2026, Volume 2 (Issue 1) Nutrition and Metabolism Journal: Clinical and Experimental

Original Article

Assessing dietary diversity using the MDD-W indicator in primary healthcare users in southern Brazil

Júlia Rainho Mendes[1], Eduarda Wolf[1], Laura Morshak Vieira[1], Caroline Buss[1]

[1]Federal University of Health Sciences of Porto Alegre (UFCSPA), Porto Alegre, Rio Grande do Sul, Brazil.

Corresponding author:
Caroline Buss (carolinebuss@ufcspa.edu.br)
Federal University of Health Sciences of Porto Alegre (UFCSPA)

Open Access

Published: July 6, 2026

Nutrition and Metabolism Journal: Clinical and Experimental: *2026, Volume 2 (Issue 1)*

DOI: 10.66154/nmj.v2i1.22

Highlights

- Nutritional counseling is linked to higher dietary diversity among SUS users.
- Intake of fruits, vegetables, eggs and nuts drives higher dietary diversity.
- Two-thirds of primary care users achieved minimum dietary diversity (MDD-W ≥5).

Abstract

Objective: Dietary diversity is a key indicator of diet quality and micronutrient adequacy, yet evidence among Brazilian Unified Health System (SUS) users remains limited.
Methods: This cross-sectional study assessed dietary diversity using the Minimum Dietary Diversity for Women (MDD-W) indicator in 166 adults registered in Primary Health Care units across three municipalities in Rio Grande do Sul, Southern Brazil. Dietary diversity was determined based on three non-consecutive 24-hour food intake diaries, with consumption of ≥ 5 of 10 food groups classified as achieving minimum dietary diversity.
Results: Sociodemographic, nutritional, and behavioral variables were examined. The median MDD-W score was 5.3 (P25–P75: 4.3–6.3), and 66.9% of the participants achieved minimum dietary diversity. Higher dietary diversity was significantly associated with older age (p=0.001), higher per capita income (p=0.028), occupational stability (p=0.033) and nutritional counseling (p=0.004). Overall consumption patterns were predominated by grains, meat, and dairy, while fruits, vegetables, and nuts were underrepresented. Achieving minimum dietary diversity was significantly driven by the consumption of nutrient-dense groups: nuts and seeds (p=0.001), eggs (p=0.004), dark-green leafy vegetables (p<0.001), vitamin A–rich fruits and vegetables (p<0.001), other fruits (p<0.001) and other vegetables (p<0.001).
Conclusion: The findings highlight that dietary diversity is influenced by socioeconomic inequalities and behavioral factors. These results emphasize the need for policies that expand equitable access to diverse and nutrient-dense foods, together with strengthening continuous and context-specific nutrition education strategies within Primary Health Care.

Keywords: Dietary Diversity; Primary Health Care; Brazil; Dietary Diversity Indicators

Introduction

Dietary diversity refers to the variety of foods or food groups consumed over a specific period. It is widely recognized as a fundamental component of a healthy and balanced diet [1]. Greater dietary variety is strongly associated with improved adequacy of both macronutrient and micronutrient intake [2], which is essential for maintaining health, sustaining physiological functions, and supporting metabolic processes throughout life [3]. The interaction between macro and micronutrients underscores the complexity of achieving adequate diet quality, which relies heavily on dietary diversity.

Despite its recognized importance, an estimated two billion people worldwide suffer from micronutrient deficiencies, largely due to monotonous diets centered on nutrient-poor staple foods [4]. Such deficiencies are particularly prevalent among vulnerable populations, where food insecurity and limited access to diverse foods compromise overall dietary quality [2]. To address this, several indicators have been developed to evaluate dietary diversity at different population levels. For instance, the Minimum Dietary Diversity for Infant and Young Child Feeding (IYCF-MDD) [5] is applied to children aged 6–23 months, while the Household Dietary Diversity Score (HDDS) [6] reflects food access at the household level. In turn, the Minimum Dietary Diversity for Women (MDD-W) [7], developed by the Food and Agriculture Organization of the United Nations (FAO), was designed to assess dietary diversity at the population level, particularly as a proxy for micronutrient adequacy among women of reproductive age (WRA, 15–49 years) [7].

