Adapting the US Nutrition5k dataset for Deep Learning-Food Image Recognition in Italy: preliminary results

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BACKGROUND: In the era of global nutrition research, the improvement of analytical methodologies for the comparability of food composition databases (FCDBs) across countries is becoming increasingly important. We aimed to adapt the Nutrition5k dataset to the Italian context in order to develop a more precise and accurate nutritional assessment tool through the training of a deep learning (DL) algorithm based on food images from Nutrition5k dataset and nutritional values from the Food Composition Database for Epidemiological Studies in Italy (BDA).

METHODS:

- Data extraction from "Dish metadata" files attached to Nutrition5k dataset
- Food matching procedure involving a check of nutritional equivalency between the ingredients reported in the Nutrition5k dataset and foods from BDA
- Data processing to tackle negative and/or missing values and to make the new dataset suitable for the DL algorithm training
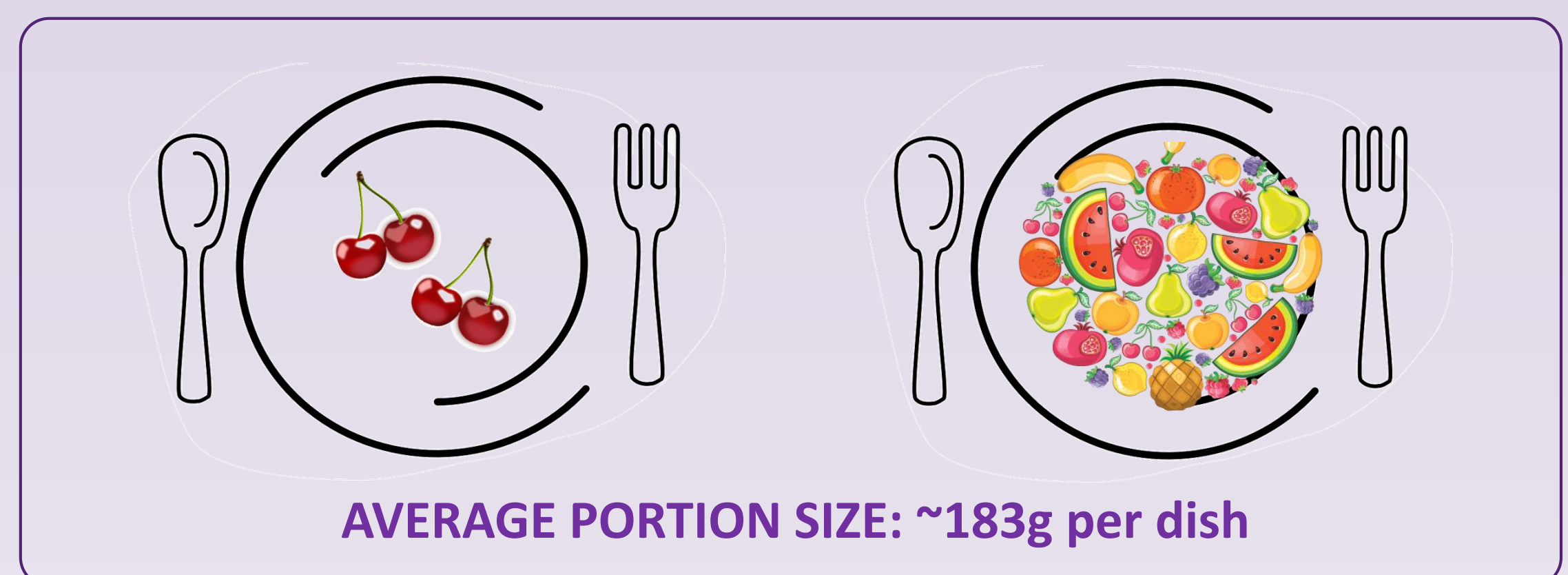

