

Mean Dietary Fiber Intake of Romanian Adults

Results of a Survey Questionnaire

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The role of dietary fibers is crucial especially for the prevention of degenerative diseases and cancer. The purpose of this study was to find practical mathematical formulas to calculate the mean dietary fiber intake of Romanian adult population. Based on the intakes of vegetables, fruits and whole cereals we calculated the Mean Dietary Fiber Intake/day/person (MDFI). Our research shows that the national average MDFI was 9.8 g fiber/day/person, meaning 38% of Dietary Requirements, and the rest of 62% representing a fiber gap that we have to take into account. Public health programs actions sustained and developed by the Romanian Dietitians should be taken towards increasing the consumption of fiber-rich products associated with an increased frequency of physical activity, because these actions will be helpful in reducing chronic diseases incidence in Romania.

Keywords: dietary fiber, fruit, vegetable, whole cereal, chronic disease

The role of dietary fibers is crucial especially for the prevention of chronic diseases. Diets high in fruits and vegetables help to reduce the risk of degenerative diseases and cancer, which grew in frequency in the last years worldwide. These foods are not just vehicles for antioxidants, they contain many plant nutrients, which have distinct effects on phase I and II biotransformation pathways, on endogenous antioxidant systems, and also on modulation of gene expression and even DNA repair pathways [1].

DNA repair is a phenotype with a heritability estimated in the range of 48-75%, the rest being attributed to environmental and lifestyle factors [2], factors that can be monitored with efficient community nutritional interventions. It is estimated that in our body, on average, there are 800 incidents of DNA damage per hour and about 19200 per day, which can give rise to cancer, if not repaired [3]. Due to this, the regulation of DNA repair may be added to the list of biological processes that can be influenced by the quality of food, plant-based food, with great outcomes in cancer prevention [1].

Szeto and co-authors [4] made a study with nine sorts of fruits and vegetables (with prevailing fiber component) that were tested in order to see which were more able to boost DNA repair: lemons, persimmons, strawberries, oranges, bok choy (Chinese cabbage), broccoli, celery, lettuce or apples. They observed that citrus fruit decreases DNA damage by about a third, also after removing ascorbic acid by ascorbate oxidase from the lemon extract it was verified that the genetically protective effect was maintained and only the antioxidant capacity decreased [4]. However, if the lemon is boiled for 30 minutes the antioxidant capacity will be lost.

Astley et al. [5] suggested in their study that carotenoids and carotenoid-rich foods can influence DNA damage by modulation of discrete stages in the DNA repair mechanisms. But different foods may affect different problems [6], that is why variety in fruit and vegetable consumption may prolong life, can decrease cancer risk,

[7], and can reduce the risk of type 2 diabetes [8] because many different bioactive compounds contained in it can offer protection against several chronic diseases [9]. Each vegetable contains an unique combination of phytonutrients, and thereby a great diversity of vegetables should be eaten in order to ensure the health benefits [9,10]. Fiber-containing foods can not only help to prevent heart disease [11], but helps treat it as well [12,13]. Recent studies have shown that dietary soluble fiber intake is associated with a significantly reduced risk of breast cancer among pre-menopausal women [14].

A proper quantity of fruits, vegetables and whole grains consumption can be regarded as an indicator for healthy eating in general [15]. For the prevention of chronic diseases such as heart disease, cancer, diabetes and obesity, as well as for the prevention and alleviation of several micronutrient deficiencies (especially in less developed countries), World Health Organization (WHO) recommends population to consume a minimum of 400 g of fruits and vegetables per day (excluding potatoes and other starchy tubers) [16].

According to the FAOSTAT food balance sheets, the Romanian's daily consumption of fruits and vegetables exceeds the recommended level (717.09 g/person/day) [17], but if we analyze the more detailed data of the household budget surveys it can be stated that the amount is below the WHO recommendation (only 220 g/person/day in Romania) [18,19].

The purpose of this study was to calculate the Mean Dietary Fiber Intake of Romanian adults and to estimate at what level it is necessary to adapt the nutritional education programs in the communities in order to have a proper consumption, based on the recommendations of Romanian Dietary Guidelines [20]. Eating more fiber foods - vegetables, fruit, whole grains - is one of the WHO recommendations since 2003, meaning that an average adult should eat at least 25 grams of fiber per day [16].

