



Rapid communication

AI dietitian: Unveiling the accuracy of ChatGPT's nutritional estimations

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ABSTRACT

We investigate the accuracy and reliability of ChatGPT, an artificial intelligence model developed by OpenAI, in providing nutritional information for dietary planning and weight management. The results have a reasonable level of accuracy, with energy values having the highest level of conformity: 97% of the artificial intelligence values fall within a 40% difference from United States Department of Agriculture data. Additionally, ChatGPT displayed consistency in its provision of nutritional data, as indicated by relatively low coefficient of variation values for each nutrient. The artificial intelligence model also proved efficient in generating a daily meal plan within a specified caloric limit, with all the meals falling within a 30% bound of the United States Department of Agriculture's caloric values. These findings suggest that ChatGPT can provide reasonably accurate and consistent nutritional information. Further research is recommended to assess the model's performance across a broader range of foods and meals. <END ABSTRACT>

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Introduction

This research examines the application of ChatGPT, an artificial intelligence (AI) model developed by OpenAI, in the domain of nutrition and health. There is a limited number of papers [1,2] focusing on how AI might have an effect on the information about nutrition and diets provided. The specific application of ChatGPT in this regard could be particularly instrumental in the context of weight loss, where the caloric and nutritional composition of meals is of utmost importance for effective diet planning.

The primary objective of this research is to scrutinize and comprehensively assess the accuracy and reliability of the nutritional information provided by ChatGPT. The investigation aims to validate the correctness of the nutritional values given by the AI model for a diverse range of foods and meals. Accuracy, in this context, is of critical importance. Inaccurate or inflated nutritional values, if provided by the AI, could derail diet plans, rendering them ineffective or counterproductive. This potential pitfall underlines the necessity of this research, particularly for those intending to use AI for nutritional planning, including weight management.

Materials and methods

For the data collection process, this research used two primary sources: United States Department of Agriculture (USDA) Food Data Central (Foundation Foods) [3] and OpenAI's ChatGPT (3.5 turbo model) [4]. Both of these sources were accessed via their respective application programming interfaces on June 26, 2023.

The USDA FoodData Central is a comprehensive and integrated food composition database that delivers access to the most current and accurate nutritional data for a wide variety of foods. It serves as a source of information for researchers, nutritionists, health professionals, and diet planners. OpenAI's AI language model was queried to provide nutritional content for 236 different food items. To accommodate potential variations in the model's responses, each food item was queried five times. This was done in recognition of the scholastic nature of the model and to ensure the robustness of the results. The exact prompt is included in the supplementary material.

For each of the five nutrients—carbohydrates, energy, protein, lipids, and water—the reference USDA value was used to calculate 10%, 20%, 30%, 40%, and 50% ranges, representing upper and lower bounds. The nutritional values provided by ChatGPT were tested to check if they fell within these percentage bounds. The percentages of ChatGPT values that fell within the 10% to 50% USDA bounds were then computed to gain insight into accuracy. If a certain nutrient was not present for a food item in the USDA Food Foundations, then bounds for that nutrient were not created, and consequently, ChatGPT's values were not tested.

Results

The analysis of the data revealed a reasonable level of accuracy in the nutritional information provided by ChatGPT, as presented in Table 1. For example, when considering energy values, it was observed that 66.4% of the responses given by ChatGPT were within a 10% bound of the USDA data, 80.2% were within a 20%

Data availability: Data can be provided upon request.

