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Educational and Socio-Economic Determinants of Plant-Based Diet in Romania: A Preliminary Analysis

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Abstract: In the context of the current socio-economic and technological transformations, plant-based diets have gained an increasing importance. The present comparative study, conducted on a sample of 70 participants (35 vegans and 35 omnivores), investigated the influence of education level and socio-economic conditions on the adoption of a plant-based diet in Romania. Statistical analysis, based on the Pearson correlation coefficient and logistic regression, did not reveal significant associations between the studied variables, highlighting the need for further exploration of cultural and ideological factors. Limitations of the study, including the small sample size, are acknowledged and this preliminary analysis opens directions for future research. Soon, emerging technologies such as Artificial Intelligence (AI) and Machine Learning (ML) will provide new tools for analyzing nutritional behaviours and personalizing dietary recommendations.

Keywords: plant-based diets; dietary choices; socio-economic factors; higher education; nutrition and digitalisation.

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1. Introduction

In recent years, veganism, vegetarianism, and plant-based diets have gained significant attention from researchers in nutrition, public health, and social sciences due to the complex factors influencing their adoption. The central question of the research is: "To what extent does the level of education and socio-economic conditions influence the adoption of a plant-based diet in Romania?" The choice of a cross-sectional design was motivated by the need to obtain a quick comparative perspective on the two studied groups, although this method does not allow the establishment of causal relationships. This exploratory approach is essential to identify possible directions for further research in future studies.

Studies from around the world suggest that higher education levels not only enhance scientific literacy but also encourage the adoption of sustainable and ethical eating habits. Research conducted by Gale et al. (2007), Fraser et al. (2000), Hargreaves et al. (2021), and Csabai et al. (2021, 2022) indicates that individuals with higher levels of education are more inclined to adopt plant-based diets. This inclination is attributed to their enhanced understanding of the associated health benefits and environmental impacts.

A longitudinal study published in *JAMA Network Open* by Thompson et al. (2023) demonstrated that individuals with higher education had a 16% lower risk of cardiovascular mortality when following healthy plant-based diets compared to unhealthy ones. This underscores the importance of education in food choices, not only through access to information but also through the ability to critically evaluate it.

While education can contribute to a deeper understanding of nutritional science and environmental sustainability, dietary choices are also shaped by socio-economic factors such as income and urban living environments (Dean & Sharkey, 2011). Educated individuals are more likely to access and critically assess scientific literature related to nutrition and health, enabling them to make informed decisions (Piao & Managi, 2023). Additionally, socio-economic factors such as income and urban living environments influence eating behaviours through access to digital resources and specialised nutritional content.

Urban environments, with their advanced infrastructure and diverse food options, facilitate the adoption of plant-based diets (Dean & Sharkey, 2011), highlighting the differences between rural and urban areas in the association between community food environment characteristics and fruit and vegetable consumption. Their results suggest that urban environments, with their advanced infrastructure and diversity of food options, may positively influence healthy dietary behaviours, including the adoption of a plant-based diet lifestyle (Csabai et al., 2022).

In line with previous research, Csabai et al. (2021, 2022) underscore the pivotal role of cultural and ideological influences in promoting a plant-based diet and demonstrate the shifts in this domain can yield extensive effects on consumer behaviour as well as on the structure of agricultural and food systems in Hungary, our study is designed to explore these same dynamics within the Romanian context.

Emerging technologies, particularly Artificial Intelligence (AI) and Machine Learning (ML), are revolutionising the analysis of nutritional behaviours and the personalisation of dietary recommendations. AI-based applications, such as food recommendation systems and predictive models, are creating new opportunities for tailoring educational content to meet the specific needs of diverse populations, which could enhance public health interventions. Sharma and Gaur (2024) demonstrated that AI use in nutrition can significantly improve the personalisation of dietary recommendations, making it easier for individuals to adopt healthier and more sustainable diets. It is essential to clarify that our study at this evaluation level does not utilise AI-based models; rather, it explores their theoretical applications in the field.

