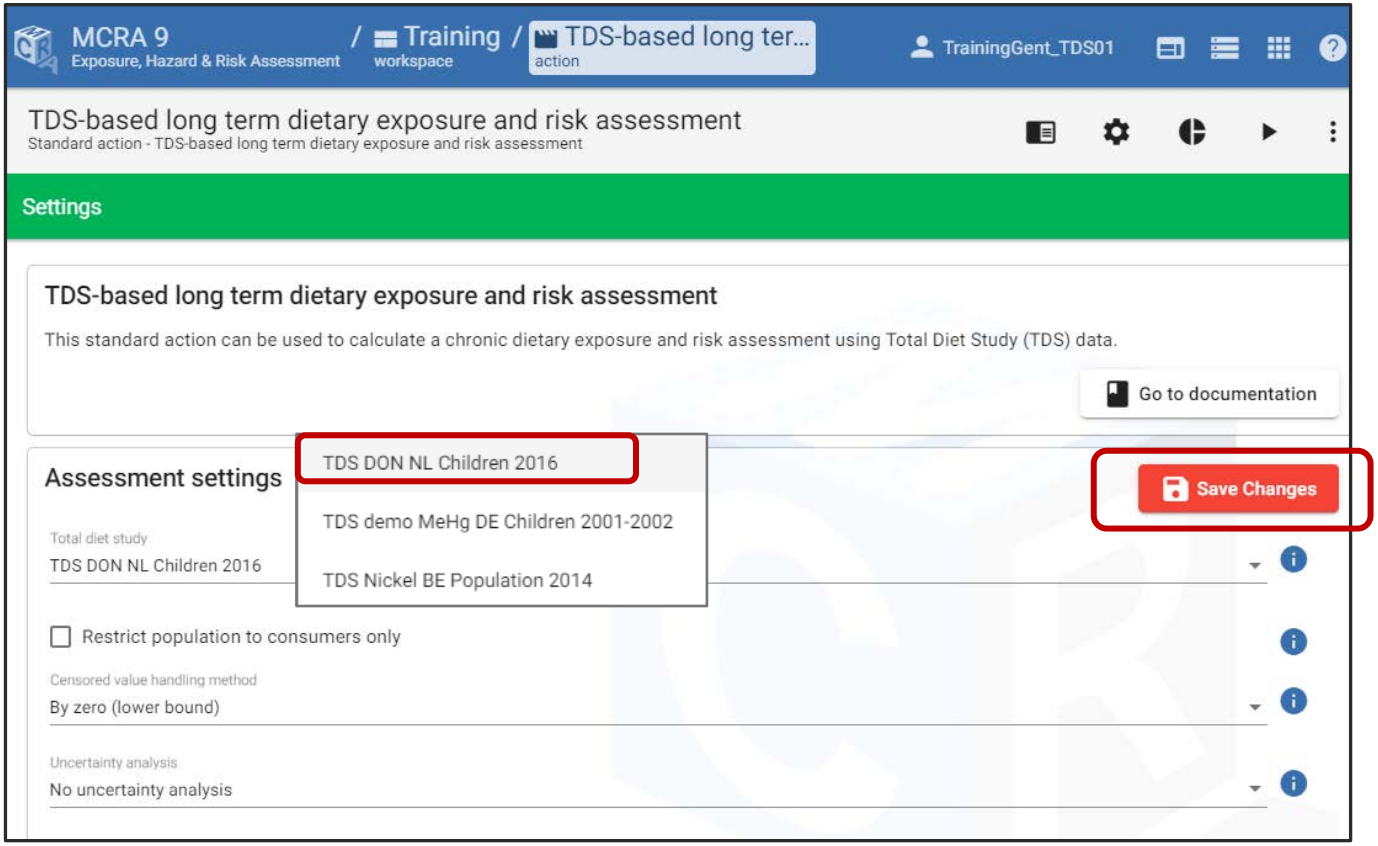
Inspect settings

- Select TDS DON NL Children 2016
- Press **Save Changes**



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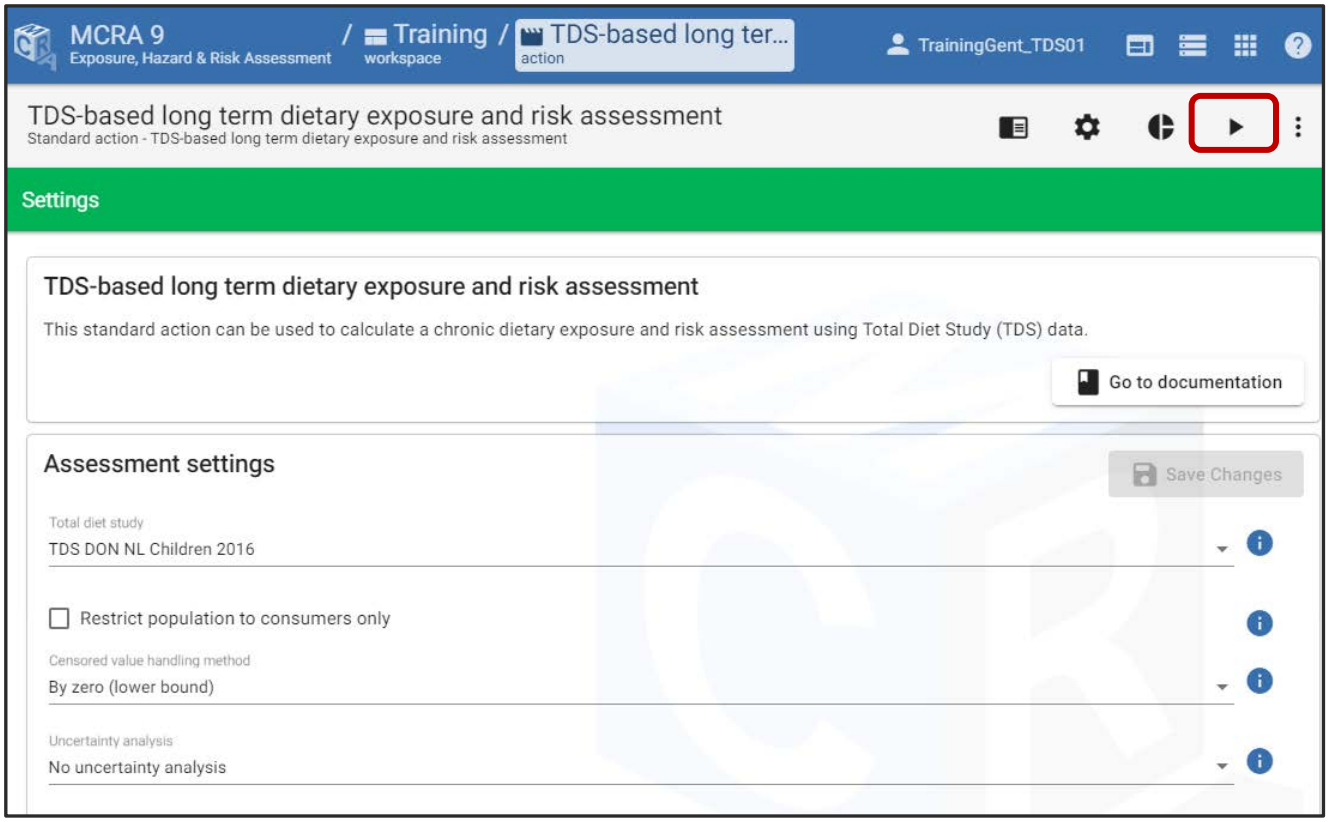
Press run

