# Determinants of the demand for fruits and vegetables: Preferences by age and gender in Europe

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**Abstract:** Fruits and vegetables form the basis of a nutritional diet for the population. In addition to the basic determinants, such as market prices and consumer income, other factors influence consumer demand. This paper aims to investigate how the age and gender of consumers influence the demand for fruit and vegetables in different European countries. In this paper, the demand for fruit and vegetables is understood through the population's preferences for fruit and vegetable consumption, i.e., the proportion of the population that prefers to consume fruit and vegetables five or more times a day. The paper uses data from Eurostat. Factor, cluster and correlation analyses were performed using the SPSS software. The results of the analyses showed that the gender significantly determines the demand for fruit and vegetables in favour of women. Regarding the effect of age, this determinant was positively correlated with the preference for 5FV consumption in most countries. Potential interventions to promote fruit and vegetable consumption should mainly target men aged 15–19 and 75+ in Bulgaria, the Czech Republic, Latvia, Austria, Slovenia and Sweden, men aged 35–44 and 75+ in Croatia, Italy, Poland and Romania and women aged 15–19 and 55+ in Bulgaria and Romania, where their preference for 5FV was the lowest.

**Keywords:** consumers preferences; demand factors; European countries; five portions per day

The vegetable market is an important part of the agricultural product market stability (Liu et al. 2019). There is currently an increasing demand for high-value agricultural products such as fresh fruits (Ihli et al. 2021). Vegetable growers often lack relevant information about people's preferences and willingness to pay for such products (Cerda et al. 2021). Research results indicate considerable variability in household consumption, which is influenced not only by economic determinants, but also by the socio-demographic determinants of demand (Mjeda et al. 2020). The impact of economic factors on the food demand has been addressed in several studies. The empirical literature on food demand suggests mixed evidence on the role of income and other socio-economic attributes on the food demand (Nsabimana et al. 2020). Consumer income has emerged as an important determinant of the demand. This is both in terms of the quantity and quality of food. In relatively wealthier parts of countries, consumers have a greater affinity for food quality (Hovhannisyan et al. 2019). For low-income populations, food affordability is the most important determinant (Lin et al. 2014). To understand consumer demand, it is beneficial to know the behaviour of different

groups of consumers and not only by the employment status, region, community size or income level. Differences between generations appear to be much more important. The criteria by which consumers make purchasing decisions usually depend on the typical values of generations of consumers. Older consumers focus on visual attributes with perceived health, and these are more important to them than to the younger generation, who are more interested in the product's history and the environmental friendliness of the production. A person's values also change within the stages of the family life cycle (Špička and Náglová 2022).

The knowledge of consumer preferences is becoming very important as an input in improving the performance of the agri-food value chain (Noor et al. 2022). One of the motivations for increasing consumer preferences to purchase fruits and vegetables is a healthy lifestyle. Reasonable food consumption is an essential guarantee of physical health and quality human capital, which are of great importance for increasing the labour productivity and promoting long-term social development (Gao et al. 2022). However, research to date suggests that only a relatively small proportion of consumers meet the recommended frequency of fruit and vegetable consumption (Deng et al. 2023). The observed very low levels of adherence to vegetable intake recommendations suggest that addressing deficiencies in vegetable consumption should be a primary focus of future nutrition interventions (Jongenelis et al. 2018). We suggest further research exploring the factors behind such patterns (Zeidan et al. 2023).

Based on a study of the available literature, we found that, in addition to price and consumer income, it is important to find out the preferences of different consumer groups to have a comprehensive understanding of the food demand. Preferences may vary by age and gender. Currently, there is a research gap that requires more attention, as there is a lack of cross-sectional studies that would allow comparing the impact of the age and gender on the consumer demand across multiple countries.

This paper aims to investigate the impact of the age and gender on the demand for fruit and vegetables across European countries.

In line with the aim of the paper, the following research questions arise, the answering of which forms the basic structure of the paper:

*i*) What are the differences in the demand for fruits and vegetables of consumers of different age groups?

*ii*) What are the differences in the demand for fruits and vegetables by gender?

*iii*) In which European countries are the preferences for fruit and vegetable demand by age and gender similar?

The results of such studies could help policymakers form more targeted interventions in the fruit and vegetable market to maintain and preserve the health of their populations.