The MDD-W functions as a dichotomous population-level indicator that classifies individuals according to whether they achieve minimum dietary diversity, defined as the consumption of at least five out of ten specific food groups within a 24-hour period [7]. Achieving this threshold serves as a proxy for adequate micronutrient intake, given its correlation with the adequacy of eleven essential micronutrients: vitamin A, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C, calcium, iron, and zinc [8].

Although initially developed for women of reproductive age, growing evidence supports the broader applicability of the MDD-W to other population groups. A study [9] based on the findings of the Latin American Study of Nutrition and Health (ELANS) in eight Latin American countries demonstrated that the indicator effectively captures dietary diversity among both men and women aged 15 to 65 years, maintaining consistent associations with micronutrient adequacy across sex and age groups. This reinforces its validity for use in mixed-gender adult populations. Unlike the IYCF-MDD and HDDS, which are designed for specific population segments or household-level assessments, the MDD-W provides a standardized and globally validated measure of dietary diversity at the population level. Its simplicity, low cost, and reproducibility make it a valuable tool for research and public health monitoring, particularly in primary healthcare contexts.

Previous studies using the MDD-W in different adult populations have shown heterogeneous results regarding dietary diversity and the consumption of specific food groups. In the previously mentioned study [9], developed on the findings of ELANS, 59% of adults reached minimum dietary diversity, with diets largely composed of grains, meats, and dairy products, and lower consumption of fruits, vegetables, and eggs. These findings highlight a global pattern of limited dietary diversity, characterized by the predominance of energy-dense staples and insufficient intake of protective food groups.
In Brazil, despite its practicality and international recognition, few studies have applied the MDD-W. Among them, a nationally-representative cross-sectional study [10] using data from the Brazilian National Dietary Survey across 44,744 individuals applied the MDD-W in combination with the Global Diet Quality Score (GDQS). This study confirmed that higher dietary diversity (MDD-W and GDQS) was associated with lower odds of nutrient inadequacy in the Brazilian population.

Another cross-sectional study [11] evaluated dietary diversity through MDD-W in 581 older adults (60 years or more) registered in Primary Health Care (PHC) services, a setting similar to the present work. In that study, 67.5% of the sample achieved minimum dietary diversity (5 or more groups). The results identified that income and a previous cancer diagnosis were positively associated with the dietary diversity score, while cognitive decline, sedentary lifestyle, and anorexia of aging were negatively associated.

Most other investigations included Brazil in multi-country analyses or applied alternative diversity indicators to children or households. Considering this scarcity of evidence, particularly in Southern Brazil, a region with distinct cultural and dietary characteristics that may influence nutritional status, this study aimed to address a relevant gap. Its primary objective was to assess dietary diversity using the Minimum Dietary Diversity for Women (MDD-W) indicator among users of primary healthcare units in three municipalities of Rio Grande do Sul, Southern Brazil. The study also aimed to examine associations between dietary diversity, sociodemographic variables, nutritional counseling, and other indicators that may reflect dietary patterns. By characterizing the dietary diversity and related factors in this population, the study intended to identify potential nutritional inadequacies, characterize regional dietary patterns, and generate evidence to inform targeted public health strategies within Brazil's primary healthcare context.

Methods

This observational, cross-sectional study was conducted as part of a broader research project approved by the Research Ethics Committee of the Federal University of Health Sciences of Porto Alegre (UFCSPA) (Opinion No. 4,330,284; CAAE 31443620.5.0000.5345). All procedures followed the ethical principles established in Resolution 466/12 of the Brazilian

National Health Council. Data collection started only after ethical approval, and all participants provided electronic informed consent.

