УДК 613.26:616-053.9:314.14
DOI: https://doi.org/10.17816/RFD631569

Влияние потребления овощей и фруктов на смертность у лиц в возрасте 65 лет и старше: результаты проспективного когортного исследования

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АННОТАЦИЯ

Обоснование. Высокое потребление овощей и фруктов ассоциировано со снижением риска развития сердечно-сосудистых заболеваний, сахарного диабета 2-го типа, онкологических заболеваний и смертности от всех причин. Однако большинство исследований о пользе потребления фруктов и овощей для здоровья традиционно сфокусированы на детях, подростках, людях молодого и среднего возраста, и лишь немногие из них включают людей пожилого и старческого возраста, и тем более в существующих работах не учтен гериатрический статус обследуемых.

Цель исследования — оценить влияние потребления овощей и фруктов на смертность в российской популяции среди лиц в возрасте 65 лет и старше.

Материалы и методы. Проспективное когортное исследование «Хрусталь» случайной выборки лиц в возрасте 65 лет и старше (n = 383). Основные параметры исследования: показатель по Краткой шкале оценки питания, антропометрические данные, результаты клинического анализа крови, уровни альбумина, общего белка, С-реактивного белка, комплексная гериатрическая оценка. Наблюдение длилось 2,5 года.

Результаты. Средний возраст обследуемых составил 77,7 ± 5,7 лет. Частота потребления овощей и фруктов была больше среди женщин, чем среди мужчин на 16,7 (95 % доверительный интервал 1,5–33,6) %. Потребление двух порций овощей и/или фруктов и более в день было ассоциировано со снижением риска смерти от всех причин с относительным риском 0,401 (95 % доверительным интервалом 0,180–0,896) после поправки на пол, возраст, наличие синдрома мальнутриции, количество потребляемой белковой пищи и выпиваемой жидкости в день, индекс массы тела, сниженный объем мышц плеча, синдром падений, когнитивный статус, потерю автономности и снижение уровня физического функционирования.

Заключение. Потребление двух порций овощей и/или фруктов и более в день является независимым фактором снижения риска смерти от всех причин у лиц возрасте 65 лет и старше на 59,9 %.

Ключевые слова: овощи; фрукты; смертность; пожилые.

Как цитировать

Турушева А.В., Пронина Д.В., Щукина А.М., Лепа В.Е. Влияние потребления овощей и фруктов на смертность у лиц в возрасте 65 лет и старше: результаты проспективного когортного исследования // Российский семейный врач. 2024. Т. 28. № 2. С. 61–68. DOI: https://doi.org/10.17816/RFD631569

Рукопись получена: 03.05.2024 **Рукопись одобрена:** 05.05.2024 **Опубликована online:** 19.06.2024

DOI: https://doi.org/10.17816/RFD631569

The impact of vegetable and fruit consumption on mortality in persons aged 65 years and older: results of a prospective cohort study

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ABSTRACT

BACKGROUND: High consumption of vegetables and fruits is associated with a reduced risk of developing cardiovascular diseases, type 2 diabetes mellitus, cancer and all — causes mortality. However, most studies on the health benefits of fruit and vegetable consumption have traditionally focused on children, adolescents, young and middle-aged people, and only a few of them included older adults, and even more so did not take into account the geriatric status of the study participants.
AIM: To assess the effect of fruit and vegetable consumption on mortality in Russian population people 65 years and older.
MATERIALS AND METHODS: A prospective cohort study of a random sample of individuals aged 65 years and older (n = 383). The main parameters of the study: the Mini Nutritional Assessment, anthropometry, a complete blood count test, albumin, total protein, C-reactive protein, comprehensive geriatric assessment, 2.5 years of follow-up.
RESULTS: The average age of the participants was 77.7 ± 5.7 years. The frequency of fruit and vegetable consumption was higher among women, compared with men by 16.7% (95% confidence interval 1.5–33.6%). Consumption of 2 or more portions vegetables and/or fruits per day was associated with a reduced risk of all-causes mortality with hazard ratio 0.401 (95% confidence interval 0.180–0.896) after adjusting for gender, age, malnutrition, protein intake, glasses drunk per day, body mass index, mid arm muscular area, falls, cognitive status, autonomy decline and a decrease in the level of physical function.
CONCLUSIONS: Consumption of 2 or more portions of vegetables and/or fruits per day was independently associated with a 59.9% reduction in the risk of all-causes mortality in persons aged 65 years and older.

