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Understanding meat and fish consumption: Socio-demographic and value insights from five European countries

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Abstract: Current dietary patterns in developed countries, characterised by high intakes of processed and animal-source foods, are linked to increased obesity and diet-related non-communicable diseases, as well as environmental burdens. This paper investigates determinants of red meat, white meat, and fish consumption across five European countries, using representative survey data from over 10 000 individuals. Our findings reveal that men consume more red meat and fish than women, though, when adjusted for body weight, women consume significantly more white meat and fish. While vegetarians are mostly people younger than 35 years, meat eaters in the same age category tend to eat more red meat than older people. Cross-country differences highlight the need for localised policy approaches. Individual values also shape dietary choices. Security-oriented people prefer red meat, while altruistic individuals consume less of it. Biospheric values, while strongly associated with being vegetarian, show no significant association with meat or fish intake. To reduce red meat consumption, policies should highlight health benefits of eating less meat, with messages tailored to specific demographic groups. Additionally, enhancing meat alternatives' affordability, taste, and appearance is essential for promoting dietary shifts.

Keywords: demographic determinants; meat intake; sustainable diet; values; vegetarians

Dietary patterns have undergone significant transformations in recent decades, with a notable shift towards increased meat consumption. According to the OECD-FAO Agricultural Outlook 2024–2033, global meat consumption reached 353 million tonnes in 2023. Although this growth is expected to continue, it will do so at a slower pace (OECD and FAO 2024), in contrast to predictions by Tilman et al. (2011), who anticipated a doubling of meat consumption between 2 000 and 2 050 tonnes. Despite the slower growth, the ongoing increase in meat consumption poses significant challenges for human health and environmental sustainability (WRAP 2019; Willett et al. 2020), especially in developed regions like the EU, where meat intake often surpasses global averages [Figure S1 in the Supplementary Electronic Materials (ESM)].

Higher consumption of red and processed meat has been consistently linked to adverse health outcomes, including increased risks of cardiovascular diseases, stroke, type 2 diabetes, and certain types of cancer

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(Sinha et al. 2009; Pan et al. 2012; Chen et al. 2013; Feskens et al. 2013; Abete et al. 2014; Farvid et al. 2014, 2015; Etemadi et al. 2017). Globally, diets high in red meat were responsible for 896 000 deaths and for 23.9 million disability-adjusted life years in 2019 (IHME 2020). The classification of processed red meat as carcinogenic and unprocessed red meat as probably carcinogenic by the International Agency for Research on Cancer further underscores the significant health risks associated with these dietary choices (Bouvard et al. 2015).

Furthermore, the intensive production processes associated with meat production contribute substantially to environmental degradation. Land use changes linked to agriculture, such as converting natural ecosystems to croplands and pastures, are major drivers of biodiversity loss (Willett et al. 2020). Moreover, the livestock sector is responsible for a considerable portion of global greenhouse gas emissions, freshwater depletion, and pesticide pollution (Tilman et al. 2001; Merrey et al. 2007; Vermeulen et al. 2012). Given that, meat and meat products have been identified as significant contributors to global warming and environmental degradation (Tukker and Jansen 2006). Reducing global meat consumption could alleviate adverse environmental and health effects of current food systems, but it would require widespread dietary changes (Willett et al. 2020). Such shifts to sustainable diets depend on several socio-demographic, economic, and behavioural factors, which we assess in this paper.

Several studies investigated the determinants of meat consumption at a macroeconomic level, using aggregated panel data. For instance, Sans and Combris (2015) focused solely on economic factors, while Kmeťková and Ščasný (2022) expanded the analysis to include gross domestic product (GDP), demographic and climate factors. Milford et al. (2019) further incorporated globalisation and natural endowment factors. However, while these studies offer valuable insights, they do not account for individual behavioural patterns.

In contrast, the survey-based studies primarily focus on the individual or household-level determinants of meat (or animal product) consumption (Schmid et al. 2017; Predanócyová et al. 2019; Koch et al. 2021). A German study found that the main motives for meat consumption were good taste, habits, and the perception of meat as a healthy and satiable food (Koch et al. 2021). Schmid et al. (2017) found that overall meat consumption frequency among middle-aged and older people in Switzerland was predicted by language region, gender, household size, and body mass index (BMI), as well as by perceptions of meat's healthiness, taste, and safety. Predanócyová et al. (2019) identified key factors affecting the consumption of meat and meat products from Slovak consumers' point of view. The most prominent reasons were price, taste, quality of meat, freshness, and country of origin. Though these studies examined what factors affect the consumption of meat or animal products within the EU, they tend to focus on one specific country or perform only descriptive analysis. Our aim is to bridge this gap and bring new insights by conducting an econometric analysis of unique data from five European countries.

In this paper, we examine the associations between red meat, white meat and fish intake and economic and socio-demographic factors as well as different food factors and values of individuals in five European countries – Czechia, Latvia, Portugal, Spain and the United Kingdom (countries were chosen because they differ in their political and socio-economic contexts as well as in consumption habits and climatic conditions, enabling us to have a broad European perspective). Using individual-level data from an original survey conducted in 2018 (Zvěřinová et al. 2020), we expand the literature on meat consumption by conducting a thorough analysis of factors explaining consumption of different types of meat and fish by socio-psychological factors, personal health and socio-economic characteristics.

To provide a deeper understanding of these associations, this study builds on Schwartz's Value Theory (1992, 1994) while integrating additional theoretical perspectives that expand its application. Schwartz's Value Theory has been widely applied in food-related research (Cicia et al. 2021), offering a framework for understanding how individual values – from self-enhancement to self-transcendence – influence dietary behaviours. Expanding on this foundation, other values, such as egoistic, altruistic, and biospheric, were proposed as a theoretical basis of environmental concern and environment-related behaviours (Stern and Dietz 1994; Stern 2000; De Groot and Steg 2007; Steg and De Groot 2012; Steg et al. 2015).

