



University of St.Gallen

Institute of Retail Management

u^b

UNIVERSITÄT
BERN

INSELSPITAL

UNIVERSITÄTSSPITAL BERN
HÔPITAL UNIVERSITAIRE DE BERNE

Universitätsklinik für Diabetologie, Endokrinologie,
Ernährungsmedizin und Metabolismus

Matthias Eggenschwiler

Melanie Stoll

Ass.-Prof. Dr. Marc Linzmajer

Prof. Dr. med. Dr. phil. Lia Bally

Meat-Restricted Diets in Switzerland



ISBN 978-3-906057-42-2

From insight to impact.

Preface

Identifying flexitarians in the Swiss population using food purchase receipts

Shifting away from diets that are high in animal-source foods, in particular red and processed meat, towards more plant-based foods is broadly considered to be beneficial to both planetary and personal health. Excess consumption of animal-sourced foods, represented mostly by high amounts of red and processed meat, in combination with low levels of plant-sourced foods, such as pulses, roots, nuts, seeds, grains, and vegetables, is a key driver of the growing burden of non-communicable diseases worldwide (Afshin et al., 2019). Similarly, excess consumption of animal-sourced foods are causing substantial negative environmental impacts being responsible for 25% of all greenhouse gas emissions, 40% of earth's surface occupation and 70% of freshwater resources (Springmann, Clark, et al., 2018).

A dietary pattern, that is characterized by reduced overall meat consumption without omitting it completely, is also referred to as a flexitarian diet. This contrasts with vegetarians who follow a meat- and fish-free diet, pescovegetarians who follow a vegetarian diet that include fish, and vegans who follow a strict plant-based diet and abstain from any animal-sourced foods. However, a flexitarian

diet framework remains open for interpretation about the degree of meat reduction and restriction of other animal-sourced foods such as dairy, eggs, fish and seafood. There is increasing evidence that flexitarian diets with modest amounts of animal-sourced foods (meat, dairy, eggs, fish) have the potential to make important contributions to reducing the environmental footprint of the food system and providing health benefits to food consumers (Springmann, Clark, et al., 2018).

A flexitarian reference diet that meets health as well as sustainability goals was developed by the EAT-Lancet Commission in 2019 (Willett et al., 2019). The Eat-Lancet diet emphasizes a plant-forward diet where whole grains, fruits, vegetables, nuts, and legumes comprise a greater proportion of foods consumed. Meat, dairy, fish, and eggs constitute important parts of the diet but in significantly smaller proportions than whole grains, fruits, vegetables, nuts, and legumes. The Eat-Lancet reference diet provides an ideal basis to characterize a flexitarian diet and to monitor adherence to a flexitarian eating pattern in dietary intake surveys. However, the Eat-Lancet nutritional targets have often been adapted to national dietary

guidelines, reflecting local culture and geography as well as providing nutritional adequacy for micronutrients and minerals (Beal et al., 2023; Lassen et al., 2020). We adapted the EAT-Lancet target values to the Swiss dietary recommendations to define the Swiss planetary health diet (CH-PHD).

Adherence to a flexitarian diet pattern has been previously assessed using food frequency questionnaires, surveys, or agricultural and economic data to monitor the food supply (Langmann et al., 2023). These methods have well-known limitations as they are either subject to misreporting or provide no information on the consumer level. Due to greater objectivity and lower time burdens for participation, commercial data provide a promising yet underutilized source of information for the assessment of dietary patterns, estimation of nutritional intake, and tracking changes over time. In this study, we use food purchases from the database of the Swiss Nutrition Atlas (see Linzmajer et al., 2022) to apply the defined CH-PHD target values to the sample of 371 households.

Table of Contents

	Page
Preface	2
Table of Contents	3
1. Summary	4
2. Study Design	6
3. Results	9
4. Strengths and Limitations	15
5. Study Authors, Sponsorship & Contact	17
6. References	19



1

Summary



Summary

Background: Shifting from diets high in animal-sourced foods towards more plant-based eating patterns can potentially improve the health of people and the environment. Reducing meat and meat-derived products, whilst not completely omitting consumption of animal-sourced foods, is also referred to as a flexitarian diet. Previous assessments of the prevalence of flexitarian diets have predominantly relied on self-reported measures without objective dietary intake analyses.

