ASSESSING ADHERENCE TO HEALTHY AND SUSTAINABLE DIETS: A COMPARISON OF MEASUREMENT PERFORMANCE OF INDICES BASED ON EAT-LANCET DIET IN FRENCH ADULTS

Agustin MIRANDA

National French Research Institute for Sustainable Development

Co-authors: Florent Vieux, Matthieu Maillot, Eric Verger

Institut de Recherche pour le Développement FRANCE

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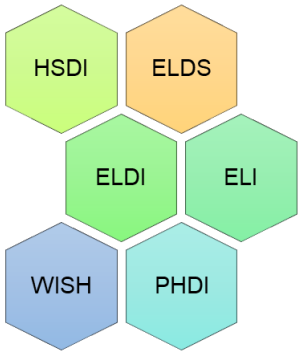
Background

Measuring adherence to **EAT-Lancet recommendations** for healthy and sustainable diets is challenging, leading to diverse methods and a **lack of consensus on standardized metrics**.

EAT-Lancet **global reference diet** (Willett et al., 2019)

Need to "quantify" the sustainability of diets

Development of several indices



Different:

- Food groups
- Cut-offs points
- Scoring systems
- Units
- Energy adjustment

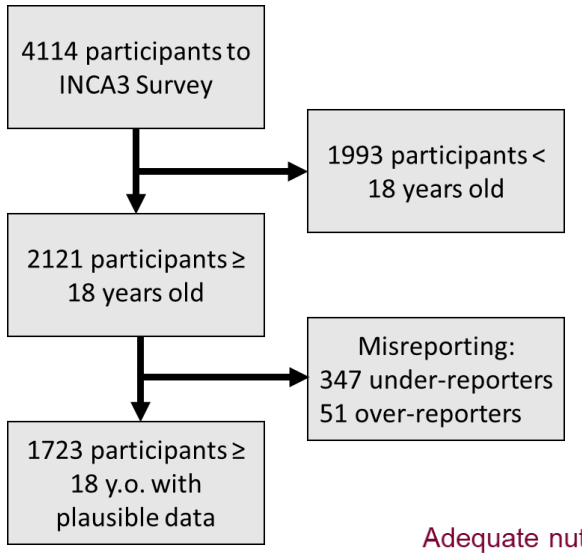
	EAT-Lancet	WISH	PHDI	ELDI	ELI	HSDI	ELDS
Whole grains	↑	↑	↑	↓	↑	↑	↓
Fruits	↑	↑	↑	↑	↑	↑	↑
Dairy	→	→	→	↓	↓	↓	↓
Nuts	↑	→	↑	↑	↑	↑	↑
Unsaturated fats	↑	↑	→	↓	↑	↓	↓
Saturated fats	↓	↓	↓	↓	✕	↓	↓
Eggs	→	→	→	↓	↓	↓	↓
Poultry	→	→	↓	↓	↓	↓	↓
Meat	↓	↓	↓	↓	↓	↓	↓
Fish	↑	→	→	↓	↑	↑	↑
Legumes	↑	→	↑	↑	↑	↑	↓
Added sugars	↓	↓	↓	↓	↓	↓	↓
Vegetables	↑	↑	↑	↑	↑	↑	↑
Tubers	↓	→	→	↓	↓	↓	↓
Soy foods	↑	↑	↑	↓	↑	↑	↓