Building on these studies, we explore the role of five value types – biospheric, altruistic, egoistic, hedonic, and security – in shaping food consumption behaviours. Biospheric values, prioritising environmental sustainability, and altruistic values, emphasising the welfare of others, can lead to reduced meat consumption or encourage vegetarianism. Hedonic values, emphasising pleasure, and egoistic values, focusing on personal benefits, might result in higher meat in-

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takes. Security values, emphasising safety, harmony, health and stability, align with the conservation dimension and self-enhancement values (Schwartz. 1992), leading to preferences for socially accepted and traditional dietary choices. By integrating these theoretical perspectives, our study contributes to the broader discourse on value-driven food consumption, offering valuable insights for policymakers seeking to promote healthier and more sustainable diets.

MATERIAL AND METHODS

Data

The five EU countries were chosen for their varied contexts, representing a broader European landscape. The survey targeted individuals aged 18–65, ensuring national representativeness in terms of gender, age, region, and education. There was a slight deviance from quotas in some sample proportions; hence, weights were derived to make all analysed countries representative in terms of gender, age, region, and education. The survey design and data analysis incorporated social-psychological, sociological, and economic approaches. The short-form Food Frequency Questionnaire (SFFFQ), which is a standardised tool that has been validated against an extensive Food Frequency Questionnaire and a 24-hour diet recall for the UK (Cleghorn et al. 2016), was used to elicit respondents' eating patterns.

After pre-survey testing, the pilot survey was conducted in July 2018, followed by the main wave. Incomplete and test observations were excluded. Table 1 shows the completed questionnaires and excluded observations ('Speeders') in each country. The final sample included 10 346 completed questionnaires.

Data from the food consumption section were used to express the dependent variables. First, respondents were categorised as vegetarians or non-vegetarians based on their weekly meat or fish consumption. Overall, 3% of our respondents were vegetarians, ranging between 1.5% in Portugal to 6.1% in the UK. For our analysis, we exclude these observations (resulting in 10 070 observations) to focus on what drives increased meat and fish consumption among non-vegetarian consumers.

Non-vegetarians then reported the frequency of consumption for specific meat and fish categories. The consumption frequencies for meat and fish were as follows: none, less than one portion a month, less than one portion a week, one portion per week, 2–3 portions per week, 4–6 portions per week, 7+ portions per week. Nutritional data from Denmark Tekniske Universitet (DTU) FRIDA aims to enhance public access to comprehensive information regarding the composition of foods consumed within Denmark and Europe (DTU 2023). It was chosen for its relevance to the European population.

National Food Institute (DTU), enabled us to estimate the calorie content, allowing us to quantify the daily consumption of red meat (RM), white meat (WM), and fish (F) in kcal *per capita*. Summary statistics for RM, WM, and F intake are shown in Table 2. Although only those who eat meat or fish were asked to declare their consumption frequency, some of them reported zero consumption of RM, WM, or F. Table S1 in ESM shows the prevalence of zero values in the dataset, which can result from two main factors:

i) Individuals who do not consume specific types of meat or fish (e.g. those who consume white meat or fish but do not consume red meat),

ii) respondents who may not have found a suitable frequency option. Among these, 3, 3, and 6% do not consume red meat, white meat, and fish, respectively.

Mean intake values, detailed in Table 3 and Table S2 in ESM, highlight that mean meat consumption is generally higher than that of fish. Figure S2 in ESM illustrates country-specific consumption patterns, with high whole meat intake in Portugal and high processed red meat intake in Latvia.

Table 1. Completed questionnaires (pilot + main wave), excluded observations ('Speeders'), and final sample size

Country	All completed	'Speeders'	Final sample (excluding speeders)
Czechia	2 138	119	2 019
Latvia	1 928	146	1 782
Portugal	1 830	172	1 658
Spain	2 287	220	2 067
United Kingdom	3 017	197	2 820
Total	11 200	854	10 346

Source: INHERIT survey data (2018)

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Table 2. Summary statistics for the consumption of red meat, white meat and fish (in kcal/day)

Food item	Min.	1st quartile	Median	Mean	3rd quartile	Max.
Red meat	0	38	93	100	154	494
White meat	0	44	83	96	132	662
Fish	0	23	47	63	80	666

Source: INHERIT survey data (2018)

Using Food Balances data from FAO (2024), we compared country averages for meat and fish supply with our consumption values. Figure S1 in ESM shows the evolution of meat (fish and seafood) supply over the past 60 years. Meat consumption has significantly increased in Spain and Portugal, while it has stagnated in the UK. Focusing on the period from 2000 to 2018 (Figure S3 in ESM), Latvia experienced the largest increases in both meat (92.5%) and fish (74%) supply, followed by Portugal (meat +12%, fish +8.3%). In contrast, Spain and the UK experienced declines in fish supply (–3.2% and –11.8%, respectively), with Spain also reducing meat supply (–4.9%). Czechia and the UK had moderate increases in meat supply (9.5% and 9.1%, respectively).

With meat supply in these countries ranging from 313 to 424 kcal *per capita* per day in 2018, well above the global average of 204 kcal (FAO 2024), it is important to explore the factors driving these high levels to inform more effective intervention design. This is particularly important given that FAO data (Figure S3 in ESM) show an increase in meat supply from 2018 to 2022 in Latvia, Spain and the UK (28.9, 10.2 and 6.2%, respectively) and no significant change in Portugal and the Czech Republic.

In 2018, the average meat supply in these countries was around 380 kcal *per capita* per day, whereas our respondents reported an average intake of approximately 200 kcal *per capita* per day. This discrepancy may arise because FAO (2024) data approximate consumption through supply and do not account for food waste. In addition, respondents often underestimate their consumption in questionnaires (Schoeller 1990).