Aim: The aim of the study was to leverage food purchase patterns to map the share of Swiss households that meet the criteria of a flexitarian diet pattern according to a self-developed classification scheme.

Method: Analyses were performed using the data of the Swiss Nutrition Atlas (371 Swiss households with a representative proportion of all three language regions, food purchase receipt collection from grocery stores, restaurants, and any other source over two weeks). The flexitarian classification algorithm

was developed using the Eat-Lancet planetary health diet targets with adaptations to align with the Swiss dietary recommendations. The criteria for a flexitarian diet (2500kcal/day) entailed restriction of meat consumption to a maximum of 300 grams per week (43g/day), while the maximum for fish and seafood intake was set at 200 grams per week (28.6g/day). Flexitarian households which demonstrated additional animal-sourced foods restrictions for eggs of 175 grams per week (25g/day), dairy (625 calcium equivalents/day for age \geq 18 years), and butter/cream (10g/day) per day were considered “ultra-flexitarian”. Households with complete omissions of meat were classified vegan, ovo-lacto-vegetarian, or pescovegetarian. With the egg and dietary cutoffs we also classified “ultra-ovo-lacto-vegetarians” and “ultra-pescovegetarians”. Remaining households were declared omnivorous.

Results: The share of flexitarian households was 18.3%, of which only 25% were considered ultra-flexitarian. The share of ovo-lacto-vegetarian and pescovegetarian diets

was 7.8 and 2.7% (50% of each group met the planetary health target for all animal-sourced food categories). 0.5% were classified vegan. Total fat consumption did not discriminate flexitarian from omnivorous households, but the former showed greater energy shares from protein at the expense of carbohydrates. Recommended dietary fibre target (14g/1000kcal) was not met by any diet group. Salt consumption was highest among omnivorous households, with no differences among other groups.

Conclusions: Less than 20% of Swiss households follow a flexitarian diet, and only 5.1% meet additional planetary health targets for all animal-sourced foods. Despite the meat-restricted diets, dietary fibre targets were not achieved, while health benefits were seen for salt intake. Apart from underscoring unmet nutritional and sustainability goals, we hereby present the potential of commercial data as novel approach for assessing dietary patterns with greater objectivity and compositional details.



2

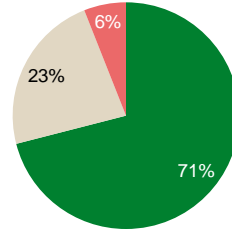
Study Design & Population



Study Design and Population

The present study used data from the Swiss Nutrition Atlas, a longitudinal study of food purchase patterns over 2 weeks in February and March 2022. The Swiss Nutrition Atlas collects purchasing data from food purchases, food orders, out-of-home consumption, and meal orders to estimate household as well as individual food intake. A detailed description of the data collection, modeling, and limitations can be found in Linzmayer et al. (2022) or on the Swiss Nutrition Atlas website (www.nutritionatlas.ch).

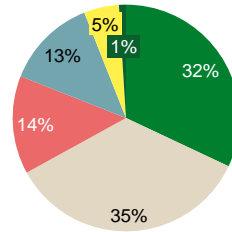
The database of the Swiss Nutrition Atlas consists of 2'984 cash receipts with 21'712 food items of a representative sample (in terms of household size and distribution of language region) of 371 households with 834 individuals. Most of the food items in the database were paired with the net weight (91%), ingredients (77%), nutrition facts label (81-83%) and a product category (86%). Nutritional information was gathered from retailers ERP systems (i.e., Migros, Coop and Spar), grocer's web sites or available databases for branded and generic food products. The authors exclusively used Swiss databases, with the exception of added sugars where also international databases were considered. The participants were not directly asked for dietary supplement usage, but supplements purchased in the two week observation period were captured by the data collection.



n = 371 households

Households by Language Region

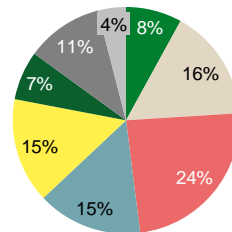
■ DE-CH
■ FR-CH
■ IT-CH



n = 371 households

Number of People Living in the Household

■ 1 Person ■ 4 People
■ 2 People ■ 5 People
■ 3 People ■ 6 People



n = 371 households

Household Net Income

■ Under CHF 2'499 ■ CHF 7'000 - CHF 8'499
■ CHF 2'500 - CHF 3'999 ■ CHF 8'500 - CHF 9'999
■ CHF 4'000 - CHF 5'499 ■ CHF 10'000 - CHF 14'499
■ CHF 5'500 - CHF 6'999 ■ CHF 15'000 and more