AVERAGE PORTION SIZE: ~183g per dish

Fig.1 Portion sizes of dishes in Nutrition5k

RESULTS: Among the 5006 Nutrition5k dishes, substantial differences were observed in portion sizes (few grams –1.1 kg, average: 183g per plate) *(Fig.1)*, dish complexity (1–34 ingredients, average: 6) *(Fig.2)*, and nutritional values. As for food-matching, out of 248 different ingredients, 169 (68%) could exactly match with BDA Italian food items, 27 (~11%) were replaced with their most similar ones from BDA, 10 (4%) were sourced from USDA FCDB, 6 (2%) were obtained through mean value calculation, and 36 (~15%) were new-created recipes *(Fig.3)*.
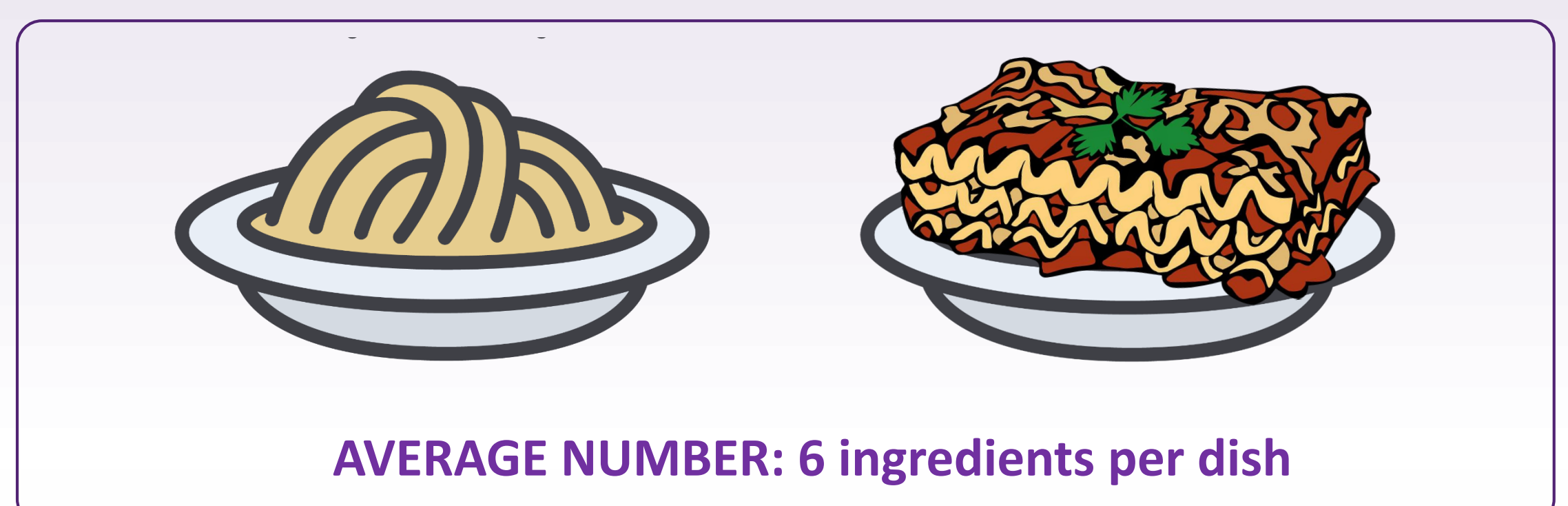

