

ORIGINAL ARTICLE

Nutritional risk and dietary patterns in an overweight Angolan population in a context of nutritional transition

Riesgo nutricional y patrones dietéticos en una población angoleña con exceso de peso en un contexto de transición nutricional

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Abstract Angola is undergoing an accelerated nutrition transition marked by the abandonment of traditional dietary patterns, the loss of cultural food practices, and persistent food insecurity, alongside an increase in diet-related noncommunicable diseases. This study described and compared dietary patterns in an Angolan population across three educational levels and analyzed their implications within the context of the nutrition transition in Sub-Saharan Africa. An observational, descriptive, cross-sectional study was conducted with 1,400 participants from Kuito, Bié Province, and Aldeia Nissi, ranging from primary school to university level. Validated questionnaires were administered to assess food-group consumption, dietary diversity, intake of ultra-processed foods and sugar-sweetened beverages, physical activity, and nutritional knowledge. The results revealed a high dependence on maize and other cereal-derived carbohydrates. Fruit and vegetable consumption decreased from 67.5% in primary school to 40.4% in secondary school and 22% at university level. In contrast, the consumption of sugar-sweetened beverages and ultra-processed foods increased, particularly among university students. A high frequency of gastritis and a decline in physical activity were also observed. These findings demonstrate a progressive deterioration in dietary habits and support the development of nutrition programs and national public health policies in Angola.

Keywords dietary assessment, dietary diversity, nutrition transition, dietary patterns, university students, noncommunicable diseases.

Resumen Angola atraviesa una transición nutricional acelerada, marcada por el abandono de patrones alimentarios tradicionales, la pérdida de prácticas culturales y la persistencia de la inseguridad alimentaria, junto con el aumento de enfermedades crónicas no transmisibles relacionadas con la dieta. Este estudio describió y comparó los patrones alimentarios de una población angoleña según tres niveles educativos y analizó sus implicaciones en el contexto de la transición dietética de África Subsahariana. Se realizó un estudio observacional, descriptivo y transversal con 1.400 participantes de Kuito, Bié, y Aldeia Nissi, desde primaria hasta universidad. Se aplicaron cuestionarios validados para evaluar grupos de alimentos, diversidad dietética, consumo de ultraprocesados y bebidas azucaradas, actividad física y conocimientos nutricionales. Los resultados evidenciaron una alta dependencia del maíz y otros carbohidratos derivados de cereales. El consumo de frutas y verduras disminuyó de 67,5 % en primaria a 40,4 % en secundaria y 22 % en universidad. En contraste, aumentó el consumo de bebidas azucaradas y alimentos ultraprocesados, especialmente entre universitarios. También se observó frecuencia de gastritis y una reducción de la actividad física. Estos hallazgos muestran un deterioro progresivo de los hábitos dietéticos y respaldan el diseño de programas nutricionales y políticas de salud pública nacionales en Angola.

Palabras clave evaluación dietética, dietas de diversidad, dieta de transición, patrones alimentarios, estudiantes universitarios, enfermedades no transmisibles.

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Introduction

Diet is a major determinant of human health and plays a key role in reducing the risk of both communicable and non-communicable diseases throughout the life course (Vorster, 2011). Over recent decades, many African countries have undergone a process commonly referred to as the nutrition transition, characterized by substantial shifts away from traditional dietary patterns. These changes have been driven by rapid urbanization, transformations in food access and availability, the globalization of agrifood systems, and increasingly sedentary lifestyles (Popkin et al., 2012; Oniang'o et al. (2025).

In Angola, this transition is unfolding within a particularly complex nutritional and epidemiological context. The country continues to face persistent food insecurity, the coexistence of infectious diseases and diet-related noncommunicable diseases, widening socioeconomic inequalities, and marked disparities in the prevalence of obesity, type 2 diabetes mellitus, and gastrointestinal disorders across population groups (Global Nutrition Report, 2023; World Food Programme, 2025). In response to these challenges, the Angolan government has introduced public policy instruments such as the National Food and Nutrition Security Strategy 2025–2034 (ENSAN II) and the National Development Plan 2023–2027 (Government of Angola, 2024).