Cutoffs for a Swiss Planetary Health Diet (CH-PHD)

Animal-sourced food category	Cutoffs for CH-PHD
Meat	≤ 300 g/week (43 g/day) for an energy intake of 2500 kcal/day
Fish and seafood	≤ 200 g/week (28.6g/day) for an energy intake of 2500 kcal/day
Dairy (without Butter/Cream)	≤ 250 g, ≤ 430 g, ≤ 625 g or ≤ 500 g milk or equivalents/day (1-3 years, 4-10 years, 11-17 years, >=18 years)
Butter/Cream	≤ 10 g/day
Eggs	≤ 25 g/day for an energy intake of 2500 kcal/day

In the present study, we assigned households with restriction or omission of meat/fish as well as other animal-sourced foods to the following diet groups: (1) vegan, (2) ovo-lacto-vegetarian, (3) pescovegetarian, and (4) flexitarian. Households that were not fulfilling the criteria for diet groups 1-4 were defined as omnivorous (5).

To assess the eligibility of the diet groups, all animal-sourced foods were assigned to the above-outlined five food categories. Honey and other insect-derived products were not included for simplicity reasons. For each of the five categories, specific cutoffs were derived based on the EAT-Lancet planetary health diet targets, with alignment to Swiss dietary recommendations, where appropriate.

Meeting cut-offs for meat and fish/seafood was considered sufficient to qualify for the flexitarian diet group. Flexitarians who also restricted the intake of dairy, butter/cream, and eggs according to targets were considered “ultra-flexitarian”. Similarly, we use the same procedure to classify “ultra-ovo-lacto-vegetarians” and “ultra-pescovegetarians”.