Table 3. Mean intakes of red meat, white meat and fish by country (in kcal/day)

Food item	All	CZ	ES	LV	PT	UK
Red meat	100	93	90	131	102	90
White meat	96	80	102	87	118	95
Fish	63	38	86	46	89	61

CZ – Czechia; ES – Spain; LV – Latvia; PT – Portugal; UK – United Kongdom

Source: INHERIT survey data (2018)

The household's total net monthly income, after tax and deductions, was the primary economic variable. Respondents chose from 12 income intervals or selected 'I do not know' or 'I prefer not to respond'. A dummy variable ('*DK income*') was created for these respondents. For simplification, each income range was assigned a numerical value based on its midpoint. Missing values were imputed with the country-specific mean income. Income was then converted to *PPS* euros due to varying currencies. Summary statistics for household income (in thousands of EUR) are shown in Table S3 in ESM.

To account for potential confounding effects, sociodemographic, *health* and *value* variables were included in the model as control variables. *Gender*, *age*, *education* and *municipality size* act as categorical variables. Unemployment, smoking and computed healthiness of diet [based on respondents' food consumption values and 'Wheel of Five' by Brink et al. (2019)] are dummy variables. An overview of these variables is in Table S4 in ESM. Another control is respondents' body weight (summary statistics in Table S3 in ESM). As a robustness check, we expressed meat and fish intakes per kg of body weight. This normalisation process ensures that comparisons of intake levels are adjusted relative to the body weight of each respondent, providing a more accurate assessment of dietary patterns across different demographic groups.

Besides that, we included variables capturing values and shopping behaviour. Food factor (FF) dummies indicate whether factors like price, taste, and convenience are perceived by respondents as the most important or not when purchasing groceries (Table S4 in ESM). We derived variables for biospheric (*nature focus*), hedonic (*pleasure focus*), egoistic (*personal resources protection*), altruistic (*welfare of others*), and security (*health*, *safety* and *stability*) values. For example, biospheric value orientation reflects how impor-

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tant people find the environment. The questionnaire included three items to measure the biospheric value: preventing environmental pollution, respecting the earth, and protecting the environment. The respondents were asked to indicate on a 9-point scale ranging from 7 (of supreme importance) to 0 (not important) and –1 (opposed to my values) how important each of the items is as a guiding principle in their life.

Confirmatory factor analysis (CFA) validated these, with a Cronbach's α of 0.9 indicating a reliable construct. The root mean square error of approximation was 0.061, which is slightly above the commonly accepted threshold of 0.05 but still within an acceptable range. Detailed CFA model and fit statistics are in Zvěřinová et al. (2020). Summary and descriptive statistics are in Table S3 and Figure S4 in ESM.

Methods and models

First, employing a probit model, we explore the factors associated with individuals' decisions to be vegetarians. Next, we examine what affects the consumption of red meat, white meat and fish. The response variable, denoted as Y_j, represents the intake in kcal per day for each meat type j. We address left-censoring, where $P(Y_j = 0) > 0$, and consider Y_j as a corner solution outcome (Wooldridge 2013). Survey data often exhibit more zeros (e.g. some meat eaters may not consume meat during the period of the survey), posing a selectivity challenge (Smutná and Ščasný 2017). To address this, we employ an extension of a simple Tobit model (Tobin 1958), assuming two different decision processes in any demand: whether to consume a given good at all and, conditional on the first decision, how much to consume (Smutná and Ščasný 2017).

Our empirical demand model consists of a participation equation [Equation (1)] and an outcome equation [Equation (2)]. The dependent variable in the former is a dummy D^*_{Dj}, which equals 1 when a person consumes a specific type of meat or fish j.

$$Y^*_{Dj} = \beta_{j0} + X\beta_{j1} + H\beta_{j2} + FF\beta_{j3} + V\beta_{j4} + \epsilon_{j1} \quad (1)$$

$$\log(Y^*_j) = \gamma_{j0} + X\gamma_{j1} + H\gamma_{j2} + FF\gamma_{j3} + V\gamma_{j4} + \epsilon_{j2} \quad (2)$$

$$\log(Y_j) = \begin{cases} \log(Y^*_j) & Y^*_{Dj} > 0 \\ 0 & Y^*_{Dj} \leq 0 \end{cases} \quad (3)$$

where: X – socio-economic variables; H – health indicators; FF – food factor; V – value variables; j – red meat (RM), white meat (WM), fish (F), and 0 otherwise; β coefficients – intercepts and regression estimates; ϵ_{j1} and ϵ_{j2} – disturbances [$\epsilon_{j1} \sim N(0, \sigma^2_{j1})$ and $\epsilon_{j2} \sim N(0, \sigma^2_{j2})$] and depending on a model, they can or cannot be correlated; the dependent variable in the outcome equation, denoted as $\log(Y^*_j)$ – logarithm of meat intake (in kcal per day) measured separately for the three meat types; in Equation (2), γ_{j0} – intercept; γ_{j1}, ..., γ_{j4} – regression estimates; this structure mirrors Equation (1).

The assumption of independent error terms is too restrictive; hence, some models allow them to be correlated (Puhani 2000). We assume the latter and estimate the sample selection model, introduced by Heckman (1976), as described in Equation (3). The (log) likelihood function is maximised using the Newton-Raphson algorithm (Toomet and Henningsen 2008).

The dependent variables are explained by a set of socio-economic variables, represented in matrix X, namely income (in thousands of PPS EUR), *gender*, *education*, *age*, *type of residence*, *country*, and *unemployment*. Matrix H consists of *health indicators* (computed healthiness of diet, body weight and smoking) and matrix FF represents a range of considerations made by respondents during food purchase choices, encompassing aspects like price, taste, quality, habitual choices, family preferences, health concerns, production methods, appearance, safety, convenience, and origin. Values like altruism, biosphere conservation, hedonism, egocentrism, and security are included in the matrix V.

We hypothesise that as people get wealthier, the amount of meat and fish in their diet increases. Income generally correlates with increased meat consumption, but results vary across studies (Muhammad et al. 2017). Some find a positive relationship (Fransen 2011; Vranken et al. 2014; Malek et al. 2018), while others report no significant difference (Stewart et al. 2021). Moreover, the relationship may not be strictly linear (Vranken et al. 2014), thus, we use log-log specification.

