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Experience of good practices

Plant-based diets among socioeconomic groups of different income levels in Riobamba

Las dietas basadas en plantas entre grupos socioeconómicos de diferentes niveles de ingreso en Riobamba

Dietas à base de plantas entre grupos socioeconômicos de diferentes níveis de renda em Riobamba

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ABSTRACT

Plant-based diets have gained recognition as a healthy and environmentally sustainable alternative; however, their implementation may be conditioned by socioeconomic factors that may be specific to the region studied. Therefore, the objective of the research is to analyze the degree of adoption of plant-based diets among socioeconomic groups of different income levels in the city of Riobamba, Ecuador, including factors such as economic barriers, and health/environmental/ethical motivations. A representative sample of the adult population (≥18 years, N=193315) classified by socioeconomic strata (n=300) was studied, recording data of interest through a questionnaire of indicators directly

related to the research. The high stratum manifested to follow a predominantly plant-based diet (41 %) compared to the rest (Medium: 26 %; Low: 12 %), while there are economic barriers in the low (78 %) and medium (55 %) stratum, being the most remarkable differences (H=28.45). Health-related motivations for plant consumption were mostly present in the high stratum (66 %), as were environmental and ethical motivations (45 %). The higher the perception of economic barriers, the lower the adoption of plant-based diets (ρ=-0.85), while there is a strong positive correlation with personal motivations (health and ethics), with health (ρ=+0.74) and with environmental/ethical motivation (ρ=+0.78). It is concluded that socioeconomic level directly influences the sustainability of plant-based diets in Riobamba. The formulation of public policies that promote equitable access to this type of diet is recommended.

Keywords: plant-based diets; food sustainability; economic barriers; socioeconomic level; public health.

RESUMEN

Las dietas basadas en plantas han ganado reconocimiento como una alternativa saludable y ambientalmente sostenible; no obstante, su implementación puede estar condicionada por factores socioeconómicos que pueden ser específicos según la región estudiada. Por ello, el objetivo de la investigación es analizar el grado de adopción de dietas basadas en plantas entre grupos socioeconómicos de diferentes niveles de ingreso en la ciudad de Riobamba, Ecuador, que incluye factores como las barreras económicas, y las motivaciones de salud/ambientales/éticas. Se estudió una muestra representativa de la población adulta (≥18 años, N=193315) clasificados por estratos socioeconómicos (n=300), registrando datos de interés mediante un cuestionario de indicadores directamente relacionados con la investigación. El estrato alto manifestó seguir una dieta predominantemente basada en plantas (41 %) en comparación con el resto (Medio: 26 %; Bajo: 12 %), mientras hay barreras económicas en el estrato bajo (78 %) y medio (55 %), siendo las diferencias más notables (H=28.45). Las motivaciones del consumo de plantas relacionadas con la salud estuvieron mayormente presentes en el estrato alto (66 %), al igual que las motivaciones ambientales y éticas (45 %). A mayor percepción de barreras económicas, menor es la adopción de dietas basadas en plantas (ρ=-0.85), mientras existe una fuerte correlación positiva con motivaciones personales (salud y ética), con la salud (ρ=+0.74) y con la motivación ambiental/ética (ρ=+0.78). Se concluye que el nivel socioeconómico influye directamente en la sostenibilidad de las

dietas basadas en plantas en Riobamba. Se recomienda la formulación de políticas públicas que promuevan el acceso equitativo a este tipo de alimentación.

Palabras clave: dietas basadas en plantas; sostenibilidad alimentaria; barreras económicas; nivel socioeconómico; salud pública.

RESUMO

As dietas à base de plantas têm ganhado reconhecimento como uma alternativa saudável e ambientalmente sustentável; no entanto, sua implementação pode ser condicionada por fatores socioeconômicos, os quais variam conforme a região estudada. Por isso, o objetivo desta pesquisa é analisar o grau de adoção de dietas à base de plantas entre grupos socioeconômicos com diferentes níveis de renda na cidade de Riobamba, Equador, considerando fatores como barreiras econômicas e motivações de ordem saudável, ambiental e ética. Foi estudada uma amostra representativa da população adulta (≥18 anos, N=193.315), estratificada por níveis socioeconômicos (n=300). Os dados foram coletados por meio de um questionário com indicadores diretamente relacionados ao objeto da pesquisa. O estrato de alta renda relatou maior adesão a uma dieta predominantemente à base de plantas (41%), em comparação com os estratos médio (26%) e baixo (12%). Barreiras econômicas foram relatadas de forma expressiva nos estratos de baixa (78%) e média renda (55%), com diferenças estatisticamente significativas (H = 28,45). As motivações relacionadas à saúde estiveram mais presentes no estrato alto (66%), assim como as motivações ambientais e éticas (45%). Quanto maior a percepção de barreiras econômicas, menor a adoção de dietas à base de plantas (ρ=-0,85), enquanto houve forte correlação positiva com motivações pessoais, tanto com a saúde (ρ=+0,74) quanto com aspectos ambientais/éticos (ρ=+0,78). Conclui-se que o nível socioeconômico influencia diretamente a sustentabilidade das dietas à base de plantas em Riobamba. Recomenda-se a formulação de políticas públicas que promovam o acesso equitativo a esse tipo de alimentação.

