

Assessment of Dietary Fiber Intake from Fruit and Vegetable Consumption: Case Study of Yerevan, Armenia

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Conflict of Interest

The authors declare no conflict of interest concerning the research, authorship, and/or publication of this article.

ABSTRACT

Fruits and vegetables are staple component of a healthy diet. They are rich sources of macronutrients (proteins, fats, carbohydrates), including dietary fiber, which is associated with a reduced risk of noncommunicable diseases. In Armenia recent population-level assessments of dietary fiber intake are lacking. Therefore, this case study aimed to estimate daily dietary fiber intake from fruits and vegetables consumed by the adult population (18-65 years old) residing in Yerevan, Armenia. By integrating data on fruit and vegetable consumption collected through a food frequency questionnaire (FFQ) with data on the dietary fiber content of these products, the daily dietary fiber intake (DI) was calculated for males and females, and the overall adult population in Yerevan. These estimates were then compared with the available international recommendations. The results showed that the overall mean daily dietary fiber intake from the studied fruit and vegetable species was 24,64 g/day, with males consuming slightly more fiber (26,59 g/day) than females (23,19 g/day), overall remaining below the generally recommended minimum requirements. However, the estimates reflect only 12 fruit and vegetable species and seasonal consumption patterns, while other dietary sources may also contribute. Therefore, broader research including a wider variety of fiber sources seasonal variations is needed in Armenia.

Introduction

Fruits and vegetables are important component of a healthy diet due to their high content of nutrients (macronutrients such as proteins, fats and carbohydrates, as well as vitamins and minerals). Regular consumption of a variety of fruits and vegetables can ensure adequate intake of essential nutrients that contribute to the prevention of noncommunicable disease and the maintenance of overall

health (WHO, 2023). Among the nutrients, the dietary fiber is of high importance in this context (Suresh, et al., 2024; World Cancer Research Fund, 2018). It's a complex of carbohydrates and their derivatives. The term "dietary fiber" was originally defined by Trowell (1972) as "that portion of food which is derived from the cellular walls of plants and digested very poorly by human beings". Traditionally, the terms "soluble" and "insoluble" dietary

fiber were used in the literature to distinguish between types of fiber. However, this classification is method-dependent and solubility does not always accurately predict physiological effects (EFSA, 2010).

Adequate dietary fiber intake has been associated with reduced risk of obesity, type 2 diabetes, cardiovascular disease, colorectal cancer and other chronic conditions (Aune, et al., 2011; Reynolds, et al., 2019; Zhang, et al., 2025, World Cancer Research Fund, 2018). Higher intake of dietary fiber from various sources were associated with lower risk of mortality (Yao, et al., 2023). Dietary fiber participates in human metabolism, prevents the development of the mentioned diseases, also boosts the production of gastric digestive juice and enhances gastrointestinal (GI) motility (Li and Zhang, 2021; Zhang, et al., 2025). Specifically, the fiber from fruits and vegetables provides protective effects against inflammatory bowel disease (Deng, et al., Milajerdi, et al., 2021).

Despite its known health benefits, global estimates indicate that dietary fiber intake remains below recommended levels (for example 25 mg per day) in many populations (EUFIC, 2023; Ioniță-Mîndrican, et al., 2022; Stephen, et al., 2017). In Armenia, where fruits and vegetables are dietary staples, population-level data on dietary fiber intake from these sources are lacking. Considering the essential role of fruits and vegetables in the Armenian diet (Stepanyan, et al., 2022), assessing dietary fiber intake from these sources is important for public health and nutrition, as well as for identifying opportunities for dietary improvement. Therefore, this case study aims to estimate daily dietary fiber intake from fruits and vegetables consumed by the adult population (18-65 years old) in Yerevan, the capital with the largest population in Armenia.

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Materials and methods

The daily dietary fiber intake (DI) from fruits and vegetables was calculated for males and females, and the overall adult population (18-65 years old) in Yerevan using the following equation:

$$DI = C \times IR,$$

where C represents the dietary fiber content in each fruit and vegetable (g/100g, converted to mg/kg), and DI is the daily consumption of fruits and vegetables (g/day, converted to kg/day) by the adult population in Yerevan.