It was shown that gender influences our dietary patterns; with women likely to have lower meat intake than men (Gossard and York 2003; Vinnari et al. 2010). Additionally, race, ethnicity, location, and social class impact overall meat consumption (Gossard and York 2003). We expect that older people tend to eat more meat and fish than young adults. Education levels might affect dietary choices, with more educated respondents opting for moderate (or reduced) meat and fish consumption.

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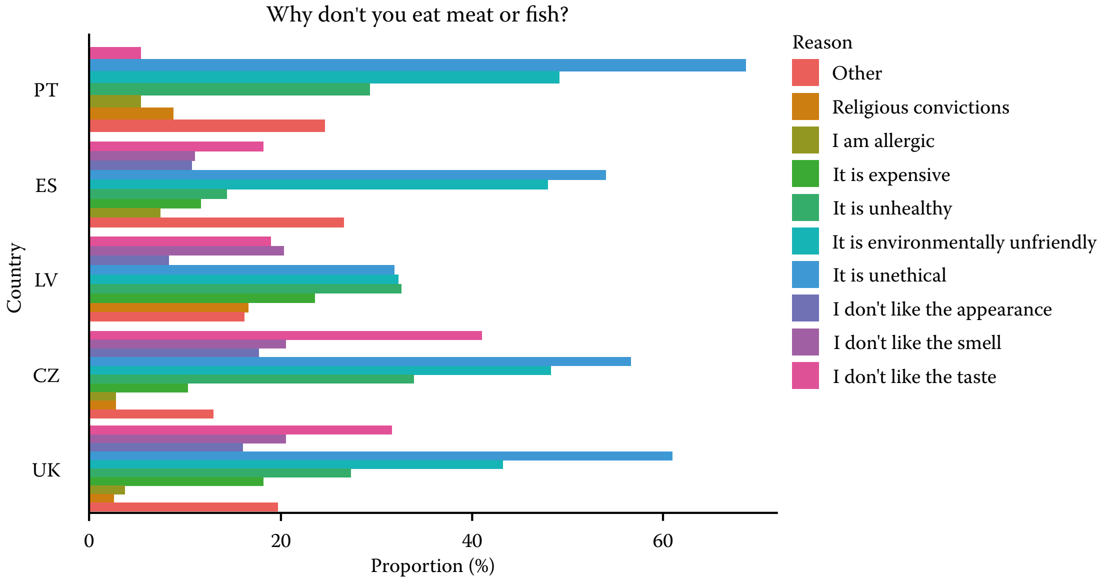

Figure 1. Reasons for not eating meat or fish in five European countries – United Kingdom (UK), Czechia (CZ), Latvia (LV), Spain (ES), Portugal (PT)

The question allowed multiple choices, resulting in a total exceeding 100%
Source: INHERIT survey data (2018)

RESULTS

Descriptive analysis shows why some people never consume meat or fish (Figure 1). Many respondents reply that it is unethical (31% in Latvia, 54–69% in the remaining countries), followed by environmental concerns (32% in Latvia, 43–49% in the remaining countries). Other frequent reasons for not consuming meat or fish are health (14% in Spain, 27–33% in the remaining countries) and taste (41% in the Czechia, 32% in the UK, 19% in Latvia, 18% in Spain, 5% in Portugal). Other reasons included being vegan or vegetarian, indicating a lifestyle choice, and concerns about animal welfare.

Regression analyses were performed in R (R Core Team 2020) [We use the package stargazer (Hlavac 2018) for regression tables]. First, we analyse the likelihood of being vegetarian. Table S5 in ESM shows the estimates of the average marginal effects and average partial effects from the probit model. The former, dis-

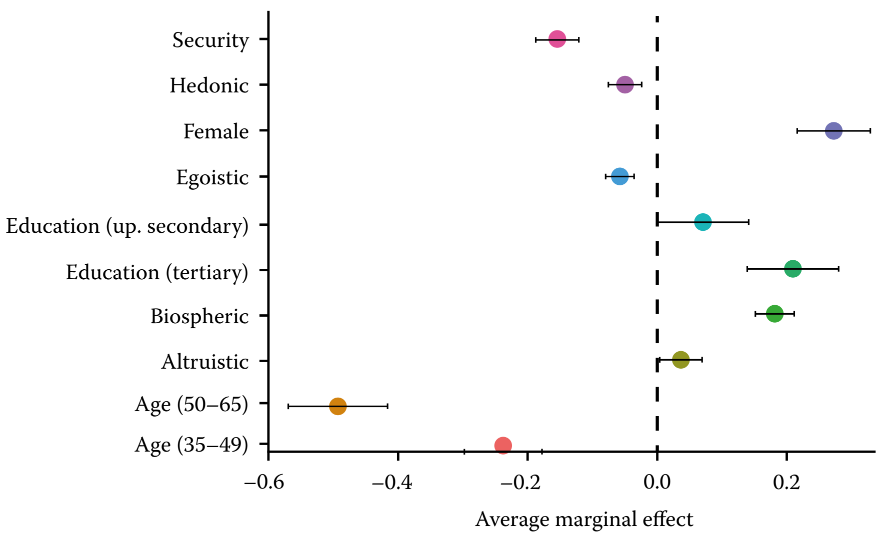

Figure 2. Probability of being vegetarian, average marginal effects, including standard errors

Source: INHERIT survey data (2018)

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played in Figure 2, offers insights into the determinants of individuals' propensity to be vegetarians. Individuals within the age groups 35–49 and 50–65 exhibit a statistically significant decrease in the predicted probability of being vegetarian (by approximately 24 and 49%, respectively, compared to the reference category of 18–34 year-olds and holding other variables constant), indicating age-related differences in dietary choices. Education might play a role, as individuals with tertiary education are more likely to follow a vegetarian diet (by 21% compared to those with primary or lower secondary education). However, there is no statistical difference between individuals with upper secondary and primary or lower secondary education. Gender disparities also surface, with females exhibiting a markedly higher likelihood of adhering to a vegetarian diet (by 27% compared to males). Similarly, a positive and statistically significant impact on the likelihood of following a vegetarian diet is associated with pro-environmental values. Conversely, egoistic, hedonic and security values exhibit negative average marginal effects, suggesting a reduced likelihood of being vegetarian.