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Experimental part

The present study intended to analyze the data of 673 Romanian adults' nutritional habits towards dietary fibers. For this purpose, six different Romanian counties with 57 cities were selected. Research data were collected with the help of a validated questionnaire with 40 items, focusing on measuring the daily and weekly intake of fruits, vegetables and whole cereals [21].

In the questionnaire, respondents were asked to report their weekly consumption of each fiber-rich item (fruits, vegetables, whole grains). Consumption frequency regarding dietary fibers was analyzed by asking the participants to indicate the average quantity of vegetables and/or salads, fruits and whole cereals in a week.

Data collection was made during autumn of 2014 (September - November 2014), when the fruit and vegetable consumption is moderate, comparing with all year long.

Data were analysed with the assistance of IBM SPSS Statistics 23.0.

The methodology was based on the following steps:

Calculation of vegetables (V), fruits (F) and whole cereals (C) Intake

For the calculation of vegetables, fruits and whole cereals intakes in grams a practical formula was developed. For this purpose our dietary tools and parameters were used (table 1):

- k^X = consumed pieces/each person/week, where X= V (vegetables), or X= F (fruits), or X= C (whole cereals), thereby k^V = consumed vegetable/person/week, when

$k^V = \overline{0.21}$, means the maximum number of vegetables consumption were 21, k^F = consumed fruit/person/week, when $k^F = \overline{0.30}$, k^C = consumed whole cereal/person/week, $k^C = \overline{0.24}$.

N_{p,k^V} = number of persons who consumed k^V ,

N_{p,k^F} = number of persons who consumed k^F ,

N_{p,k^C} = number of persons who consumed k^C .

In order to quantify the vegetable/fruit/whole cereal consumption during a week the formula below was used:

$$\sum_{k^V=0}^{21} N_{p,k^V} = P, \quad \sum_{k^F=0}^{30} N_{p,k^F} = P,$$

$$\sum_{k^C=0}^{24} N_{p,k^C} = P, \text{ where } P = \text{total analyzed person} = 673$$

$$\sum_{k^V=0}^{21} N_{p,k^V} \cdot k^V = V, \quad \sum_{k^F=0}^{30} N_{p,k^F} \cdot k^F = F,$$

$$\sum_{k^C=0}^{24} N_{p,k^C} \cdot k^C = C,$$

In the above formula, V = total consumed vegetables, F = total consumed fruits, C = total consumed whole cereals.

According to the 673 Romanian adult's data vegetables consumption was 4110 g vegetables/week, fruit consumption was 6328 g fruit/week and whole cereals consumption was 4032 g whole cereal/week (table 1).

Calculation of Mean Dietary Fiber Intake/day/person base on the way vegetables (DF_V), fruits (DF_F) and whole cereals (DF_C) Intake

For the calculation of MDFI/day/person from the analyzed foodstuffs, a simple mathematical formula was used: total intake of food multiplied with 3.5 in case of vegetables, with 2.5 in case of fruits and with 4.0 in case of whole cereals. We obtained the multiplier number 3.5 by an arithmetic calculation of the average quantity of fiber from all vegetables on the list (which can be purchased by consumers), also 2.5 represent the average quantity of fiber from all fruits and 4 was the mean quantity of fibers from whole cereals found in the menus.

In table 1, results obtained for the weekly and daily MDFI, for all participants and also by individual, using the next calculations, are shown:

- dietary fiber intake from vegetable/week/all participants: $DF_V = V \times 3.5 \text{ g} = 4110 \times 3.5 \text{ g} = 14385 \text{ g}$

- Dietary fiber intake from fruit/week/all participants: $DF_F = F \times 2.5 \text{ g} = 6328 \times 2.5 \text{ g} = 15820 \text{ g}$

- Dietary fiber intake from whole cereal/week/all participants: $DF_C = C \times 4 \text{ g} = 4032 \times 4 \text{ g} = 16128 \text{ g}$

- Dietary Fiber intake/day/all participants = Dietary Fiber intake/week/all participants: 7

- Dietary Fiber intake/week/person = Dietary Fiber intake/week/all participants: 673

- Dietary fiber intake/week/each person: $DF_V/673$, $DF_F/673$ and $DF_C/673$.

