

Supplementary Material

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Health and Environmental Impacts of Shifting to Plant-Based Analogues: A Risk-Benefit Assessment

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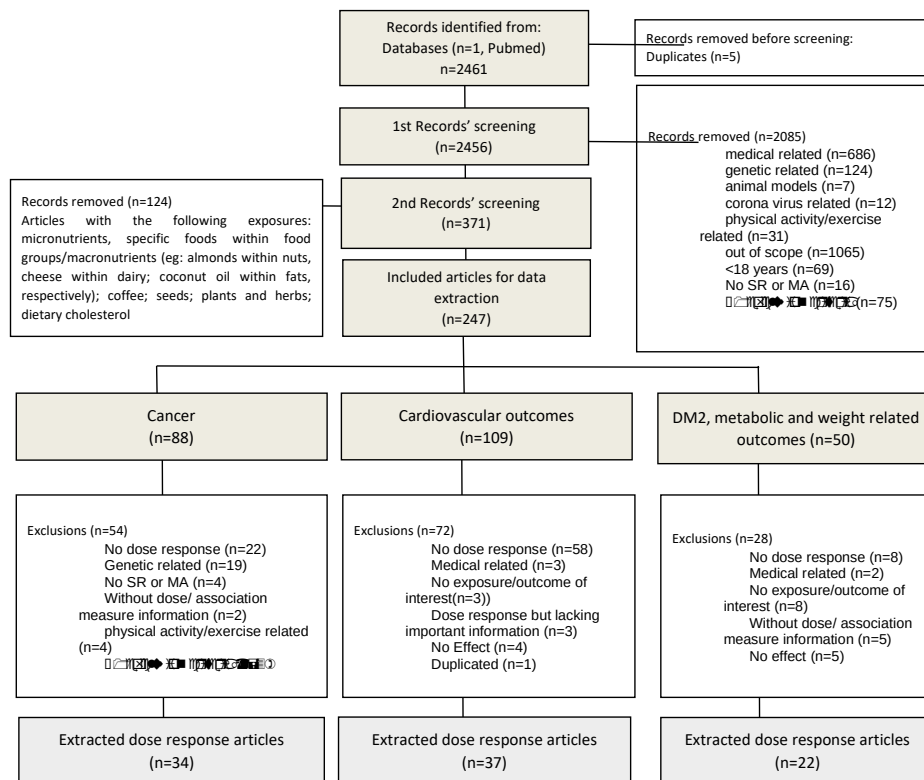


Figure S1. Flowchart of the selection of articles of associations between relevant exposures and outcomes.

The final search expression was: *((("food"[tw], "animal-based"[tw] OR "meat"[tw] OR "fish"[tw] OR "eggs"[tw] OR "dairy products"[tw] OR "milk"[tw] OR "milk substitutes"[tw]) OR ("plant-based"[tw] OR "legume"[tw] OR "pulses"[tw] OR "nuts"[tw] OR "grain"[tw] OR "whole grains"[tw] OR "meat alternatives"[tw] OR "plant-based meat alternatives"[tw]) OR ("dietary proteins"[tw] OR "dietary fats"[tw] OR "fatty acids"[tw] OR "saturated fat"[tw] OR "Fatty Acids, Omega-3 +"[tw] OR "Fatty Acids, Omega-6 +"[tw] OR "omega-3"[tw] OR "cholesterol"[tw] OR "fiber"[tw] OR "dietary fiber"[tw] OR "micronutrients"[tw] OR "iron"[tw] OR "zinc"[tw] OR "vitamin B 12"[tw] OR "calcium"[tw] OR "sodium"[tw] OR "sodium, dietary"[tw])) AND ("neoplasms"[tw] OR "cancer"[tw] OR "cardiovascular diseases"[tw] OR "obesity"[tw] OR "mortality"[tw] OR "diabetes mellitus"[tw] OR "health outcomes"[tw] OR disease[tw] OR "disorders"[tw]))*

