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The impact of optimized diet patterns at a macro-level: the case of Tunisia

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Introduction

Mediterranean countries have lost their traditional dietary patterns and face emerged diseases linked to a non-balanced diet associated to excessive energy consumption.

Tunisia is confronted to the triple burden linked to the coexistence of undernourishment (reduced to 5% but still remaining), nutrient deficiencies and obesity. Nutritional transition was largely influenced by the food subsidy system. Food security was insured by Tunisian social policies based on direct subventions to families and indirect ones by lowering the prices of essential food products (wheat, milk, seed oils, sugar and tomato paste).

In this context, we consider the following questions:

- Do domestic food availabilities in Tunisia able enough to comply with the nutritional needs of the population?
- If Tunisian people decided to comply with the WHO nutritional recommendations what would be the impact on the Tunisian supply and demand?

Materials and methods

Non-linear programming approach, as described in Srinivasan (2007) and Shankar et al. (2008), was used. We minimized Z , which is the sum of the square of the differences between the observed (X_i) and the optimized consumption (X'_i) times a coefficient (α_i) which is the calorific share of each item in the total observed calorific content under a set of constraints related to the WHO dietary recommendations, for a subset of 34 nutrients. E_i is the calorific content of each item i .

$$\text{Min } Z = \sum_i \alpha_i \left(\frac{X'_i - X_i}{X_i} \right)^2$$

$$\text{With } \alpha_i = \frac{E_i X_i}{\sum_i E_i X_i}$$

Two sources of data were reconciled to conduct this analysis: (i) the 2010 food balance sheets from FAO, which give data estimates of production, utilization and trade of 63 food items (FAO, 2001) and (ii) two databases of food contents in macro and micro nutrients: the French databases Ciqual (Ciqual, 2012) and Nutrinet (Nutrinet-Santé, 2013).

Table 1: Nutritional constraints (WHO recommendations)

	Male		Female	
	Min	Max	Min	Max
Proteins g/d	60.8		57.5	
Total fat %Energy	15	35	15	35
Saturated Fatty Acid %Energy		10		10
Total PUFA %Energy	6	11	6	11
n-6 PUFA %Energy	2.5	9	2.5	9
n-3 PUFA %Energy	0.5	2	0.5	2
EPA+DHA g/d	0.25	2	0.25	2
Carbohydrates % Energy	50	75	50	75
Fibers g/d	25		25	
Free sugars % Energy		10		10
Vitamin A µg RE/d	600	3000	500	3000
Vitamin B1 mg/d	1.2		1.1	
Vitamin B2 mg/d	1.3		1.1	
Vitamin B3 mg/d	16	35	14	35
Vitamin B5 mg/d	5		5	
Vitamin B6 mg/d	1.3	100	1.3	100
Biotin µg/d	30		30	
Folate µg DFE/d	400	1000	400	1000
Vitamin B12 µg/d	2.4		2.4	
Vitamin E mg/d	10		7.5	
Vitamin C mg/d	45	1000	45	1000
Vitamin D µg/d	5	50	5	50
Calcium mg/d	900		900	
Magnesium mg/d	260	350	224	350
Iodine µg/d	150	30/kg	150	30/kg
Zinc mg/d	7	45	4.9	45
Selenium µg/d	34	400	26	400
Iron mg/d	11.4		24.5	
Sodium g/d		2		2
Copper mg/d	1.35	12	1.15	10
Potassium mg/d	3510		3510	

Results

Computation of the Nutrient Adequacy Ratios (NAR_i = intake of nutrient_i / needs in nutrient_i) showed that the main needs in macro- and micronutrients are already covered by the food supply in Tunisia (see fig. 1). However, the Tunisian mean energy intake estimated by the Medina Study Group, equivalent to 2583 kcal for a woman and 2682 kcal for a man is too rich in added sugar and carbohydrates and too poor in calcium.

The adherence to all the dietary nutritional recommendations would induce an imperative shift to a less consumption of sugar, and products from the milling products. Conversely, the share of dairies should be increased to cover the deficit in calcium (see fig.2).

As a consequence, the adherence to these recommendations would have impacts at the macro-level (see fig.3):

The reduction in carbohydrates intake would induce a decrease in wheat-based products demand (-430,000 t), and sugar (-71,000 t) but not enough to decrease the dependence from the international markets.