- Dietary fiber intake/day/person = all participants intake/week/person: 7.

Results and discussions

A total of 673 valid questionnaires were processed, from which 53.6% were completed by women and 46.4% by males, with ages between 18 to 92 years (35.81 ± 15.61).

Results of MDFI calculations can be found in table 1. Based on this it can be stated that the MDFI/day/person

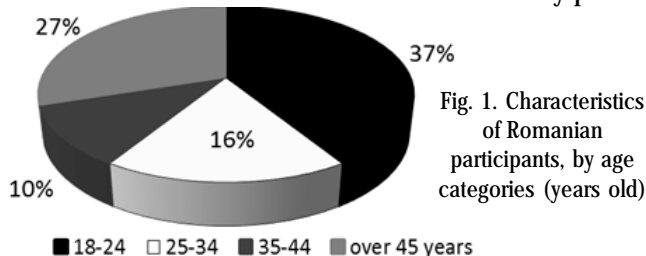


Fig. 1. Characteristics of Romanian participants, by age categories (years old)

was 9.8 g and the MDFI/week/person was 68.8 g (much smaller than daily recommendations [15, 16]).

Prevalence of Romanian consumers with good or bad habits regarding the intake of rich fiber diets was followed, too. 42.3% of the participants reported the consumption of vegetables less than one time daily, 31.6% consumed fruits less than one time and 63.6% consumed whole cereals less than one time per day (table 2), which is not in line with WHO recommendations. The study suggests that only 0.4% of Romanians reached the recommended dietary fiber intake, which is 4 pieces of vegetables & fruits daily (therefore 28 pieces weekly). The average vegetables intake was estimated as 91 g per day, the average fruits intake was 120.25 g per day, less than requirements (220 g per day vegetables and 220 per day fruits).

Fruit and vegetable consumption patterns are determined by a wide range of factors:

- The increase of fruit and vegetable intake is a priority for international organizations as well as national governments, in order to prevent chronic diseases [22].

- Age, gender and socio-economic status influence the consumption patterns mediated by other factors (e.g.

Table 1
THE PARAMETERS AND MEAN DIETARY FIBER INTAKE/DAY/PERSON RELATED TO THE WEEKLY CONSUMPTION OF VEGETABLE/FRUIT/
WHOLE CEREAL IN ROMANIA

k^A	$N_{P,V}$	$N_{P,F}$	$N_{P,C}$	Consumed Vegetables (in grams)	Consumed Fruits (in grams)	Consumed Whole cereals (in grams)
0	168	19	129	0	0	0
1	14	6	70	14	6	70
2	14	19	42	28	38	84
3	21	12	28	63	36	84
4	84	63	56	336	252	224
5	32	36	75	160	180	375
6	39	58	30	234	348	180
7	37	45	45	259	315	315
8	66	79	40	528	632	320
9	14	19	6	126	171	54
10	70	99	18	700	990	180
11	8	20	2	88	220	22
12	24	46	23	288	552	276
13	5	10	4	65	130	52
14	27	27	23	378	378	322
15	21	24	11	315	360	165
16	8	24	26	128	384	416
17	6	9	4	102	153	68
18	1	15	6	18	270	108
19	1	7	3	19	133	57
20	12	18	21	240	360	420
21	1	6	6	21	126	126
22	0	2	2	0	44	44
23	0	2	2	0	46	46
24	0	3	1	0	72	24
25	0	2	0	0	50	0
26	0	2	0	0	52	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	0	0	0	0	0	0
30	0	1	0	0	30	0
Total	673	673	673	V = 4110	F = 6328	C = 4032
Mean Dietary Fiber intake/week/all participants				V x 3.5 = 14385 g	F x 2.5 = 15820 g	C x 4 = 16128 g
Mean Dietary Fiber intake/day/all participants				2055 g	2260 g	2304 g
Mean Dietary Fiber intake/week/person				21.37 g	23.51 g	23.96 g
Mean Dietary Fiber intake/day/person = 9.8 g				3.052 g	3.358 g	3.422 g

animal origin food preferences, knowledge, skills and attitudes towards fruit and vegetables) [23].