Press run ▶



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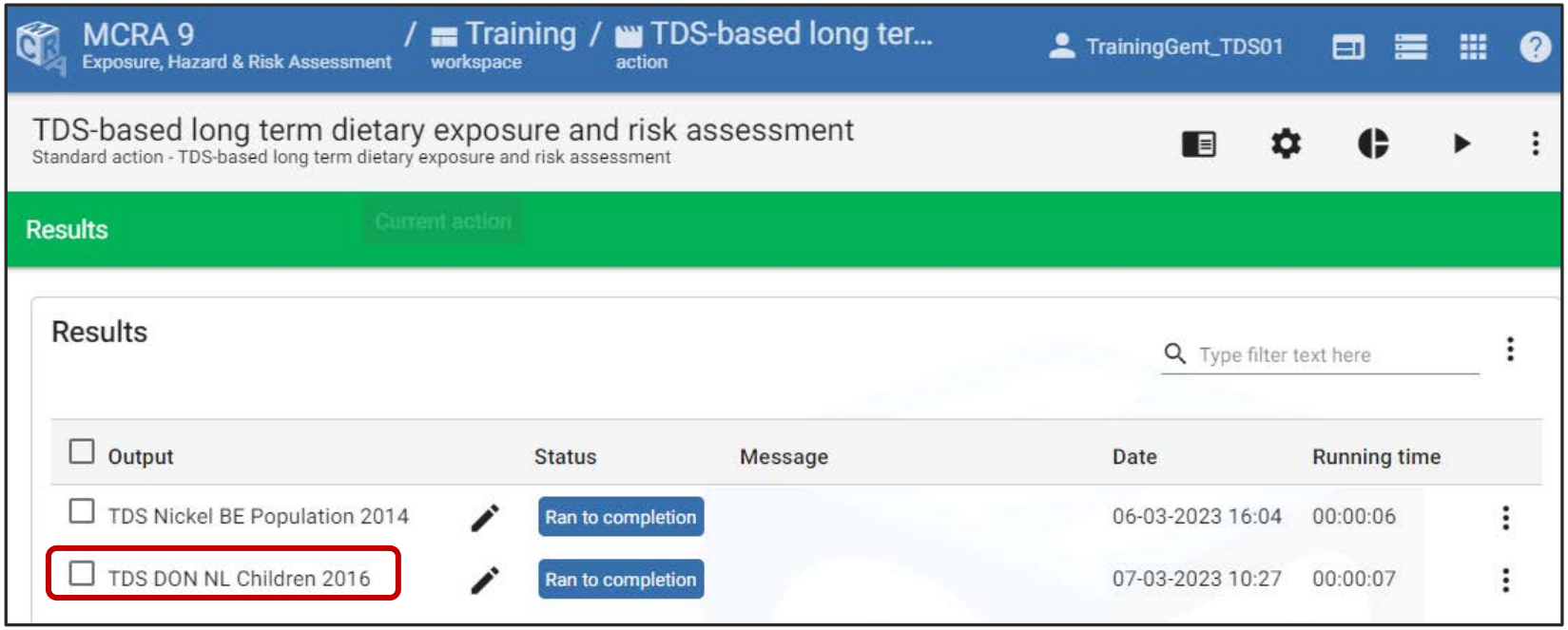
Wait for completion and open the report

Wait until the job has finished → Ran to completion

Open report by clicking on the name of the output



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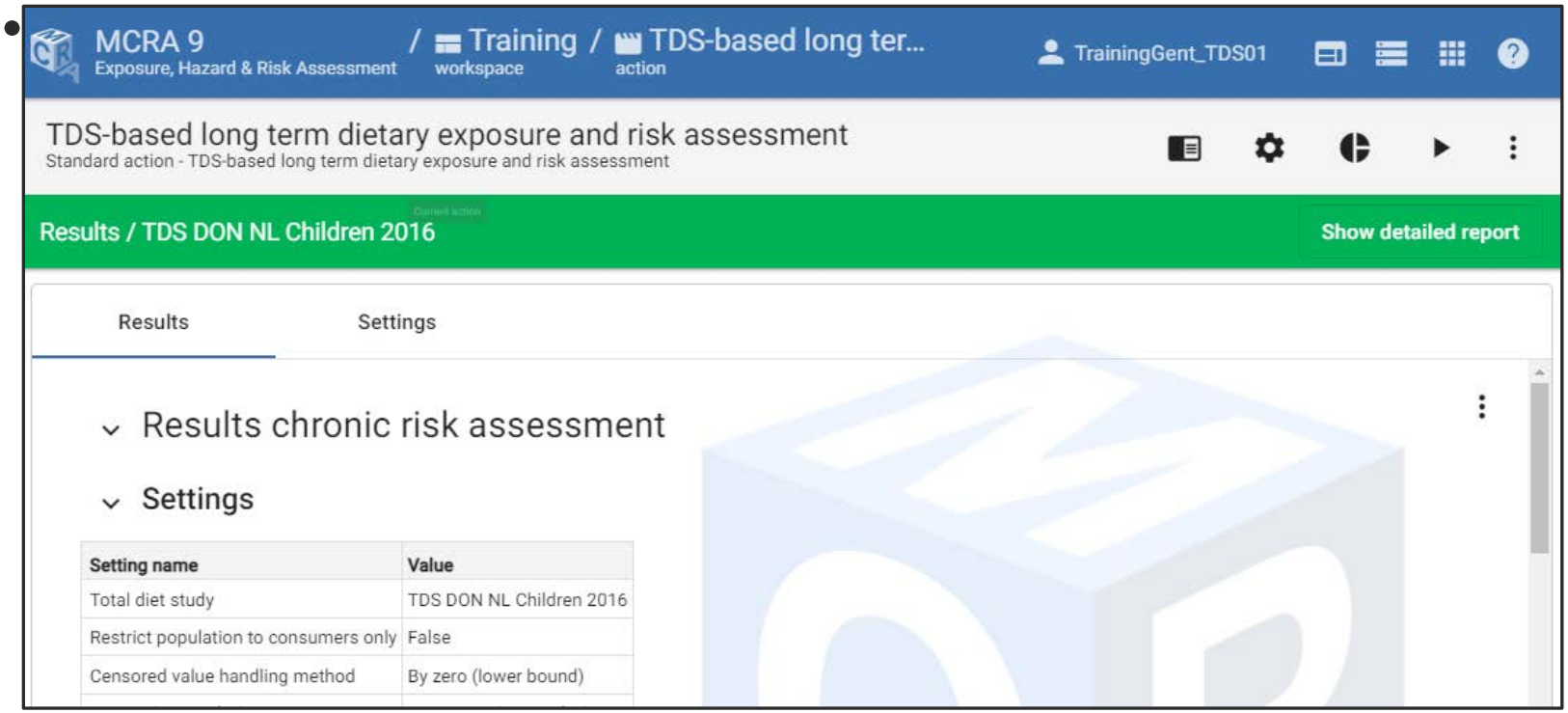
Browse through the report

- 

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Exercise E2

- Report the exposure at the 50- and 95-percentile.
- Which foods are contributing most to the dietary exposure at main level?
- Which foods are contributing most to the dietary exposure at level 1?