Next, Table 4 displays the results of the outcome equation from modelling meat and fish consumption by non-vegetarians (results from the participation equation can be found in Table S6 in ESM). The first three columns report the model results for red meat, white meat, and fish consumption in kcal per day, while the last three columns report the results for the same three meat types, expressed in in terms of calorie intake per kilogram of body weight.

Income seems to play a role, but the effect is small. The elasticity between income and the amount of RM, WM and F is positive but very inelastic. Increasing income by 10% was estimated to increase the amount of RM, WM and F by 0.6, 0.4 and 0.4%, respectively (similar values for per kg of body mass intakes). Being unemployed is not associated with changes in daily RM or WM intake, but it does have a small negative impact on the F intake.

The results show no statistical difference between the level of education and daily RM or WM consumption; however, there seems to be a positive association between fish consumption and higher education (consistent for regressions after normalisation).

Table S7 in ESM presents the interaction effects (gender × age) derived from the Heckman regression model, providing insights into the non-linear relationships between these demographic factors and the consumption of RM, WM, and F. The effect of gender is now conditional on the age group (and *vice versa*). Figure 3 shows that females are associated with consuming less red meat than males, in particular by 15% when being in the age group 18–34 or 35–49, and by 9% when they are 50–65. Similarly, females tend to consume less fish than males, and this negative effect decreases as age increases (from 22% to 5%). The effect of gender on white meat is not as significant (middle-aged females are likely to consume 4% more white meat than males).

This association changes when looking at the per kilogram intakes (Figure 3). Females are likely to consume more WM per kg of body mass than males (by 13, 22 and 16% when young, middle-aged and old, respectively) and F (by 9% and 14% when middle-aged and old, respectively). The associations for RM are more complex and age-dependent. In the age group 18–34, there is no statistical difference in per-kilogram intakes. Among respondents aged 35–49, females tend to consume slightly less RM (by 1%), whereas females aged 50–65 show a trend towards higher RM consumption than males (by 4%).

Looking at females specifically, as they get older, their WM consumption decreases (by 10% for middle-aged and 28% for old compared to young females). After normalisation of intake for body weight, this trend is even stronger (a decrease of 18 and 40%, respectively). Also, females have a decreasing tendency to per kilogram RM consumption as they get older (no effect on per kg fish consumption). Among males, a higher age is also a significant factor. It follows a similar path as described for females, but the effect is even larger in all above-mentioned cases (Figure S5 in ESM). The effect of age on fish (dependent on gender) is not very straightforward – while there is no statistical difference for per kg intakes of fish between middle-aged and young groups, older females are associated with a slightly higher per kg intake of fish compared to young females, and older males are associated with a decreased per kg intake of fish compared to young males (by 13%).

There are also significant differences in the consumption of meat and fish among analysed countries. Compared to the Czechs, almost all other countries are estimated to consume more of RM, WM and F (same for per kg intakes). In Latvia, they tend to consume around 34% more RM but have comparable WM consumption. On average, Portuguese (Spanish) people are likely to eat more RM, WM and F by 21% (13%), 37% (28%) and 68% (66%) compared to the Czechs.

Among health indicators, smoking, body weight, and computed healthiness of diet are significant. Respond-

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Table 4. Overall and per kg of body mass intake of red meat (RM), white meat (WM) and fish (F), expressed in kcal/day, Heckman sample selection model, outcome equation

Variable	Overall intake			Intake per kg of body mass		
	log(RM)	log(WM)	log(F)	log(RM)	log(WM)	log(F)
log(income)	0.059*** (0.012)	0.036*** (0.011)	0.042*** (0.011)	0.069*** (0.013)	0.041*** (0.012)	0.045*** (0.013)
DK income	0.039 (0.026)	0.006 (0.025)	−0.002 (0.025)	0.063** (0.029)	0.059** (0.028)	0.018 (0.028)
Female	−0.155*** (0.031)	−0.041 (0.029)	−0.215*** (0.029)	−0.037 (0.032)	0.128*** (0.031)	0.001 (0.032)
Education (tertiary)	0.010 (0.023)	−0.018 (0.022)	0.072*** (0.022)	0.002 (0.024)	−0.020 (0.023)	0.090*** (0.024)
Education (upper secondary)	0.033 (0.022)	0.001 (0.020)	0.029 (0.020)	0.025 (0.022)	0.002 (0.022)	0.032 (0.022)
Age (35–49)	−0.025 (0.030)	−0.182*** (0.028)	−0.027 (0.028)	−0.106*** (0.031)	−0.267*** (0.030)	−0.106*** (0.031)
Age (50–65)	−0.116*** (0.032)	−0.317*** (0.030)	−0.042 (0.030)	−0.222*** (0.032)	−0.436*** (0.031)	−0.132*** (0.032)
Female × age (35–49)	0.007 (0.040)	0.080** (0.038)	0.093** (0.038)	0.025 (0.042)	0.091** (0.041)	0.092** (0.042)
Female × age (50–65)	0.067 (0.043)	0.037 (0.041)	0.164*** (0.041)	0.076* (0.045)	0.037 (0.043)	0.138*** (0.044)
Town	0.011 (0.020)	0.066*** (0.019)	0.003 (0.019)	0.001 (0.021)	0.067*** (0.020)	0.006 (0.021)
ES	0.127*** (0.031)	0.277*** (0.029)	0.651*** (0.029)	0.206*** (0.031)	0.370*** (0.030)	0.768*** (0.031)
LV	0.341*** (0.030)	0.012 (0.028)	0.066** (0.028)	0.359*** (0.031)	0.014 (0.030)	0.060** (0.031)
PT	0.213*** (0.032)	0.372*** (0.031)	0.678*** (0.030)	0.295*** (0.032)	0.459*** (0.031)	0.785*** (0.032)
UK	0.155*** (0.029)	0.230*** (0.028)	0.362*** (0.027)	0.155*** (0.032)	0.278*** (0.029)	0.420*** (0.030)
Unemployed	−0.010 (0.032)	−0.020 (0.030)	−0.079*** (0.030)	−0.035 (0.033)	−0.025 (0.032)	−0.078** (0.033)
Healthy diet	−0.370*** (0.025)	−0.231*** (0.024)	0.214*** (0.023)	−0.393*** (0.027)	−0.210*** (0.025)	0.232*** (0.025)
Body weight	0.003*** (0.001)	0.002*** (0.0005)	−0.00004 (0.0005)	–	–	–
Smoking	0.101*** (0.019)	0.048*** (0.018)	0.077*** (0.018)	0.129*** (0.020)	0.059*** (0.019)	0.096*** (0.019)
FF price	0.048** (0.020)	0.021 (0.019)	−0.096*** (0.019)	0.036* (0.021)	0.010 (0.021)	−0.098*** (0.021)