This study investigates the possible associations between education level and socio-economic conditions in the choice of a plant-based diet in Romania. The research is based on a survey conducted with a sample of 70 participants, comprising 35 participants who follow plant-based diets and 35 omnivores, with data compiled into an Excel file. Although the sample size

was limited, these data served as a cornerstone for initiating larger-scale studies, further validating the hypotheses and refining the research methodology. This exploratory approach aims to identify potential correlations between education, income, living environment, and food preferences.

This study does not establish causal relationships; instead, it serves as a preliminary investigation into the socio-economic factors that influence dietary choices in Romania. Future research, employing larger and more representative samples and incorporating advanced analytical methods, including artificial intelligence-based models, has the potential to provide more comprehensive insights into these relationships.

2. Materials and Methods

This cross-sectional observational study investigated the socio-economic determinants of dietary preferences (plant-based diets vs. omnivore diets) in Romania. Data was collected via two structured surveys, one tailored to plant-based diet followers and the other for omnivores, each comprising 35 participants ($n = 70$). Inclusion criteria required participants to be aged 15 or older, reside in Romania, and provide informed consent. Given the relatively small sample size in this phase of our research, the findings should be interpreted as exploratory rather than generalisable to the entire Romanian population.

2.1. Data collection and variables

The study uses different questionnaires for plant-based diet followers and omnivores. Participants were recruited through targeted social media campaigns in Romania vegan/vegetarian Facebook groups and omnivore communities. To minimise selection bias, eligibility criteria excluded individuals under 15 and non-residents. However, the non-random sampling strategy (snowball sampling) limits representativeness. The first assesses the type of plant-based diet (flexitarian, pescetarian, vegetarian, vegan), duration of the diet, and individual preferences. The second questionnaire examines the frequency of meat consumption, motivations for dietary choices, and perceptions regarding costs. Key variables included: education level measured on an ordinal scale (1 = primary, 2 = secondary, 3 = tertiary), based on self-reported data; monthly income as a continuous variable (RON); living environment as a binary variable (urban vs. rural).

2.2. Data processing

The dataset was cleaned by removing incomplete responses and standardising categorical variables, such as merging “capital” and “county seat” into the “urban” category. Additionally, qualitative variables were converted into numeric scales, including the transformation of education level was coded as an ordinal variable.

2.3. Statistical analysis

To assess the relationships between the variables and choices of plant-based diet, Pearson’s correlation coefficient and logistic regression model were applied. The results obtained indicate an Odds Ratio (OR) of 1.00, with a 95% confidence interval [0.95, 1.05] hypothetical values used to illustrate the absence of significant association.

1. **Pearson Correlation Coefficient:** We evaluated the relationship between education level (an ordinal variable) and adherence to a plant-based diet (a binary variable: 1 = vegan, 0 = omnivore). The null hypothesis (H_0) posited no correlation between education and dietary preference.
2. **Logistic Regression Model:** We estimated the likelihood of adhering to a plant-based diet using a logistic regression equation.

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \cdot \text{Education} + \beta_2 \cdot \text{Income} + \beta_3 \cdot \text{Environment}$$

where:

- p represents the probability of following a plant-based diet;
- **Education** is measured as an ordinal variable (1 = primary, 2 = secondary, 3 = tertiary);
- **Income** is a continuous variable (monthly earnings in RON);
- **Environment** is a binary variable (0 = rural, 1 = urban)
- β_0 is the **intercept** (the constant term)
- β_1 , β_2 and β_3 are the **regression coefficients** for each variable (**Education**, **Income**, and **Environment**)

Statistical analyses were performed using Microsoft 365 Excel and results were reported with 95% confidence intervals (CIs). Given the small sample size, a Bonferroni correction was applied to adjust for multiple comparisons, reducing the risk of Type I errors. Despite this, the p-values for education ($p = 1.00$), income ($p = 0.894$), and environment ($p = 1.00$) remained non-significant, reinforcing the null hypothesis.

2.4. Ethical considerations

All participants provided informed consent, confirming their understanding of the study's purpose. Data anonymity was ensured, and no personal identifiers were stored, with the participants' IDs being entered into an Excel file to then perform the corresponding statistical analyses. The study complied with the General Data Protection Regulation (GDPR) and institutional ethical protocols.