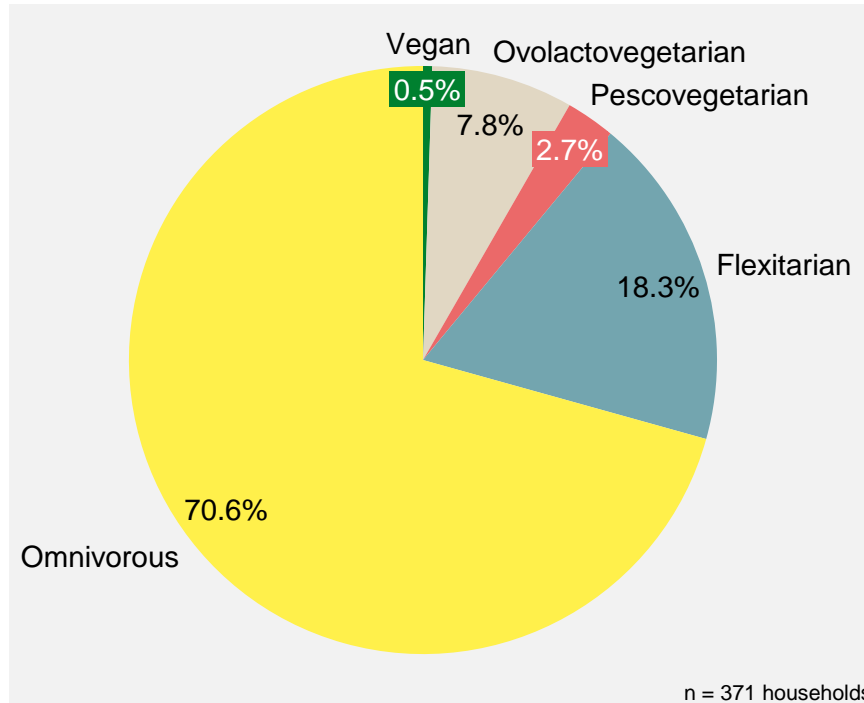


3

Results

Proportion of Dietary Patterns in Switzerland

Meat-reduced diet groups account for just under a third of the Swiss population



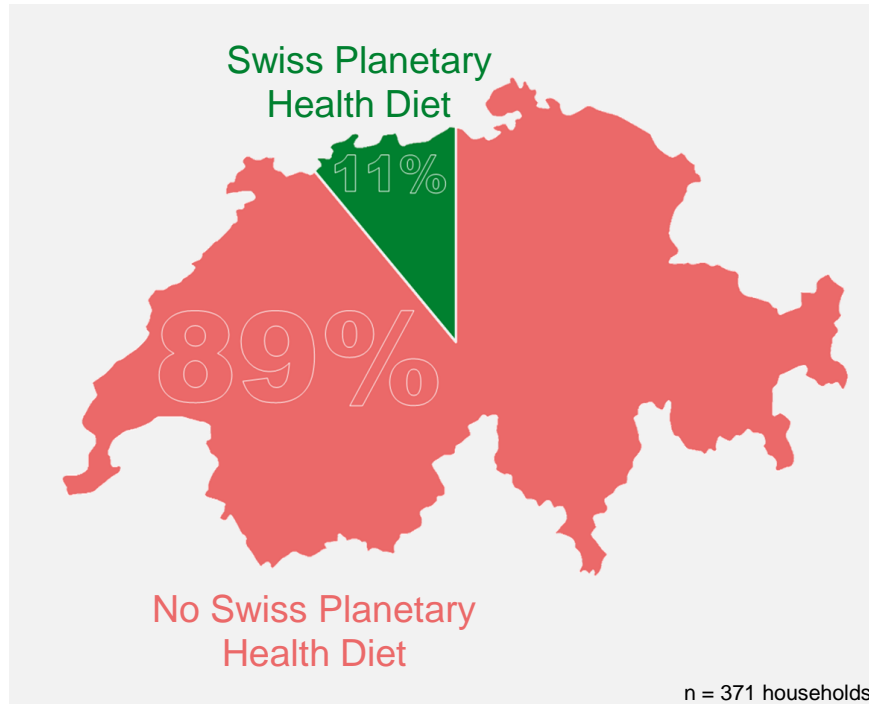
Reading example: 0.5% of the Sample's households were classified to follow a vegan diet.

FURTHER RESULTS AND INTERPRETATION

- Two households (0.5%) follow a strict vegan diet, completely omitting animal-sourced foods.
- 29 households (7.8%) follow an ovolutovegetarian diet, avoiding any meats (incl. fish and seafood).
- Ten households (2.7%) showed a pescovegetarian dietary pattern, avoiding meat, but not fish and seafood.
- 68 households (18.3%) revealed a flexitarian dietary pattern, restricting meat and fish consumption (for daily energy intake of 2500kcal not exceeding 300 g/week (43 g/day) meat or 200 g/week (28.6 g/day) fish).
- The remaining households (262; 70.6%) were classified omnivorous.

Proportion of Households that Follow a CH-PHD

Only 11% of the Swiss households follow a Swiss planetary health diet



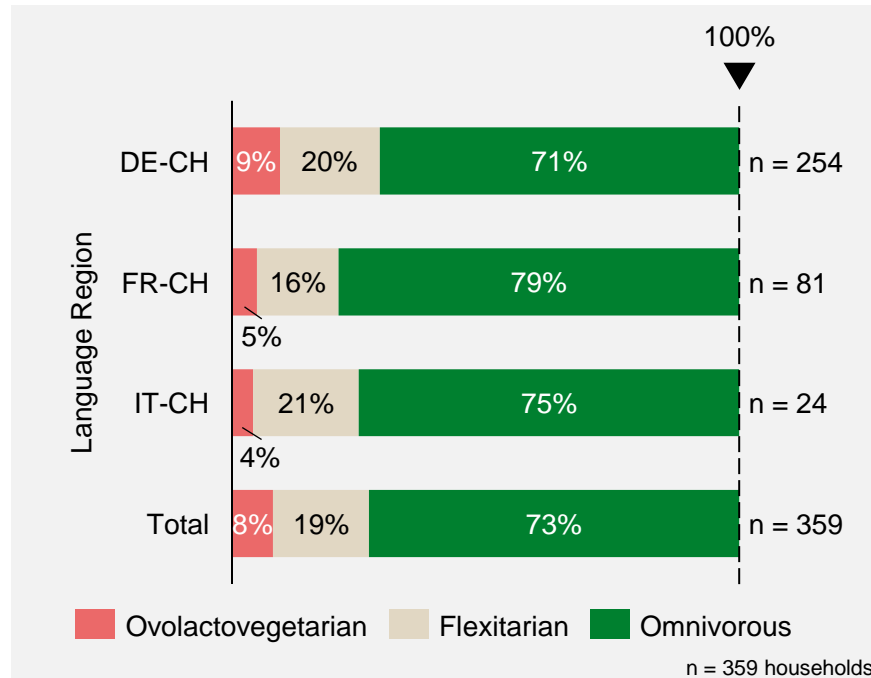
Reading example: 11% of the Sample's households were classified to follow a planetary health diet according to the defined cutoffs on slide 9.

