Environmental impact and nutritional quality of adult diets in France based on fruit and vegetable intakes

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1. Introduction

Sustainable diets as defined by the Food and Agriculture Organization of the United Nations (FAO) must include more healthy plant-based foods such as fruit and vegetables (FV) than current diets (1). The health benefits of FV consumption for humans have been widely explored, with many studies confirming their role in preventing several chronic diseases such as cardiovascular diseases and certain types of cancer, as well as premature mortality (2,3). However, the consumption of FV like most agricultural products, is also associated with environmental impacts (4). The aim of this study was to explore the nutritional quality and the environmental impacts of self-selected diets of adults in France in relation to FV intakes.

2. Methods

Estimates of food and nutrient intakes were taken from the French INCA3 dietary survey (2014-2015). The population (n=2 121 adults) was split into five quintiles of FV intakes, in g/d (Q1 representing the lowest intake). The nutritional quality of diets was assessed through 4 indicators: mean adequacy ratio (MAR) of nutrients to favour, solid energy density, mean excess ratio (MER) of nutrients to limit, and Programme National Nutrition Santé guideline score 2 (PNNS-GS2) used to estimate adherence of diets to the French Nutrition and Health Programme recommendations. Their environmental impacts were measured with environmental footprint (EF) score (a weighted mean of 16 environmental impacts) and 4 additional indicators: a) climate change (in kg CO2 eq); b) ozone depletion (in E-06 kg CFC 11 eq), which increases exposure to harmful ultraviolet radiation; and c) fine particulate matter (E-06 disease incidence) that has an effect on human health via air exposure and d) blue water (fresh surface and groundwater used for irrigation), called here water use (in m3). Indicators were compared between quintiles of FV intakes. Analysis was conducted on diets adjusted to 2 000 kcal.

3. Results and discussion

Nutritional quality and PNNS-GS2 increased systematically with increasing intakes of FV. Hence, high FV intakes were characterised by lower solid energy density and higher intakes of vitamins C, B9, potassium and fibre, contributing to a higher MAR and lower amounts of free sugars compared to groups consuming less FV. No significant difference in single EF score were observed between quintiles of FV consumption, showing that the environmental impact is independent of the level of FV consumption when estimated with an aggregate indicator. When analysed separately, higher FV consumptions were associated with less impact on climate change, fine particulate matter and ozone depletion, even for the highest consumers of FV (Q5). Conversely, water use impact increased when FV intakes increased (Table 1).

4. Conclusions

Higher intake of FV is associated with higher nutritional quality of diets and lower environmental impacts, except for water use. Given their benefits for human and environmental health, promoting high FV consumption is essential, but it is also important to reduce their impact on water use by improving the related agricultural upstream.

5. Acknowledgements

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6. References

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	Q1	**Q2**	**Q3**	**Q4**	**Q5**	***p*-value**	***p*-trend**
Unadjusted amounts of FV (g/d) 95%CI	118.6 (111.3-125.8)	243.4 (238.4-248.3)	355.9 (352.0-359.8)	465.7 (461.1-470.2)	693.6 (672.6-714.6)	<0.001	
Unadjusted energy intakes (kcal/d)	1894	2065	2110	2167	2277	0.0014	
Nutritional quality indicators (adjusted to 2 000 kcal)							
MAR, % adequacy	74.6	77.2	80.1	81.24	82.9	<0.001	<0.001
MER, % excess	27.8	28.7	28.0	24.85	24.7	0.010	0.016
Solid energy density, kcal/100g	193.1	175.8	165.4	149.37	133.7	<0.001	<0.001
PNNS-GS2	-2.3	-2.2	-0.6	0.1	0.8	<0.001	<0.001
Nutrients to favour in % of DRV (adjusted to 2 000 kcal)							
Proteins	172.2	172.4	168.7	168.3	165.7	0.563	0.126
Fibres	51.9	57.2	62.4	70.0	78.4	<0.001	<0.001
Linoleic acid	81.3	78.5	81.0	76.6	78.3	0.542	0.259
Alpha linolenic acid	41.4	43.2	45.6	45.4	47.9	0.094	0.008
EPA+DHA	44.1	59.2	60.6	60.8	68.5	0.001	0.001
Vitamin A	85.3	126.6	133.0	141.5	169.6	<0.001	<0.001
Thiamin	139.3	151.0	152.8	151.0	157.8	0.004	0.013
Vitamin B2	103.0	105.4	112.9	109.1	112.5	0.033	0.008
Vitamin B3	169.0	160.8	151.0	154.7	151.8	0.027	0.002
Vitamin B6	96.1	96.9	101.1	106.0	110.4	<0.001	<0.001
Folates	72.1	81.4	92.7	99.4	109.4	<0.001	<0.001
Vitamin B12	133.5	131.1	136.8	129.3	136.0	0.970	0.922
Vitamin C	42.5	62.3	84.4	96.8	126.6	<0.001	<0.001
Vitamin E	90.4	92.5	109.2	103.5	116.0	<0.001	<0.001
Vitamin D	18.8	20.9	21.6	21.8	21.8	0.082	0.010
Calcium	87.3	92.7	100.9	97.5	98.6	0.001	<0.001
Potassium	76.6	80.2	84.3	89.8	97.4	<0.001	<0.001
Iron	72.1	72.6	73.1	74.3	76.4	0.383	0.096
Magnesium	98.3	97.7	99.4	101.5	104.2	0.172	0.024
Phosphorus	211.1	212.2	219.4	220.4	220.3	0.033	0.003
Zinc	92.4	93.5	89.0	88. 6	85.8	0.187	0.052
Copper	90.3	93.7	94.2	100.6	108.4	0.001	<0.001
Iodine	90.2	90.7	100.1	98.9	104.2	<0.001	<0.001
Selenium	176.1	169.6	175.9	182.9	190.8	0.012	0.019
Nutrients to limit in % of DRV (adjusted to 2 000 kcal)							
Saturated fatty acids	121.4	122.4	121.4	118.5	114.1	0.012	0.012
Sodium	126.2	133.2	134.9	133.6	140.5	0.004	<0.001
Free sugars	109.8	105.5	100.9	95.8	85.2	<0.001	<0.001
Environmental impact indicators (adjusted to 2 000 kcal)							
EF Score, mPt	0.7	0.7	0.7	0.7	0.7	0.530	0.199
Climate change, kg CO2 eq	5.6	5.6	5.3	5.3	5.0	0.011	0.003
Ozone depletion, E-06 kg CFC 11 eq	0.7	0.7	0.7	0.6	0.6	0.008	<0.001
Fine particulate matter, E-06 disease incidence	0.6	0.6	0.5	0.5	0.5	0.014	0.001
Water use, m^3	6.0	6.6	7.8	8.9	9.1	<0.001	<0.001

Table 1. Mean nutritional characteristics and environmental impacts of French adult diets according to the quintiles of FV consumption (*Dietary References Values).