To maintain health, the World Health Organization (WHO) recommends that populations consume five or more portions of fruit and vegetables per day, which equates to approximately 400 g per day. We therefore measure the demand for fruit and vegetables by the consumers' efforts to eat healthily. The proportion of the population that follows the recommendations and consumes five or more fruits and vegetables per day is selected for the analysis. Some previous studies have also worked with this fruit and vegetable intake frequency (Alsunni and Badar 2015; Zeidan et al. 2023).

## MATERIAL AND METHODS

The data used were from the anonymous EU-SILC 2019 household income and living conditions survey, available from Eurostat. The proportion of the population that consumed fruit and vegetables at least five times a day was divided by gender and age into eight age groups: 15–19, 20–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75+. The youngest age group, 15–24, was divided into two smaller groups, namely 15–19 and 20–24, because the 15–24 age group would have been made up of two groups of young people whose preferences were markedly different. In the 15–19 years of age, young people mostly live with their parents, and their preferences for fruit and vegetable consumption are strongly influenced by family habits and the school environment. Currently, most initiatives to promote healthy eating are exclusively targeted at these younger age groups (Poscia et al. 2017). Young people aged 20–24 are gradually becoming independent, developing their preferences for fruit and vegetable demands.

Twenty-seven European countries were included in the analysis. The analyses were carried out using SPSS software. Descriptive analyses, factor analyses, principal component analyses, factor analyses, cluster analyses and correlation analyses were used.

A principal components analysis (PCA) was used in the available studies to identify the factors that cause differences in fruit and vegetable consumption between people of different age groups in the analysed countries. Principal component analyses have been used to diagnose risk behaviours in the frequency of fruit, vegetable, whole grain and dairy consumption

by studies in Germany (Geigl et al. 2022) and in fruit and vegetable consumption in Turkey (Unüsan 2004).

The factor analysis was used to identify the factors that cause differences in fruit and vegetable consumption among people of different age groups in the analysed countries. We tested the suitability of the variables for factor analysis by Bartlett's sphericity test and the Kaiser-Meyer-Olkin measure and individual measure sampling adequacy (*MSA*) in the anti-image matrix.

$H_0$: The correlations between the variables are random.

We chose the number of factors based on the screeplot. The extraction method was a PCA and principal axis factoring, which has more room for the replication of the correlations and, thus, explained the factors that should better explain the relationships between the variables. Unrotated results from a factor analysis are not easy to interpret (Osborne 2015). We used Varimax factor rotation which minimises the number of items a factor acts on and thus simplifies the interpretation of the factors. Rotation is literally a rotation of x and y axes in order to align clusters of variables plotted in two-dimensional space with the axis lines, which has the effect of clarifying the loading patterns in tables (Osborne 2015).

The results of the factor analysis are input into the cluster analysis, which aims to group European countries that have a similar proportion of the population consuming fruit and vegetables five or more times a day, and where this proportion evolves similarly depending on the age group of the population. Hierarchical clustering, specifically Ward's method, was used, where the distance of a group was given by the increase in the within-group sum of squares of the merged group compared to the within-group sum of squares.

## RESULTS AND DISCUSSION

A descriptive analysis showed how the proportion of the population consuming five portions of fruit and vegetables per day (5FV) varies by age and gender on the one hand, and how it differs between countries on the other.

The women's preference for 5FV consumption increased with age (Table 1). A slight decrease was observed in the 45–54 age group (–0.208) and the 75+ age group (–0.856). The highest average proportion of women in the study countries preferring 5FV was in the 65–74 age group.

In this age group, the actual values across the countries were scattered around the mean most significant-

ly (standard deviation of 8.95, range of values of 38.8). A standard deviation > 8 was also seen in the age groups 20–24, 45–54, and 75+. The minimum value was reached in the 55–64 age group in Romania (1.9%; Figure 1). The maximum value was in the 45–54 age group in Ireland (42%). The distribution was more pointed than normal, left-handed in most age groups.

The men's preference for 5FV consumption increased with age, similar to that of women. A slight decrease was noted in the 35–44 (–0.605) and 75+ (–0.281) age groups. The highest average proportion of men who preferred 5FV was in the 65–74 age group (Table 2).

The difference in men's preferences for the 5FV consumption between countries was marked, especially at the extremes of the age groups. In the 75+ age group, the standard deviation was 8.43 and the range of values was 36.5; in the 15–19 age group, the standard deviation was 8.25 and the range of values was 40.7. The maximum value was reached in the 15–19 age group in Ireland (40.7%) and the minimum value was reached in the same age group in Cyprus (0%; see Figure 2).