Stubbendorff et al., 2024
Neta et al., 2023
Alexandropoulou et al., 2022

Aim

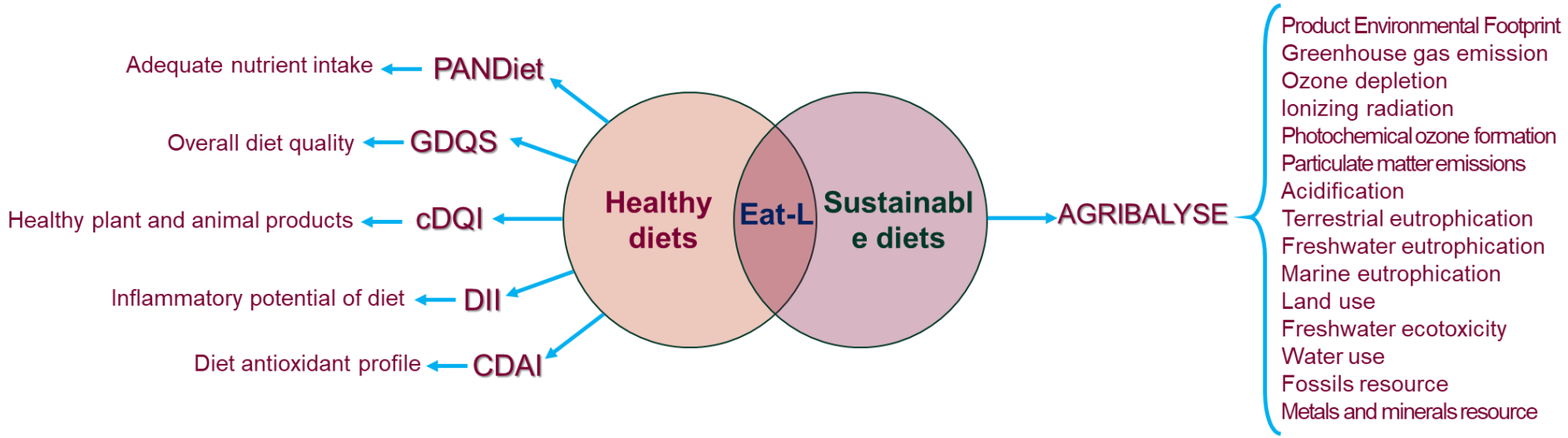
This study aimed to evaluate and compare the **measurement performance** of six dietary indices for assessing adherence to the EAT-Lancet reference diet (WISH, PHDI, ELD-I, ELI, HSDI and ELDS)

Methods



Data derived from the **third Individual and National Study on Food Consumption (INCA3)**.

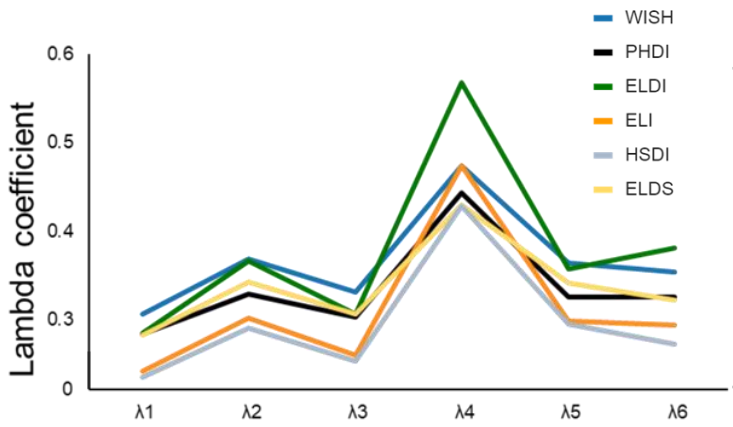
Food consumption was recorded using **3 nonconsecutive 24-hour dietary recalls** over a **3-week period**.



Results

Key Insights on reliability and structural validity

Indices assessing their food components with quantitative scoring have higher **reliability**.
All indices were structurally valid, however, PHDI and ELD-I had higher CD values.