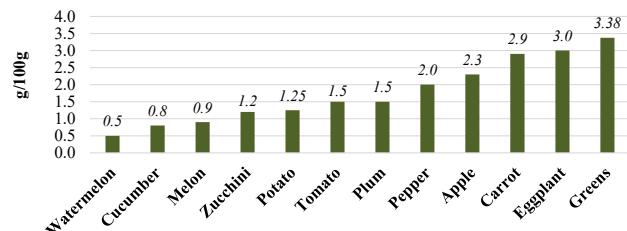


Figure 1. Mean dietary fiber content (g/100g) in fruits and vegetables (FAO, 2010).

The data (Figure 1) on dietary fiber content in 12 species of fruits (apple, plum, watermelon, melon) and vegetables (tomato, cucumber, eggplant, carrot, greens, zucchini, pepper, potato) were obtained from the FAO's food composition table for Armenia (FAO, 2010).

Data on the consumption of the aforementioned 12 fruits and vegetables were taken from the database created by the Informational-Analytical Center for Risk Assessment of Food Chain at the Center for Ecological-Noosphere Studies (CENS). Consumption data were collected through an interviewer-administered, semi-quantitative, 12-item food frequency questionnaire (FFQ), developed to assess the dietary intake of the Yerevan population during summer 2017. Although some fruits and most vegetables are available year-round in Yerevan, their intake varies by season. Consumption of fruits and vegetables has noticeable seasonal fluctuations, which depend not only on seasonal production but also on changes in the socio-economic conditions. Therefore, the FFQ questionnaire focused on fruit and vegetable consumption by season.

The FFQ is a checklist in which each participant is asked about the frequency and portion size of foods consumed over a specific period. In general, FFQs are reliable, valid, and cost-effective tool for assessing usual dietary intake within a population over a defined period. The questionnaire included questions about consuming frequency and portion size, as well as demographic characteristics (such as age, gender). A detailed description of the FFQ is provided by Beglaryan et al. (Beglaryan, et al., 2025).

A total of 1329 individuals (563 males and 766 females), aged 18-65 years and residing in Yerevan, voluntarily participated in face-to-face surveys. The representative sample size was calculated and selected to represent the entire Yerevan population, with participants enrolled from all 12 districts of the city.

Data entry and statistical analysis were performed using SPSS Software (version 22.0).

Results and discussions

The estimated mean daily dietary fiber intakes (DI) from 12 commonly consumed fruits and vegetables among the adult population in Yerevan are summarized in Table.

Table. Estimated daily dietary fiber intake (DI) from fruit and vegetable consumption by the adult population in Yerevan*

Fruits and vegetables	Estimated daily dietary fiber intake (DI), Mean \pm SD (g/day)		
	DI for all consumers	DI for males	DI for females
Apple	4.52 \pm 3.60	4.55 \pm 3.57	4.50 \pm 3.63
Plum	1.00 \pm 0.94	1.08 \pm 0.98	0.94 \pm 0.89
Watermelon	3.03 \pm 2.25	3.44 \pm 2.33	2.71 \pm 2.13
Melon	1.15 \pm 0.94	1.28 \pm 0.99	1.05 \pm 0.89
All fruits (excluding watermelon and melon)	5.52 \pm 3.84	5.63 \pm 3.85	4.77 \pm 3.84
All fruits (including watermelon and melon)	9.70 \pm 5.11	10.34 \pm 5.20	9.21 \pm 4.97
Tomato	4.52 \pm 2.74	5.10 \pm 2.87	4.09 \pm 2.57
Cucumber	1.33 \pm 0.90	1.50 \pm 0.95	1.21 \pm 0.84
Eggplant	2.61 \pm 2.23	2.69 \pm 2.19	2.56 \pm 2.26
Carrot	1.02 \pm 0.91	1.07 \pm 0.92	0.98 \pm 0.91
Greens	0.86 \pm 1.06	0.83 \pm 1.05	0.89 \pm 1.06
Zucchini	0.82 \pm 0.73	0.85 \pm 0.73	0.80 \pm 0.73
Pepper	1.78 \pm 1.46	1.98 \pm 1.53	1.63 \pm 1.38
Potato	1.99 \pm 1.54	2.22 \pm 1.68	1.82 \pm 1.41
All vegetables (excluding potato)	12.95 \pm 7.05	14.02 \pm 7.17	12.16 \pm 6.89
All vegetables (including potato)	14.94 \pm 7.48	16.24 \pm 7.61	13.98 \pm 7.27
Overall DI (Σ DI)	24.64 \pm 10.28	26.59 \pm 10.51	23.19 \pm 9.88

Note: SD - standard deviation.