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Table 1
Accuracy of ChatGPT nutritional information within specified bounds

| Nutrient | Bound 10 (%) | Bound 20 (%) | Bound 30 (%) | Bound 40 (%) | Bound 50 (%) |
|-----------------------------|--------------|--------------|--------------|--------------|--------------|
| Carbohydrate, by difference | 52.31 | 65.00 | 76.35 | 80.96 | 85.96 |
| Energy | 66.39 | 80.21 | 88.66 | 96.29 | 96.91 |
| Protein | 48.18 | 71.73 | 84.53 | 90.76 | 94.49 |
| Total lipid (fat) | 29.87 | 47.67 | 58.77 | 69.69 | 75.68 |
| Water | 62.02 | 73.95 | 79.74 | 82.46 | 84.21 |

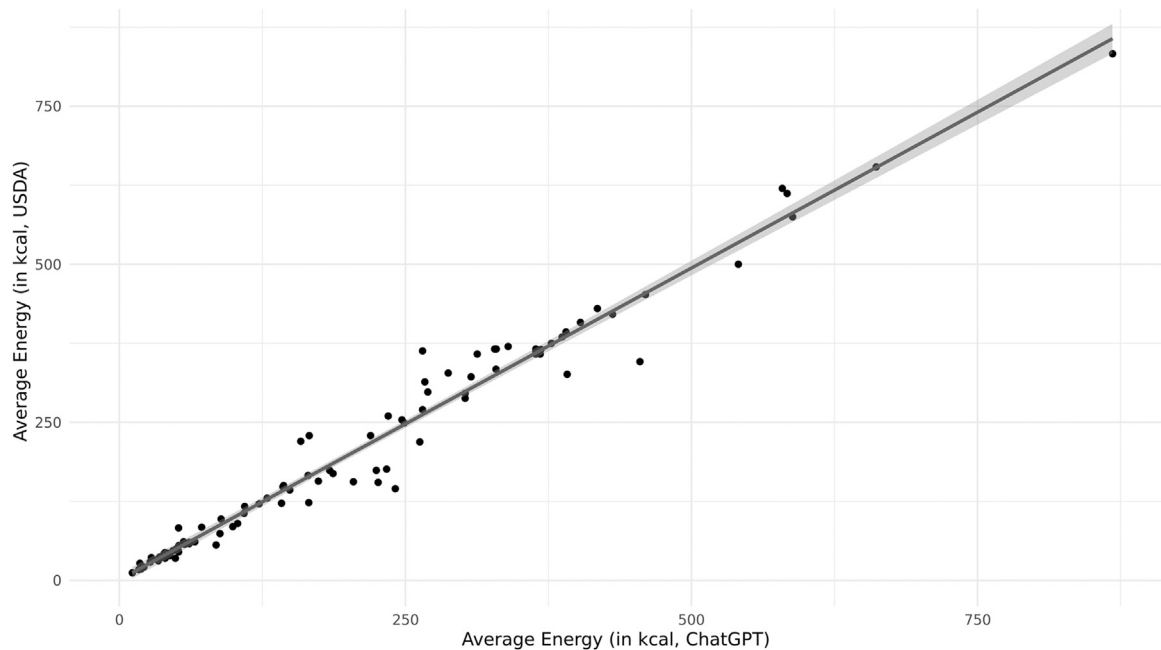


Figure 1. Comparison of energy values from the United States Department of Agriculture and ChatGPT.

bound, and so on, up to a 50% bound. These percentages give a quantitative measure of the accuracy of ChatGPT's nutritional information. The results reveal some variability in the accuracy across different nutrients. Energy values had the highest level of accuracy, with nearly 97% of the values provided by ChatGPT falling within a 40% difference of the USDA data.

Figure 1 illustrates the correlation between the average energy values (expressed in kilocalories) sourced from the USDA and those provided by ChatGPT. This graphical depiction serves to validate the numerical data, offering a lucid visual demonstration of the robust alignment between ChatGPT's energy value outputs and the standardized data from the USDA.