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Table 4. To be continued

Variable	Overall intake			Intake per kg of body mass		
	log(RM)	log(WM)	log(F)	log(RM)	log(WM)	log(F)
FF taste	0.080***	0.002	−0.019	0.084***	−0.006	−0.013
	(0.018)	(0.017)	(0.017)	(0.019)	(0.018)	(0.018)
FF quality	0.022	0.028	0.103***	0.050**	0.041*	0.110***
	(0.021)	(0.020)	(0.020)	(0.022)	(0.021)	(0.021)
FF habit	0.069***	0.013	−0.031*	0.057***	0.012	−0.039**
	(0.019)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
FF family	0.086***	0.042**	0.023	0.104***	0.033*	0.014
	(0.018)	(0.017)	(0.017)	(0.019)	(0.018)	(0.018)
FF health	−0.076***	0.042**	0.094***	−0.087***	0.047**	0.093***
	(0.020)	(0.018)	(0.018)	(0.020)	(0.019)	(0.020)
FF production methods	−0.021	−0.008	0.006	−0.051*	−0.00005	0.041
	(0.027)	(0.025)	(0.025)	(0.028)	(0.027)	(0.027)
FF appearance	0.067***	0.031*	−0.017	0.064***	0.030	−0.030
	(0.019)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
FF safety	0.013	0.020	0.072***	0.011	0.017	0.062***
	(0.022)	(0.021)	(0.020)	(0.022)	(0.022)	(0.022)
FF convenience	−0.024	−0.005	−0.029	−0.034	−0.017	−0.037*
	(0.020)	(0.019)	(0.019)	(0.021)	(0.020)	(0.021)
FF origin country	−0.027	−0.021	0.015	−0.026	−0.032	0.001
	(0.023)	(0.022)	(0.022)	(0.024)	(0.023)	(0.023)
Altruistic	−0.024**	−0.003	0.008	−0.024**	−0.008	0.005
	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)
Biospheric	−0.002	−0.010	0.002	−0.010	−0.006	0.007
	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Egoistic	−0.020***	0.019***	0.054***	−0.014**	0.022***	0.053***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Hedonic	0.017*	0.011	−0.004	0.019**	0.011	−0.004
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Security	0.040***	0.006	−0.035***	0.044***	0.005	−0.034***
	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
Constant	3.845***	3.992***	3.477***	−0.352***	−0.240***	−0.975***
	(0.070)	(0.066)	(0.069)	(0.059)	(0.057)	(0.062)
Observations	10 070	10 070	10 070	9 248	9 245	9 289
Log Likelihood	−12 657.950	−12 212.370	−12 895.430	−11 957.460	−11 499.220	−12 234.010
ρ	−0.953***	−0.907***	−0.053	−0.012	−0.682***	−0.080
	(0.008)	(0.013)	(0.086)	(0.152)	(0.042)	(0.080)

*, **, ****P* < 0.1, 0.05, 0.01, respectively; robust standard error in parentheses; 10 070 observations (vegetarians excluded); RM – red meat; WM – white meat; F – fish; DK – do not know; ES – Spain; LV – Latvia; PT – Portugal; UK – United Kingdom; *FF* – food factor

Source: INHERIT survey data (2018)

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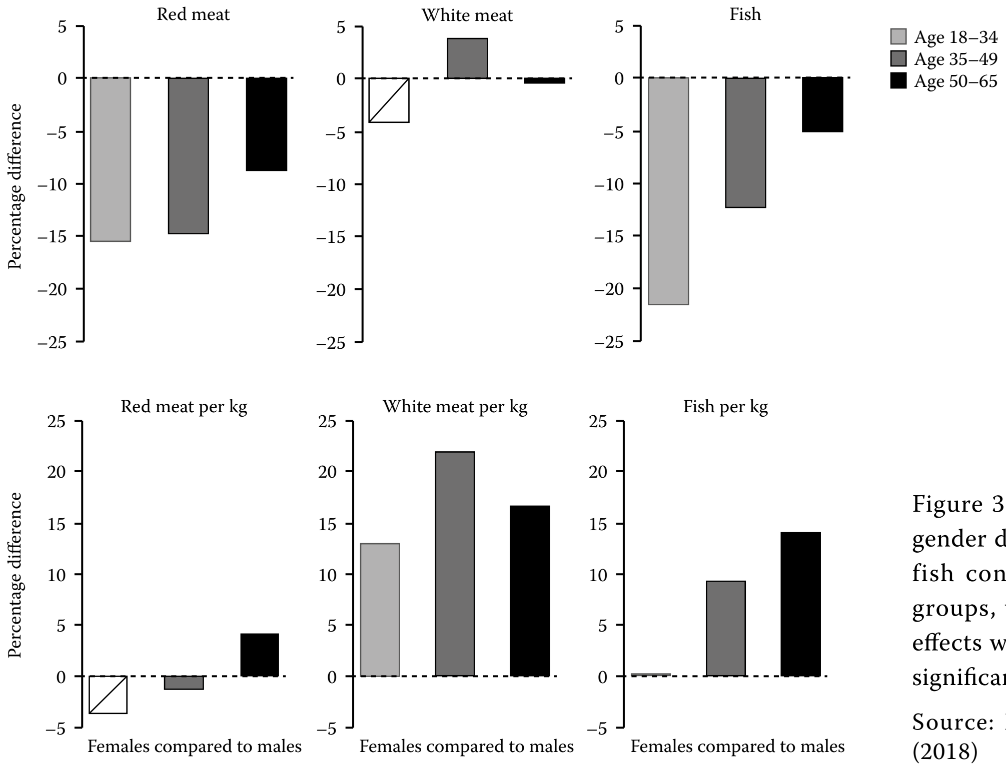