The preliminary analysis by age showed that the proportion of females consuming 5FV was significantly higher than the proportion of males. Higher preferences for fruit and vegetable consumption were found in both sexes at older ages. They were the highest in the 65–74 age group, and, in the 75+ age group, the preferences decreased slightly.

In terms of differences between countries, a lower proportion of both sexes consuming 5FV at most ages was observed, especially in Romania (average proportion of the population preferring 5FV: 3.09% for females, 2.18% for males; Figures 1 and 2). On the contrary, in Ireland and the Netherlands, both sexes preferred to consume 5FV more than the residents of the other studied countries (mean proportion of residents preferring 5FV in Ireland: 36.08% for females, 27.26% for males; in the Netherlands: 29.44% for females, 27.10% for males).

**Estimation of the factors behind the correlation of the variables.** The identification of the factors behind the correlation of the variables was carried out using a factor analysis. Before the factor analysis itself, we tested the suitability of the variables for the factor analysis. Based on Bartlett's test of sphericity at siginificance $P < 0.01$ and the summary Kaiser–Meyer–Olkin measure *MSA*, which took the value of 0.88 for females and 0.86 for males, we rejected the $H_0$ on the randomness of the correlation of the variables, see Table 3. The correlations between the variables were not random and could be used for the factor analysis. According

Table 1. Results of descriptive analysis – share of women preferring 5FV (%) by age

| Age group | 15–19 | 20–24 | 25–34 | 35–44 | 45–54 | 55–64 | 65–74 | 75+ |
|---|---|---|---|---|---|---|---|---|
| Mean | 14.32 | 12.83 | 13.31 | 14.59 | 14.39 | 14.79 | 16.01 | 15.16 |
| SE | 1.49 | 1.54 | 1.24 | 1.54 | 1.69 | 1.49 | 1.72 | 1.70 |
| SD | 12.50 | 11.70 | 11.50 | 12.40 | 12.60 | 12.70 | 14.20 | 11.80 |
| Sample variance | 7.75 | 8.02 | 6.43 | 8.00 | 8.79 | 7.75 | 8.95 | 8.82 |
| Kurtosis | 60.12 | 64.40 | 41.34 | 63.98 | 77.21 | 60.12 | 80.14 | 77.80 |
| Skewness | 1.59 | 0.24 | 0.93 | 2.36 | 2.75 | 0.97 | 1.22 | –0.12 |
| Range | 1.27 | 0.91 | 1.13 | 1.54 | 1.55 | 0.97 | 1.04 | 0.86 |
| Minimum | 33.30 | 31.00 | 24.80 | 35.10 | 37.90 | 33.70 | 38.80 | 31.30 |
| Maximum | 2.80 | 2.30 | 4.50 | 3.10 | 4.10 | 1.90 | 2.00 | 2.20 |

5FV – at least five portions of fruits and vegetables per day
Source: Authors' own calculations

Table 2. Results of descriptive analysis – share of men preferring 5FV (%) by age

| Age group | 15–19 | 20–24 | 25–34 | 35–44 | 45–54 | 55–64 | 65–74 | 75+ |
|---|---|---|---|---|---|---|---|---|
| Mean | 8.66 | 8.80 | 9.49 | 8.88 | 9.12 | 10.26 | 11.08 | 10.80 |
| SE | 1.59 | 1.01 | 1.24 | 1.21 | 1.22 | 1.30 | 1.29 | 1.62 |
| SD | 8.26 | 5.27 | 6.46 | 6.27 | 6.36 | 6.74 | 6.70 | 8.43 |
| Sample variance | 68.15 | 27.75 | 41.67 | 39.36 | 40.47 | 45.49 | 44.87 | 71.09 |
| Kurtosis | 8.13 | 3.76 | 2.50 | 3.49 | 4.46 | 2.43 | 0.96 | 3.00 |
| Skewness | 2.48 | 1.79 | 1.65 | 1.88 | 1.94 | 1.45 | 0.99 | 1.58 |
| Range | 40.70 | 22.80 | 26.60 | 24.70 | 28.70 | 28.00 | 26.80 | 36.50 |
| Minimum | 0.00 | 3.40 | 1.90 | 2.40 | 1.50 | 1.30 | 1.80 | 1.40 |
| Maximum | 40.70 | 26.20 | 28.50 | 27.10 | 30.20 | 29.30 | 28.60 | 37.90 |

5FV – at least five portions of fruits and vegetables per day
Source: Author's own calculations

to the diagonal of the anti-image matrix, where all the individual *MSA* > 0.8, all the variables were suitable for the factor analysis.