The coefficient of variation, a standardized measure of dispersion, was calculated for each nutrient. The average coefficient of variation was 12.2% for carbohydrates, 3.3% for energy, 6.3% for protein, 13.9% for lipids, and 8.5% for water. These relatively low coefficient of variation values suggest that the variation in ChatGPT's responses is relatively low, hence indicating consistency in its provision of nutritional information. On July 13, 2023, the research assessed ChatGPT's ability to generate a daily meal plan within a specific calorie limit. The model was prompted with, "Please prepare a daily meal plan with 1800 kcal and include the calorie count for each meal." The generated plan included 15 meals and had a total of 1853 calories. All the meals fell within a 30% bound of the USDA's caloric values, highlighting the model's accuracy in caloric estimation. Interestingly, 8 out of 15 meals matched

the exact caloric data from the USDA (including Standard Reference Legacy foods), further emphasizing the model's precision.

Discussion

This research provides evidence that ChatGPT can offer reasonably accurate nutritional information for individuals looking to manage their weight through diet planning. However, some limitations must be highlighted. First, the analysis was primarily restricted to basic nutritional values of single food items. More complex recipes and meal plans should be evaluated in more detail in future studies. Also, the range of foods and meals tested, although diverse, was not exhaustive. Second, the accuracy was variable across different nutrients, with carbohydrates and fats having lower conformance with USDA data compared with calories and protein. Third, and perhaps most significantly, an aspect of this study was the inability to assess the suitability of ChatGPT-generated meal plans for individuals with chronic conditions like diabetes, cardiovascular disease, kidney disorders, etc.

These populations require highly specialized dietary recommendations tailored to their medical status and to mitigate complications. ChatGPT does not inherently contain built-in precautions for people with chronic illnesses. Therefore, indiscriminate adherence to ChatGPT's generic diet advice, which does not account for individual health profiles or restrictions, could be detrimental for people with such comorbidities. Consultation with a professional

dietician or doctor is critical when considering the use of AI dietary tools for those with underlying health issues. ChatGPT does not conduct medical evaluations or consider personal medical history when providing dietary suggestions. At present, ChatGPT's nutritional estimations, although promising, are not a substitute for personalized medical advice. Caution is warranted when applying AI to the nuanced dietary needs of populations with chronic illnesses. For instance, Sharma et al. [5] warn that if ChatGPT offers faulty or inaccurate medical recommendations, individuals with diabetes could experience detrimental health effects.

Future iterations of AI dietician tools should aim to incorporate safeguards and adjustments that carefully consider individual health restrictions and needs. Further research must continue to scrutinize ChatGPT's performance across broader food choices and suitability for specific populations. Therefore, future research should concentrate on exploring the capability of AI platforms, like ChatGPT, to tailor dietary recommendations based on individuals' health histories, while ensuring the utmost confidentiality and integrity of personal data. With further advancement in AI capabilities and integration of medical knowledge bases, future iterations of chatbot dieticians may eventually be able to safely provide individualized meal plans tailored to users' health profiles. But extensive future research and rigorous real-world testing are critical before AI diet tools can be considered a reliable option for those managing chronic illnesses through diet.

Conclusions

This study reflects Naumova's [6] call to control and monitor the adverse effects of technological advances. New digital technologies must offer long-lasting and true solutions to public health issues. An analysis of ChatGPT's predictions in nutrition suggests that this tool meets the call. Nevertheless, we must bear in mind—as is commonly echoed in the literature [7]—that ChatGPT follows users' instructions. This feature enhances interactions with humans on one hand, but on the other, could also generate convincing misinformation disguised as human-made. In such a context, De Angelis et al. [8] refer to an “AI-driven infodemic”—a public health threat stemming from an enormous number of texts

produced in a short period, which might not be underpinned by any research. Our results indicate that ChatGPT's recommendations are comparable with data grounded in research. This is in line with De Angelis et al.'s [8] idea to develop digital tools, like ChatGPT, with features that can identify whether they are generating misinformation. Although Biswas [9] highlights ChatGPT's limited accuracy in public health related to healthy lifestyle choices, our results suggest that methodically sound instructions counteract poor accuracy and are an integral part of a tool that minimizes the production of ill-informed views.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.nut.2023.112325](https://doi.org/10.1016/j.nut.2023.112325).

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