The study was carried out in Primary Health Care units of the Brazilian Unified Health System (SUS) located in three municipalities of Rio Grande do Sul, Southern Brazil: Porto Alegre (urban capital), Guaíba (metropolitan/peri-urban area), and Pontão (rural area).

The study population comprised adults receiving care in SUS Primary Health Care units. Participants were initially recruited face-to-face during routine health visits or immunization campaigns, followed by remote contact for data collection. Inclusion criteria were: age ≥18 years, registration in SUS Primary Health Care, and literacy (defined as completion of at least the 4th grade of elementary school or ability to read and write).

Exclusion criteria included pregnancy, severe chronic diseases (hepatic, cardiac, or renal), inflammatory bowel disease, celiac disease, disabling neurological conditions that could impair participation, or other conditions known to significantly affect nutritional status. A total of 166 participants met the eligibility criteria and were included in the analysis. No formal sample size calculation was performed, as the study was exploratory and based on feasibility within the broader research project.

Sociodemographic, behavioral, and health variables were collected using structured questionnaires administered remotely via WhatsApp and Google Forms. Variables included age, sex, marital status, education level (participant and household head), occupation, total household income, per capita income, physical activity, smoking and alcohol consumption, self-reported weight and height, presence of chronic diseases, and receipt of nutritional counseling in the previous six months. Dietary intake was assessed using food diaries. Each participant completed three non-consecutive 24-hour food diaries within one month, including at least one weekend day, to better estimate usual intake. Participants received standardized instructions and materials to record foods and beverages consumed, portion sizes, preparation methods, and meal context. Diaries were reviewed within one week of completion, and participants were contacted for clarification when necessary. All food records were transcribed into Dietbox® software [12]. For the purposes of this study, all food items with an edible portion greater than 15 g were extracted and compiled into a Google Sheets database [13], identified by participant code and amount consumed (grams).

Dietary diversity was assessed using the Minimum Dietary Diversity for Women (MDD-W) indicator [7], adapted for use with food diary data. Participants were evaluated for consumption of foods from the ten core MDD-W food groups: (1) grains, white roots and tubers; (2) pulses; (3) nuts and seeds; (4) dairy; (5) meat, poultry and fish; (6) eggs; (7) dark-green leafy vegetables; (8) vitamin A–rich fruits and vegetables; (9) other vegetables; and (10) other fruits.

A regional adaptation was applied to plantains, which were classified as fruits rather than staples, in accordance with FAO recommendations for culturally justified adaptations [7]. Food classification was performed independently by two trained researchers. Discrepancies were resolved by consensus, consulting the FAO MDD-W guide and its appendices to ensure consistency with inclusion, exclusion, and decision rules.

Mixed dishes were disaggregated into their components, and each ingredient was classified separately, following FAO guidance. Foods rich in vitamin A were identified using FAO criteria (≥120 retinol equivalents per 100 g, or ≥60 RE per 100 g for liquids) [7,14]. Optional non-core food groups (e.g., sweets, sugar-sweetened beverages, oils and fats) were coded for descriptive purposes but did not contribute to the diversity score [8].

Each participant received one point per core food group consumed per day (score range 0–10). The mean score across the three food diaries was used as the primary indicator of usual dietary diversity. Participants with mean scores ≥5 were classified as achieving minimum dietary diversity. Additionally, the quantities (grams/day) consumed from each food group were calculated to characterize dietary patterns.

All data were verified and managed using REDCap [15], which ensured data validation, traceability, and audit trails. After internal verification, the database was exported to RStudio for analysis [16]. Descriptive statistics were used to characterize the study population in terms of the main sociodemographic and nutritional variables: age (years), sex, city of residence (Porto Alegre, Guaíba, Pontão), education level, occupation, family income, per capita income, body mass index (BMI), and receipt of nutritional counseling in the previous six months (yes/no).

Normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed variables were expressed as mean ± standard deviation, while non-normally distributed variables were presented as median and interquartile range (P25–P75). Categorical variables were reported as absolute and relative frequencies. Bivariate analyses compared participants who achieved and did not achieve minimum dietary diversity (≥5 vs. <5 food groups). Student's t-test or Mann–Whitney U test was applied for continuous variables, according to distribution. Associations between categorical variables and dietary diversity status were assessed using Chi-square or Fisher's exact test. Spearman's rank correlation coefficient was used to examine associations between continuous MDD-W scores and age, per capita income, and BMI. Statistical significance was set at $p<0.05$. All analyses were performed using RStudio version 4.3.1 [17].

Results

A total of 166 participants were included in the analysis, and women represented the majority (77.7%). Concerning access to nutritional care, 20.4% reported having received nutritional counseling in the previous six months.

The overall median MDD-W score across the three non-consecutive days of dietary records was 5.3 (P25–P75: 4.3–6.3). Of the 166 participants, 111 (66.9%) achieved the minimum dietary diversity (MDD-W ≥5), while 55 (33.1%) did not. **Table 1** presents the bivariate analysis comparing sociodemographic and nutritional variables between participants who did not achieve minimum dietary diversity (<5 food groups) and those who achieved or exceeded the minimum (≥5 food groups).

Table 1: Bivariate analysis of sociodemographic and nutritional variables and achievement of Minimum Dietary Diversity (MDD-W) among primary healthcare users (n=166) in southern Brazil.

Variable	MDD-W < 5 (n=55)	MDD-W ≥ 5 (n=111)	p-value
Age (years)	39.8 ± 12.7	47.1 ± 14.2	0.001*
BMI (kg/m²)	29.2 ± 6.70	29.3 ± 6.20	0.905
Sex (n, %)			0.199
Female	39 (23.5)	90 (54.2)	
Male	16 (9.6)	21 (12.7)	
Total income (BRL)	3,000 (2,000–4,500)	3,500 (2,425–5,000)	0.074
Per-capita income (BRL)	1,133.33 (891.67–1,750.0)	1,500 (1,000–2,500)	0.028**
Occupation (n, %)			0.033**
Retired or pensioner	5 (2.9)	24 (14.3)	
Self-employed	17 (10.1)	17 (10.1)	
Unemployed	3 (1.8)	12 (7.1)	
Others	30 (17.9)	60 (35.7)	
Education (n, %)			0.215
Complete elementary	2 (1.2)	2 (1.2)	
Incomplete elementary	3 (1.8)	6 (3.6)	
Undergraduate	19 (11.4)	35 (21.1)	
Complete high school	14 (8.4)	47 (28.3)	
Incomplete high school	4 (2.4)	4 (2.4)	
Technical degree	5 (3.0)	3 (1.8)	
Graduate	8 (4.8)	14 (8.4)	
Received nutritional counseling (past 6 months) (n, %)			0.004
No	50 (48.5)	79 (48.5)	
Yes	4 (2.5)	30 (18.4)	

Age (p=0.001), per capita income (p=0.028), and occupation (p=0.033) presented significant differences between groups. Furthermore, having received nutritional counseling in the previous six months was significantly associated with achieving minimum dietary diversity (p=0.004). In contrast, BMI (p=0.905), educational level (p=0.215), and gender (p=0.199) showed no significant differences between the two groups.

The most frequently consumed groups were grains, roots, and tubers, reported in 97.4% of the records with a median intake of 206g (P25–P75: 125.8–324.3g), and meat, poultry, and fish, appearing in 90.2% of records with a median intake of 129g (70–200g). Conversely, nuts and seeds were the least consumed group, reported in only 9.0% of records, and had a median intake of 0g. Median intakes of other fruits, vitamin A–rich vegetables, dark green leafy vegetables, and eggs were also 0g/day.

Table 2 explores the proportion of participants who consumed each food group among those who achieved (≥5 food groups) or did not achieve (<5 food groups) minimum dietary diversity (MDD-W).