Based on the coefficients of the residual matrix < 0.01, the principal axis factoring method with two factors estimated was the most appropriate factor analysis method for identifying the factors causing the women's preference to consume 5FV. For the men, the principal component analysis method with three factors estimated was the most appropriate. Table 4 presents the diagonal of the reproduced matrix (extraction column). All the individual correlations were $r > 0.8$ for both men and women. Thus, there were common factors behind the variables.

Varimax rotation minimises the number of variables on which the factor acts, simplifying the interpretation. The rotated factor matrix contains the correlation of the factors with each variable (Table 5). The vari-max rotation helped to identify two factors for the females. Factor 1 correlated more strongly with younger age groups and factor 2 correlated more strongly with older age groups. In men, there were three factors. Factor 1 correlated more strongly with older age groups, factor 2 with younger age groups, and factor 3 with younger and middle age groups.

**Similarity of preferences for 5FV consumption in the studied countries.** A cluster analysis was performed to investigate the similarity of the effect of age and gender on the demand for fruit and vegetables across European countries. The factors were described above. Using Ward linkage, the sample of countries was divided into six relatively homogeneous subsets (clusters) individually for women and men. The clustering criterion was the factor causing the change in preferences of women and men by age group. Before the clustering, we checked whether the factors were sig-
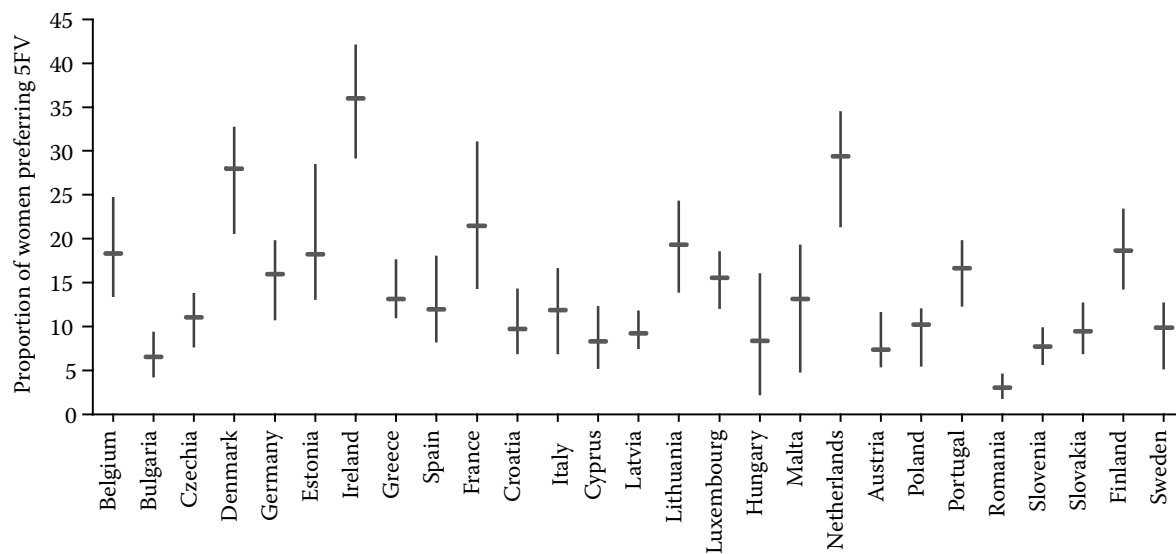
Figure 1. Mean and range of women's preference for 5FV across countries (%)