*Composed by the authors.

The obtained data (Table) indicate daily dietary fiber intakes from individual food items, aggregated categories for fruits and vegetables, and overall total (Σ DI), for all consumers, males and females. All values are reported as mean \pm standard deviation (SD) in grams per day (g/day).

The overall DI (Σ DI) from all assessed fruits and vegetables was 24.64 ± 10.28 g/day. When analyzing separately by gender, males had a higher intake of fiber (26.59 ± 10.51 g/day) compared to females (23.19 ± 9.88 g/day).

Fruits contributed approximately 39.4% (9.7 g/day) of the total fiber intake, while vegetables had the major share of around 60.6% (14.94 g/day). The highest fiber intake from fruits was observed for apples (4.52 ± 3.6 g/day), followed by watermelon (3.30 ± 0.25 g/day) and melon (1.15 ± 0.94 g/day). Combined fruit intake, excluding watermelon and melon, was 5.82 ± 3.85 g/day, increasing to 9.70 ± 5.20 g/day when including these items, indicating their notable seasonal impact. Among vegetables, tomatoes contributed the most fiber (4.52 ± 2.74 g/day), followed by eggplant (2.61 ± 2.23 g/day) and potato (1.99 ± 1.54 g/day). Daily fiber intake from vegetables in case of excluding potato was 12.95 ± 7.05 g/day, reaching to 14.94 ± 7.48 g/day when potato was included.

The contributions of each studied fruits and vegetables in the estimated daily dietary fiber intake (DI) for all consumers, males and females are shown in Figure 2, Figure 3 and Figure 4, respectively.

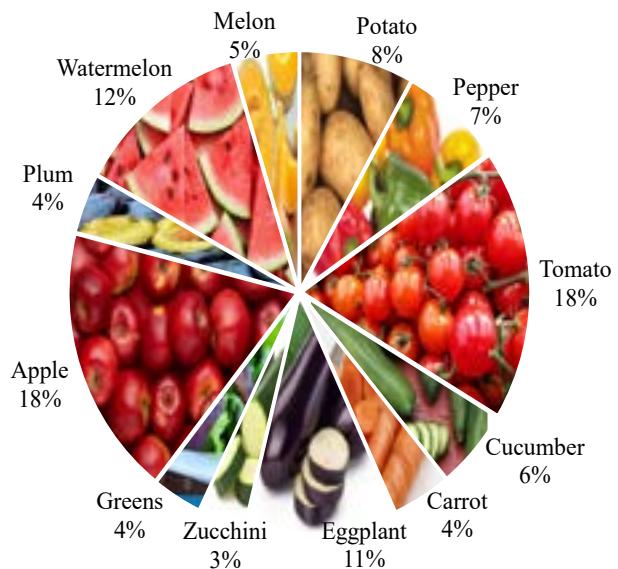


Figure 2. Contribution of fruits and vegetables in dietary fiber intake (DI) for all consumers (composed by the authors).

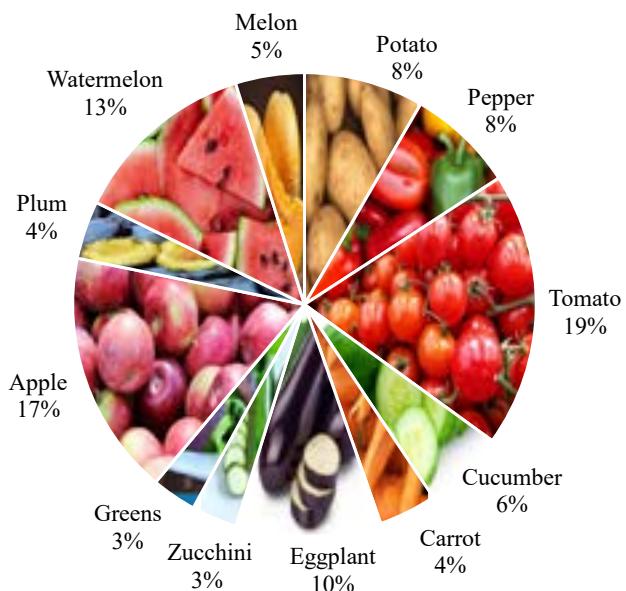


Figure 3. Contribution of fruits and vegetables in dietary fiber intake (DI) for males (*composed by the authors*).