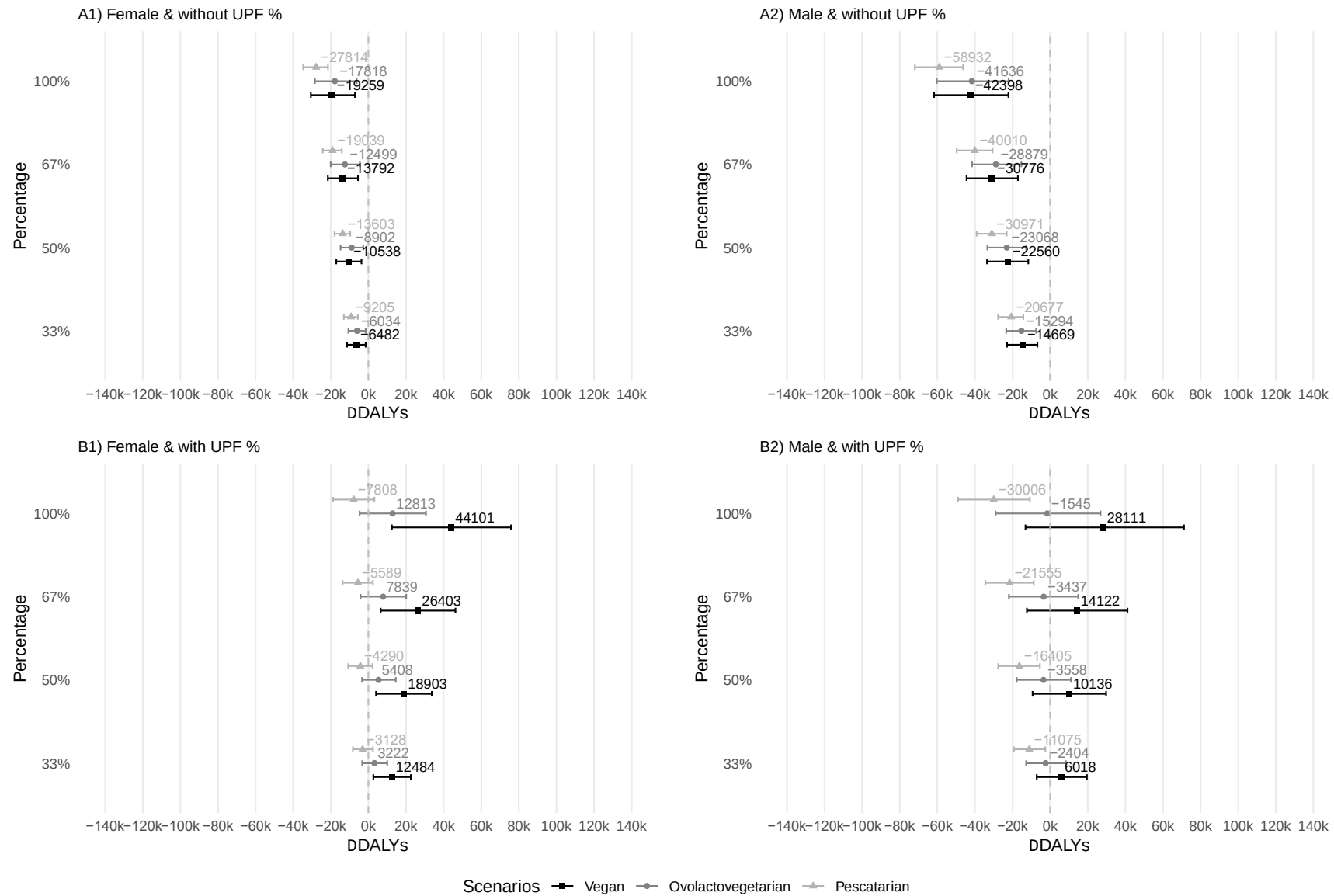


Figure S2. Health impacts (Δ DALY) of alternative scenarios compared with the reference, per sex. Figure 2A represents the results disregarding the possible effects of ultra-processed foods (UPF) for females (A1) and males (A2), while Figure 2B represents the results including the UPF effects, for females (B1) and males (B2).