Food frequency questionnaires (FFQs) are widely used, practical, and cost-effective instruments for estimating habitual dietary intake in nutritional epidemiology, particularly in large population-based studies and resource-constrained settings. When appropriately adapted and methodologically validated, including through comparisons with dietary records or nutritional biomarkers, FFQs can provide reliable information on food consumption patterns (Willett, 2012; FAO, 2024). They are commonly used to characterize dietary patterns, assess dietary diversity, and identify groups at nutritional risk, thereby generating evidence to support the design of targeted public health interventions.

Students constitute a particularly vulnerable population during the nutrition transition. Changes in educational environments, greater autonomy in food selection, time constraints, and increased access to inexpensive convenience foods may encourage the adoption of less healthy dietary patterns (Ali et al., 2023; Phetla et al., 2024). These behaviors may become more pronounced as students progress through the educational system, especially during the transition to university, when parental supervision often decreases and lifestyle routines change substantially.

This article presents the baseline findings from the first cohort of a broader longitudinal study designed to examine the determinants and consequences of nutritional status through an integrated assessment of students from Kuito, Bié Province, and Aldeia Nissi. By comparing participants across

primary, secondary, and university education, the study provides evidence on how dietary patterns and health-related behaviors may change throughout the educational trajectory.

This study aimed to systematically describe and characterize the dietary patterns identified through food frequency questionnaires administered to a heterogeneous Angolan sample of more than 1,400 participants across three educational levels—primary, secondary, and university—and to analyze the nutritional implications of these patterns within the context of the ongoing nutrition transition in Sub-Saharan Africa.

Methodology

An observational, descriptive, cross-sectional study was conducted using baseline data from the first phase of a broader longitudinal research project. The cross-sectional design enabled the assessment of dietary characteristics at a specific point in time, as well as comparisons among educational groups and the identification of differences in food consumption patterns across educational levels.

The study included 1,433 students classified into three groups according to educational level: primary school, secondary school, and university. Participants were recruited from educational institutions located in Kuito, the capital of Bié Province, and from the community of Aldeia Nissi. These semi-urban and rural settings differ in their degree of exposure to urbanization and the globalization of food systems. University students were enrolled at the Universidade Internacional do Cuanza (UNIC).

Dietary exposures were assessed using structured questionnaires covering several dimensions. These included the frequency of consumption of cereals and cereal products, tubers, legumes, fruits, vegetables and horticultural crops, animal-source foods, sugar-sweetened beverages, and ultra-processed foods. Dietary diversity was evaluated using a score designed to measure the variety of food groups consumed. The questionnaires also assessed the comparative intake of traditional or locally sourced foods and industrially produced sources of macronutrients, general dietary habits such as meal frequency, meal timing, and water consumption, self-reported physical activity, and basic nutritional knowledge through multiple-choice questions. The instruments were adapted to the local context based on assessments by experts in nutrition and public health. A pilot test was subsequently conducted to evaluate participants' understanding of the questions and improve the clarity of the instruments.

The primary outcome variables were the frequency of consumption of each food group, dietary diversity score, predominant dietary pattern according to educational level, and consumption of sugar-sweetened beverages and ultra-pro-

cessed foods. Additional variables included the self-reported frequency of gastrointestinal symptoms or conditions not clinically diagnosed by a physician, level of physical activity, and nutritional knowledge.

The study was conducted in accordance with the ethical principles established in the Declaration of Helsinki and its subsequent amendments. Written informed consent was obtained from all adult participants. For participants younger than 18 years, informed consent was obtained from their parents or legal guardians, together with the participants' informed assent. Participation was voluntary, anonymous, and free from coercion. The research protocol was reviewed and approved by the [name of the academic or ethics committee] of UNIC.

The findings presented in this article are limited to the dietary assessment phase conducted using questionnaires. A subsequent phase, currently underway, includes anthropometric, clinical, and biochemical evaluations. Because the information was self-reported, the results may be affected by recall bias and social desirability bias. Furthermore, the cross-sectional design allows associations and differences among educational groups to be identified but does not permit the establishment of causal relationships or changes over time.