5FV – at least five portions of fruits and vegetables per day
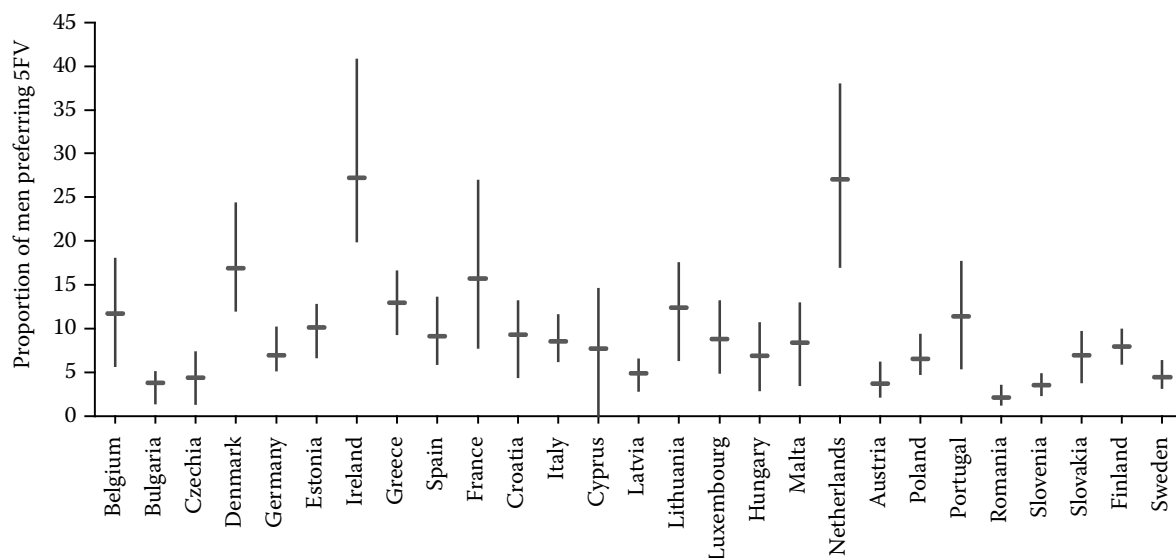Source: Authors' own calculations



Figure 2. Mean and range of men's preference for 5FV across countries (%)

5FV – at least five portions of fruits and vegetables per day
Source: Authors' own calculations

nificantly correlated with each other. The correctness of clustering was verified by discriminant analysis. The results of the discriminant analysis indicated that seven countries for the women and six countries for the men were misclassified into clusters. For this reason, the countries were reclassified into different clusters.

Table 6 provides an insight into the adjusted classification of the countries into clusters.

Table 7 provides an overview of the means (centroids) of the proportion of women and men preferring to consume 5FV by age group in each cluster and Pearson's correlation coefficient between the age and the

Table 3. Results of the tests of the suitability of the variables

| Test | Measure | Female | Male |
|---|---|---|---|
| Kaiser–Meyer–Olkin | *MSA* | 0.88 | 0.86 |
| | approx. $\chi^2$ | 342.64 | 296.96 |
| Bartlett's | d*f* | 28.00 | 28.00 |
| | significance | 0.00 | 0.00 |

*MSA* – measure of sampling adequancy
Source: Authors' own calculations

Table 4. Communalities

| Age group | Female | | Male | |
|---|---|---|---|---|
| | initial | extraction | initial | extraction |
| 15–19 | 0.83 | 0.78 | 1.00 | 0.98 |
| 20–24 | 0.88 | 0.85 | 1.00 | 0.95 |
| 25–34 | 0.96 | 0.98 | 1.00 | 0.90 |
| 35–44 | 0.96 | 0.95 | 1.00 | 0.96 |
| 45–54 | 0.97 | 0.95 | 1.00 | 0.94 |
| 55–64 | 0.96 | 0.95 | 1.00 | 0.96 |
| 65–74 | 0.92 | 0.96 | 1.00 | 0.98 |
| 75+ | 0.87 | 0.85 | 1.00 | 0.94 |

Extraction Methods: principal axis factoring (female), principal component analysis (male)
Source: Authors' own calculations

Table 5. Rotated matrix

| Age group | Rotated factor matrix (females) | | Rotated component matrix (males) | | |
|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 3 |
| 15–19 | 0.82 | 0.34 | 0.30 | 0.36 | 0.87 |
| 20–24 | 0.76 | 0.52 | 0.44 | 0.79 | 0.36 |
| 25–34 | 0.84 | 0.52 | 0.47 | 0.69 | 0.45 |
| 35–44 | 0.79 | 0.57 | 0.52 | 0.63 | 0.54 |
| 45–54 | 0.71 | 0.67 | 0.71 | 0.37 | 0.55 |
| 55–64 | 0.56 | 0.80 | 0.80 | 0.37 | 0.43 |
| 65–74 | 0.42 | 0.89 | 0.86 | 0.35 | 0.34 |
| 75+ | 0.44 | 0.81 | 0.82 | 0.48 | 0.18 |

Rotation method: varimax with Kaiser normalisation; rotation convereged in 3 iterations (females), 6 iterations (males)
Source: Authors' own calculations

at 10.86%, and the lowest proportion was in the 75+ age group at 8.40% (Table 7). Pearson's correlation coefficient was not statistically significant for the age and the proportion of women preferring 5FV in the second cluster ($r = -0.18$; $P > 0.05$).