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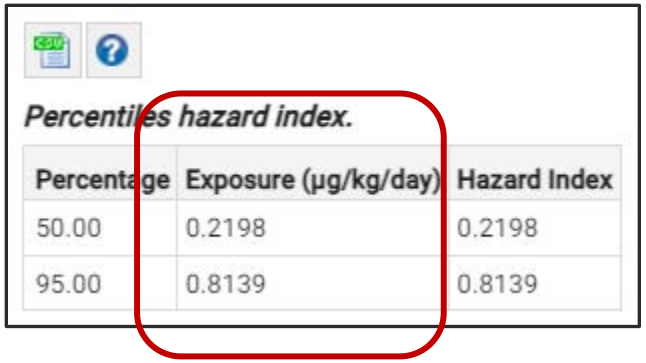
Exposure at p50- and p95



Percentiles hazard index.

Percentage	Exposure (µg/kg/day)	Hazard Index
50.00	0.2198	0.2198
95.00	0.8139	0.8139

FNS-Cloud Food Nutrition Security

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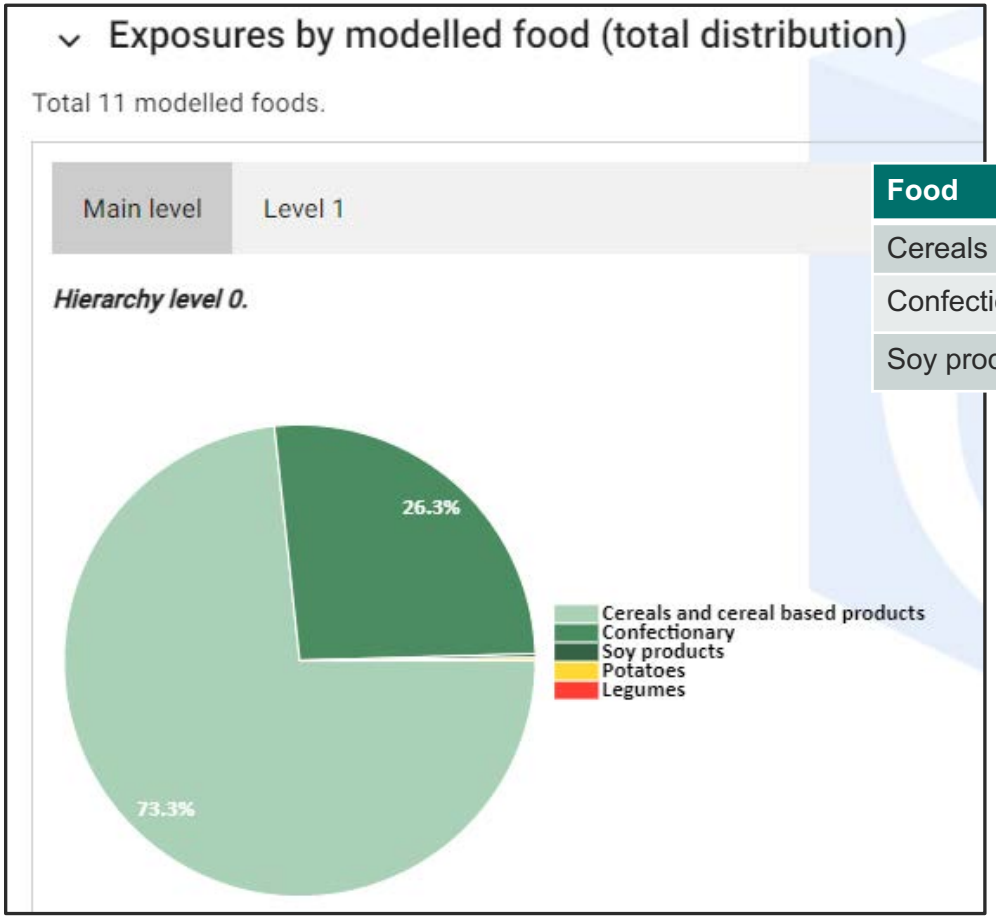
Foods contributing the most at main level



Food	Contribution (%)
Cereals and cereal based products	73.3
Confectionary	26.3
Soy products	0.3

FNS - Cloud Food Nutrition Security

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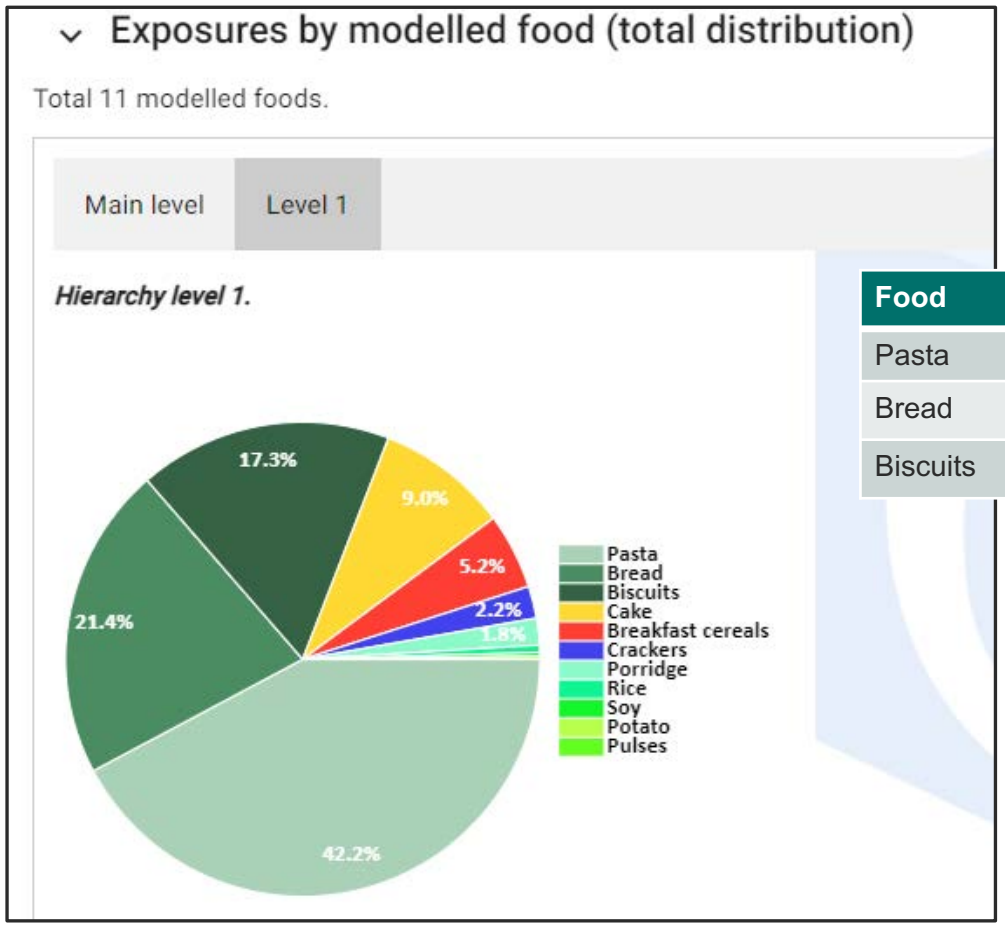
Foods contributing the most at level 1