Results and discussion

Participants across all three educational levels showed a marked dependence on cereal-based energy sources. Traditional maize preparations, particularly funge, one of the principal staple foods in the Angolan diet, accounted for approximately 80% of daily meals, considering both reported meal frequency and estimated intake volume. This finding indicates that the dietary pattern of the study population remains strongly centered on maize and other cereal-derived carbohydrates. Similar patterns have been described in Sub-Saharan African populations undergoing nutrition transition, where traditional staple foods continue to provide most dietary energy while being progressively accompanied or displaced by industrially processed products (Popkin et al., 2012; Oniang'o et al., 2025).

Although cereal-based staples are culturally and nutritionally important, excessive dependence on a limited number of food groups may reduce dietary diversity and contribute to inadequate micronutrient intake, particularly when meals contain insufficient fruits, vegetables, legumes, and animal-source foods. Therefore, the persistence of a maize-dominated diet should be interpreted not only as an expression of Angolan food culture but also as a possible indicator of limited access to a more varied diet.

Regular fruit and vegetable consumption decreased progressively as educational level increased. The highest proportion was observed among primary-school participants,

at 67.5%, followed by 40.4% among secondary-school students and approximately 22% among university students. This pattern is presented in Figure 1 and indicates a gradual deterioration in the consumption of protective foods throughout the educational trajectory.

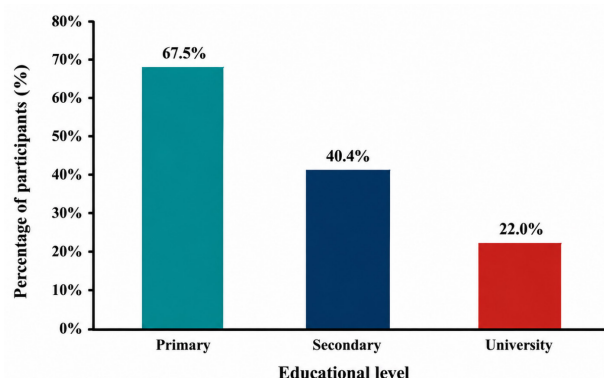


Figure 1. Regular fruit and vegetable consumption by educational level. The value for university students represents a conservative estimate based on the reported low-to-moderate consumption category.

The decline may be related to changes in food availability, increasing autonomy in food selection, reduced parental supervision, time constraints, and greater exposure to food environments that favor inexpensive and energy-dense products. University students may also experience irregular schedules and limited access to affordable fresh foods, which could contribute to the lower consumption observed in this group. However, because educational level is closely related to age, lifestyle, and degree of independence, the findings should not be interpreted as evidence that education itself causes poorer dietary quality.

An inverse pattern was observed for sugar-sweetened beverages and ultra-processed foods. Sugar-sweetened beverage consumption increased from approximately 28% among primary-school participants to 62% among secondary-school students and 81% among university students. Similarly, ultra-processed food consumption increased from 22% in primary school to 58% in secondary school and 77% at university level, as shown in Figure 2.

The marked increase at higher educational levels may be associated with the greater availability and accessibility of these products in secondary-school and university environments. Changes in daily schedules, greater purchasing autonomy, convenience, affordability, and increased exposure to food marketing may also influence consumption (Ali et al., 2023; USDA FAS, 2025). These findings are consistent with the nutrition transition model, in which traditional diets are gradually supplemented or replaced by products containing high levels of added sugars, refined carbohydrates, sodium, and unhealthy fats.

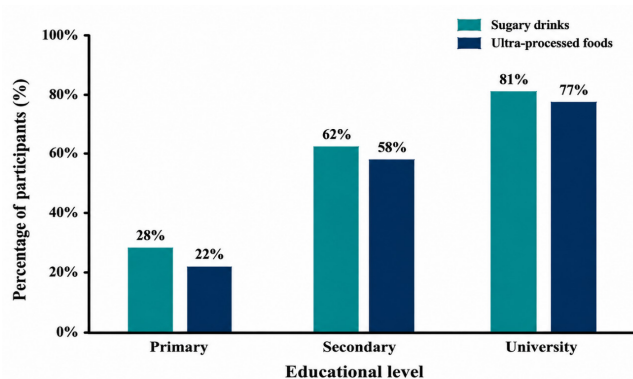


Figure 2. Consumption of sugar-sweetened beverages and ultra-processed foods by educational level.