Keywords: vegetables; fruits; mortality; older adults.

To cite this article
Turusheva AV, Pronina DV, Shchukina AM, Lepa VE. The impact of vegetable and fruit consumption on mortality in persons aged 65 years and older: results of a prospective cohort study. *Russian Family Doctor.* 2024;28(2):61–68. DOI: https://doi.org/10.17816/RFD631569

Received: 03.05.2024 **Accepted:** 05.05.2024 **Published online:** 19.06.2024

BACKGROUND

A diet rich in fruits and vegetables is associated with reduced risk of cardiovascular disease, type 2 diabetes, cancer, and all-cause mortality. The World Health Organization recommends that individuals consume at least five servings of fruits and vegetables (approximately 400 grams) daily, in addition to sweet potato, cassava, and other starchy vegetables[1].

The special nutritional needs of the older adults require specific adaptations of clinical nutrition guidelines. However, most studies on the health benefits of fruit and vegetable consumption have focused on children, adolescents, young and middle-aged people, and few have included older adults, and the existing studies did not consider the geriatric status of the participants [1, 2].

This study aimed to evaluate the effect of fruit and vegetable consumption on mortality in the Russian population aged ⩾65 years.

MATERIALS AND METHODS

Study design

The study was based on the analysis of the results of the second screening of the prospective cohort study "Crystal," which involved a random sample of individuals aged ⩾65 years. The first screening was conducted in 2009 (n = 611) and the second screening in 2011–2012. In total, 130 individuals declined to participate in the second screening, 98 died before the second screening, and 4 died during the second screening and did not have time to complete the full range of diagnostic tests. However, they completed the nutritional assessment questionnaire and were therefore included in the analysis. The main clinical and demographic characteristics obtained at the first screening were compared between those who declined to participate in the subsequent screening and those who agreed to participate in the second screening to identify any potential errors associated with refusal to participate in the subsequent screening. No significant differences were observed. The total followup period was 30.9 (26.6 ± 6.1) months. The study design has been described in more detail previously [3].

The participants provided informed consent to participate in the study.

Main survey parameters

The nutritional pattern analysis included the following parameters:

1. Nutritional status was evaluated using the Mini Nutritional Assessment. Individuals scoring ⩽23.5 points were classified as having malnutrition syndrome, whereas those scoring >23.5 points were described as having normal nutritional status [4].
2. Data regarding the frequency of fruit and vegetable consumption, in addition to protein and fluid intake, were obtained from the Mini Nutritional Assessment (answers to questions marked with an "M"). One serving of vegetables was defined as a medium-sized vegetable (75 g) and one serving of fruit as one medium-sized fruit (150 g) [4].
3. Anthropometric assessment was performed based on measurements of body weight, height, mid upper arm circumference (MUAC), and triceps skinfold thickness (TSFT). Mid arm muscular area (MAMA) was calculated using the formula:

$$MAMA = MUAC - 0{,}314*TSFT.$$

4. Body mass index (BMI) was calculated as the ratio of body weight in kilograms to height in meters squared. Individuals with a BMI <18.5 kg/m^2 were classified as underweight, those with a BMI between 18.5 and 24.9 kg/m^2 as having a normal weight, and those with a BMI between 25.0 and 29.9 kg/m^2 as overweight. The classification of obesity was as follows: obese I degree, 30.0–34.9 kg/m^2; obese II degree, 35.0–39.9 kg/m^2; and obese III degree, ⩾40 kg/m^2.
5. Laboratory tests included a complete blood count test, total protein, albumin, and C-reactive protein levels.

Furthermore, the patients were examined for comorbidities and therapy by interview and review of medical records, functional status (The Short Physical Performance Battery and grip strength), autonomy (The Barthel index), emotional status (The Geriatric Depression Scale), cognitive function (The Mini Mental State Examination), sensory deficits, urinary incontinence, and falls in the past year [4, 5].

Statistical analysis

Means and standard deviations (M ± SD) were used to analyze continuous data. The Mann–Whitney test, χ^2, and the comparison of proportions test were applied to assess differences between groups. Kaplan–Meier survival curves and multinomial Cox regression were employed to evaluate the association between the number of servings of fruit and/or vegetables consumed and mortality in the study population. The critical limit of validity was considered to be p = 0.05.

Basic statistical calculations were performed using SPSS 26.0 (SPSS Inc., USA) and MedCalc 19.5.3 (MedCalc Software Ltd.).