FURTHER RESULTS AND INTERPRETATION

- For the three diet groups, ovo-lacto-vegetarian, pesco-vegetarian, and flexitarian, we further differentiated the groups into planetary and non-planetary health diets based on the defined cutoffs for Switzerland.
- Approx. 50% of the ovo-lacto-vegetarian households (i.e., 4.0% of all households) followed a diet where all animal-sourced food categories were below our defined cutoffs.
- Approx. 50% of the pesco-vegetarian households (i.e., 1.1% of all households) followed a diet where all animal-sourced food categories were below our defined cutoffs.
- Approx. 25% of the flexitarian households (i.e., 5.1% of all households) followed a diet where all animal-sourced food categories were below our defined cutoffs.
- This result indicates that most households who follow a flexitarian diet minimize only meat and fish intake but not so much the intake of other animal-sourced foods (e.g., eggs and dairy products).
- In sum, we find only 11 percent of Swiss households fulfilling the criteria of a Swiss planetary health diet. 89 percent of Swiss households overeat in at least one animal-sourced food category.

Share of Diet Group by Language Region

The French-speaking region of Switzerland tends to be less meat-restrictive



Note: Vegan and pescovegetarian households are excluded due to the small sample size.

Reading example: 9% of the Sample's households in the German-speaking region of Switzerland were classified to follow an ovolactovegetarian diet.

FURTHER RESULTS AND INTERPRETATION

- A chi-square test was used to compare language region and diet. Results do not show a significant relationship between language region and diet, $\chi^2(4) = 3.084$, $p = .544$.
- This suggests that there is no clear indication for differences in the adherence to the specified diet groups between Swiss language regions based on this study.
- Studies done in the past, however, showed differences in the amount of meat consumption across Swiss language regions. Specifically, overall meat consumption was found to be highest in Italian-speaking language areas, followed by French-speaking and German-speaking regions in that order (Tschanz et al., 2022).

Animal-Sourced Food Intake by Diet Group

Flexitarians restrict meat and fish consumption, but not so much in other animal-sourced foods

Animal-Sourced Food Intake	Ovolacto-vegetarian	Flexitarian	Omnivorous
Meat	0 g/day	17.6 g/day	130.6 g/day
Fish and Seafood	0 g/day	2.9 g/day	5.3 g/day
Dairy (without Butter/Cream)	311.6 g*/day	419.8 g*/day	405.4 g*/day
Butter/ Cream	8.7 g/day	22.0 g/day	21.1 g/day
Eggs	10.2 g/day	16.1 g/day	16.5 g/day

Notes: Values represent average daily consumption of milk or dairy equivalents per capita in grams (marked with *).

Outliers were removed using $1.5 \cdot \text{IQR}$ below Q1 and above Q3 (smallest cell 24).

$n_{\text{before cleaning}} = 359$ households (vegan and pescovegetarian households are excluded due to the small sample size).

FURTHER RESULTS AND INTERPRETATION

- Vegetarians omit any meat and fish by definition. Consequently their intake is zero. Flexitarian households restricted their meat consumption to a maximum of 40 grams of meat and 28.6 grams of fish per day per 2500 kilocalories. Consequently, the intake of both meat and fish differed drastically between all groups.
- It was interesting, however, that only ovolactovegetarian households have a significantly lower intake of dairy products (including butter/cream) and eggs compared to the flexitarian and omnivorous households. The analyses of our study showed that the intake in dairy products and eggs was not lower for flexitarian households.

Reading example: On average, ovolactovegetarian households eat 0 grams of meat and fish, 312 grams of milk or dairy equivalents, 9 grams of butter or cream and 10 grams of eggs per capita per day.