Palavras-chave: dietas à base de plantas; sustentabilidade alimentar; barreiras económicas; nível socioeconômico; saúde pública.

INTRODUCTION

In recent decades, plant-based diets have aroused growing interest in both the scientific community and public opinion, due to their potential to promote human health and mitigate the environmental impact of current food systems (Ponce et al., 2024; Rodríguez León & Quevedo Olaya, 2024). Several researches have shown that a dietary pattern predominant in vegetables, fruits, legumes, whole grains and nuts can significantly reduce the risk of chronic noncommunicable diseases, such as type 2 diabetes, cardiovascular diseases and certain types of cancer (DeClercq et al., 2022; Hardt et al., 2022; Schiattarella et al., 2021), which can be enhanced by a systematic practice of specialized physical activity and other holistic interventions (Sagarra-Romero et al., 2017, 2018; Schiattarella et al., 2021).

Currently, environmental sustainability has become an urgent challenge in the face of advancing climate change, natural resource scarcity, and ecosystem degradation (Sun et al., 2022). Among the multiple strategies to mitigate these impacts, the consumption of plants as a food base emerges as a key alternative. Several studies have shown that plant-based food production generates a significantly lower carbon footprint compared to animal production, while reducing water consumption and minimizing soil degradation (Kozicka et al., 2023). By adopting diets centered on plant-based products, it is not only decreased greenhouse gas emissions, but also it is promoted a more efficient and equitable use of natural resources. In this context, encouraging a more plant-based diet is not only a healthy option, but also a powerful tool for climate action and environmental conservation.

However, the adoption of plant-based diets is not homogeneous among different population sectors (Ali & Yanwen, 2024; Viroli et al., 2023). In socioeconomically diverse contexts, such as that of Riobamba, Republic of Ecuador, structural conditions may limit access to food products (Aguilar Reyes et al., 2024), which includes those of fresh, varied and high nutritional quality plant origin, being these conditions of diverse nature, usually socioeconomic and educational (Peñafiel Rodríguez et al., 2024); therefore, the relationship between economic level and the adoption of plant-based diets will allow the establishment of an index of accessibility and sustainability based on empirical data.

In this framework, the analysis focuses on factors such as economic barriers and health, environmental and ethical motivations. Specifically, it seeks to identify consumption patterns, cost

perceptions, economic barriers and motivations associated with the adoption of these diets, in order to generate evidence to support the design of public policies aimed at promoting food equity. Therefore, the present study aims to analyze the degree of adoption of plant-based diets among socioeconomic groups of different income levels in the city of Riobamba, Ecuador.

MATERIALS AND METHODS

A quantitative cross-sectional study with a descriptive and analytical approach was carried out in the city of Riobamba, Ecuador, between October 2024 and February 2025. This design allowed to obtain a comparative view of dietary patterns and perceptions associated with plant-based diets, considering the differences between socioeconomic groups.

Participants

The target population consisted of adults (≥18 years, N=193315), population constituted according to data provided by the National Institute of Statistics and Census (Inec, 2023), residing in areas representative of the low, middle and high strata of Riobamba (Low Income: 60-65 % "of the total percentage of the population"; Middle Income: 30-35 %; High Income: 5-10 %). The final sample included 300 participants (n=100 per stratum; Reliability: 95 %; Error: 6 %), exceeding the ideal representative sample (n=267) in order to seek greater precision in the results, increased statistical power, better generalization capacity, greater robustness to data loss, more complex analyses and reduced bias due to chance.

The entire sample was selected by stratified sampling with equal allocation. Inclusion criteria were: minimum one-year residence in the city, ability to answer the instrument on their own, and informed consent to participate in the study.