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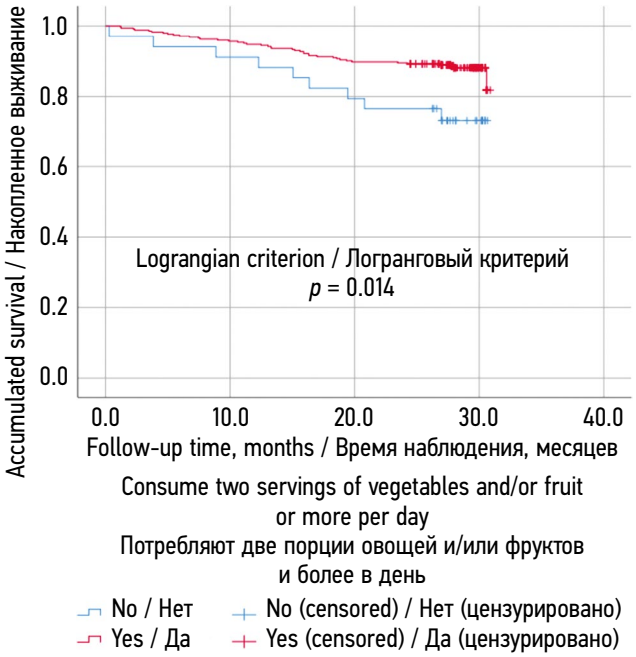

Figure. Kaplan–Meier curves to estimate survival at different levels of fruit and vegetable consumption per day over 2.5 years of follow-up (*n* = 383)
Рисунок. Кривые Каплана – Мейера для оценки выживаемости при разных уровнях потребления фруктов и овощей в день в течение 2,5 лет наблюдения (*n* = 383)

RESULTS

This study included 383 participants aged 68–94 years, with a mean age of 77.7 ± 5.7 years. Of these, 24.8% (*n* = 95) were male. Two or more servings of vegetables and/or fruits per day were consumed by 90.8% (*n* = 348) of the individuals. The frequency of fruit and vegetable consumption was 16.7% (95% confidence interval (CI), 1.5%–33.6%) higher in women than in men.

During 2.5 years of followup, 13.1% (*n* = 50) of the individuals died. When the influence of dietary composition on mortality was analyzed, a reduction in mortality risk was observed in individuals who consumed two or more servings of vegetables and/or fruits per day (Figure).

No significant differences were found in the prevalence of chronic noncommunicable diseases and geriatric syndromes in individuals who consumed both less than two servings and two servings or more of fruits and/or vegetables per day, except for differences in the prevalence of malnutrition and falls (Table). The prevalence of falls in the group of individuals consuming less than two servings of vegetables and/or fruits per day was 21.7 (95% CI: 5.8–38.3) higher, and malnutrition was 27.7 (95% CI: 10.7–43.4) higher. This difference remained significant after

Table. Clinical and demographic characteristics of study participants with different amounts of portions of vegetables and fruits intake per day (*n* = 383)
Таблица. Клинико-демографическая характеристика лиц, потребляющих разное количество порций овощей и фруктов в день (*n* = 383)

Indicators	Consuming less than two servings of vegetables and/or fruits per day (*n* = 35)	Consuming two servings of vegetables and/or fruits or more per day (*n* = 348)	Level *p*
Men, *n* (%)	14 (40.0)	81 (23.3)	0.028
Age, mean and standard deviation, years	76.9 ± 5.5	77.0 ± 5.7	0.056
Examined at home, *n* (%)	12 (35.3)	111 (32.2)	0.422
Frequency of chronic diseases			
Myocardial infarction, *n* (%)	9 (26.5)	51 (14.8)	0.068
Stroke, *n* (%)	6(17.6)	72 (20.9)	0.426
Atrial fibrillation, *n* (%)	18 (52.9)	144 (41.7)	0.141
Type 2 diabetes mellitus, *n* (%)	7 (20.6)	76 (22.0)	0.528
Chronic obstructive pulmonary disease, *n* (%)	6 (17.6)	16 (17.7)	0.606
Asthma, *n* (%)	3 (8.8)	19 (15.5)	0.315
Cancer, *n* (%)	–	19 (5.5)	0.160
Peripheral artery disease, *n* (%)	8 (23.5)	86 (24.9)	0.532
Arthritis/arthrosis, *n* (%)	24 (70.6)	285 (82.8)	0.068
Frequency of geriatric syndromes			
Falls, *n* (%)	15(45.5)	82(23.8)	0.008
Fractures, *n* (%)	4 (11.4)	41 (11.9)	0.620
Visual impairment, *n* (%)	27 (79.4)	301 (87.2)	0.155
Hearing loss, *n* (%)	4 (11.8)	33 (9.6)	0.430
Autonomy decline, *n* (%)	10 (29.4)	86 (25.1)	0.355