Countries including the USA, Canada, Denmark and Australia have specific dietary guidelines on dietary fibers intake (especially focused on whole grains), but most of European countries do not, including Romania [24]. Thus, the evaluation of the intake is essential in order to validate the need for national standard improvements.

The European Dietary Survey Report made in 2011 revealed that the mean vegetable intake (including pulses and nuts) in Europe is 220 g per day, the mean fruit intake is 166 g per day, implying that the average consumption of fruit and vegetables is 386 g per day [24]. Further data showed that vegetable consumption is higher in the South than in the North of Europe and that the regions with the

Table 2
CORRELATIONS BETWEEN PERCENTAGE OF POPULATION AND THE PORTIONS OF FOOD RICH IN FIBERS CONSUMED BY ROMANIAN SUBJECTS DURING ONE WEEK

1-6 portions/week	7-10 portions/week	11-15 portions/week	16-20 portions/week	21-25 portions/week	26-30 portions/week
Vegetables					
42.3%	35.9%	16.2%	5.4%	0.2%	0%
Fruits					
31.6%	36%	18.9%	10.8%	2.3%	0.4%
Whole cereals					
63.6%	16.3%	9.5%	9%	1.6%	0%

highest intake of fruits are those of Central and Eastern Europe followed by those in the South [24-28].

In the frame of the present study the developed formulas (*Mean Dietary Fiber Intake/person* per day or per week) were validated, in order to find more precise tools to evaluate fiber intake. This methodology can be extrapolated to the evaluation of other nutrients intake and dietary parameters, too.

Based on the results it can be stated that the average Romanian adult eats only 9-10 g of fibers per day, during autumn season when it is supposed to intake the biggest amount in a year. Comparing to the rest of the Europe especially the Southern part [23] and WHO recommendations (25-30 grams in total or 15-20 grams per 1,000 calories), the calculated amounts are much lower.

Similar studies from Europe [25-28] and Japan [29] showed that their adult population ate less than the required amount, like Romanian ones did, especially for whole grains and seeds. Although one third of Romanian consumers try to comply with the national recommendation to consume a starchy food with each meal, they do so with minimal consumption of whole grain foods. The responses to the validated questionnaire [30, 31] contained detailed information on the daily diet, diseases and bodyweight [32]. Over half of the respondents reported never consuming any whole grain, and in participants who did, consumption levels were very low [32, 33]. Our research showed that the national average was 9.8 g fiber/day/person, that is 38% content of international dietary requirements, with the remaining percentage 62% representing a fiber gap we have to take into account. Probiotics administration can be recommended to complete this gap.

The perceived differences between the survey results can be due to the differences in the data collection methods [34].

Besides a proper diet, physical activity is also important; nutrition and exercise can induce epigenetic changes influencing the evolution of the metabolism [35].

Obesity represents a major health problem with several harmful consequences on lipid, glucose and protein metabolism with hyperglycemia and insulin resistance, hyperlipidemia and hyperuricemia [36]. Critical factors are: busy lifestyles leading to personal health deterioration, with poor choices of convenience foods and poor exercise [37].

Consumers need to know and accept that dietary fibers are macronutrients with important health benefits. We suggest also that the quantity of fibers need to be noticed on all food labels and the consumers to be educated to read it and to calculate the amount they need.

Conclusions

Nutrition educational programs in schools and communities must include more practical information and skills development tools in order to know and evaluate the proper consumption of fibers from daily diet, to know how to read the ingredient lists from food products labels, to know more about the portions recommended to children, adults and elderly for prophylactic interventions against chronic diseases.

An increased availability of whole-grain foods and local fruits along with education may help to increase fiber intake in countries without specific recommendations like Romania.

Dietary habits of Romanian adults and also our standards need improvements. Public health actions should be taken in order to increase the consumption of fiber-rich products by diet and also to increase the frequency of physical activity. These actions have to be sustained and developed by our Dietitians or General Practitioners among communities at risk and it will be helpful in reducing the chronic diseases frequency in our country and improving life quality.

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