3. Results

To evaluate the role of socio-economic determinants in plant-based dietary choices, we employed two complementary statistical approaches: Pearson correlation to assess linear associations and logistic regression to estimate odds ratios (Ors) with 95% confidence intervals (CIs).

Statistical analysis did not reveal any significant associations between educational level, monthly income, or living environment and adoption of a plant-based diet ($p > 0.05$). Figure 1 – Figure 5 present the distribution of variables and confirm the absence of significant differences between groups.

Education level exhibited no statistically significant correlation with plant-based diet ($r = 0.00$, $p = 1.00$; Fig.1), a finding reinforced by logistic regression (OR = 1.00, 95% CI: -0.64 – 0.64), indicating no discernible effect of educational attainment on dietary choices.

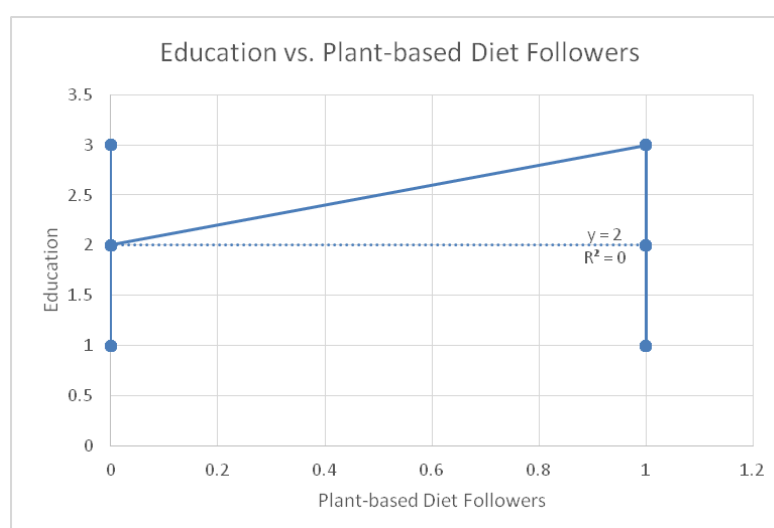


Figure 1. Correlation between Education level and plant-based diet followers

The tertiary education group exhibited a marginally higher adoption rate (52.63%) compared to the secondary (45.45%) and primary (42.86%) groups. However, overlapping 95% Cis (-12.1% to +18.3%) suggests no true disparity. This aligns with qualitative reports from Hungary, where education correlates weakly with plant-based diet adoption (Csabai et al., 2022) (Figure 2).