End of Table / Окончание таблицы

Indicators	Consuming less than two servings of vegetables and/or fruits per day (*n* = 35)	Consuming two servings of vegetables and/or fruits or more per day (*n* = 348)	Level *p*
Not leaving the house for walks, *n* (%)	5 (14.7)	57 (16.6)	0.501
Barthel index <95, *n* (%)	9 (26.5)	64 (18.6)	0.187
Urinary incontinence, *n* (%)	20 (58.8)	145 (42.0)	0.042
Short Physical Performance Battery <8, *n* (%)	18 (56.5)	149 (50.5)	0.334
Grip strength <10th centile, *n* (%)	10 (29.5)	19 (26.1)	0.408
Depression, *n* (%)	13 (38.2)	137 (39.9)	0.500
The Mini Mental State Examination:			0.410
• 30–28 points, *n* (%)	12 (35.3)	142 (41.3)	
• 27–24 points, *n* (%)	8 (23.5)	84 (24.4)	
• <24 points, *n* (%)	14 (41.2)	118 (34.3)	
Nutritional status			
Body mass index:			
• <18.5 kg/m^2, *n* (%)	1 (2.9)	5 (1.4)	
• 18.5–24.9 kg/m^2, *n* (%)	10 (29.4)	56 (16.1)	
• 25.0–29.9 kg/m^2, *n* (%)	13 (38.2)	147 (42.2)	
• 30.0–34.9 kg/m^2, *n* (%)	8 (23.5)	97 (27.9)	
• 35.0–39.9 kg/m^2, *n* (%)	2 (5.9)	33 (9.5)	
• >40.0 kg/m^2, *n* (%)	–	10 (2.9)	
Anemia, *n* (%)	11 (32.4)	88 (25.4)	0.246
C-reactive protein <5 mg/L, *n* (%)	10 (30.3)	73 (21.0)	0.156
Total protein <60 g/L, *n* (%)	–	10 (2.9)	0.388
Albumin <35 g/L, *n* (%)	2 (5.7)	12 (3.5)	0.360
Protein food intake, *n* (%):			0.000
• One serving of dairy products (1 cup milk, 60 g cottage cheese, 30 g cheese, and 3/4 cup yogurt) per day, *n* (%)	11 (31.4)	28 (8.0)	
• Two or more servings of legumes and eggs per week (1 serving of 200 g legumes and 1 egg), *n* (%)	13 (37.1)	123 (35.3)	
• Meat, fish, or poultry every day, *n* (%)	11 (31.4)	197 (56.6)	
Fluid intake:			0.017
• <3 cups (0 points), *n* (%)	3 (8.6)	9 (2.6)	
• 3–5 cups (0.5 points), *n* (%)	23 (65.7)	190 (54.6)	
• •>5 cups (1 point), *n* (%)	9 (25.7)	149 (42.8)	
Number of meals per day:			0.062
1, *n* (%)	–	1 (0.3)	
2, *n* (%)	1 (2.9)	48 (13.8)	
3, *n* (%)	34 (97.1)	299 (85.9)	
Malnutrition, *n* (%)	19 (55.9)	98 (28.2)	0.001
Low Mid Arm Muscular Are, *n* (%)	10 (29.4)	54 (15.6)	0.040

adjustment for sex and age. Individuals who consumed less than two servings of vegetables and/or fruit per day were more likely to have lower protein intake, lower BMI, and low MAMA (Table).

Malnutrition syndrome, low BMI, and inadequate protein food and fluid intake may have increased the risk of all-cause mortality in the group of individuals who consumed less than two servings of vegetables and/or fruits per day. However, the association with a high risk of mortality during 2.5 years of followup remained significant even after adjustment for gender, age, malnutrition, amount of protein food and fluid intake per day, BMI, low MAMA, and fall syndrome (HR: 0.446; 95% CI: 0.203–0.977). The link between reduced risk of all-causes mortality and high fruit and/or vegetable consumption remained significant after additional adjustment for cognitive status, loss of autonomy, falls in the past year, and low physical functioning (HR: 0.401; 95% CI: 0.180–0.896).