Food	Contribution (%)
Pasta	42.2
Bread	21.4
Biscuits	17.3

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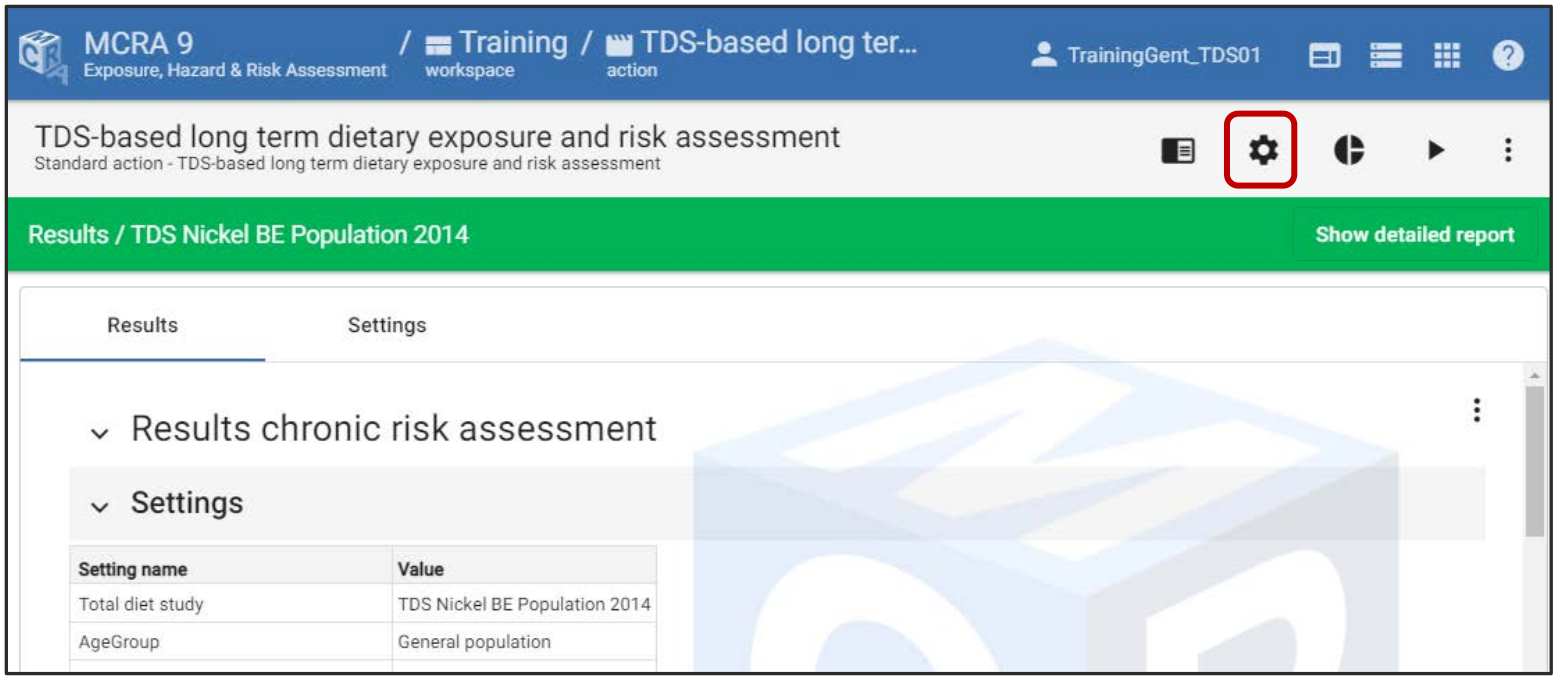
TDS Germany seasonal and regional

- Go to Settings 



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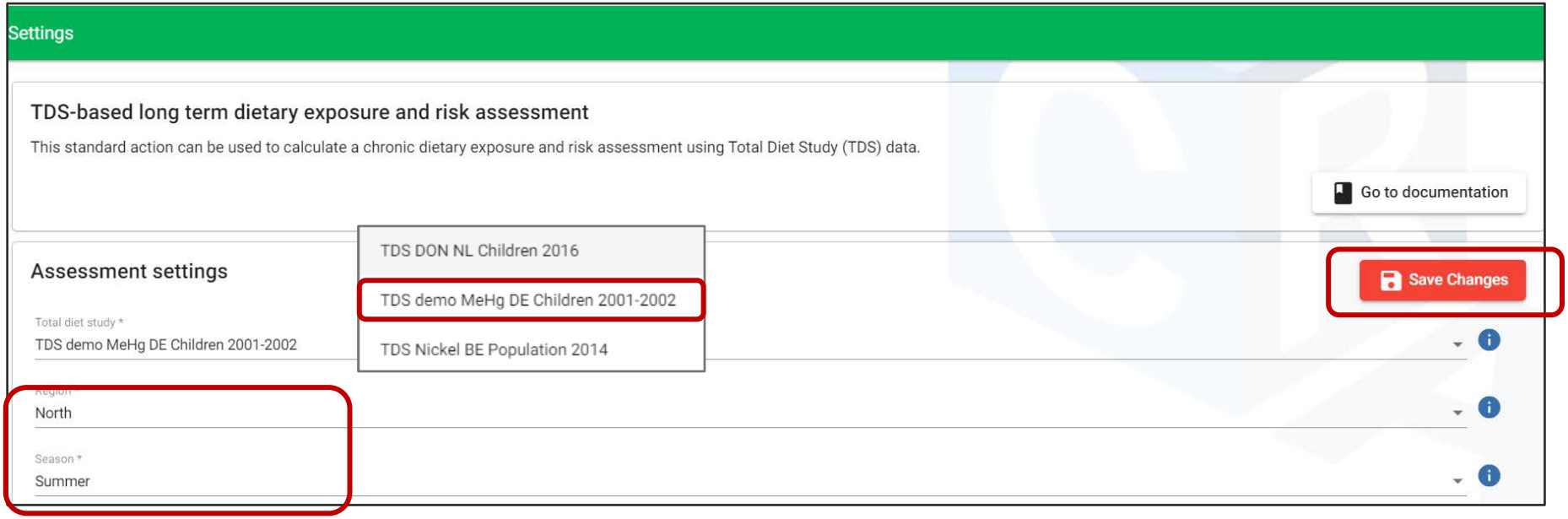
Inspect settings

- Select TDS demo MeHg Children 2021-2002
- Select Region North and Season Summer
- Press **Save Changes**



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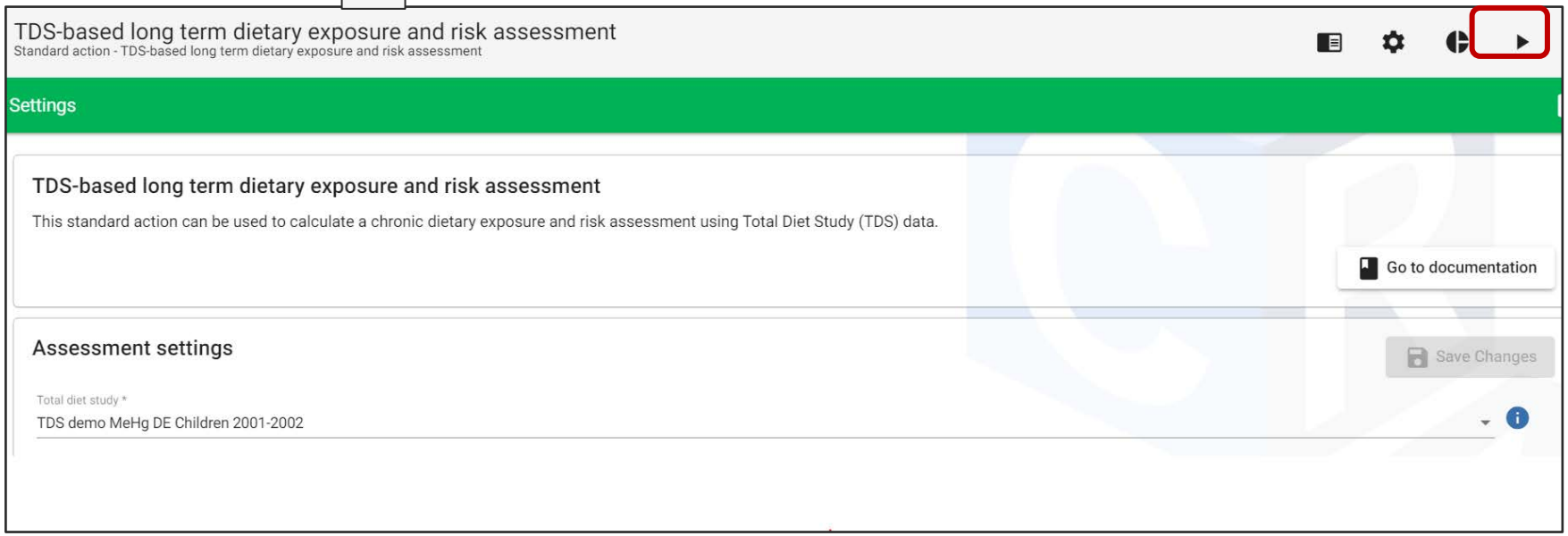
Press run