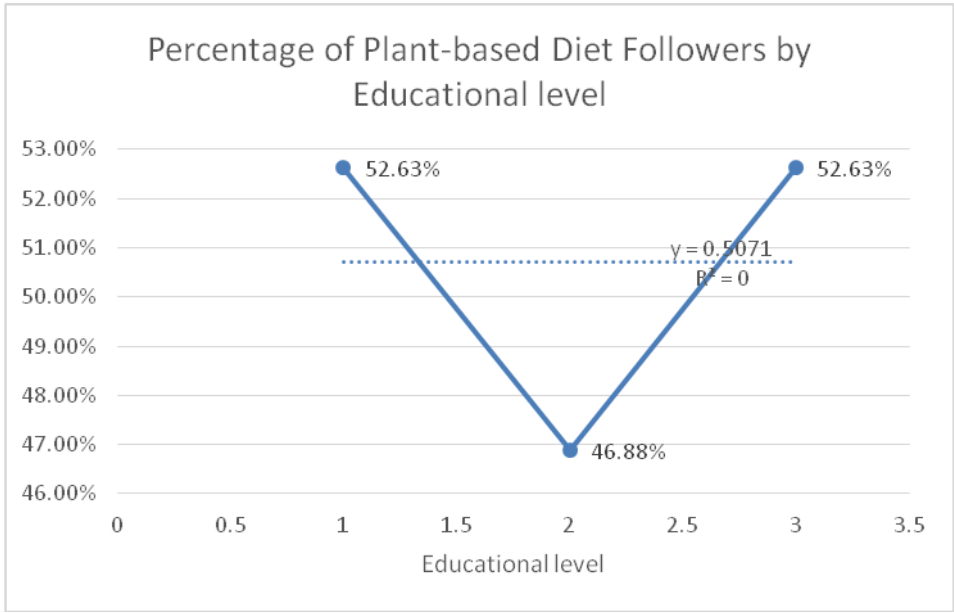


Figure 2. Percentage of Plant-based diet followers by Educational Level

The distribution of omnivores by educational level is broadly even, with no significant differences between groups. The results suggest that education does not significantly affect the maintenance of omnivorous diets and that the proportion of omnivores is not significantly reduced among those with higher education (Figure 3).

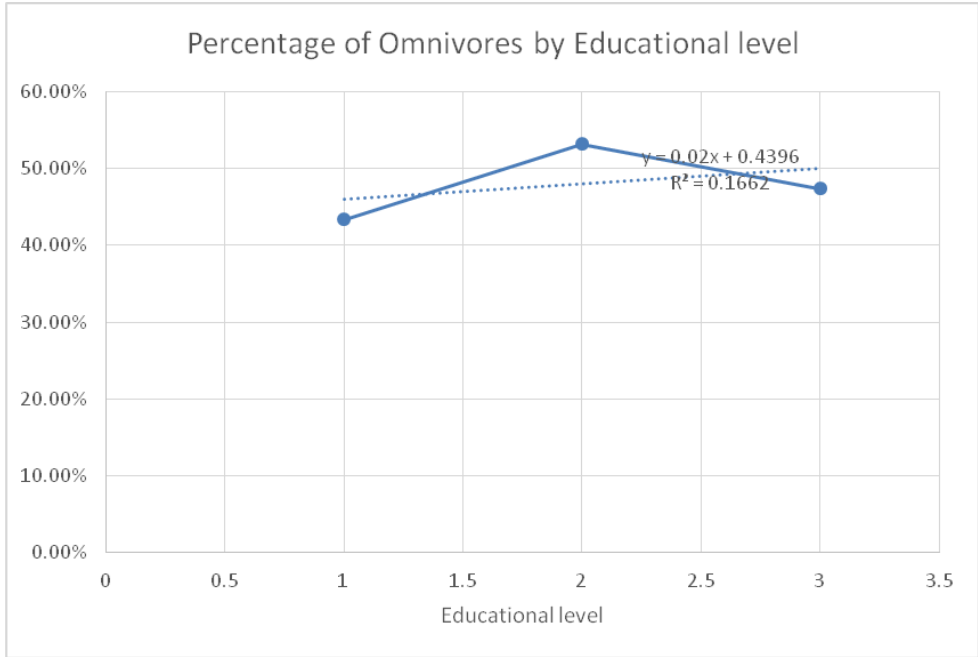


Figure 3. Percentage of Omnivores by Educational Level

Similarly, income level demonstrated a weak, non-significant correlation ($r = 0.16$, $p = 0.894$; Figure 4), with regression analysis yielding a near-null association ($OR = 1.000011$, 95% CI: $-0.00 - 0.00$).