Nutrient Intake by Diet Groups

Meat-restricted diets have a lower salt intake and a lower protein intake

Nutrient Intake	Ovolacto-vegetarian	Flexitarian	Omnivorous
Total Energy Intake (TEI)*	1159.3 kcal/day	1573.5 kcal/day	1532.9 kcal/day
Fat Intake	39.1 % of TEI	41.5 % of TEI	42.5 % of TEI
Saturated Fat Intake	14.5 % of TEI	15.5 % of TEI	16.5 % of TEI
Protein Intake	11.8 % of TEI	12.4 % of TEI	15.6 % of TEI
Carbohydrate Intake	47.3 % of TEI	46.7 % of TEI	41.8 % of TEI
Fibre Intake	10.4 g/1000 kcal	10.1 g/1000 kcal	9.7 g/1000 kcal
Salt Intake	2.4 g/1000 kcal	2.7 g/1000 kcal	3.4 g/1000 kcal

Notes: Values represent average daily consumption per capita. Outliers were removed using $1.5 \cdot \text{IQR}$ below Q1 and above Q3 (smallest cell 28). $n_{\text{before cleaning}} = 359$ households (vegan and pescovegetarian households are excluded due to the small sample size). * TEI can not be interpreted due to the used statistical correction applied.

FURTHER RESULTS AND INTERPRETATION

- Fat consumption did not discriminate the different diet groups, but the omnivorous group showed lower carbohydrate with compensatory higher protein shares.
- Protein contributions were significantly lower in households which restrict animal/fish. Due to the lower bioavailability of plant-based protein sources, net protein utilization may be lower.
- The obvious difference in salt intake underscores that meat, mainly in processed forms, is a relevant sodium-source.

Reading example: On average, ovolactovegetarian households eat 1159 kilocalories per capita per day. Of those kilocalories, 39% come from fats, 14.5% from saturated fats, 12% from protein, and 47% from carbohydrates. Per 1000 kilocalories ovolactovegetarian households eat 10 grams of fibre and 2 grams of salt.



4

Strengths & Limitations

Strengths and Limitations of the Study

While this study has yielded valuable insights and contributions, it is essential to acknowledge its inherent limitations. Recognizing these constraints is crucial for comprehensively understanding the research and its implications.

First, our study has limitations as the Swiss Nutrition Atlas database consists of food purchase data, representing only an indirect approximation of consumption. Nonetheless, we believe that for an analysis of meat-restricted diets, food purchases might even be a more reliable data source than traditionally used food frequency questionnaires or diet records. Because our study included an analysis of the purchased products' ingredients, we were able to identify most animal-sourced ingredients. That makes it especially robust to classify vegan and vegetarian diets on the basis of clear definitions.

Second, our analysis is only a snapshot and not cross-sectional. The Swiss Nutrition Atlas was conducted in February and March 2022. Additionally, the households were observed over two weeks. Those two weeks might not represent the average consumption for the rest of the year. However, other studies have shown that two weeks of food purchase data collection are enough to assess dietary intake reliably (French et al., 2009).

Third, our classification of diet types is done on household level, not representing the individuals' diet types. For example, a household with a vegan and an omnivore is classified in our algorithm as either flexitarian (if the omnivore does not eat more than twice our defined cutoffs) or as an omnivore household (if the omnivore eats more than twice our defined cutoffs). When analyzing individual diet types, other studies might draw different conclusions.

Fourth, not all products in the Swiss Nutrition Atlas database have a list of ingredients and macronutrients. Thus, for a minority of the household's food purchases, we could not classify the products as containing animal-sourced ingredients. For those products, we assumed that the amount of animal-sourced ingredients was the same as in the rest of the households' purchases. If we could only identify 95% of the purchased products from one household, and in those products, we did not find any animal-sourced ingredient, we assumed that the remaining 5% of products also do not contain animal-sourced ingredients.

Despite all limitations, our study is one of the first assessments based on food purchase receipts. It represents a complementary method adding a new dimension to traditionally used subjective dietary intake assessment (food frequency questionnaire or diet recalls). The data allows for greater objectivity and deep insights into product selection and its ingredients.



5

**Study Authors,
Sponsorship &
Contact Details**

The Authors



Matthias Eggenschwiler

Research Associate
IRM-HSG



Melanie Stoll

Nutrition Scientist
UDEM



Ass.-Prof. Dr.
Marc Linzmajer

Vice Director
IRM-HSG



Prof. Dr. med. Dr. phil.
Lia Bally

Head of Nutritional Medicine,
Metabolism and Obesity
Head of Research UDEM

Note: We thank Danone Schweiz AG, which supported the research project with an unrestricted grant. This funding source had no role in the research methodology, design and execution of the analyses, nor in the interpretation of the data and the dissemination of the findings.