Procedures

A structured survey composed of five sections was designed and applied: (1) sociodemographic characteristics, (2) dietary habits and frequency of consumption of plant-based products, (3) perception of the costs of plant-based diets, (4) barriers to access, and (5) motivations for adopting this type of diet. The instrument was validated by a panel of experts in nutrition, public health and statistics. In addition, a pilot test was conducted with 30 people to ensure the clarity, consistency and relevance of the items.

Instruments

The variables analyzed and instruments are described below:

1. Plant-Based Adoption. Definition: Level at which individuals have incorporated a plant-based diet, either partially (flexitarianism) or totally (vegetarianism, veganism). It allows measuring how widespread the transition to plant-based diets is in the population studied. Instrument: Food survey with Likert scale (frequency and type of consumption of plant vs. animal foods). Scales (1-10 points): 0-3 points (Low adoption): Diet predominantly based on animal products; 4-6 points (Medium adoption): Flexitarianism (partial reduction of animal products); 7-10 points (High adoption): Predominantly plant-based diet (vegetarian, vegan or with strong reduction of animal products).
2. Economic Barriers. Definition: Economic barriers that hinder the adoption of plant-based diets, such as the perceived cost of fruits, vegetables, grains and plant alternatives. It analyzes the impact of socioeconomic status on the viability of a sustainable diet, especially in contexts of economic diversity. Instrument: Economic perception scale. Scale (Scale: 1-5 Points): 4-5 (High barrier): It perceives the plant-based diet as expensive and not economically viable; 2.5-3.9 (Medium barriers): It perceives some difficulties, but not impossible to overcome; 1-2.4 (Low Barriers): It considers this diet economically viable.
3. Health Motivation. Definition: Degree to which personal health concerns (disease prevention, weight control, general well-being) motivate the adoption of plant-based diets. It allows understanding whether health concerns are a primary driver of dietary choice. Instrument: Motivational survey with importance scale for *items* such as: disease prevention, weight control, improved well-being. Scale (1-5 points): 1.0-2.4 (Low motivation): Health is not a key motivation; 2.5-3.9 (Medium motivation): Health partially influences food choice; 4.0-5.0 (High motivation): Health is a key determinant for following a plant-based diet.
4. Environmental/Ethical Motivation. Definition: Extent to which ecological (reduced environmental impact) and ethical (animal welfare, social justice) reasons drive the adoption of plant-based diets. It assesses the weight of ethical and environmental factors in the decision to change dietary habits. Instrument: Attitudinal questionnaire with items such as: environmental impact, animal welfare, social justice. Scale (1-5 points): 1.0-2.0 (Low motivation): Ethical or ecological reasons have no influence; 2.1-3.5 (Medium motivation): There is some sensitivity to environmental or ethical issues; 3.6-5.0 (High motivation): Ethics or sustainability is a major factor in dietary choice.

Data analysis

The data obtained were subjected to normality test (Kolmogorov-Smirnov), demonstrating the non-existence of a normal distribution, for which non-parametric statistical was used, as is the case of the Kruskal-Wallis Test for k independent samples ($\rho \leq 0.05$) that allowed the analysis in terms of differences between each social stratum studied, also Spearman's correlation coefficient was used to measure the strength and direction of the monotonic relationship between two variables.

To convert Likert-type scales or individual scores into percentages, a linear proportional scaling methodology was used based on the following mathematical formula:

$$Percentage = \frac{Obtained\ Score - Minimum\ Score}{Maximum\ Score - Minimum\ Score} * 100$$

For tabulation and calculation of statistics with percentage frequencies, Microsoft Excel 2021 was used, and to calculate normality and the aforementioned correlational statistics, SPSS v27 was used.

RESULTS AND DISCUSSION

The proportion of participants who reported following a predominantly plant-based diet was highest in the high stratum (41 %) as tabulated in table 1, followed by the middle stratum (26 %) and the low stratum (12 %) respectively.

The analysis of perceived economic barriers revealed that 78 % of participants in the low stratum considered healthy plant products to be expensive or unaffordable, in contrast to 55 % in the middle stratum and 22 % in the high stratum.

Regarding motivations, specifically related to health, participants of the high socioeconomic level were aware of the need for priority consumption (66%) as a nutritional indicator related to healthy habits, an aspect that decreases in middle-income (49%) and low-income citizens respectively (32%), perhaps due to a lack of knowledge of the health benefits of plant consumption, and socio-cultural aspects.