Figure 3. Interaction effects – gender differences in meat and fish consumption across age groups, visualising significant effects with solid colours, non-significant effects with lines

Source: INHERIT survey data (2018)

ents who smoke tend to eat more RM, WM and F per day (ranging from 5% to 10%). The positive association between body weight and RM or WM intake is almost negligible; every one-kilogram increase in body weight is likely to result in a 0.3% (0.2%) increase in RM (WM) intake. Respondents with healthy diets are likely to consume less RM and WM (by 37 and 23%) and more fish (by 21%).

Those who indicated price, taste, habit, family and appearance of food as important factors in their food choices are likely to consume more red meat (by 5, 8, 7, 9, and 7%, respectively). On the other hand, those who value health are likely to eat lower amounts of RM. In the case of WM, there is a positive relationship with respect to family and health. For fish, there is a negative association with respect to price (and marginally with habit). In contrast, those who value quality, health and safety tend to eat more fish.

We do not find a significant association between biospheric values and meat or fish consumption. Altruistic individuals tend to eat less RM. Egoists are also likely to eat less RM, but they tend to eat more WM and F. Those who value security are associated with higher RM consumption and lower F consumption. Hedonic values were also found to be positively associated with RM consumption. These estimates are similar for per kg intakes of the respective categories.

Overall, examining the influence of individual values on dietary choices, such as the decision to be vegetarian and the consumption of meat and fish, revealed intriguing patterns. As expected, hedonistic and security values decrease the likelihood of being vegetarian and increase meat consumption. Altruism is associated with a higher probability of being vegetarian and lower meat intake, while biospheric values primarily influence the initial decision to consume or abstain from meat (i.e. being vegetarian), but they do not significantly affect the quantity of meat or fish consumed.

DISCUSSION

In this paper, we analysed meat and fish consumption in five EU countries. Ethical reasons were the most common explanation for not eating meat or fish, followed by environmental and health concerns. This is in line with Ruby (2012), who finds that vegetarianism is often linked to a broader concern for environmental sustainability, social equality, and ethical considerations.

Age-related differences emerged, with individuals aged 35–49 and 50–65 less likely to be vegetarian. Tertiary education had a positive impact on being vegetarian, consistent with Koch et al. (2021). Gender disparities align with Ruby (2012) and Haverstock and

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Forgays (2012), showing higher vegetarianism rates among females.

Pro-environmental values strongly correlated with embracing a vegetarian diet, while egoistic or security values reduced the likelihood of being vegetarian. This is consistent with research on value orientations (De Groot and Steg 2007; Steg and De Groot 2012), where individuals with strong biospheric values tend to adopt more environmentally friendly behaviours, while those with egoistic or hedonic orientations are less likely to do so.

Goffman (1979) argued that men maximise, and women minimise meat intake in their everyday lives. Our results show that females are more likely to consume lower amounts of RM and F [similar to findings by Gossard and York (2003); Keller and Siegrist (2015); Love and Sulikowski (2018); Koch et al. (2019)]. However, after normalisation of intake for body weight, the effect of gender changes – females tend to consume more white meat and fish per kilogram of body mass (in all age groups) and similar amounts of red meat as males when they are young, but slightly higher when they are old. These gender disparities in food preferences, as observed in our study, are echoed by Spinelli et al. (2020), who suggest that women may favour specific foods like fish and lean meats, and by Liobikienė and Brizga (2025), who found women consume white meat more frequently than men, with no significant gender effect on red meat consumption. Our findings highlight the importance of normalising food consumption data for body weight [or energy intake as Shi et al. (2023)], depending on the study's context, population, and methodology, to ensure a more equitable comparison across individuals.

Previous research has explored the effect of sociodemographic factors on meat intake (Koch et al. 2019; Kirbiš et al. 2021). In Germany, lower meat consumption is more frequent among women, old and higher-educated individuals (Koch et al. 2019). Our analysis similarly shows that older individuals consume less WM and RM compared to younger people, with a stronger effect in males. In Slovenia, educational level and socioeconomic status affect meat consumption frequency and sustainable attitudes (Kirbiš et al. 2021). However, unlike these studies, we found no significant link between education and meat consumption. Tertiary education appears to positively impact only fish consumption. This suggests that in our sample, food choices may be more influenced by personal values than by education alone.

Regarding economic variables, income is associated with all meat categories (RM, WM, F), aligning with Vranken et al. (2014); Malek et al. (2018), and Liobikienė and Brizga (2025). Though our results show the effect is positive, it is rather negligible, implying that income-based approaches alone may not effectively promote healthier, sustainable diets. The perceived significance of food prices plays a more crucial role, negatively affecting fish consumption, while price-conscious respondents consume 5% more red meat. Einhorn (2021) suggests that lower socioeconomic status in Western countries leads to higher meat consumption and preference for cheaper meat. This highlights the need for policies that make healthy, sustainable food more affordable. Reducing the cost of plant-based proteins and vegetables compared to cheaper and processed meats can encourage healthier choices. Policymakers can use price sensitivity to promote better dietary habits through measures like meat taxes or subsidies for plant-based alternatives.