AVERAGE NUMBER: 6 ingredients per dish

Fig.2 Complexity of dishes in Nutrition5k
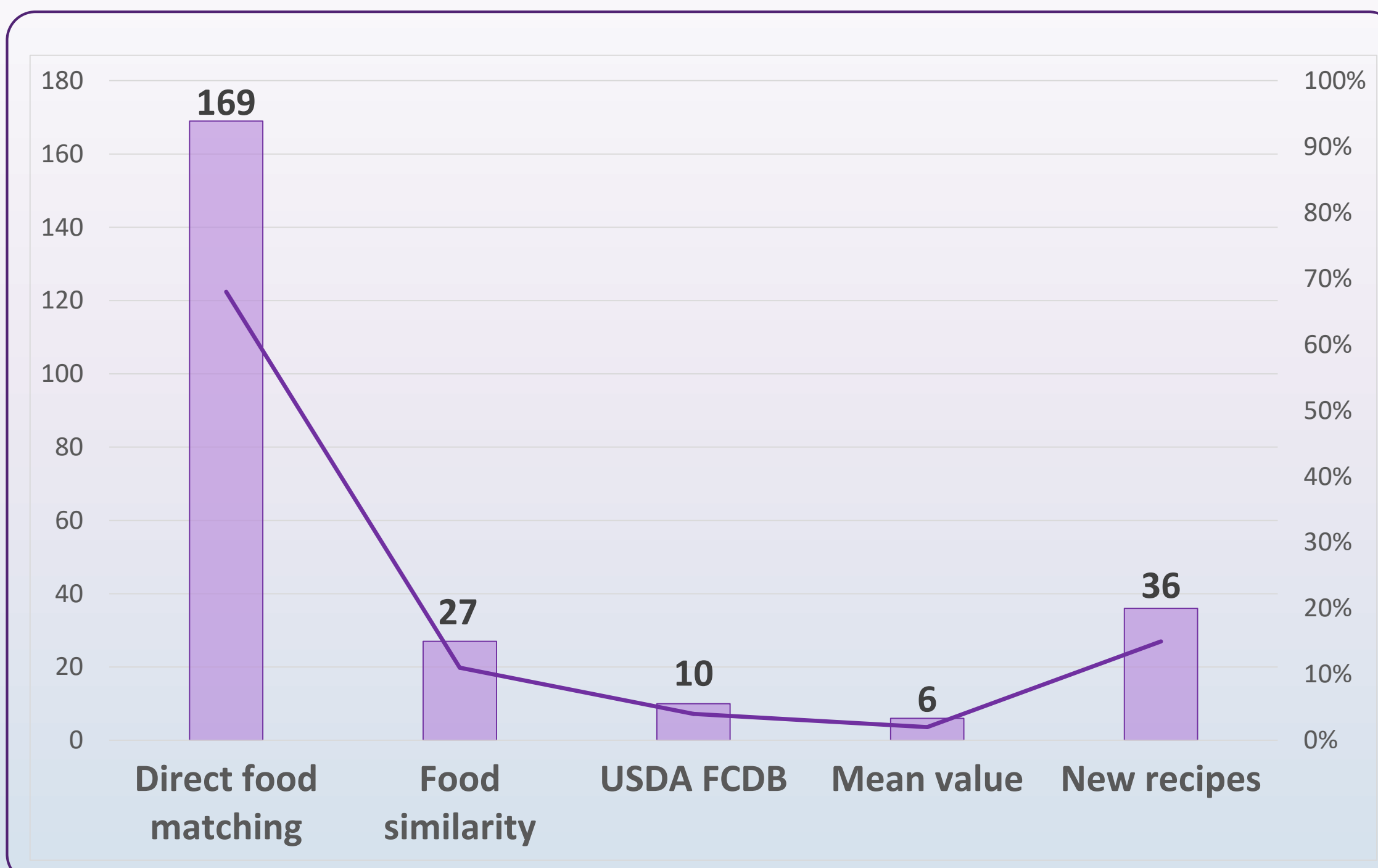
Fig.3 Food-matching between BDA Italian food items and ingredients in dishes of Nutrition5k