Press run ▶



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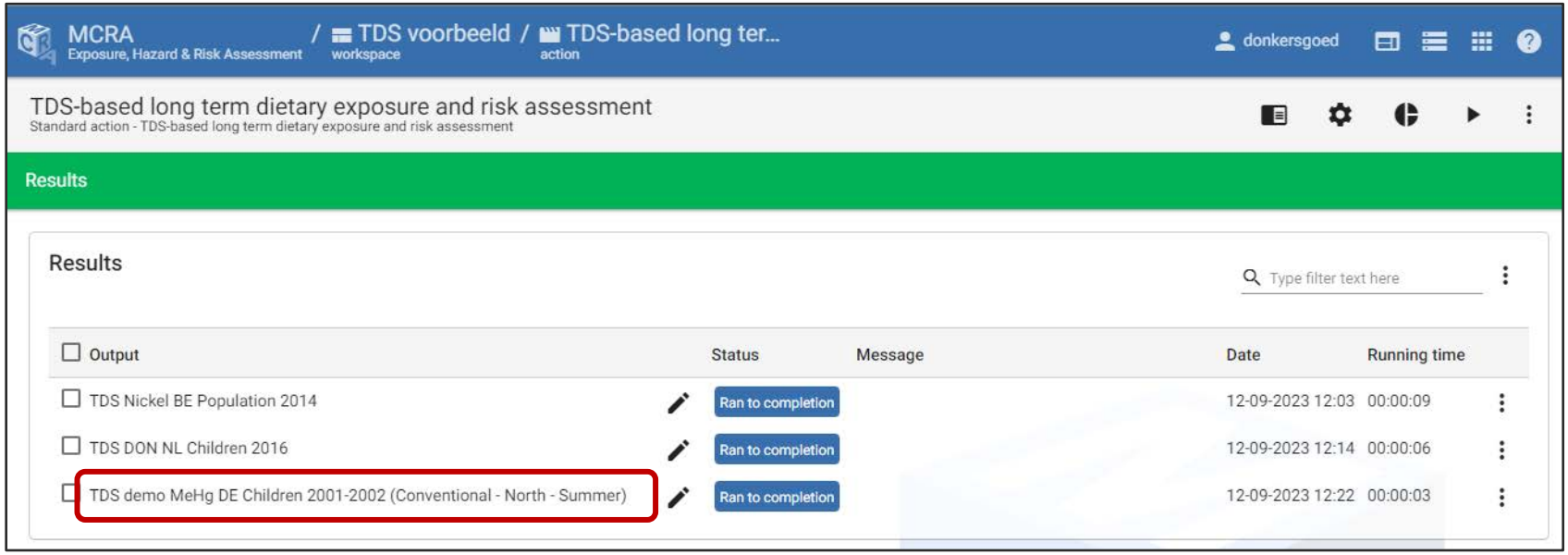
Wait for completion and open the report

Wait until the job has finished → Ran to completion

Open report by clicking on the name of the output



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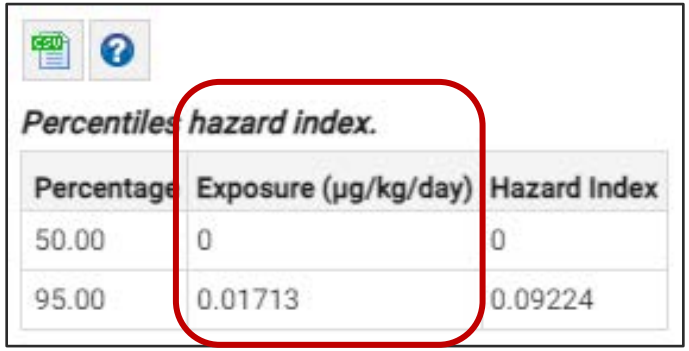
Exposure at p50- and p95



Percentiles hazard index.

Percentage	Exposure (µg/kg/day)	Hazard Index
50.00	0	0
95.00	0.01713	0.09224

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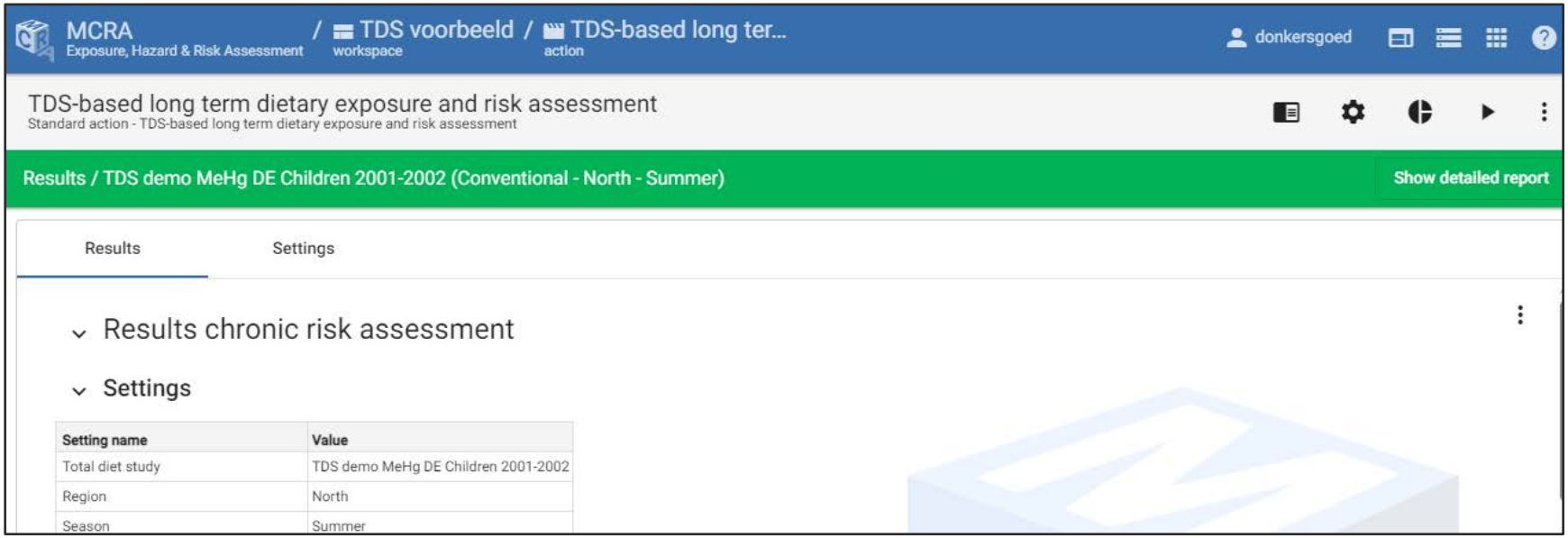
TDS Germany seasonal and regional