The significant differences in RM, WM, and F consumption among the five countries highlight the importance of local dietary habits. Compared to Czechia, where meat consumption is already high, all other countries exhibit even higher RM intake. Fish consumption in Czechia remains notably lower, likely due to its geographic and cultural context. As a landlocked country with limited access to fresh fish, it has historically relied more on meat. In contrast, coastal nations like Portugal incorporate fish more prominently into their diets.

While meat consumption continues to rise across these countries (Figure S1 in ESM), dietary trends are also evolving. In Spain, particularly among students and young adults, there is a growing shift toward plant-based products, influenced by increasing awareness of food sustainability and environmental concerns (Gaspar et al. 2022). These dynamics highlight the importance of considering country-specific dietary patterns when designing food policies.

Beyond these geographic and cultural influences, individual values also play some role in shaping dietary choices. While egoistic values were expected to correlate with higher overall meat intake, our findings suggest a more nuanced relationship, where egoists favour white meat and fish over red meat – potentially due to health considerations. Security-oriented individuals prefer red meat and consume less fish, which may reflect traditional dietary habits and food safety concerns [similar to Hayley et al. (2015)]. Hedonic values were also correlated with higher red meat intake, which is in line with Lehto et al. (2023).

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Contrary to our hypothesis, biospheric values do not significantly correlate with amount of meat or fish consumed, a finding consistent with a UK study by Clonan et al. (2015). However, altruistic individuals consume less red meat, aligning with ethical concerns, such as global mass production, global hunger, and low animal welfare (Stoll-Kleemann and Schmidt 2016). These findings reinforce the idea that dietary behaviours are not only shaped by external, structural factors like geography and culture but also by internal value-driven motivations, as described by Schwartz's framework (1992) and research on value orientations (Stern and Dietz 1994; Stern 2000; De Groot and Steg 2007).

In high-income countries with high animal food consumption, price-based interventions like meat taxes may reduce demand depending on consumer price sensitivity (Bonnet et al. 2020). Although taxes on meat are generally unpopular, they are considered effective by many economists (OECD 2023). For better public acceptance, these could be framed as 'levies,' with revenues used for social benefits (Funke et al. 2022). Combining these taxes with discounts on vegetarian options and animal welfare standards might increase their popularity, especially when aimed at supporting low-income households (Fesenfeld et al. 2020).

When consumer responsiveness to price changes is limited, awareness-raising interventions can be beneficial (Bonnet et al. 2020). Front-of-pack labels that include nutritional and environmental information (Ikonen et al. 2020), carbon calculators (Enlund et al. 2023) or supportive newsletters (Sommer et al. 2024) could be an effective tool. However, the long-term impact of such interventions is mixed, with some studies indicating that the effects diminish over time (Jalil et al. 2020; Fosgaard et al. 2021; Enlund et al. 2023; Sommer et al. 2024).

Our results indicate that younger meat eaters consume more RM than older individuals. While males generally consume more RM than females, this difference disappears after adjusting for body weight. In contrast, females show higher WM consumption per kg of body weight. This highlights the need for tailored interventions for different demographics, with further research needed on long-term effectiveness. Additionally, habits and family values are closely linked to RM consumption. Subsidised health programs and educational programs on vegetarian cooking may support habit change (Kwasny et al. 2022). Behavioural nudges, like default plant-based options in cafeterias, can promote healthier, eco-friendly diets (Kwasny et al. 2022). Tailored interventions are needed for high meat consumers, considering diverse preferences to ensure lasting change.

CONCLUSION

This study examined the relative importance of economic, socio-demographic, and food-related factors, as well as personal values, in explaining meat and fish consumption patterns. The results suggest that the impact of income on meat and fish consumption is very modest. While people who perceive food prices as an important factor in their purchasing decisions tend to eat more RM and F, other factors like age, gender, healthy diet, and values are more influential. For instance, those who prioritise price, taste, habit, family, or appearance tend to consume more red meat, whereas valuing health reduces red meat intake. This indicates the need to improve the taste and presentation of plant-based products and meat alternatives, as well as ensure their prices are competitive to encourage habitual consumption.

To promote healthier and more sustainable diets, dietary interventions should align with personal values – such as emphasising quality and health benefits for egoistic consumers or addressing food safety and health concerns for security-oriented individuals. Policy interventions could further support this shift by taxing less healthy food options and subsidising plant-based foods, making them more accessible and appealing. Such measures should be complemented by targeted campaigns that highlight the health and environmental benefits of reduced meat consumption, tailored to specific demographic groups. This aligns with global efforts to promote sustainable and health-conscious eating habits.

One of the limitations of our study is that the meat and fish consumption data relied on self-reported portions, which may not accurately reflect actual intake (Bedard et al. 2004), though the use of a validated SFFFQ aims to minimise this issue. Another limitation is the lack of data on specific product prices, respondents' health conditions, and religious beliefs, which could have provided further insights. Additionally, using 2018 data may be considered a limitation due to possible changes in the studied countries over the past years. However, given the scarcity of comprehensive and up-to-date food consumption data across European countries, our results still contribute meaningfully to the existing discourse in the field.

Future research should explore the sustainability of diets and nutritional adequacy tailored to individu-

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al needs. Intervention studies can provide insights into the effectiveness of various strategies, guiding policymakers and public health stakeholders. Additionally, emerging research on willingness-to-pay analysis can assess the monetary value individuals place on meat alternatives, including plant-based substitutes.

Our findings highlight the complex nature of dietary decisions, advocating for comprehensive approaches that consider age, education, gender, and values to promote sustainable and health-conscious eating habits. A comprehensive approach to well-being should also include the management of diet, exercise, physical health, mental health, sleep, and stress levels.

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