Deriving Sustainable Food-Based Dietary Guidelines for Germany via Multidimensional Optimization: Insights to Operationalise the Diet-Health Dimension

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Objectives: Development of a diet optimization methodology, forming the next generation of food-based dietary guidelines (FBDG) in Germany, to identify dietary changes accounting for various dimensions: diet-health relations, environmental impact, and nutrient needs while staying culturally acceptable.

Methods: Three parameters define the German Nutrition Optimization Model (GNOM): The decision variables, which are observed food intakes (FoodEx2 food grouping); acceptability constraints (acceptability upper limits (AL) are set for foods based on P95), and the linear objective function. The latter consists of three components that are weighted between each other and minimizes environmental impact (greenhouse-gas emissions and land use), diet-related health burden (disability adjusted life years), and relative deviation from the observed dietary intake (cultural acceptability). Also, deviations from nutritional needs for 39 nutrients are minimized. Five models were run on the adult population by increasing weight on diet-health and decreasing weight on cultural acceptability progressively (by steps of 20%, from 0% in model 1 (M1) to 80% in model 5 (M5)), with a fixed environmental weight at 20%. Dietary changes are exemplary described for fruits, vegetables, whole grains and red meat.

Results: All models satisfied nutrient needs and, compared to the observed diet, increased in fruits, vegetables, and whole grains and decreased in red meat; dietary changes were higher with increasing weight on diet-health. Compared to the observed intake (174,4g/d), fruits increased moderately in M1–3 (205,7g/d - 338,8g/d) and reached the AL of 552g/d in M4 and M5. Vegetables reached the AL of 267g/d in every model (observed intake: 96,3g/d) except M1 (261,5g/d). Whole grains increased progressively from 13g/d in observed intake to 16,3g/d and 16,7g/d in M1 and M2, 61,9g and 67,9g in M3 and M4 and increased strongly to 250,7g/d in M5. The observed amount of red meat was 34,4g/d, which dropped from 2,5g/d in M1 to 0g/d in M5.

Conclusions: This methodology accounts for multidimensional requirements in FBDGs and is flexible regarding the importance given to each dimension. Preliminary results suggest that using this innovative approach to operationalize diet-health relations, GNOM is able to help derive German FBDG.

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