Total Diet Studies: A comprehensive tool for dietary exposure assessment

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INTRODUCTION

Total Diet Studies (TDS) are a cost-effective, scientifically robust public health tool recommended by WHO to estimate long-term population exposure to dietary chemical contaminants.
Unlike traditional monitoring, TDS analyse food "as consumed," and consider the overall diet, offering realistic insights into chronic risks and supporting public health policy. Standardised methods, such as those from TDS-Exposure and EFSA/FAO/WHO, enhance data quality and facilitate trend analysis and cross-country comparability.

AIM

To describe the harmonised TDS methodology based on the TDS-Exposure project approach for assessing dietary exposure to chemical contaminants.

METHODOLOGY

Sampling - Planning Phase

1

Food consumption data (pre-existing)

- Representative of the studied population.
- Collected at individual level.
- Minimum two non-consecutive 24-hour food consumption recalls.

TDS food list

- Classify each food by FoodEx2 food classification system.
- Average consumption of each food (g or mL/kg body weight/ day).
- Apply selection criteria at food group level:
  - foods that contribute to at least 90% of overall food intake;
  - major contributors to exposure.

Figure 1

± 1000 food items

TDS samples

- Select food items to pool into each TDS sample applying:
  - Mixed Food Approach - combines various foods within the same food group (e.g., different species of fruit)

    and/or
  - Individual Food Approach - grouping similar items, such as different varieties of a single fruit species or various brands of the same product.

Figure 2

100-300 Samples
Each TDS sample – 12 subsamples

Sampling plan

- Define "Food collection plan" and "Food shop list" considering the key factors:

  Region, place of purchase, seasonal influence, brand and potential contamination levels.

Figures 3 & 4

Sampling - Fieldwork Phase

2

Organization of food collection and sample preparation

- Make ready:
  - Materials and equipment for food collection, transport, and preparation, including kitchen laboratory tools.
  - Staff involved in food collection, transport, processing, and cooking.
  - Standardized kitchen food preparation protocols.

Food collection

- Purchase foods based on "Food collection Plan" (**Figure 3**) and "Shop Food List" (**Figure 4**).

Sample reception

- Check for compliance of each subsample and record relevant information.

Sample preparation and storage

- Apply culinary treatments to prepare subsamples "as consumed".
- Prepare composite samples.
- Homogeneise.
- Store aliquots.

Chemical analysis

3

Analytical methods

- Robust and reliable.
- Validated (accuracy, precision, uncertainty).
- Accredited – ISO/IEC 17025.
- Speciation.

Exposure assessment & risk characterization

4

Exposure assessment

- Combines food contamination data with food consumption data linked by FoodEx2 codes.

Method

- Semi-probabilistic approach.

Exposure estimates

- Food as measured (TDS samples).
- Food as eaten (TDS subsamples).
- Mean, median (P50), and 95th percentile (P95).
- µg/kg bw/day or µg/kg bw/week.
- Age and gender groups.

Risk characterisation

- Assess estimated exposure levels using:
  - HBGVs (TDI, TWI).
  - Margin of exposure (MOE) – when no HBGVs.

Figure 1 - "TDS sample definition" template.

Input data from the table AVG FCD								Decision	Suggested TDS Food List for PT							
		Data from the national FCDB - raw, edible portion Average consumption (g/kg b.w./day)								FCDB intended for next exposure assessment Average consumption (g/kg b.w./day)**						
(sorted by this field)		years	years	years	years			Decision to include in TDS food list*	TDS Food list Name of composites are equal to FoodEx2 EN name	years	years	years	years			
FoodEx2 Hierarchy code	FoodEx2 uniq code FoodEx2ENname National uniq code National food name	sex	sex	sex	sex				FoodEx2 ENname FoodEx2 uniq code FoodEx2 Hierarchy code	sex	sex	sex	sex			
Total consumption		0	0	0	0					0	0	0	0			

*Decision to include in TDS food list
1 Yes, as part of 90% of average consumption
2 Yes, as expected major contributor to exposure
3 Yes, other reason (see notes)
4 Combined into one item
N No, as not part of 90% of average consumption, nor expected major contributor

**In combined items the value presents sum of original average

Figure 2 - "Food Shopping List" template.

TDS sample

Box 1 Sample characterization and number of subsamples (in national languages)

No.	TDS sample name:	Foodex2 code:		Total N subsamples:
1				12
	Items from the TDS food list	Characteristics (if needed):	Considered consump.	N of subsamples:
		Total	0.00	#DIV/0!

Box 2 Food items selection criteria (only in EN)

Nat/Reg:	Seasonal changes in TDS sample composition	National criteria for choosing of subsamples:	Place of purchase (type of store):

Box 3 Shopping list (in national languages)

	Food items purchased:	National criteria			Place of purchase	Purchased quantity and other details	
No.	Subsample	Type	Brand	Package		Min. (ml)	Notes
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Figure 3 - "Food Collection Plan" template.

Sampling plan - TDS EXPOSURE - pilot study
Campaign 1 - Season, year (month, month, month)

TDS sample number	FoodEx2 Code	TDS sample name	National (N) /Regional (R)	Week 1		Week 2		Week 3		Week 4		Week 5	
				when	where	when	where	when	where	when	where	when	where
				Date 1	Place 1	Date 4	Place 4	Date 7	Place 7	Date 10	Place 10		
				Date 2	Place 2	Date 5	Place 5	Date 8	Place 8	Date 11	Place 11		
				Date 3	Place 3	Date 6	Place 6	Date 9	Place 9	Date 12	Place 12		

Figure 4 - "Food shop list" template.

Campaign: Purchase date:

Place of purchase: | Purchase team | Purchasing managers | Chauffeur

Codes for corrective actions
1. Replacement with an item of the same range
2. Replacement with an item of a different range
3. Discontinued item
4. Other. Please specify.

Sample code	Subsample	Characteristic	Brand/Homemade	Amount	Unit	kind of storage	Preparation type	Ingredients	Corrective actions	Notes

RESULTS

A TDS provides a national overview of dietary exposure to chemical contaminants. Results typically include identification of major dietary sources of exposure demographic exposure profiles, and exposure data for trend tracking and policy evaluation.

CONCLUSIONS

TDS are an essential tool in modern food safety. By integrating consumption and contaminant data in a realistic, whole-diet population-wide context, they support risk assessment and evidence-based regulation. TDS are highly effective for assessing chronic dietary exposure, providing authorities with evidence to prioritize risks and protect public health.

TOPIC RELEVANCE

Amid growing concerns over food contamination, climate change, and evolving diets, TDS play a valuable role in strengthening international food safety standards, guiding national programs, and contributing to achieve the Sustainable Development Goals.

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