On the other hand, the motivations related to environmental and ethical aspects are better reflected in the high-income group, where related motivations that could enhance the consumption of plants

predominated (45%), while in the middle and low strata there was less awareness related to environmental and ethical issues (22% and 9%, respectively).

Table 1. Main data by socioeconomic stratum

Variable	Low income (n = 100)	Middle income (n = 100)	High income (n = 100)
Plant-Based Adoption	12 % *(avg. scale: 1.2 / 10)*	26 % *(avg. scale: 2.6 / 10)*	41 % (*avg. scale: 4.1 / 10)*
Economic Barriers	78 % (*avg. scale: 4.1 / 5)*	55 % (*avg. scale: 3.2 / 5)*	22 % (*scale average: 1.9 / 5)*
Health Motivation	32 % (*avg. scale: 2.3 / 5)*	49 % *(avg. scale: 3.0 / 5)*	66 % *(avg. scale: 3.6 / 5)*
Environmental/Ethical Motivation	9 % *(avg. scale: 1.4 / 5)*	22 % (*avg. scale: 2.0 / 5)*	45 % (*avg. scale: 2.8 / 5)*

Source: Own elaboration

The comparisons made with the Kruskal-Wallis test determined a significance level of less than 0.05 for all values (Table 2), with notable values between at least two income groups for each of the variables analyzed. The most notable differences were established in the economic or financial barriers (H=28.45), suggesting the existence of a strong relationship between income and the perceived cost of a specialized plant-based diet.

Table 2. Kruskal-Wallis Test

Variable	H (statistic)	gl (degrees of freedom)	p-value	Significance
Plant-Based Adoption	15.62	2	0.0004	Yes (p<.05)
Economic Barriers	28.45	2	<0.0001	Yes (p<.05)
Health Motivation	12.80	2	0.0016	Yes (p<.05)
Environmental/Ethical Motivation	19.73	2	<0.0001	Yes (p< 05)

Source: Own elaboration

Spearman's correlation test (Rho) tabulated in table 3, evaluated the strength and direction of the monotonic relationship between ordinal or interval variables without assuming normality, with the values marked in bold significantly different ($p<0.01$).

The results show that the higher the perception of economic barriers, the lower the adoption of plant-based diets, given that Plant-Based Adoption shows a high negative correlation with Economic Barriers ($\rho=-0.85$). This validates the hypothesis that cost is a key barrier, especially at lower socioeconomic levels.

On the other hand, in consideration of the subjects studied there is a strong positive correlation with personal motivations (health and ethics), with health ($\rho=+0.74$) and with environmental/ethical motivation ($\rho=+0.78$), which has implications that food decisions are strongly influenced by internal reasons and not only by accessibility.

As for the Correlations between Barriers and Motivations, they were determined to be inverse, where Barriers vs Health ($\rho=-0.69$) and Barriers vs Ethics ($\rho=-0.61$) suggest that when there are economic obstacles, the importance given to these motivations also decreases, possibly due to prioritization of basic needs. While Health and Ethics are moderately correlated ($\rho=+0.59$), given that people motivated by their health also tend to consider ethical/environmental aspects, which may indicate a more conscious and informed profile.

Table 3. Spearman correlation between variables

Variables	Plant-Based Adoption	Economic Barriers	Health Motivation	Environmental/Ethical Motivation
Plant-Based Adoption	1.00	**-0.85**	**+0.74**	**+0.78**
Economic Barriers	-0.85	1.00	-0.69	-0.61
Health Motivation	+0.74	-0.69	1.00	+0.59
Environmental/Ethical Motivation	+0.78	-0.61	+0.59	1.00

Source: Own elaboration

The results indicate that the adoption of a plant-based diet is strongly associated with motivational factors (health and ethics) and hindered by financial or economic barriers. These correlations reinforce the need to create interventions that reduce economic barriers in vulnerable sectors, such as creating educational campaigns on health and environmental benefits, as well as providing comprehensive approaches that combine financial access with social awareness.

The objective of this study was to analyze the degree of adoption of plant-based diets among socioeconomic groups of different income levels in the city of Riobamba, Ecuador, and to evaluate how factors related to economic barriers, health motivations, and environmental/ethical motivations influence adoption.

The results showed a clear inequality in the adoption of plant-based diets according to income level. The high-income group presented an average adoption rate of 41%, compared to 12% in the low-income group. In turn, the perception of economic barriers was significantly higher in the low-income sectors (78 %) and was negatively correlated with adoption (ρ=-0.85, $p<.01$).