- Go to Settings ⚙



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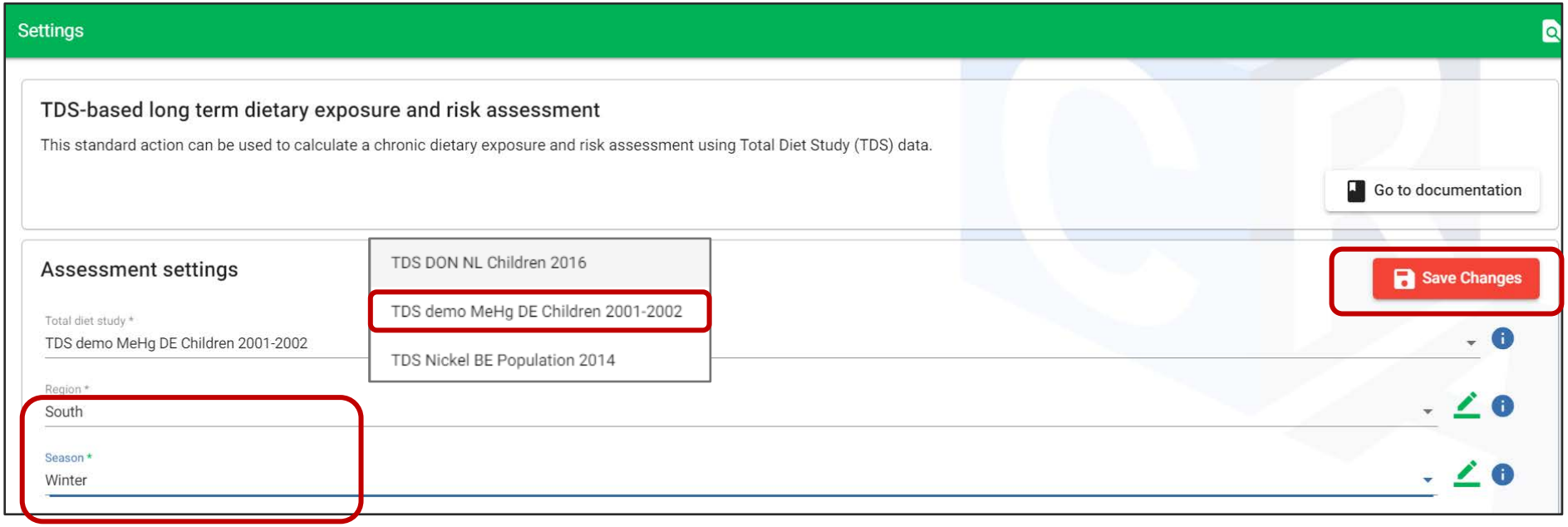
Inspect settings

- Select TDS demo MeHg Children 2001-2002
- Select Region South and Season Winter
- Press **Save Changes**



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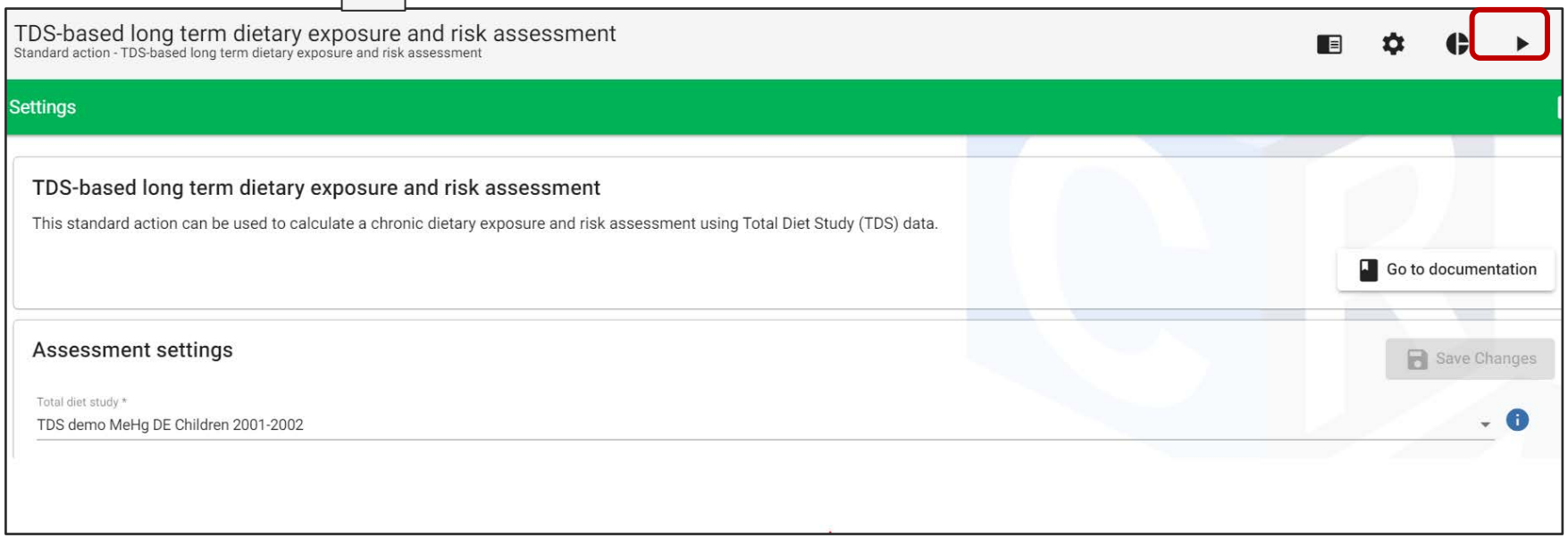
Press run

Press run ▶



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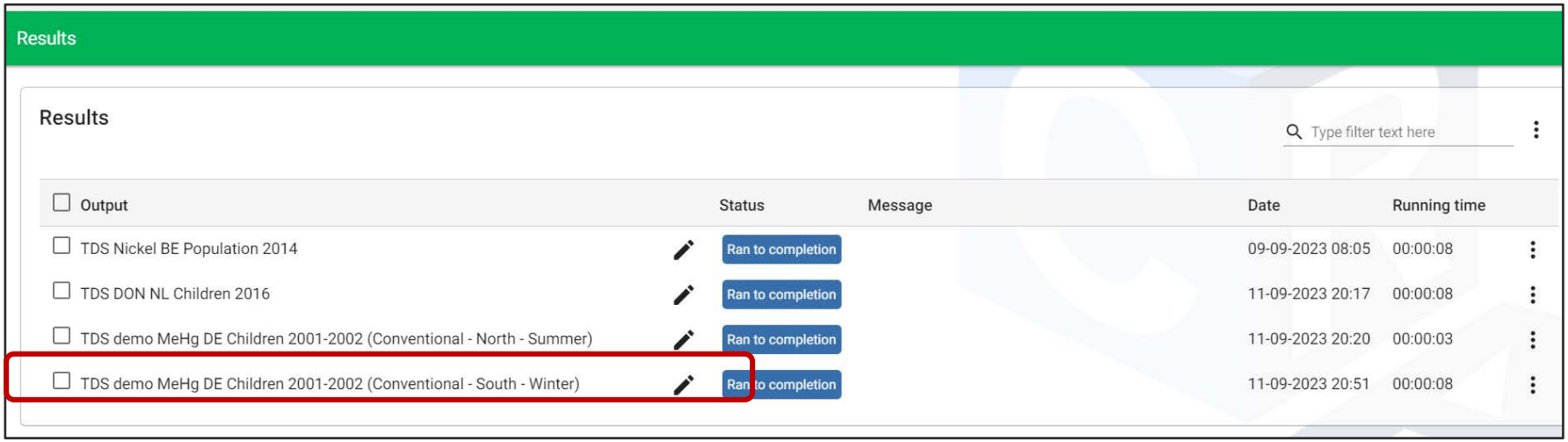
Wait for completion and open the report