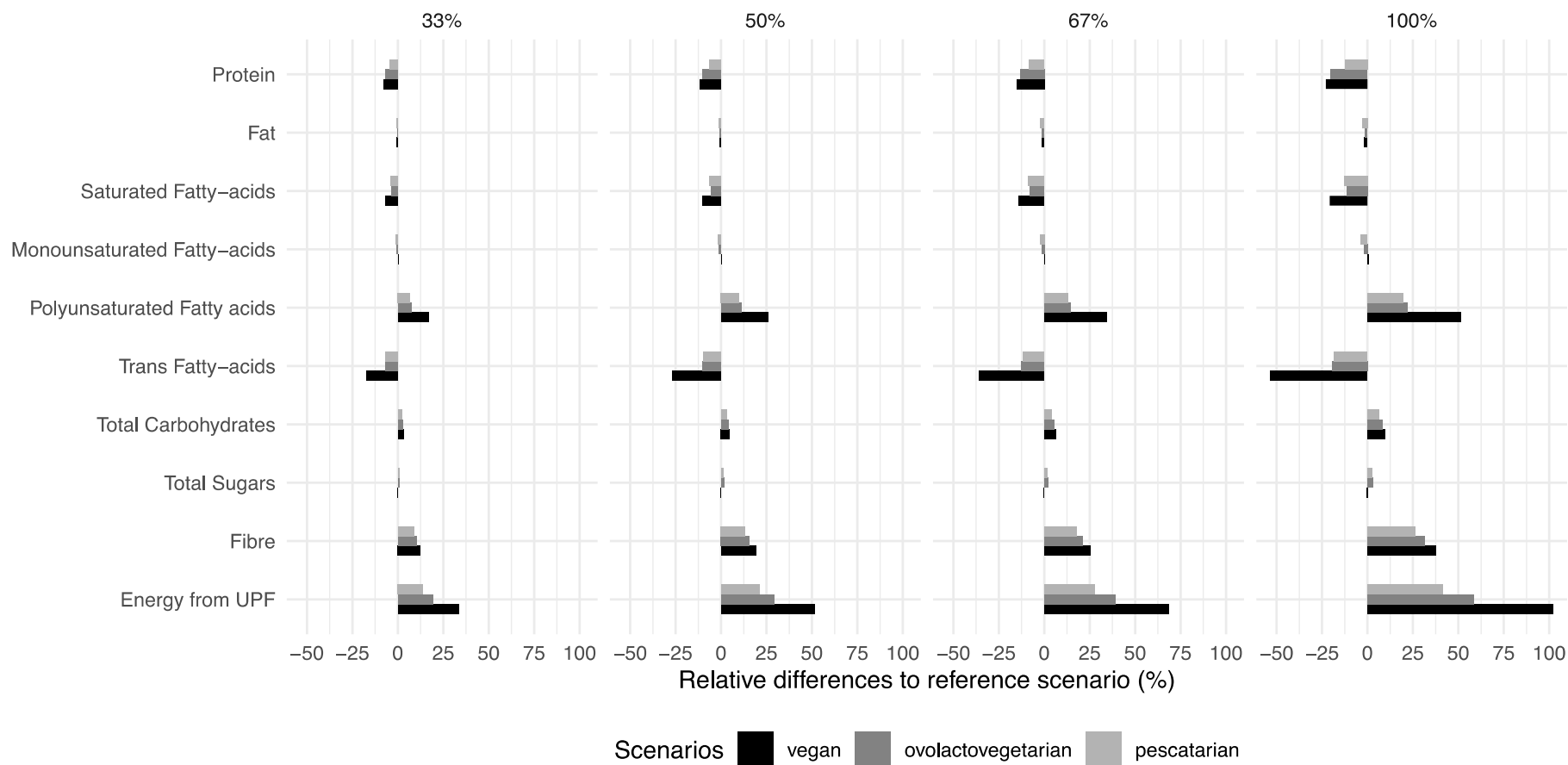


Figure S3. Differences (%) in energy from ultra-processed food (UPF) and macronutrient intake between the reference (current consumption from Portuguese Food and Physical Activity Survey) and alternative scenarios of Plant-Based Analogues consumption.