Contact Details

Email: handelsmanagement@unisg.ch

Phone: +41 71 224 28 56

Universität St.Gallen (IRM-HSG)
Institute of Retail Management
Dufourstrasse 40a, CH-9000 St.Gallen



6

References

Bibliography

- Afshin, A., Sur, P. J., Fay, K. A., Cornaby, L., Ferrara, G., Salama, J. S., Mullany, E. C., Abate, K. H., Abbafati, C., Abebe, Z., Afarideh, M., Aggarwal, A., Agrawal, S., Akinyemiju, T., Alahdab, F., Bacha, U., Bachman, V. F., Badali, H., Badawi, A., . . . Murray, C. J. L. (2019). Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, 393(10184), 1958-1972. [https://doi.org/10.1016/S0140-6736\(19\)30041-8](https://doi.org/10.1016/S0140-6736(19)30041-8)
- Beal, T., Ortenzi, F., & Fanzo, J. (2023). Estimated micronutrient shortfalls of the EAT–Lancet planetary health diet. *The Lancet Planetary Health*, 7(3), e233-e237. [https://doi.org/10.1016/S2542-5196\(23\)00006-2](https://doi.org/10.1016/S2542-5196(23)00006-2)
- French, S. A., Wall, M., Mitchell, N. R., Shimotsu, S. T., & Welsh, E. (2009). Annotated receipts capture household and food purchases from a broad range of sources. *International Journal of Behavioral Nutrition and Physical Activity*, 6(1), 37. <https://doi.org/10.1186/1479-5868-6-37>
- Hargreaves, S. M., Rosenfeld, D. L., Moreira, A. V. B., & Zandonadi, R. P. (2023). Plant-based and vegetarian diets: an overview and definition of these dietary patterns. *European Journal of Nutrition*, 62(3), 1109-1121. <https://doi.org/10.1007/s00394-023-03086-z>
- Langmann, F., Ibsen, D. B., Tjønneland, A., Olsen, A., Overvad, K., & Dahm, C. C. (2023). Adherence to the EAT-Lancet diet is associated with a lower risk of type 2 diabetes: the Danish Diet, Cancer and Health cohort. *Eur J Nutr*, 62(3), 1493-1502. <https://doi.org/10.1007/s00394-023-03090-3>
- Lassen, A. D., Christensen, L. M., & Trolle, E. (2020). Development of a Danish Adapted Healthy Plant-Based Diet Based on the EAT-Lancet Reference Diet. *Nutrients*, 12(3). <https://doi.org/10.3390/nu12030738>
- Linzmajer, M., Eggenschwiler, M., & Bally, L. (2022). Der Schweizer Ernährungsatlas – Eine Schätzmethode des Ernährungsverhaltens der Schweizer Bevölkerung basierend auf Einkaufsdaten. U. S. G. Forschungszentrum für Handelsmanagement. <https://www.ernaehrungsatlas.ch/>
- Neufingerl, N., & Eilander, A. (2022). Nutrient Intake and Status in Adults Consuming Plant-Based Diets Compared to Meat-Eaters: A Systematic Review. *Nutrients*, 14(1), 29. <https://www.mdpi.com/2072-6643/14/1/29>
- Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., . . . Willett, W. (2018). Options for keeping the food system within environmental limits. *Nature*, 562(7728), 519-525. <https://doi.org/10.1038/s41586-018-0594-0>
- Tschanz, L., Kaelin, I., Wróbel, A., Rohrmann, S., & Sych, J. (2022). Characterisation of meat consumption across socio-demographic, lifestyle and anthropometric groups in Switzerland: results from the National Nutrition Survey menuCH. *Public Health Nutr*, 25(11), 3096-3106. <https://doi.org/10.1017/s136898002200101x>
- Weibel, C., Ohnmacht, T., Schaffner, D., & Kossmann, K. (2019). Reducing individual meat consumption: An integrated phase model approach. *Food Quality and Preference*, 73, 8-18. <https://doi.org/https://doi.org/10.1016/j.foodqual.2018.11.011>
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., . . . Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170), 447-492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)