Wait until the job has finished → Ran to completion

Open report by clicking on the name of the output



FNS-Cloud Food Nutrition Security

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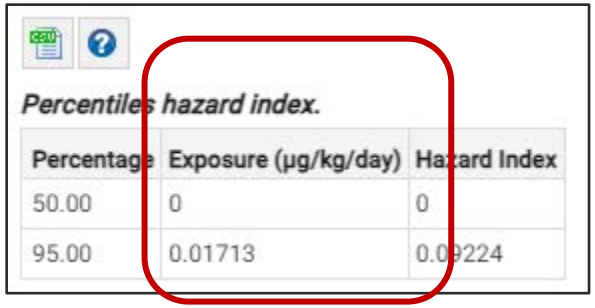
Exposure at p50- and p95

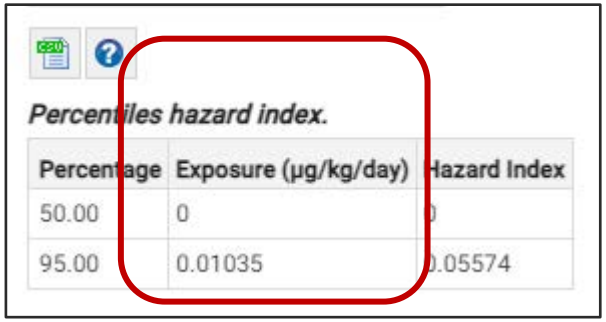
North summer



Percentiles hazard index.

Percentage	Exposure (µg/kg/day)	Hazard Index
50.00	0	0
95.00	0.01713	0.09224

South winter



Percentiles hazard index.

Percentage	Exposure (µg/kg/day)	Hazard Index
50.00	0	0
95.00	0.01035	0.05574

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Upload own data

- It is possible to organize your own TDS data in the standard formats (relevant for TDS centers)
- Use standard templates as agreed with the European Food Safety Authority (EFSA)
- Follow-up training for TDS centers on how to upload data to MCRA, if you are interested mail to MCRA support
- More functionalities for analyzing TDS data available in MCRA in full actions

FNS-Cloud Food Nutrition Security

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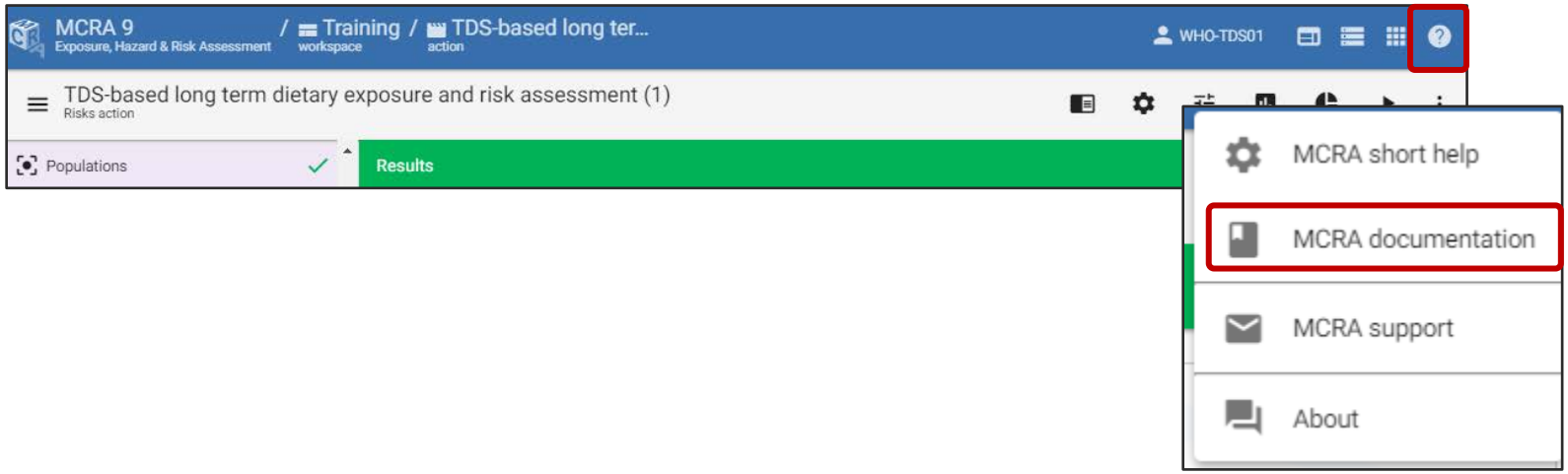
MCRA Documentation (1)

- By clicking on ? you can go to the MCRA documentation.