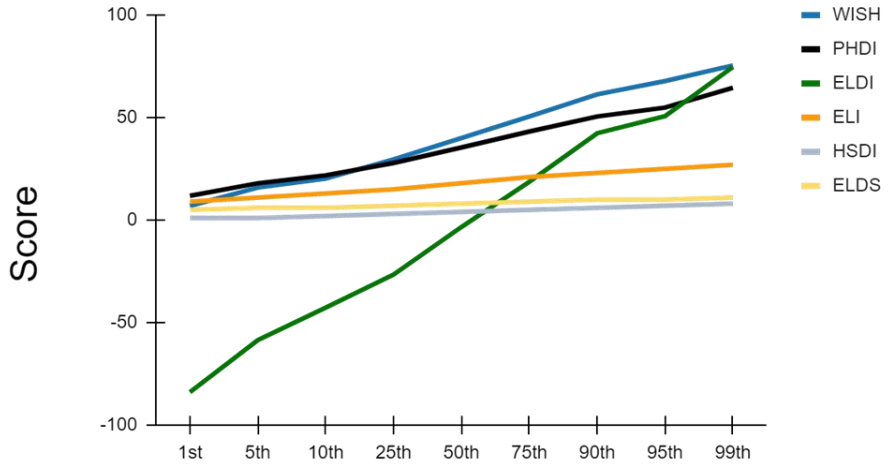


Fit indices for Confirmatory Factor Analysis

	Expected	WISH	PHDI	ELD-I	ELI
χ2/df	2.50	1.65	1.77	2.34	1.60
RMSEA	<0.08	0.019	0.021	0.028	0.019
CFI	≥0.90	0.922	0.904	0.911	0.928
SRMR	<0.05	0.025	0.027	0.028	0.023
CD	The higher, the better	0.323	0.568	0.466	0.364

Key Insights on variability and energy dependence

Indices assessing their food components with quantitative scoring captured **dietary variability**, with PHDI and ELD-I being less dependent on energy intake.



	Energy intake (kcal/d)
WISH	-0.2542
PHDI	-0.0881
ELD-I	-0.1066
ELI	-0.2789
HSDI	-0.2274
ELDS	-0.3055

Key Insights on convergent validity:

- **Continuous Score Systems (WISH, PHDI, ELD-I):**
  - Correlated with **nutrition adequacy** and **better diet quality**.
- **ELD-I & ELI Indices:**
  - Associated with **lower environmental impact**.
  - Other indices show a similar, though lesser, association.

Considerations:

- **Higher adherence** was linked to:
  - **Lower adequacy** of **Zinc** and **Vitamin B-12**.
  - **Higher water use**.

Environmental Impact	EAT-Lancet Dietary Indices					
	WISH	PHDI	ELD-I	ELI	HSDI	ELDS
Product Environmental Footprint	-0.07*	-0.02	-0.23***	-0.20***	-0.11***	-0.21***
Greenhouse gas emission	-0.12***	-0.05*	-0.30***	-0.29***	-0.13***	-0.24***
Ozone depletion	-0.06*	-0.08**	-0.12***	-0.09**	-0.15***	-0.17***
Ionizing radiation	-0.10***	-0.05*	-0.15***	-0.23***	-0.11***	-0.18***
Photochemical ozone formation	0.11***	0.00	-0.07*	0.13***	-0.16***	-0.13***
Particulate matter emissions	-0.08**	-0.06*	-0.29***	-0.21***	-0.13***	-0.23***
Acidification	-0.09**	-0.06*	-0.31***	-0.23***	-0.13***	-0.23***
Terrestrial eutrophication	-0.03	-0.03	-0.21***	-0.14***	-0.11***	-0.18***
Freshwater eutrophication	-0.13***	-0.07*	-0.34***	-0.30***	-0.12***	-0.23***
Marine eutrophication	-0.13***	-0.05	-0.19***	-0.22***	-0.14***	-0.21***
Land use	-0.12***	-0.02	-0.13***	-0.20***	-0.09**	-0.16***
Freshwater ecotoxicity	-0.12***	-0.01	-0.29***	-0.32***	-0.07	-0.19***
Water use	0.16***	0.21***	0.22***	0.17***	0.12***	0.08**
Fossils resource	-0.03	-0.03	-0.11***	-0.11***	-0.13***	-0.19***
Metals and minerals resource	-0.08*	-0.04	-0.13***	-0.13***	-0.14***	-0.18***