Denmark, Ireland and the Netherlands were in the third cluster (Table 6), with an average proportion of women preferring 5FV at 31.18%. Of all the country clusters, this cluster had the highest proportion of women preferring 5FV. This was particularly significant for middle-aged and older women. In the 45–54 age group, the proportion of women preferring 5FV was 33.87% (Table 7). As in most country clusters, the women's preference for 5FV consumption declined at age 75+, but was still relatively high. Even at this age, 32.3% of women preferred to consume 5FV. Pearson's correlation coefficient confirmed a medium-strong positive correlation between the age and the proportion of women preferring 5FV in this cluster ($r = 0.55$; $P < 0.01$).

The fourth cluster consisted of the countries Germany, Estonia and Finland (Table 6). The average proportion of women preferring 5FV was 17.66%. The highest proportion of women preferring 5FV was in the age group 20–24 years, namely 20.80%. The preference in these countries decreased with the increasing age. A medium-strong correlation was confirmed by Pearson's correlation coefficient ($r = -0.65$; $P < 0.01$).

The fifth cluster of countries included Spain, Italy, Cyprus, Hungary and Slovakia (Table 6). The average proportion of women preferring 5FV was 10.02%. The very significant difference in the women's preferences was particularly marked between the 19–20 and 20–24 age groups, where the proportion of women de-

proportion of women and men preferring 5FV in each cluster. The critical value of Pearson's correlation coefficient was 0.37 ($P < 0.05$) and 0.47 ($P < 0.01$).

**Clusters by women's preference.** The first cluster of countries was made up of Belgium, France, Lithuania, Luxembourg, Malta, and Portugal (Table 6). In the first cluster of countries, the average proportion of women in the youngest age group consuming 5FV was relatively high at 17.44%. The lowest preference for fruit and vegetable consumption was among women in the 20–24 age group (Table 7). From this age onwards, preferences begin to increase. The significance level of Pearson's correlation coefficient confirmed a medium-strong positive correlation between age and the proportion of women preferring 5 FV in this cluster of countries ($r = 0.77$; $P < 0.01$).

The second cluster of countries consists of the Czech Republic, Greece, Croatia, Latvia, Austria, Poland, Slovenia, and Sweden (Table 6). The average proportion of women who consume 5FV in the second cluster countries is 9.82%. In terms of age, it was balanced. In this cluster of countries, the highest proportion of women consuming 5FV was in the 35–44 age group

Table 6. Clusters

| Cluster | Countries |
|---|---|
| **Females** | |
| 1 | Belgium, France, Lithuania, Luxembourg, Malta, Portugal |
| 2 | Czechia, Greece, Croatia, Latvia, Austria, Poland, Slovenia, Sweden |
| 3 | Denmark, Ireland, Netherlands |
| 4 | Germany, Estonia, Finland |
| 5 | Spain, Italy, Cyprus, Hungary, Slovakia |
| 6 | Bulgaria, Romania |
| **Males** | |
| 1 | Belgium, Finland, Spain, Cyprus, Lithuania, Hungary, Malta, Portugal, Slovakia |
| 2 | Bulgaria, Czechia, Latvia, Austria, Slovenia, Sweden |
| 3 | Germany, Estonia, Greece, Luxembourg |
| 4 | Ireland, Denmark |
| 5 | France, Netherlands |
| 6 | Croatia, Italy, Poland, Romania |

Source: Authors' own calculations

Table 7. Average proportion of the population preferring to consume 5FV by cluster (%)