The constraint on fats would induce a reduction of 38,000 t in the fats and oils bundle except olive oil for which we constrained the consumption to the baseline.

Eggs demand must be reduced by 17,000 t but that of red meats would increase by 22,000t.

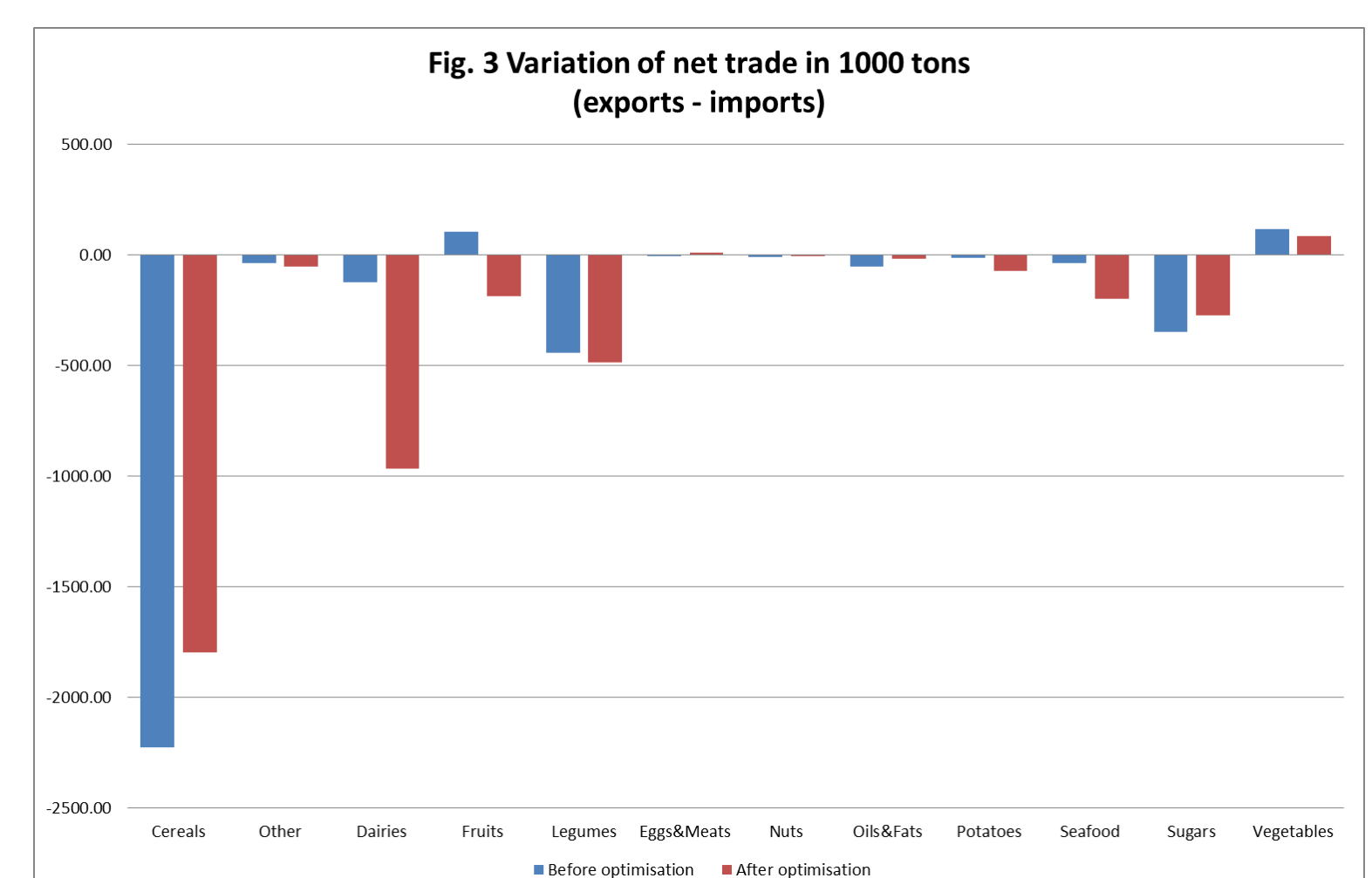
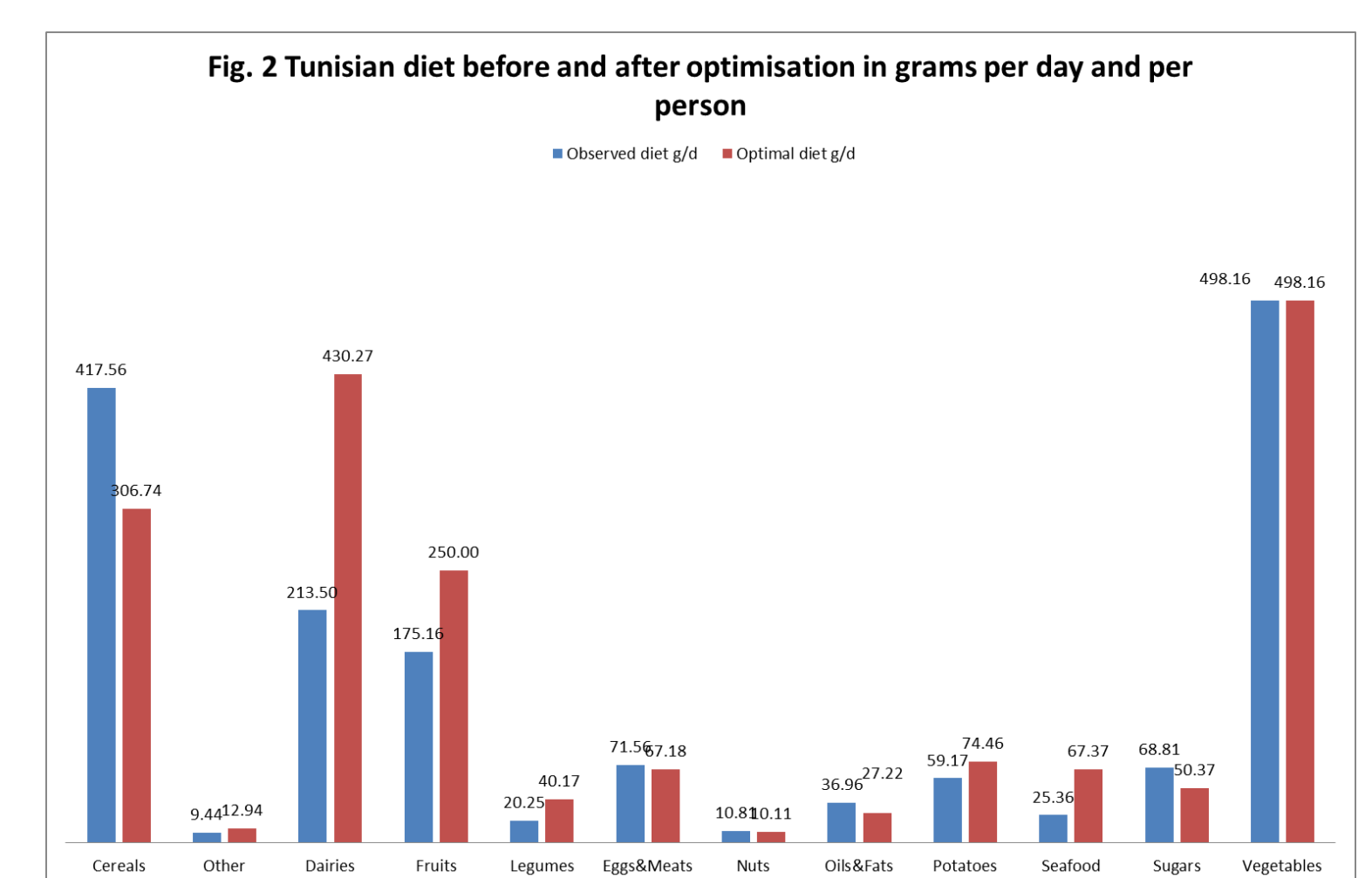
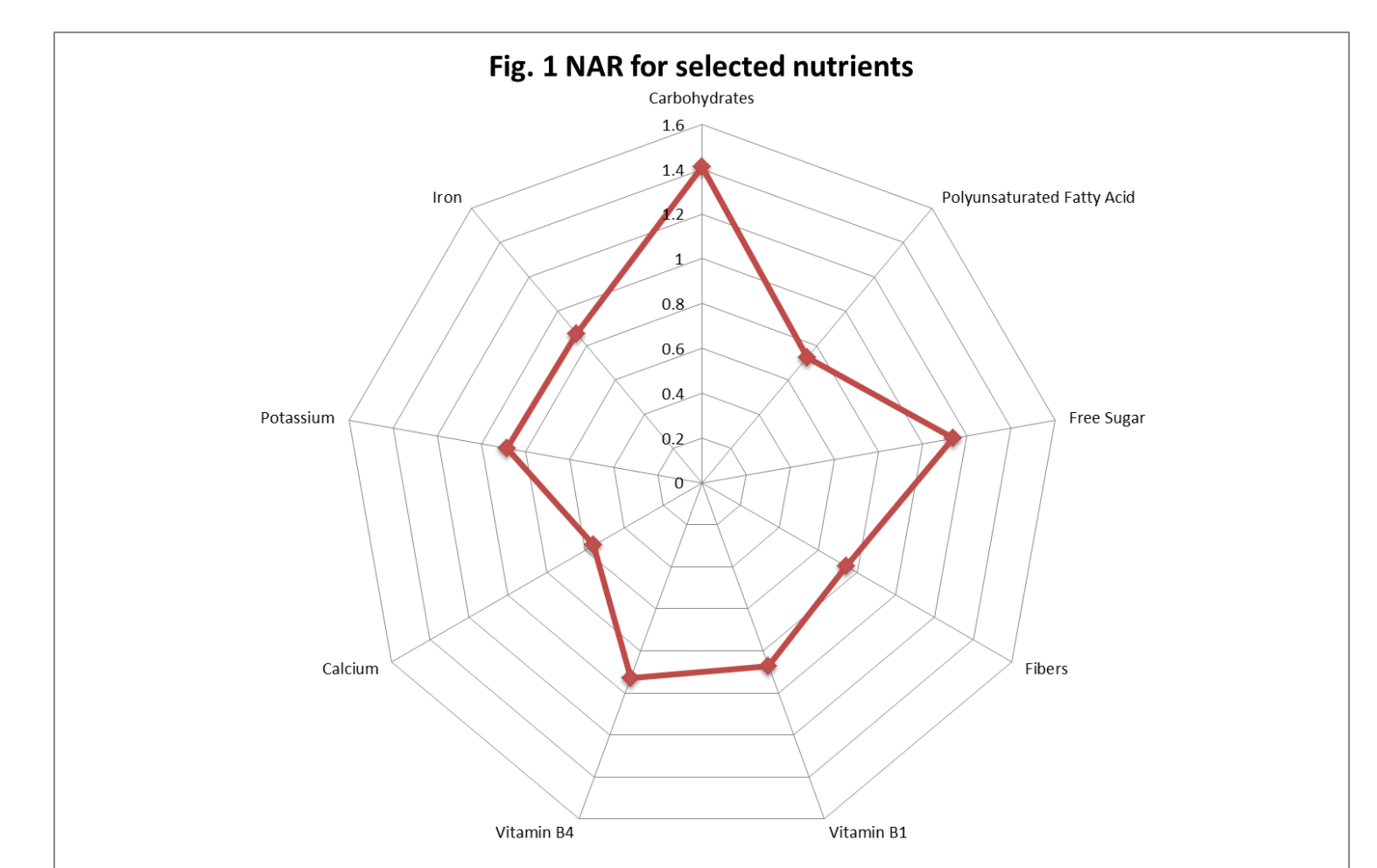
The deficiency in calcium would induce an increase in the demand of milk and dairies by 841,000 t.

In line with the deficiency in several vitamins, Tunisian consumers should increase their fruit intake (+290,000 t).

The consumption of vegetables of ~500g/d is already adequate, thus we have constrained it to the baseline.

The consumption of legumes would change by +80,000 t.

Seafood and fish demand would increase by 163,000 t.



Conclusions

In Tunisia nutritional transition was largely influenced by the food subsidy system. Food security was insured by Tunisian social policies based on direct subventions to families and indirect ones by lowering the prices of essential food products (wheat, milk, seed oils, sugar and tomato paste). As stressed by Lobstein (2002) food policies fail in delivering healthy diets. Our work proposes insights for redesigning public food policies. We took into account the actual dietary pattern of the Tunisian population at a macro-level and the capacity of production and the international trade to improve the food intakes. The results of the optimization show that if Tunisians would strictly adhere to the WHO recommendations, thus the country would increase its dependence to international markets. This conclusion reinforces the needs to improve the sustainable productivity of agriculture and to redirect public funds.

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