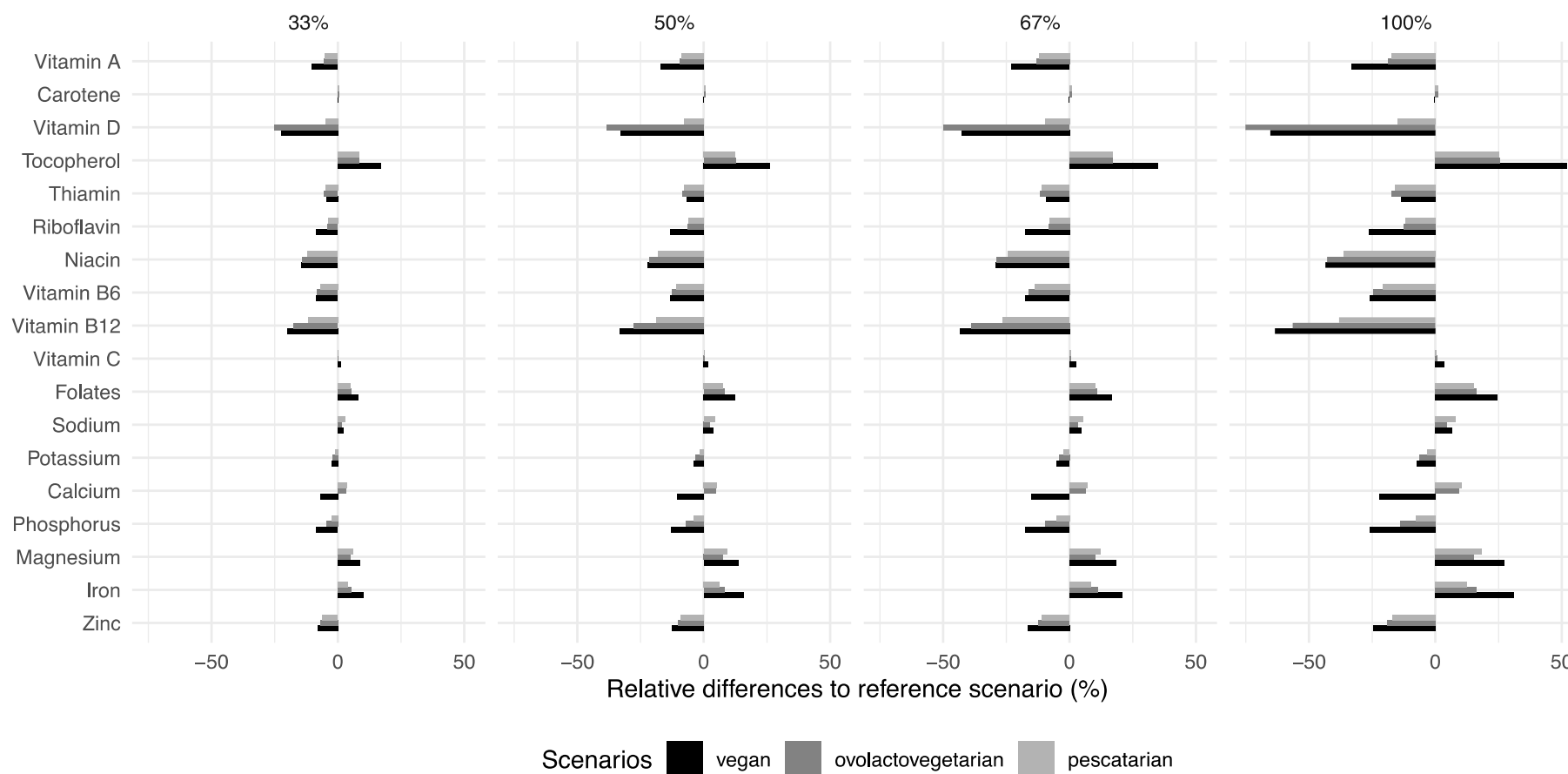


Figure S4. Differences (%) in micronutrient intake between the reference (current consumption from Portuguese Food and Physical Activity Survey) and alternative scenarios of Plant-Based Analogues consumption.

Table S1. Disability-Adjusted Life Years (DALYs) for the Portuguese population aged over 20 years for the outcomes under study, stratified by sex and extracted from the Global Burden of Disease study.