| Age group | 1. cluster | 2. cluster | 3. cluster | 4. cluster | 5. cluster | 6. cluster |
|---|---|---|---|---|---|---|
| **Females** | | | | | | |
| 15–19 | 17.62 | 9.51 | 31.60 | 16.30 | 10.50 | 4.35 |
| 20–24 | 14.25 | 9.61 | 26.80 | 20.80 | 5.98 | 5.70 |
| 25–34 | 14.45 | 9.84 | 26.30 | 19.87 | 8.34 | 6.85 |
| 35–44 | 15.65 | 10.86 | 33.13 | 19.20 | 9.00 | 5.60 |
| 45–54 | 16.65 | 9.88 | 33.87 | 18.60 | 8.36 | 5.15 |
| 55–64 | 19.00 | 10.20 | 30.97 | 17.00 | 10.38 | 4.00 |
| 65–74 | 21.43 | 10.25 | 34.47 | 15.50 | 13.12 | 3.15 |
| 75+ | 20.50 | 8.40 | 32.30 | 14.03 | 14.50 | 3.80 |
| Pearson coefficient | 0.77** | −0.18 | 0.55** | −0.65** | 0.73** | −0.61** |
| **Males** | | | | | | |
| 15–19 | 4.91 | 3.15 | 13.08 | 30.75 | 16.85 | 7.75 |
| 20–24 | 7.89 | 4.73 | 11.96 | 17.05 | 17.00 | 6.10 |
| 25–34 | 8.17 | 4.25 | 13.40 | 22.85 | 20.55 | 6.90 |
| 35–44 | 8.06 | 4.35 | 11.34 | 22.75 | 18.60 | 5.05 |
| 45–54 | 9.72 | 4.02 | 8.12 | 21.15 | 18.85 | 6.53 |
| 55–64 | 10.98 | 4.57 | 9.42 | 22.25 | 22.45 | 7.40 |
| 65–74 | 12.56 | 4.22 | 10.76 | 21.05 | 24.75 | 7.85 |
| 75+ | 11.29 | 3.70 | 11.42 | 18.85 | 32.40 | 5.68 |
| Pearson coefficient | 0.94** | 0.11 | −0.54** | −0.48** | 0.86** | −0.08 |

**$P < 0.01$; 5FV – at least five portions of fruits and vegetables per day
Source: Authors' own calculations

creased by almost 57% compared to the previous age group, (Table 7). From age 45 onwards, the average share increased, even in the highest age group, which was not typical for clusters 1–4. The significance level of Pearson's correlation coefficient confirmed a medium-strong positive correlation between age and the

proportion of women preferring 5FV in the fifth cluster ($r = 0.73$; $P < 0.01$).

The sixth cluster of countries included Bulgaria and Romania (Table 6). The average proportion of women preferring 5FV in the countries included in the sixth cluster was 4.83% and, in all the age groups, was the lowest among the clusters (Table 7). Fruit and vegetable consumption preferences gradually declined from age 25 onwards. At the age of 65–74 years, only 3.15% of women preferred 5FV. Pearson's correlation coefficient confirmed a medium-strong negative correlation between age and the proportion of women preferring 5FV in the sixth cluster ($r = -0.65$; $P < 0.01$).

**Clusters by male preference.** The first cluster of countries included Belgium, Finland, Spain, Cyprus, Lithuania, Hungary, Malta, Portugal and Slovakia, with an average male preference for 5FV of 9.47% (Table 6). It was characteristic of the countries included in the first cluster of men that the preference for 5FV consumption increased with age. The highest proportion of men preferring 5FV was in the 65–74 age group at 12.93% (Table 7). The strong positive correlation with age was confirmed by Pearson's correlation coefficient ($r = 0.94$; $P < 0.01$).

The countries Bulgaria, the Czech Republic, Latvia, Austria, Slovenia and Sweden were in the second cluster with the lowest proportion of men preferring 5FV (Table 6). In this cluster of countries, the average proportion of men preferring 5FV was 4.53%. In the countries of this cluster, the ratio between the age groups was very even. The highest proportion in this cluster of countries was in the 20–24 age group at 5.27%, and the lowest was in the 15–19 age group at 3.41% (Table 7). Pearson's coefficient was not statistically significant for the age and the proportion of men preferring 5FV in the second cluster ($r = 0.11$; $P > 0.05$).

The third cluster of countries included Germany, Estonia, Greece and Luxembourg (Table 6), with an average proportion of men preferring 5FV of 10.08%. The proportion of men preferring to consume 5FV was higher in younger age groups. In the age group 15–19, for example, it was 12.20% (Table 7). Pearson's correlation coefficient confirmed a medium-strong negative correlation between the age and the proportion of men preferring to consume 5FV in the third cluster ($r = 0.54$; $P < 0.01$).

In the fourth cluster of countries, Ireland and Denmark were included, where the average proportion of men preferring 5FV was the highest of all the clusters at 22.09%. The highest proportion of men was in the lowest age group at 30.75%. The preference

gradually decreased with age. At the age of 75+, it was 18.85%. Pearson's correlation coefficient confirmed a medium-strong negative correlation between the age and the proportion of men preferring to consume 5FV in the fourth cluster ($r = -0.48$; $P < 0.01$).