dish_1567714934
☐ Parmesan cheese
☐ Caesar dressing
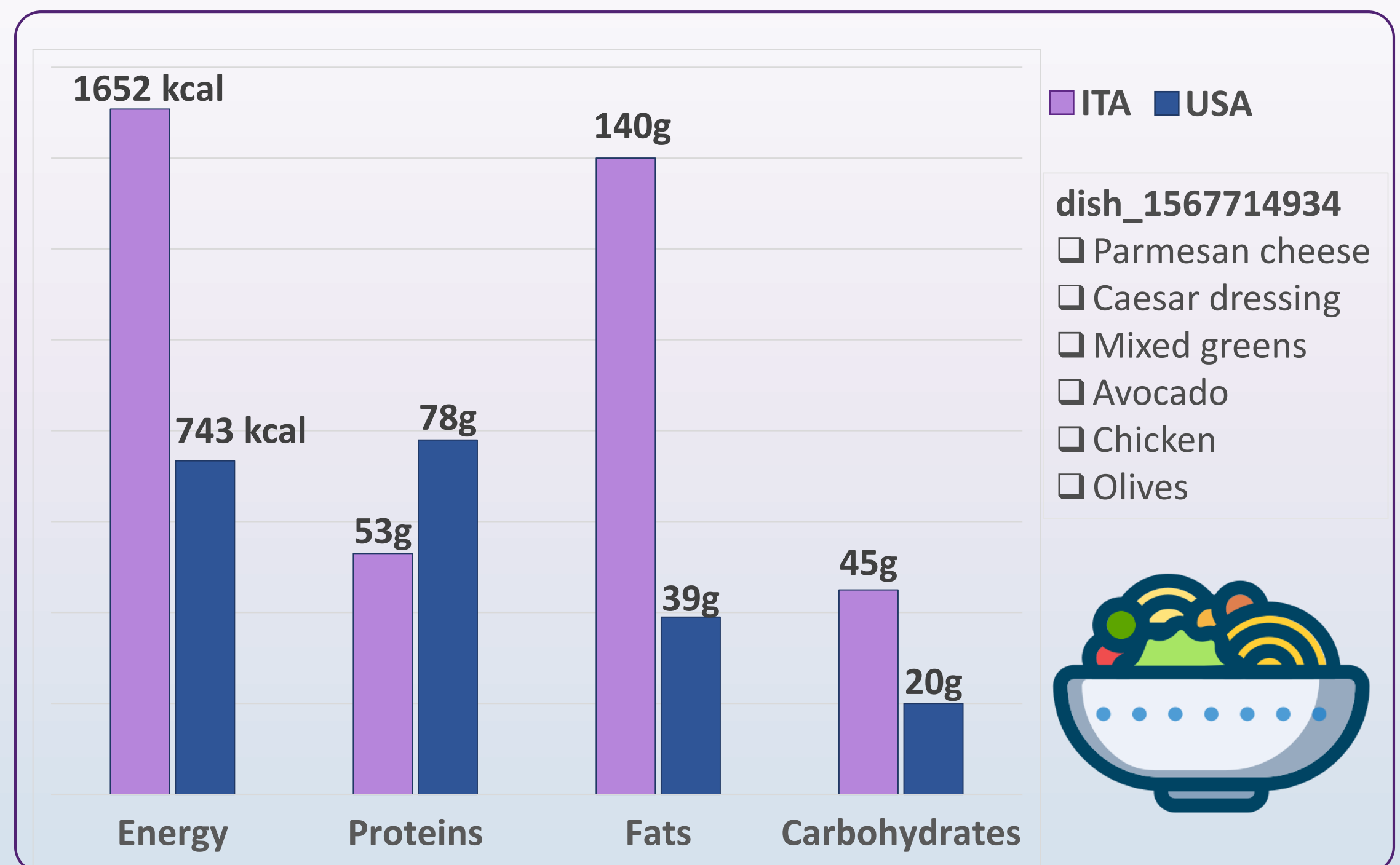☐ Mixed greens
☐ Avocado
☐ Chicken
☐ Olives

Fig.4 Nutritional content of the dish presenting the greatest differences between Italian and US nutritional values

Considering the nutritional content, the "dish_1567714934" (ingredients: Parmesan cheese, Caesar dressing, avocado, mixed greens, chicken, and olives) presented the greatest differences (Italian values: 1652 kcal, 53g proteins, 140 g fats, 45 g carbohydrates; US values: 743 kcal, 78g proteins, 39g fats, and ~20g carbohydrates) *(Fig.4)*.

CONCLUSION: To our knowledge, no one has computed a cross-country harmonization process of FCDB for the application of a DL algorithm for food image-recognition in nutritional epidemiology. Therefore, through methodological insights, our work holds promise for enhancing the accuracy of dietary assessments in Italy, and for paving the way toward a more globally applicable framework of DL in nutritional epidemiology.

References:
Gnagnarella et al. libreriauniversitaria.it edizioni, Padova, 2022.
Thames et al. Proceedings of the IEEE Computer Society Conference on CVPR. 2021, 8899