In contrast, health and ethical motivations were positively associated with plant-based adoption (ρ=+0.74 and +0.78 respectively), especially at middle and high income levels. These findings suggest that both financial/economic capability and intrinsic motivations are crucial determinants of sustainable food habit change.

These results are consistent with global studies that point to economic constraints as one of the main barriers to adopting healthy and sustainable diets, especially in middle- and low-income countries. For example, according to Kumar el at. (2024), technological immaturity, high investment, lack of customer awareness and acceptance, as well as technological limitations and lack of eco-innovation are identified as substantial barriers in the adoption of sustainable consumptions such as those related to plant consumption, while Culliford and Bradbury (2020) evidence differences in perceptions and willingness to adopt sustainable eating behaviors among demographic groups.

Likewise, studies such as Hopwood et al. (2020) highlight that health motivations are more influential than environmental or ethical motivations for most people, especially when it comes to making a dietary change. Although health, environment, and animal rights represent the top three reasons people cite for vegetarian diets in the West, health was the most common reason for non-vegetarians to consider vegetarian diets and presented the widest range of correlates, primarily related to

community and agency values (Hopwood et al., 2020). This is reflected in the findings of the present study, where health motivation showed significant correlations with adoption at all income levels.

It has also been observed that people with higher educational level and purchasing power are more likely to adopt sustainable diets for ethical and environmental reasons (de Boer et al., 2017), which is clearly reflected in the results of the high-income group in Riobamba, where 45 % reported environmental/ethical motivations.

The study demonstrates that the promotion of plant-based diets cannot be approached uniformly, but must consider structural differences in economic access, educational level and personal priorities (Fehér et al., 2020; Kraak & Aschemann-Witzel, 2024). Accordingly, it is advisable to develop public policies that subsidize or facilitate access to plant-based foods for vulnerable sectors, design food education strategies focused on the benefits for health and the environment, with language adapted to the local context, and promote local initiatives for accessible plant production (urban gardens, agroecological fairs).

Despite the significant results obtained, this research has some limitations that should be considered when interpreting the findings. First, the limited sample size by economic stratum (n=100 per group), although allowing for comparative analysis, does not represent the entire population of Riobamba, nor its intersectoral diversity (rural/urban, age, gender), affecting the generalization of the results to other Ecuadorian cities. In addition, the responses to the questionnaires used may be influenced by desirable social bias, especially in questions about ethical or health motivations, which could lead to approaches in perception of economic barriers, where the real price of a plant-based diet was analyzed objectively in comparison with other common diets in the city, which could complement the analysis of financial sustainability if studied in greater depth. On the other hand, the lack of control by educational level and access to nutritional information may be a factor that could decisively influence dietary adoption, aspects that were not directly evaluated in this study.

As future work, longitudinal studies are recommended to observe how dietary practices evolve over time and to evaluate educational interventions or food subsidies, as well as to establish relevant comparisons between cities and rural areas in mixed research to examine whether the same barriers and motivations are repeated or change in contexts with different economic and cultural dynamics.

Likewise, it is necessary to carry out real economic feasibility studies, comparing the weekly or monthly cost of a conventional vs. a plant-based diet with local products to identify whether the

perception of high cost has a real basis, and to include psychosocial and educational variables such as educational level, environmental awareness, exposure to health campaigns or knowledge about nutrition, which could moderate the relationship between income and adoption of sustainable diets.

The adoption of plant-based diets is significantly conditioned by the socioeconomic level of individuals in favor of middle and high income, where economic barriers predominated at the low income level, limiting sustainability and equity in the transition to healthy and ecological diets. Personal motivations for health and environmental ethics are positively related to the adoption of plant-based diets, with emphasis on the upper stratum.

The financial sustainability of plant-based diets cannot be analyzed in isolation, but rather in direct relation to the structural conditions of access, information and motivation of each population group. Therefore, the need for public, educational and subsidy policies that reduce economic barriers and promote sustainable diets in vulnerable populations, without depending exclusively on individual purchasing power, is reaffirmed.

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Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

Raquel Virginia Colcha Ortiz and María Verónica González Cabrera designed the study, analyzed the data and prepared the draft.

Carmen Amelia Samaniego Erazo and Nilo Israel Cabezas Oviedo were involved in data collection, analysis and interpretation.

All the authors reviewed the writing of the manuscript and approve the version finally submitted.