In the fifth cluster of countries, the countries France, and the Netherlands were included (Table 6). The average proportion of men preferring 5FV was 21.43%. In the fifth cluster of countries, fruit and vegetable consumption preferences increased gradually with age. In the age group 75+ years, the average proportion of men consuming 5FV was 32.4% (Table 7). Pearson's correlation coefficient confirmed a strong positive correlation ($r = 0.86$; $P < 0.01$).

The sixth cluster of countries consisted of Croatia, Italy, Poland and Romania (Table 6). The mean proportion was 6.57% and was even across all the age groups. The highest proportion of males was in the 65–74 age group at 7.85% (Table 7). Pearson's correlation coefficient was not statistically significant in this cluster ($r = -0.08$; $P > 0.05$).

**Discussion.** The effect of the age and gender on the frequency of fruit and vegetable consumption among university students has been investigated in studies in Italy, Saudi Arabia and Australia. According to a study in Italian universities, 15.8% of males and 26.3% of females reported consuming at least one portion of fruit and vegetables every day. The students' age was not found to influence the fruit or vegetable consumption (Poscia et al. 2017). A study conducted on 10–19-year-old young consumers in Arab countries found that the proportion of those who met the recommendations to eat five servings per day ranged between 10 and 29% (Zeidan et al. 2023). In Saudi Arabia, gender was not found to be significantly associated with fruit and vegetable consumption (Alsunni and Badar 2015).

Only 50% of Western Australian high school students aged 12–17 years correctly identified their vegetable and fruit intake as inadequate. Very few students in this study met the national guidelines for vegetable intake (Jongenelis et al. 2018). Female students placed more emphasis on health-related factors and followed more specific dietary patterns than male students (Tam et al. 2017). Female students ate fruits and vegetables more frequently compared to male students, (Unüsan 2004). 70% of Chilean students did not meet the recommended amounts for fruit consumption and was 72% for vegetables (Rahal et al. 2023). A study in rural China found younger adults have higher fruit and vegetable consumption than older adults (Gao et al. 2022). In Finland, the prevalence of the daily

vegetable intake was found to have increased from 12% to 35% in men and from 18% to 56% in women for the last 35 years (Kähäri 2022). Most older people consume less than the recommended amount of fruit and vegetables per day (Sabzghabaee et al. 2010).

## CONCLUSION

This paper aimed to investigate how the age and gender of consumers influence the demand for fruit and vegetables in different European countries. The results of the analyses show that the proportion of women who prefer a high daily consumption of fruit and vegetables was higher than that of men.

The results of the cluster analysis showed that age is a significant determinant of the female and male demand for fruit and vegetables in almost all European countries. The proportion of women preferring to consume 5FV increased with the age in the first cluster countries, i.e. Belgium, France, Lithuania, Luxembourg, Malta and Portugal; the third cluster, i.e. Denmark, Ireland, the Netherlands; and the fifth cluster, i.e. Spain, Italy, Cyprus, Hungary, Slovakia. For men, it was in the countries of the first cluster, i.e. Belgium, Finland, Spain, Cyprus, Lithuania, Hungary, Malta, Portugal and Slovakia; and of the fifth cluster, i.e. France, the Netherlands.

Age had a negative effect on women's preferences in the countries of the fourth cluster, i.e. Germany, Estonia, Finland and the sixth cluster, i.e. Bulgaria and Romania. For men, it was in the countries of the third cluster, i.e. Germany, Estonia, Greece, Luxembourg and the fourth cluster, i.e. Ireland, Denmark.

The main contribution of the paper is that it has provided extensive information on the preferences of the population of each European country by age and gender. As the long-term improvement of a healthy lifestyle of the population is one of the strategic objectives of national health programmes, the research results are particularly useful for policymakers. Interventions to promote fruit and vegetable consumption should be targeted primarily at men in the countries of the second cluster, which include Bulgaria, the Czech Republic, Latvia, Austria, Slovenia and Sweden (especially critical for the 15–19 and 75+ age groups), and on men in the countries of the sixth cluster, namely Croatia, Italy, Poland and Romania. When promoting fruit and vegetable consumption among women, it is appropriate to focus on countries belonging to the sixth cluster, namely Bulgaria and Romania, focusing on the age groups 15–19 and 55+ years.

We see the limitations of the study mainly in the fact that it focuses on only one year. In the future, it would be beneficial to observe changes in the impact of age and gender across European countries over more years. The second limitation we see is the exclusively positive setting of consumer preferences. We suggest that further research should focus on consumers who do not consume fruit and vegetables at all or only very rarely and what factors lead them to do so.

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