Outcome category	Health outcome	DALY (95%CI) ²	
		Females	Males
Cancer	Colorectal cancer	36105 (30754; 41473)	53900 (47684; 61298)
Cardiovascular diseases	CHD	67712 (56962; 73798)	110168 (103925; 116462)
	Stroke	107113 (90355; 117239)	99216 (91723; 104983)
DM2, metabolic and weight-related outcomes	DM2	76726 (61167; 96878)	70842 (56561; 88105)
	Overweight/ obesity	83934 (24712; 141387) ³	49234 (18556; 80967) ³

Abbreviations: CHD – coronary heart disease; DM2 – diabetes mellitus type 2; UPF – ultra-processed foods; pp – percentual points; RR: relative risks; CI: confidence intervals; DALY: Disability-Adjusted Life Years; %TEI – percentual contribution to the total energy intake;

¹ Variability in the exposure to each parameter in each scenario is considered in the model as *Gamma* (α_i , β_i) distributions (g/day).

² DALY values were extracted from the 2019 Global Burden of Disease study (GBD)

³ DALY for overweight/obesity in the GBD is represented by the risk factor “High Body-Mass Index” (DALY_{BMI}), which includes DALY for multiple causes due to high BMI, including the other health outcomes considered in this RBA, namely DM2, CHD, stroke and colorectal cancer. To avoid double counting the burden of disease of these outcomes, the DALY_{BMI} was corrected, and the DALY for the causes DM2, CHD, stroke and colorectal cancer explained by the risk-factor factor “High Body-Mass Index” was subtracted from the DALY_{BMI} for all causes.

Table S2. Prevalence of nutrient intake below the reference values in each scenario, in the Portuguese population, using data from the Portuguese Food and Physical Activity Survey (IAN-AF 2015-2016).

		Vegan				Ovolactovegetarian				Pescatarian			
	Ref	33	50	67	100	33	50	67	100	33	50	67	100
		%				%				%			
Prevalence (%) of intake below the AR													
Protein	12.2	16.4	19.0	22.0	28.3	15.4	17.2	19.2	23.7	14.0	15.0	15.6	17.7
Vitamin A	31.7	38.8	42.7	46.8	55.0	34.3	35.9	36.3	39.5	33.8	35.2	35.5	38.1
Vitamin C	45.2	44.4	44.0	43.1	42.5	45.0	44.8	44.9	44.7	45.1	44.9	45.0	44.8
Vitamin B6	19.2	26.5	30.9	34.6	45.5	26.4	29.5	32.9	43.4	25.2	28.0	30.2	38.6
Riboflavin	40.4	48.7	54.2	59.3	69.1	43.8	45.8	47.6	51.7	43.7	45.6	46.9	51.0
Folates	55.3	46.9	42.5	39.2	31.4	49.8	46.9	44.2	39.6	50.1	47.6	45.1	40.6
Calcium	57.4	64.3	68.0	72.5	82.1	54.2	52.9	51.8	49.0	53.9	52.4	51.4	48.3
Iron	11.8	7.6	5.9	4.6	3.1	9.2	7.9	7.7	5.8	9.8	8.7	8.6	7.2
Prevalence (%) of intake above the safe and adequate intake													
Sodium	78.9	81.3	82.3	83.4	85.5	81.1	82.0	82.8	84.5	81.5	82.6	83.1	85.1
Prevalence (%) of intake below AI													
Fibre	84.9	76.7	71.9	66.3	56.4	78.2	74.4	70.2	62.1	79.3	75.8	72.9	66.1
Vitamin B12	54.7	67.8	75.2	81.7	94.3	65.8	72.3	78.7	90.8	62.1	66.0	69.0	76.8
Vitamin D	97.2	98.5	98.8	99.1	100.0	98.4	98.9	99.3	100.0	97.3	97.4	97.3	97.5
Magnesium	71.5	60.5	55.4	51.2	42.1	65.4	62.6	60.6	55.1	64.4	61.2	58.0	51.8
Phosphorus	2.5	3.8	4.9	6.0	9.8	3.2	3.6	3.9	5.2	3.0	3.1	3.1	3.8
Potassium	65.3	68.2	69.6	70.2	72.9	67.2	68.0	69.7	72.0	66.1	66.5	66.9	68.2
Abbreviations: AR – Average requirement; AI – Adequate intake; Ref – Reference scenario													