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Nutritional metrics		EAT-Lancet Dietary Indices					
		WISH	PHDI	ELD-I	ELI	HSDI	ELDS
Nutrient Adequacy	PANDiet score	0.34***	0.22***	0.27***	0.27***	0.15***	0.14***
	Adequacy sub-score	0.15***	0.16***	0.17***	0.07***	-0.01	0.00
	Protein	-0.04	-0.02	-0.03	-0.10***	-0.12***	-0.09**
	LA	0.02	0.16***	-0.03	0.06**	0.00	-0.06*
	ALA	0.09**	0.11***	0.05*	0.14***	0.01	0.04
	DHA	0.27***	0.05	0.10***	0.39***	-0.13***	0.01
	EPA+DHA	0.28***	0.06*	0.11***	0.39***	-0.12***	0.02
	Fibre	0.23***	0.28***	0.35***	0.21***	0.16***	0.15***
	Vitamin A	0.05*	0.07*	0.12***	0.05	-0.01	0.08
	Thiamine	0.17***	0.09**	0.15***	0.10**	0.09**	0.15***
	Riboflavin	0.03	0.01	0.03	-0.12***	-0.06**	-0.07**
	Niacin	-0.08**	-0.02	-0.06*	-0.15***	-0.10***	-0.09**
	Pantothenic acid	0.00	0.01	0.04	-0.09***	-0.09**	-0.08**
	Vitamin B-6	0.08**	0.11***	0.11***	-0.01	-0.01	-0.04*
	Folate	0.18***	0.21***	0.26***	0.13***	0.07**	0.09**
	Vitamin B-12	0.03	-0.02	-0.09**	-0.04	-0.13***	-0.13***
	Vitamin C	0.26***	0.26***	0.35***	0.25***	0.23***	0.19***
	Vitamin D	0.10***	-0.01	-0.02	0.11***	-0.13***	-0.07**
	Vitamin E	0.11***	0.22***	0.12***	0.16***	0.02	0.00
	Iodine	0.11***	0.00	0.14***	0.05*	-0.06**	-0.05*
	Magnesium	0.08*	0.13***	0.13***	0.03	-0.01	0.02
	Phosphorus	-0.01	-0.02	-0.05	-0.05*	-0.03	-0.05*
	Potassium	0.10***	0.13***	0.12***	0.01	0.00	-0.02
	Selenium	0.06**	0.05*	0.10***	0.01	0.01	0.03
	Zinc	-0.17***	-0.12***	-0.31***	-0.35***	-0.09**	-0.21***
	Copper	0.08**	0.16***	0.18***	0.06	0.02	0.03
	Manganese	0.12***	0.19***	0.25***	0.15***	0.06*	0.11**
	Calcium	0.04	-0.01	0.09**	-0.12***	-0.09**	-0.04
	Iron	-0.03	0.09**	0.00	-0.10***	-0.05*	-0.10***
	Moderation sub-score	0.21***	0.06*	0.10***	0.21***	0.18***	0.15***
	Protein	0.02	0.00	0.07**	0.08**	0.03	0.12***
	Carbohydrates	0.07*	0.08**	-0.10***	0.05*	-0.04	0.05*
	Total fat	0.03	-0.07**	0.19***	0.01	0.03	0.00
	SFA	0.17***	0.11***	0.24***	0.21***	0.20***	0.02
	Sugars	0.20***	0.06*	0.01	0.15***	0.19***	0.19***
	Sodium	0.00	-0.03	-0.13***	0.05**	-0.02	0.02
Diet Quality	GDQS total	0.41***	0.40***	0.43***	0.52***	0.19***	0.33***
	GDQS -	0.35***	0.19***	0.39***	0.41***	0.32***	0.39***
	GDQS +	0.29***	0.39***	0.28***	0.38***	0.02	0.16***
	cDQI	0.60***	0.41***	0.56***	0.69***	0.32***	0.49***
	aDQI	0.30***	0.07*	0.36***	0.45***	-0.05*	0.16***
	pDQI	0.55***	0.48***	0.47***	0.58***	0.45***	0.52***
	CDAI	0.19***	0.25***	0.23***	0.17***	0.12***	0.08*
	DII	-0.12***	-0.17***	-0.14***	-0.06*	-0.04	-0.03