Regular physical activity also showed a clear decline across educational levels. It was reported by 85% of primary-school participants and approximately 79% of secondary-school students, but by only 31% of university students. Figure 3 illustrates this progressive reduction.

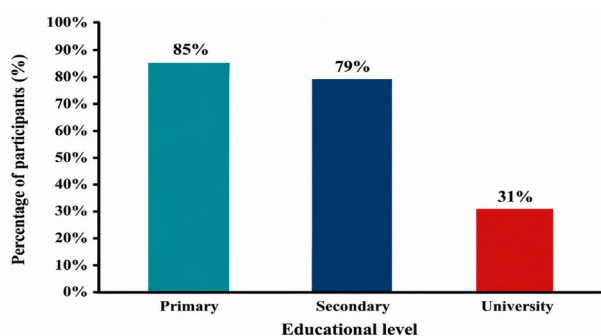


Figure 3. Regular physical activity by educational level. The university value represents a conservative estimate based on the predominantly irregular physical activity category.

The combination of low physical activity, high consumption of sugar-sweetened beverages and ultra-processed foods, and limited fruit and vegetable intake may contribute to an unfavorable cardiometabolic risk profile among university students. Nevertheless, these results are descriptive and do not establish a causal relationship between educational level and physical activity. Age-related changes, academic workload, transportation patterns, limited recreational opportunities, and prolonged sedentary time may partially explain the observed differences.

Figure 4 summarizes the four principal dietary and behavioral indicators assessed across the three educational levels: fruit and vegetable consumption, sugar-sweetened beverage consumption, ultra-processed food consumption, and regular physical activity. Fruit and vegetable intake and physical activity were considered protective indicators, for which higher values are desirable, whereas sugar-

sweetened beverage and ultra-processed food consumption were considered risk indicators, for which higher values are undesirable.

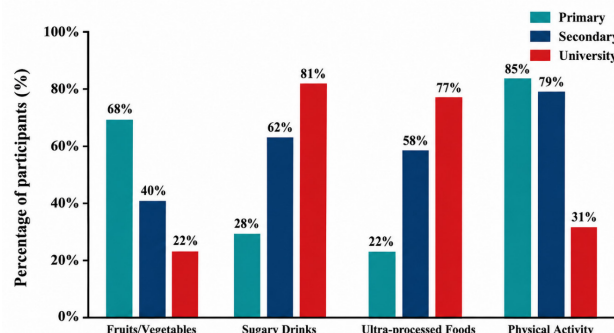


Figure 4. Comparative dietary and behavioral profile by educational level. Protective indicators—fruit and vegetable consumption and regular physical activity—decreased as educational level increased, whereas risk indicators—sugar-sweetened beverage and ultra-processed food consumption—increased.

For the four main indicators. The indicators protectors (fruits/vegetables, physical activity) show lower values; risk factors (sugar-sweetened beverages, ultra-processed foods) indicate increasing values with the educational level.

The integrated analysis showed that university students had the least favorable profile. This group presented the lowest values for both protective indicators and the highest values for the two dietary risk indicators. Primary-school participants showed the most favorable overall profile, whereas secondary-school students occupied an intermediate position. These findings suggest that the transition from secondary education to university may represent a particularly vulnerable period for the adoption of unhealthy dietary and lifestyle behaviors.

Gastrointestinal problems were frequently reported, with gastritis identified by 33% of respondents as the most common condition and with the highest frequency observed among university students, as presented in Table 1. Because these conditions were self-reported and were not necessarily diagnosed by a physician, the results should be interpreted as perceived or reported gastrointestinal problems rather than clinically confirmed disease.

Low fruit and vegetable intake, high consumption of acidic and sugar-sweetened beverages, irregular meal schedules, and academic stress co-occurred more frequently among university students. Although the cross-sectional design does not permit causal conclusions, the concurrence of these factors provides a biologically plausible context for increased gastrointestinal discomfort and digestive morbidity. Such problems may negatively affect students' quality of life, attendance, concentration, and academic performance.