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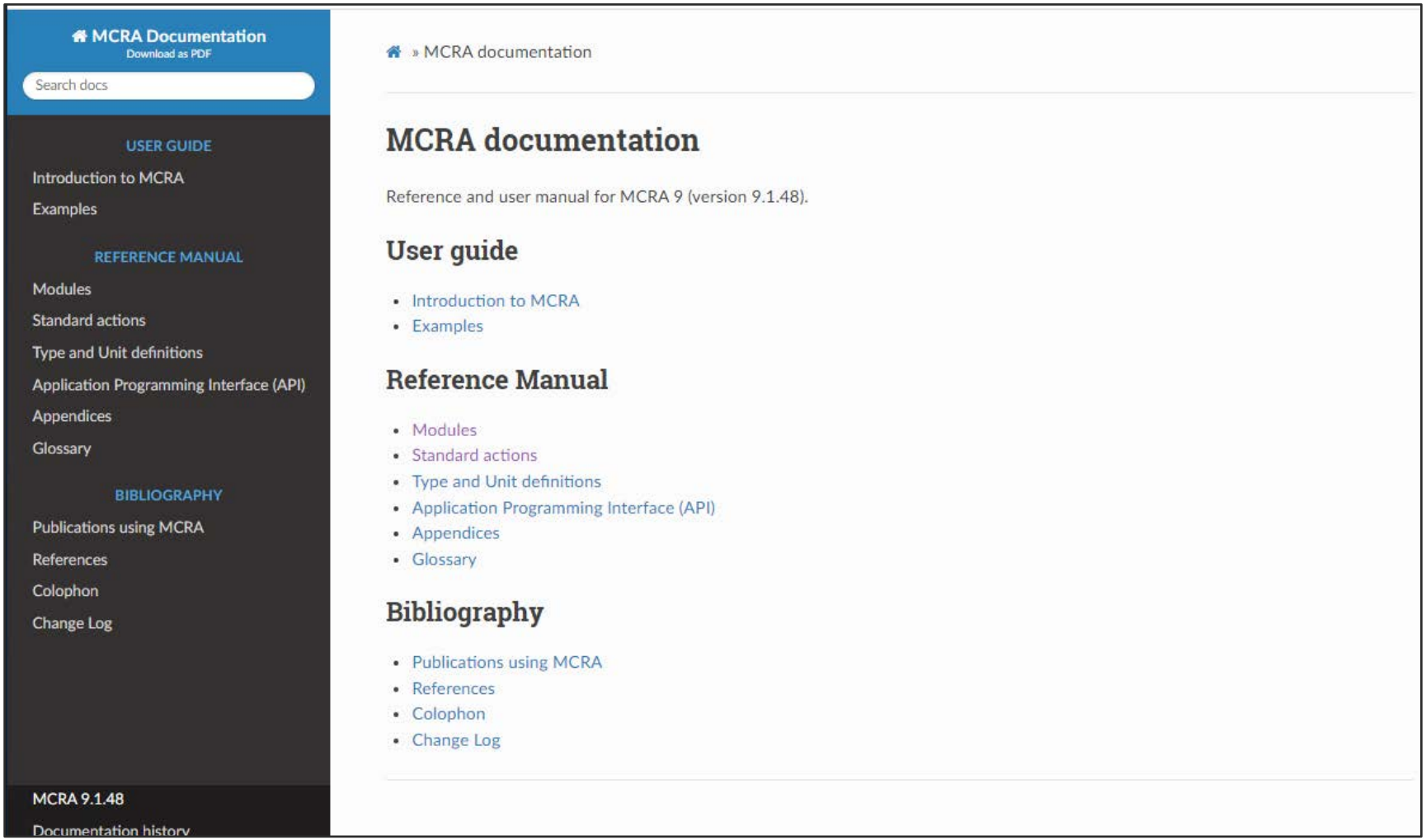
MCRA documentation (2)



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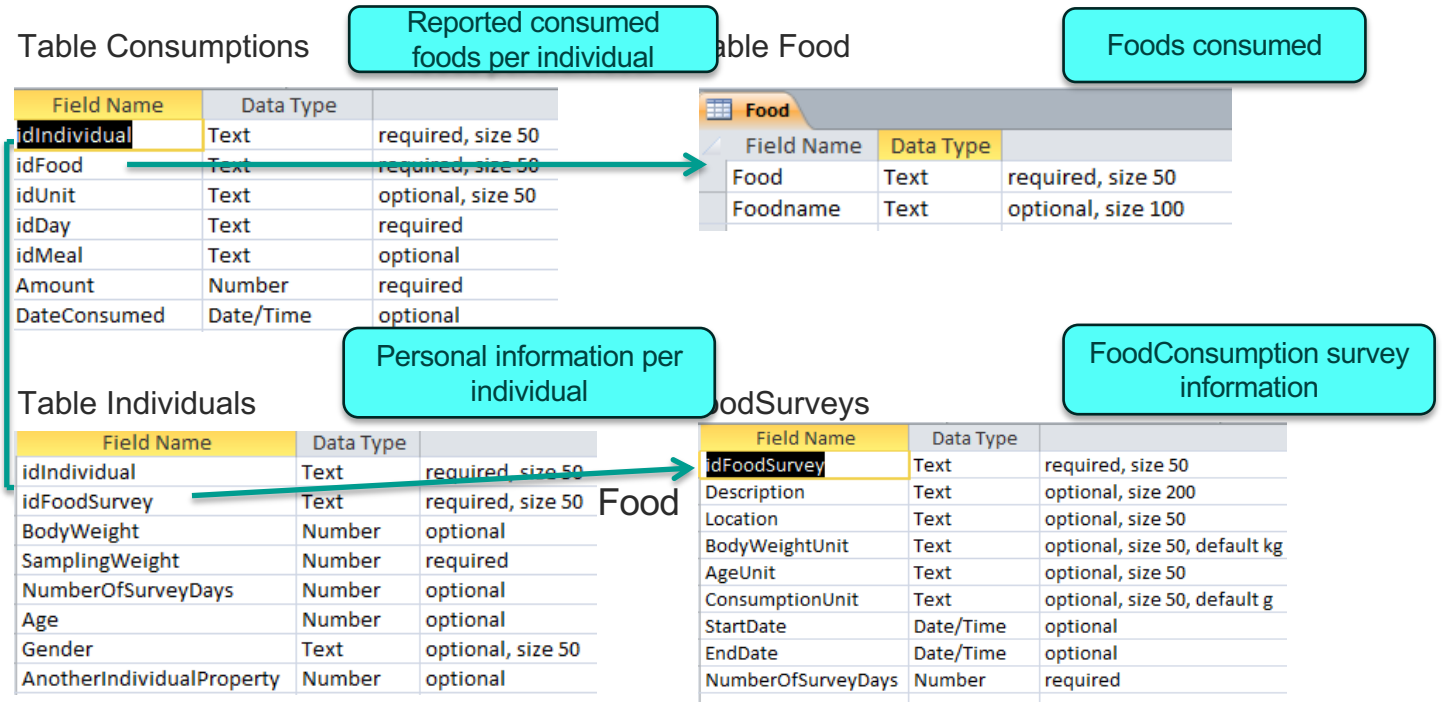
Consumptions - format



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Catalogues - Foods

Table Foods (format)

Field Name	Data Type	
idFood	Text	required, size 50
Name	Text	required, size 100

Table Foods (example)

A026F	Beerwurst
A00QG	Beetroots
A00AJ	Beignets
A01DT	Berries and small fruits
MENG.CRAC.12-18	beschuit, knackebrod
A01FE	Bilberries (generic)
A00AE	Biscuit with inclusions, filling or coa
A009V	Biscuits
MENG.KOEK.24-36	Biscuits
A00AB	Biscuits, oat meal
A03RA	Biscuits, rusks and cookies for child
A009X	Biscuits, sweet, plain
A00AA	Biscuits, sweet, wheat wholemeal
A034G	Bitter chocolate

The foods table is the main table of the food definitions. Includes all food codes present in Consumptions, ConcentrationsSSD, TDSFoodSampleComposition, FoodCompositions, ReadAcrossFoodTranslations, FoodHierarchy

FNS-Cloud Food Nutrition Security

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2. Concentrations - format

Table ConcentrationsSSD

ConcentrationsSSD

Field Name	Data Type
labSampCode	Short Text
labSubSampCode	Short Text
sampCountry	Short Text
prodCode	Short Text
sampY	Number
sampM	Number
sampD	Number
analysisY	Number
analysisM	Number
analysisD	Number
paramCode	Short Text
resUnit	Short Text
resLOD	Number
resLOQ	Number
resVal	Number
resType	Short Text

omposi

TDSFoodSampleCompositions

Field Name	Data Type
idTDSFood	Short Text
idFood	Short Text
PooledAmount	Number

The TDS food sample compositions table contains the descriptions of the TDS samples and specifications of the foods (with amounts) included in the TDS samples.

Concentrations data are analytical measurements of chemical substances occurring in food samples.

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Thank you for your attention!

Don’t forget to follow us: @FNSCloudEU FNSCloudEU FNS-Cloud @FNSCloudEU2019

www.fns-cloud.eu
www.fnscloud.eu
www.myfnscloud.eu

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