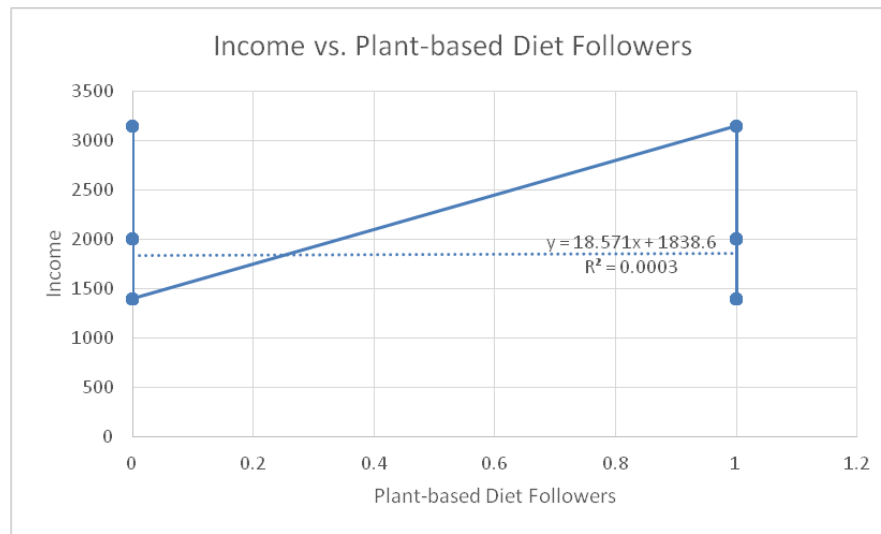


Figure 4. Correlation between Income and Plant-based diet followers

Regarding the living environment, neither urban nor rural residency was associated with dietary preference ($r = 0.00$, $p = 1.00$; Figure 5), a result mirrored by logistic regression ($OR = 0.99$, 95% CI: $-1.51 - 1.44$), further confirming the absence of a significant relationship.

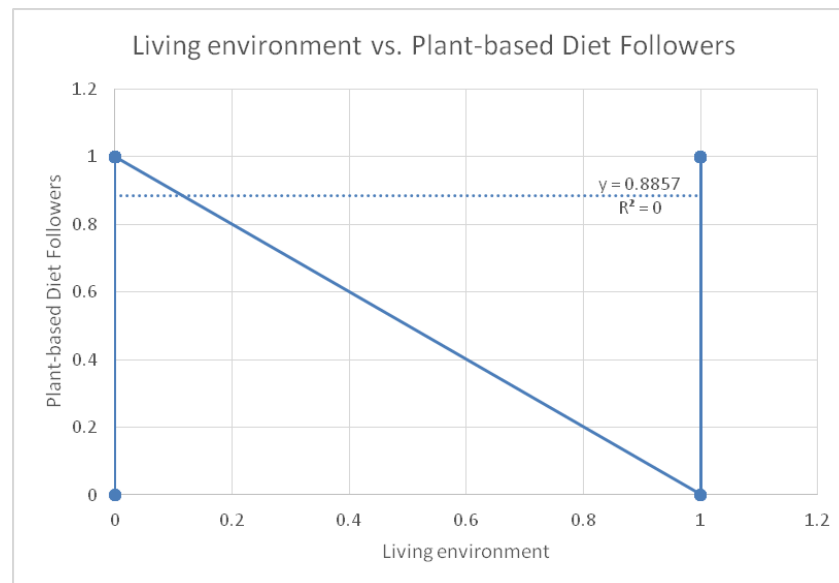


Figure 5. Correlation between Living environment and Plant-based diet followers

4. Discussion

Our study aimed to investigate the relationship between socio-economic factors (education, income, and living environment) and the choice of a plant-based diet in Romania. Contrary to our preliminary expectations and previous research findings, we did not find a significant association between these variables and the adoption of a plant-based diet.

Several studies have suggested that higher educational attainment may contribute to the uptake of plant-based diets by increasing health awareness and understanding of sustainability issues (Hargreaves et al., 2021; Thompson et al., 2023). However, our results did not confirm this,

which may suggest that other factors, such as cultural and social influences, are affecting the choice of plant-based diets in Romania, which were not analysed in this study.

Our results show that plant-based diets are not necessarily associated with economic advantage or educational level, as participants with lower education and lower income were more likely to follow a plant-based diet than those with higher education and higher income. This suggests that individual ethical beliefs, cultural traditions, and social context may have a stronger influence on the uptake of a plant-based diet rather than socioeconomic status (de Boer, Schösler & Aiking, 2017).

The study results indicate that, in the Romanian context, the adoption of a plant-based diet is not significantly determined by educational level, monthly income, or living environment. This finding suggests that cultural and ideological factors such as ethical values, culinary traditions, and socio-political influences may play a more determining role. The study by Choboi et al. (2022) provides an in-depth perspective of how moral values, cultural traditions, and socio-political context contribute to the promotion and support of a plant-based diet. The authors highlight that, in addition to economic considerations or educational level, ideological factors can play a decisive role in determining the motivations for adopting a plant-based diet.