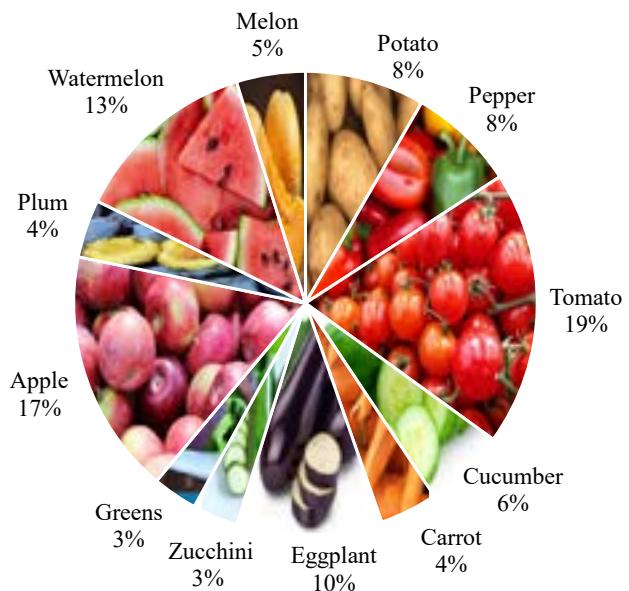


Figure 4. Contribution of fruits and vegetables in dietary fiber intake (DI) for females (*composed by the authors*).

Differences in contributions to the overall *DI* were observed for most of the studied fruits and vegetables consumed by males and females (Figure 3 and Figure 4). Notably, tomato consumption contributed the most to overall fiber intake among males, while apple consumption had the highest contribution among females.

International agencies and organizations recommend average minimum daily intake values for dietary fiber, which generally range from 25 to 35 g/day for adults, depending on gender, age and energy intake (EFSA, 2010; EUFIC, 2023; Marconi, et al., 2025; South, 2025). The European Food Safety Authority set the dietary reference value (DRV) for an adequate intake (AI) of fiber at 25 g/day for adults to support normal bowel function (EFSA, 2025). However, in most European countries, daily dietary fiber intake remains below this recommended value. For example, average intakes of fiber were around 20 g/day in Germany and Norway, followed in decreasing order, by Denmark, the Netherlands, Sweden, Belgium, Ireland, the UK, Spain and France (EUFIC, 2023). In the Nutritional Recommendations for the French population, a fiber intake above 25 g/day is suggested for maintaining a healthy colon, with 30 g/day as the preferred level to decrease the risk of colon cancer (EFSA, 2010). In the Nordic Nutrition Recommendations, fiber intake is set at 25 g/day for women and 35 g/day for men (Nordic Nutrition Recommendations, 2023). The

UK government guidelines state that dietary fiber intake should increase to 30 g/day as part of a healthy, balanced diet (NHS, 2025). The US Food and Drug Administration (FDA) recommends 28 g/day for a 2000 kcal/day diet, while the American Dietetic Association specifies 14 g/day per 1000 kcal/day diet (Marconi, et al., 2025). The Food and Nutrition Development Guideline in China (2025-2030) recommends increasing daily dietary fiber intake to 25-30 g/day (WFP, 2025).

When drawing a comparison between the obtained results and international recommendations, the overall mean daily dietary fiber intake of 24,64 g/day among adults in Yerevan is slightly below the adequate intake (AI) of 25 g/day set by EFSA, and remains lower than the higher recommended levels of 28-35 g/day suggested by other international guidelines.

Conclusion

The findings of this study provide important insights into the daily dietary fiber intake derived specifically from fruits and vegetables among the adult population in Yerevan, Armenia. The overall mean intake of dietary fiber was 24,64 g/day ($SD=10,28$ g/day), with variations observed between male and female consumers. Individual differences are also reflected in the estimated standard deviations. Notable, male consumers had slightly higher

intake of dietary fiber (26.59 g/day) compared to females (23.19 g/day), reflecting differences in consumption patterns.

Although the overall mean daily intake of dietary fiber for the Yerevan adult population is below the generally recommended value of 25-35g/day, it should be noted that these intake estimates are based only on 12 species of fruits and vegetables, while other dietary sources of fiber may also contribute. In addition, the observed consumption patterns primarily reflect the season when these particular fruits and vegetables are commonly and frequently consumed.

Overall, study emphasizes the need for broader research that includes a wider range of fiber sources and covers different seasons to provide more comprehensive assessment of dietary fiber intake among the Armenia population.

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