Table 1. Summary of dietary and behavioral indicators by educational level

Indicator	Primary School	Secondary School	University
Regular fruit and vegetable consumption	67.5%	40.4%	~22% (low–moderate)
Sugar-sweetened beverage consumption	Moderate (~28%)	High (~62%)	Very high (~81%)
Ultra-processed food consumption	Low–moderate (~22%)	High (~58%)	Very high (~77%)
Gastrointestinal problems	Moderate	Moderate–high	High (gastritis)
Regular physical activity	High (~85%)	79%	Irregular (~31%)
Nutritional knowledge	Basic	Moderate (56.4%)	Moderate, with no apparent behavioral impact
Dietary diversity	Higher	Moderate	Lower

Note: The data correspond to findings obtained during the questionnaire-based dietary assessment phase ($n > 1,400$). The university-level percentages for fruit and vegetable consumption and physical activity are conservative estimates based on the reported ordinal categories.

Regarding nutritional knowledge, 56.4% of secondary-school students correctly identified the relationship between excessive sugar intake and an increased risk of obesity. However, this knowledge was not consistently reflected in healthier dietary practices. This finding illustrates a “knowledge–behavior gap,” in which awareness of nutritional risks does not necessarily result in behavioral change. Nutritional interventions should therefore extend beyond the provision of information and address the structural, cultural, environmental, and economic factors that influence food choices (Phetla et al., 2024).

Taken together, the findings summarized in Figures 1–4 indicate that the assessed Angolan student population is experiencing a progressive nutrition transition. Although the traditional maize-based diet remains predominant, protective dietary and behavioral practices decreased across educational levels, while the consumption of sugar-sweetened beverages and ultra-processed foods increased. This pattern was particularly pronounced among university students.

The deterioration observed during the transition from secondary school to university may reflect several interacting factors, including greater independence in food selection, separation from the family environment, academic demands, stress, irregular schedules, limited time for meal preparation, and the ready availability of processed foods and sugary drinks. Together, these conditions resemble what has been described in the literature as an obesogenic university environment.

The observed patterns are consistent with the nutrition transition framework described by Popkin et al. (2012), the findings reported by Ali et al. (2023), and recent regional evidence summarized by Oniang’o et al. (2025). The coexistence of low dietary diversity and possible micronutrient inadequacy with increased consumption of energy-dense ultra-processed foods reflects the double burden of malnutrition reported across several African settings. This situation is also consistent with the broader trends described in the Global Nutrition Report (2023) and

by the World Food Programme (2025).

The study has several limitations. Dietary and behavioral data were self-reported and may therefore be affected by recall and social desirability bias. Anthropometric, biochemical, and clinically confirmed health data were not collected during this phase, preventing direct assessment of nutritional status and cardiometabolic outcomes. The cross-sectional design limits causal inference and does not demonstrate changes within the same individuals over time. Finally, participants were recruited from educational institutions in Kuito and Aldeia Nissi; therefore, the findings should not be generalized to the entire Angolan population without caution.

Conclusions

This study identified a progressive deterioration in dietary and behavioral patterns across educational levels, with university students representing the most vulnerable group. The coexistence of poor dietary quality, low physical activity, gastrointestinal complaints, and limited translation of nutritional knowledge into healthier practices highlights the need for comprehensive student health strategies. Nutrition interventions should therefore extend beyond information-based approaches and address the environmental, cultural, social, and economic factors that shape food choices and lifestyle behaviors. The findings provide a relevant foundation for the next phase of the project, which will incorporate anthropometric, clinical, and biochemical assessments to obtain a more comprehensive understanding of nutritional status. They also support the development of culturally appropriate and multisectoral interventions, particularly within university settings, to strengthen nutrition promotion, disease prevention, and public health planning in Angola.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Author contributions

Jaime Azpiazu: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, validation, writing-original draft, writing—review and editing.

Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Statement on the use of AI

The authors acknowledge the use of generative AI and AI-assisted technologies to improve the readability and clarity of the article.

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