DISCUSSION

Based on the study results, consumption of two or more servings of vegetables and/or fruit per day was shown to reduce the risk of mortality by 59.9% over a 2.5-year followup period in people aged ≥65 years, regardless of nutritional and geriatric status.

The association between mortality and fruit and vegetable consumption has been reported in other studies [1, 2]. Two meta-analyses showed that the lowest risk of mortality was associated with consumption of two fruits and three vegetables per day [1, 2]. Eating one fruit per day reduced the risk of all-cause mortality by 6%, and eating one vegetable per day reduced the risk by 5% [2].

The present study does not show a beneficial effect of consuming two or more servings of vegetables and/or fruit per day on reducing the risk of cardiovascular disease, as has been shown in other population-based studies [6–8]. In a meta-analysis of eight prospective cohort studies, individuals who consumed five or more servings of vegetables and/or fruit per day had a 26% lower risk of stroke than those who consumed less than three servings of vegetables and/or fruit per day [6]. Another meta-analysis of nine prospective cohort studies reported a 4% reduction in the risk of coronary heart disease for each additional serving of fruit and vegetables per day, with the standard serving calculated as 106 g [7]. In the present study, the lack of association between fruit and vegetable intake and cardiovascular disease risk reduction may be due to several factors.

For example, there are regional differences in the types of fruits and vegetables consumed. Different varieties, grown under different conditions, contain different combinations and concentrations of vitamins and minerals and have different effects on the health of the older population. According to studies, vitamin C, vitamin E and its derivatives, carotenoids (alpha- and beta-carotene, beta-cryptoxanthin and lycopene), and potassium have the most pronounced effect on reducing the risk of cardiovascular disease and mortality [5]. Additionally, the amount of fruits and vegetables consumed and their variety in the diet play a significant role in reducing cardiovascular risk and mortality from cardiovascular disease [10]. However, in a study by Sun et al., only the presence of bananas and apples in the diet influenced the reduction of the risk of mortality during the 10-year followup, whereas the consumption of other fruits, including pears, pineapples, and grapes, which also contain high concentrations of vitamin C, vitamin E, carotenoids, and potassium, did not contribute to the reduction of the risk of mortality [11].

Most researchers who found an association between fruit and vegetable intake and cardiovascular disease risk reduction have used comprehensive dietary questionnaires to assess intake. The present study used the Mini Nutritional Assessment, which was developed to detect malnutrition and does not adequately assess the amount of fruits and vegetables consumed per day. These questionnaires can identify those who consume two or more or less than two servings of fruits and vegetables per day. However, the exact proportion of people in the group who consume less than two servings or one serving of fruits and vegetables per day and who do not consume fruits and vegetables at all remains unknown.

The strengths of this study were its prospective observational study design, random sampling, and comprehensive geriatric assessment analysis. These elements may have contributed to the higher mortality rates among individuals who consumed less than two servings of vegetables and/or fruit per day.

CONCLUSIONS

Consuming two servings or more of vegetables and/or fruits is an independent factor in reducing the risk of all-cause mortality in persons aged ≥65 years.

ADDITIONAL INFORMATION

Funding source. The first examination in the Crystal study was carried out with the support of the Grant of the President of the Russian Federation No. 192-RP, the second — without funding.

Competing interests. The authors declare that they have no competing interests.

Author contribution. All authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Personal contribution of each author: *A.V. Turusheva* — concept and design of the study, data analysis, text writing, editing; *V.E. Lepa, D.V. Pronina, A.M. Shchukina* — literature review, text writing.

Ethics approval. The present study protocol was approved by the local Ethics Committee of the North-Western State Medical University named after I.I. Mechnikov (No. 1 dated 22.01.2014).

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Источник финансирования. Первое обследование в исследование «Хрусталь» выполнено при поддержке гранта Президента Российской Федерации № 192-RP, второе — без финансирования.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Наибольший вклад распределен следующим образом: *А.В. Турушева* — концепция и дизайн исследования, анализ данных, написание текста, редактирование; *В.Е. Лепа, Д.В. Пронина, А.М. Щукина* — обзор литературы, написание текста.

Этический комитет. Протокол исследования был одобрен локальным этическим комитетом СЗГМУ им. И.И. Мечникова (№ 1 от 22.01.2014).

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