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Letter to the Editor

No nutritional lessons can be learned from a misspecified and over-restricted model with no sensitivity analysis.

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1 Dear Editor:

2 In an article published recently in *The Journal of Nutrition*, Vieux *et al.* used a diet optimization model
3 to conclude that nutritionally adequate diets need to contain approximately >50% animal protein (1).

4 We have many concerns about this work.

5 Diet modeling using optimization can be used for two purposes: to identify which is the “best” diet in
6 a well-established context, which is useful to inform food-based dietary guidelines (2), or to analyze a
7 nutritional question, which is useful to characterize and understand nutrient issues and dietary
8 levers. In this latter case, which is that addressed by Vieux *et al.*, because diet modeling results
9 depend on the data used and the constraints applied (3, 4), a sensitivity analysis must be conducted
10 to explore how the chosen constraints influence or restrict the solutions identified (5). This is critical
11 to establish the overall significance of the results. Here, unfortunately, the authors provided hardly
12 any indications regarding the influence of their chosen constraints, while they drastically narrowed
13 the domain of feasible dietary solutions, all combined with a flawed research strategy, as we will
14 argue below.

15 Regarding the constraints chosen, the greatest possible consumption of each food item and group
16 was set at the 95th percentile of intake in the old survey used by the authors, for reasons of
17 theoretical “acceptability”. It is difficult to agree that intakes higher than the 95th percentile
18 consumption observed 16 years ago are simply unattainable in our current context of marked food
19 transition. The food repertoire was also very short, especially regarding plant protein (n=2 for
20 legumes; n=2 for plant-based meat substitutes, vs n=19 for meat) (1). In particular, while legumes are
21 acknowledged as a cornerstone of nutrient-rich healthy plant-based diets, it is striking that they
22 remained embedded in the “starchy food” group and restricted to two food items (boiled beans and
23 lentils). Furthermore, no information was given about the dietary constraints (on the consumption of
24 food items or groups) that were active and therefore limiting for the identification of more plant-
25 based dietary solutions. It is not reasonable to study potentially major changes to the share of
26 animal/plant protein based on the premise of such conservative – and indeed outdated – dietary
27 patterns, and capping the consumption of likely dietary levers at binding values. Indeed, such a
28 constraint on legume consumption has been waived in the modelling scenarios that underpin food-
29 based dietary guidelines for French women (2). Current dietary guidelines advocating several
30 servings of legumes per week (6) would be considered impossible according to the authors’ model.

31 The authors also chose to limit the deviation in food mass and number of food items from the
32 observed diet to arbitrary values, while it was precisely identified as increasing in line with the
33 potential share of plant protein. It was also unusually restrictive to constraint at the same or lower

34 cost, as this simply discarded all dietary solutions at even a 1% higher cost. This constraint was
35 systematically binding, as recognized by the authors, but they did not investigate the effects of its
36 relaxation. Furthermore, the costs of the food items studied dated from 16 years ago. Given the food
37 price fluctuations seen since then and cruelly illustrated today, such a constraint is inappropriate
38 when trying to study a long-term dietary transition. Indeed, current diets would be considered
39 impossible using their model.

40 Lastly, the authors applied a research strategy that was conceptually flawed in modelling terms. After
41 determining modelled diets containing an increasing share of plant protein under an initial set of
42 constraints, the authors discarded some of the most plant-based solutions using a second set of
43 constraints as *a posteriori* criteria, such as protein intake adequacy. However, they were unable to
44 prove that another solution which satisfied these *a posteriori* constraints could not have been found
45 if they had been integrated beforehand. In particular, if a sufficient amount of protein in the
46 modelled diets had logically been required beforehand with other nutritional constraints of the same
47 type, it is possible and indeed likely that a solution would have been found for the share of plant
48 protein rejected by the authors. Diets containing >50% plant protein were thus ruled out due to
49 model misspecification, as a nutritional constraint was omitted. It is certain that an opposite
50 conclusion would have been reached if the authors had omitted the reference values for fiber or
51 saturated fatty acids, rather than protein.

52 In conclusion, there was no sensitivity analysis of the influence of the restrictive and questionable
53 constraints that prevented greener dietary solutions, combined with the *a priori* omission of a
54 nutritional constraint (sufficient protein intake) that was nevertheless used *a posteriori* to discard the
55 greenest dietary solutions inadequately built because of this misspecification. This invalidates the
56 authors' conclusion that diets containing <50% animal protein are intrinsically unable to ensure
57 nutritional adequacy. This misleading conclusion, as captured unfortunately by the paper's title, is
58 further contradicted by other literature findings (7-9). In particular, we recently modelled fully
59 nutritionally adequate diets containing only 20% animal protein (9). Diets with a lower share of
60 animal protein are also better for long-term health and the environment (8-10). Finally, because it
61 did not identify critical nutrients or analyze the influence of the many non-nutritional constraints
62 chosen, this work offers no information on what should be considered an obstacle to reducing the
63 share of animal products, which is the question at issue (5).

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The authors' responsibilities were as follows: FM drafted the paper and all authors participated actively in critically reviewing of this draft and its revision and read and approved the final manuscript.

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