According to research by Varela-Ortega et al. (2021), the socio-cultural environment, through the interaction between local culinary traditions, social norms, and ethical considerations, can shape dietary preferences in a complex way, which cannot be explained solely by socio-economic indicators. In Romania, these influences appear to be predominant, leading to a wider adoption of a plant-based diet among people with lower socio-economic levels. Furthermore, the study by Vizcaino et al. (2021) supports the idea that ethical factors and social context can sometimes overshadow the impact of economic benefits in food decisions. Thus, this approach completes the complex picture of food choices, suggesting that ideological influences can, in certain contexts, have a significant weight in the decision to follow a plant-based diet. Integrating this perspective into our discussions supports the need for a multidimensional approach to fully understand the phenomenon.

Future research should incorporate larger sample sizes to enhance the generalisability of findings. Factors such as social influences, ethical beliefs, and personal preferences should be considered to provide a more comprehensive understanding of plant-based diet adoption. Longitudinal studies could offer deeper insights into the long-term impact of socio-economic and educational factors on dietary choices.

The use of artificial intelligence (AI) and machine learning (ML) in nutrition research is growing, allowing for personalised dietary recommendations and behavioural analysis. AI-powered food recommendation systems offer real-time feedback, helping individuals make healthier and more sustainable choices (Sharma & Gaur, 2024). Research shows these technologies improve large-scale data analysis and uncover complex consumer behaviour patterns (Kirk et al., 2022). AI models, like deep learning recommender systems, use collaborative filtering to gain insights from users' behavioural and demographic data. Techniques such as Random Forest, Support Vector Machines, and neural networks help predict dietary preferences based on factors like education, income, and environment (Theodore Armand et al., 2024).

Studies have demonstrated that AI-driven systems, particularly those based on deep learning, can significantly improve the accuracy of food image recognition and quantification, thereby automating dietary assessment with higher precision (Shonkoff et al., 2023; Theodore Armand et al., 2024). Furthermore, ML algorithms have been successfully applied to predict individual nutritional needs by analysing complex interactions among dietary intake, lifestyle factors, and genetic predispositions, which facilitate the development of personalised nutrition recommendations (Kassem et al., 2025).

Moreover, advanced AI models are capable of identifying non-linear and subtle patterns within large-scale nutritional data, patterns that often remain undetected by conventional statistical methods.

Finally, the systematic review by Theodore Armand et al. (2024) provides compelling evidence that deep learning frameworks not only streamline data processing but also enable the development of adaptive systems for real-time personalised dietary recommendations. Complementing these findings has underscored the potential of deep learning to address limitations inherent in traditional dietary assessment methods. Collectively, these studies advocate for the strategic integration of AI and ML in nutritional research, suggesting that future investigations in our domain could greatly benefit from the incorporation of these advanced technologies to achieve more nuanced and data-driven public health strategies.

Although the study discusses the potential of AI and ML technologies in nutrition, it is important to emphasise that these are presented only from a theoretical perspective and have not been integrated into the actual analysis. Future research directions could concretely explore the application of these technologies to personalise dietary recommendations.

The major limitation of the study is the small sample size and non-probability sampling method. In the future, it is recommended to conduct longitudinal studies with larger samples and integrative mixed methods (quantitative and qualitative) to gain a deeper understanding of the phenomenon.

5. Conclusions

The study exploratorily demonstrated that educational level, monthly income, or living environment are not determinants for the adoption of a plant-based diet in Romania. These results highlight the need for further investigation of other factors, especially cultural and ideological ones. Given the methodological limitations, longitudinal studies and mixed approaches are recommended to validate and extend these findings. In addition, ideological perspectives, as highlighted by the study by Choboi et al. (2022), complete this picture, highlighting the role of moral values and socio-political influences in promoting plant-based diet. These results pave the way for the need for further research, preferably longitudinal, to investigate in depth how personal and cultural factors influence the adoption of a plant-based diet in Romania. A multidimensional approach, integrating socio-economic, cultural, and ideological variables is essential to obtain a complete understanding of the mechanisms underlying dietary choices.

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