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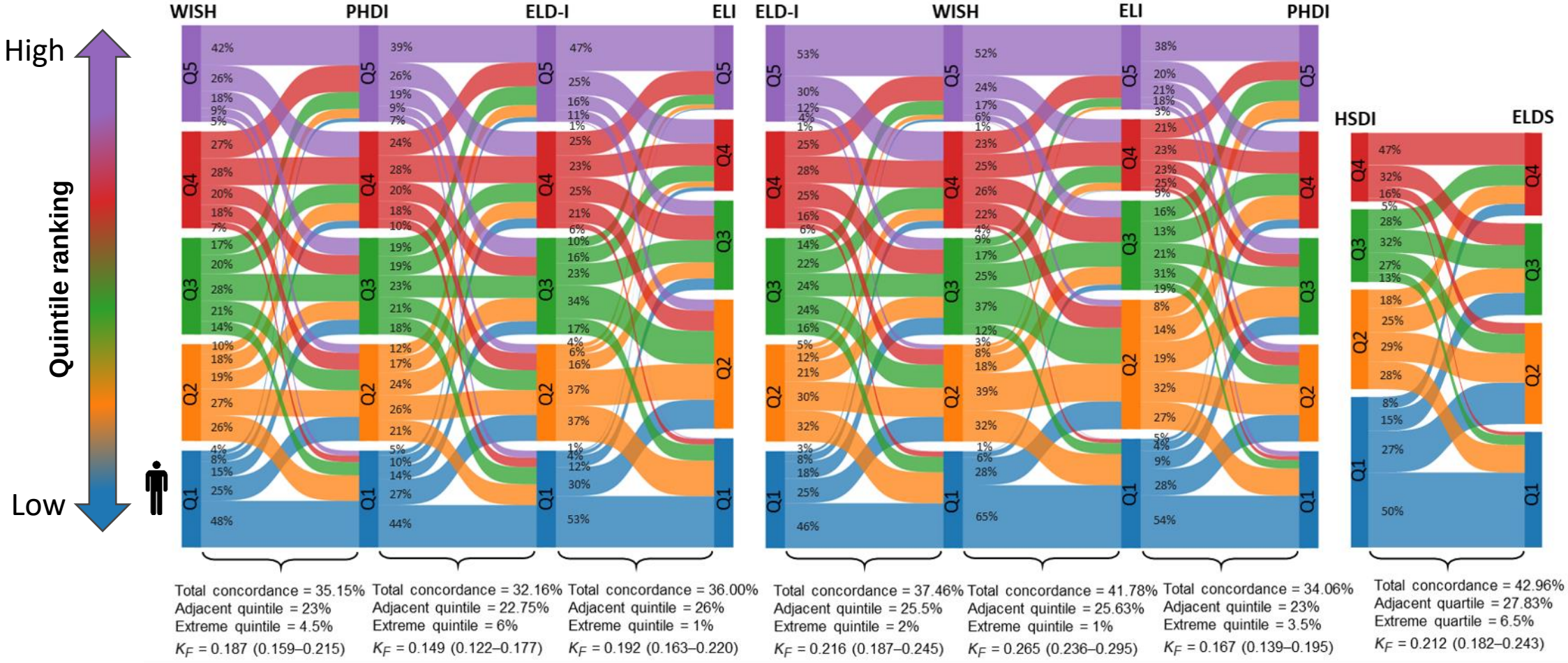
Key Insights on Inter-index Concordance:

- **Low concordance** was observed between the indices.
- Only **32% to 43%** of individuals were classified into the same quintile across different indices.



Key Insights on Concurrent-Criterion Validity:

- **Overall, the indices** effectively distinguished between demographic groups that are **theoretically associated with healthier diets**.
- Binary Scoring Indices: Showed weaker associations with demographic factors.

	WISH	PHDI	ELD-I	ELI	HSDI	ELDS
Sex						
Women	♀	♀		♀		♀
Men						
Age						
18-44 years-old	AGE	AGE	AGE	AGE	AGE	AGE
45-64 years-old						
≥ 65 years-old						
Education						
Primary and middle school						
High school						
1 to 3 years of post-secondary education						
≥ 4 years of post-secondary education						
Monthly income [a]						
<900 €/month/CU	$	$	$	$		$
900-1,340 €/month/CU						
1,340-1,850 €/month/CU						
≥ 1,850 €/month/CU						
Weight status						
Underweight						
Normal						
Overweight						
Obesity						
Morbid obesity						
Smoking status						
No						
Yes						
Physical activity						
Low						
Moderate						
High						

Scores

Conclusions

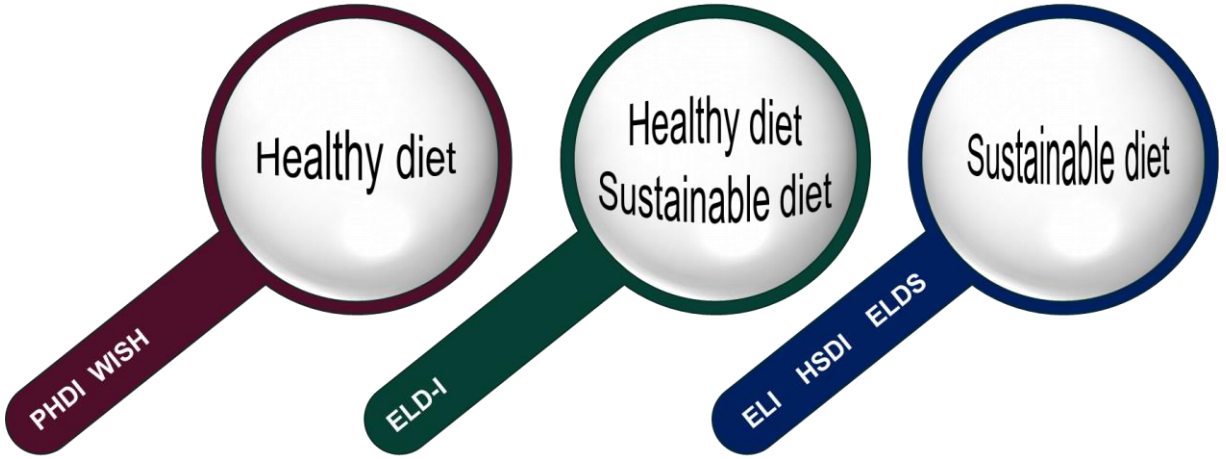
How did the indices perform?

Properties		WISH	PHDI	ELDI	ELI	HSDI	ELDS
		Quantitative			Semi-quantitative		Binary
Variability capture	Do the indices provide sufficient variation in scores among individuals?	🟡	🟡	🟢	🔴	🔴	🔴
Energy independence	Do the indices assess diet quality independently of diet quantity?	🟡	🟢	🟢	🟡	🟡	🟡
Reliability	Are the items consistent in measuring the intended constructs?	🟡	🟡	🟢	🟡	🟢	🔴
Structural validity	Do the indices accurately reflect the dimensionality of the constructs being measured?	🟡	🟢	🟢	🟡	–	–
Concurrent criterion validity	Can the indices effectively differentiate between groups with known variations in diet quality?	🟢	🟡	🟢	🟡	🔴	🟡
Convergent validity (nutritional)	Do the indices correlate well with other indicators that measure similar constructs?	🟢	🟢	🟢	🟡	🔴	🔴
Convergent validity (environmental)		🟡	🟡	🟢	🟢	🟡	🟢
Ease of computation	Is the metric straightforward to calculate?	🟡	🔴	🔴	🟢	🟡	🟢
Ease of interpretation	Is the metric easy to interpret?	🟢	🟢	🔴	🟢	🟢	🟢

🟢 Good 🟡 Fair 🔴 Poor

Are the indices measuring the same phenomena?

Maybe… but in a different way:



- The different approaches to assess adherence to a sustainable and healthy diet are **complementary**, and the superiority of one method over another cannot be asserted.

- It is crucial to carefully **address methodological issues** to better understand the utility and applicability of these indices, including the precise clarification of objectives and assumptions, as well as a detailed description of score composition.

The selection of an index depends on the specific needs and objectives of the researchers

- Quantitative scoring systems → > complexity and useful in precision-focused research, such as clinical trials or epidemiological research
- Qualitative scoring systems → simpler and faster methods for surveys, observational studies, and public health

Comment > Lancet. 2023 Jul 29;402(10399):352-354. doi: 10.1016/S0140-6736(23)01290-4. Epub 2023 Jul 10.

EAT-Lancet Commission 2.0: securing a just transition to healthy, environmentally sustainable diets for all

EAT–Lancet 2.0 Commissioners and contributing authors. Electronic address: fabrice@eatforum.org

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This becomes even more relevant with the anticipated release of EAT-Lancet version 2.0 in 2025, which is expected to address the main concerns identified in recent years.

Thank you!

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