Table 2: Prevalence of food group consumption (%) among primary healthcare users (n=166) in southern Brazil. Classified as achieving (≥ 5 food groups) or not achieving (< 5 food groups) minimum dietary diversity (MDD-W).

Food groups (MDD-W)	Prevalence of consumption among those who achieved MDD-W (%)	Prevalence of consumption among those who did not achieve MDD-W (%)	p-value
Grains, roots and tubers	99.1	98.2	0.549
Dairy	90.3	78.2	0.058
Legumes	87.6	81.8	0.440
Nuts and seeds	20.4	1.8	0.001*
Meat, poultry and fish	95.6	98.2	0.665
Eggs	66.4	41.8	0.004**
Dark green leafy vegetables	68.1	25.5	<0.001**
Vitamin A–rich vegetables	79.6	25.5	<0.001**
Other vegetables	66.1	25.0	<0.001*
Other fruits	96.5	58.2	<0.001*

The following food groups showed a significant association with achieving the minimum dietary diversity threshold: nuts and seeds (p=0.001), eggs (p=0.004), dark green leafy vegetables (p<0.001), vitamin A–rich fruits and vegetables (p<0.001), other vegetables (p<0.001), and other fruits (p<0.001). No significant differences were found between the two groups for the remaining four food groups (grains, meat, dairy, legumes).

Discussion

This study assessed dietary diversity among users of Primary Health Care services in Southern Brazil using the Minimum Dietary Diversity for Women (MDD-W) indicator. The proportion of participants achieving minimum dietary diversity was moderate and comparable to findings from Primary Health Care settings in São Paulo [11] and other Latin American populations [9]. These results reinforce that limited dietary diversity remains a common pattern among adults in low and middle-income contexts, where access to nutrient-dense foods is constrained by socioeconomic conditions.

The predominance of middle-aged women reflects the typical profile of users of the Brazilian Unified Health System (SUS) [17] and aligns with evidence that women are more likely to seek preventive health services [18]. However, the lack of association between sex and dietary diversity suggests that structural and socioeconomic factors outweigh gender-related behavioral differences in shaping dietary patterns within this context.

The mean body mass index (BMI) in the overweight range mirrors national data showing that more than half of Brazilian adults are overweight [19]. The absence of an association between BMI and dietary diversity supports previous evidence that excess body weight may coexist with micronutrient inadequacy [20]. In this population, BMI appears to contextualize the broader nutritional environment rather than directly explain dietary quality.

Socioeconomic and occupational conditions emerged as central determinants of dietary diversity. The predominance of self-employed workers highlights the vulnerability of SUS users, who often face income instability and limited social protection [17]. Retired or pensioned participants were more likely to achieve minimum dietary diversity, possibly due to income stability and more structured daily routines. Per capita income, but not total household income, was positively associated with dietary diversity, reinforcing its relevance as a more accurate indicator of food purchasing power and access. Lower income likely restricts diets to inexpensive, repetitive staples, a pattern consistent with findings from previous Brazilian studies [11].

Despite relatively high educational levels compared with national averages [17], education was not associated with dietary diversity, suggesting that economic and occupational barriers tend to outweigh the effect of formal education in shaping food choices. Age was positively associated with dietary diversity, with older participants more likely to achieve minimum diversity. This may reflect greater adherence to traditional dietary patterns, more regular meal routines, and access to fixed income sources. However, the small number of participants aged 65 years or older limits the generalizability of this finding. Studies focused on older populations indicate that physiological and behavioral changes, such as reduced appetite and functional limitations, may negatively affect dietary diversity [11], underscoring the need for age-specific research. Among behavioral and healthcare-related factors, nutritional counseling emerged as a strong and modifiable determinant. Participants who received nutritional counseling were significantly more likely to achieve minimum dietary diversity,

highlighting the role of structured guidance in promoting healthier and more varied diets. Nutritional counseling may help individuals overcome barriers related to food access, preparation, and planning within their socioeconomic context. These findings are consistent with national intervention studies demonstrating improvements in dietary behavior and health outcomes following nutrition counseling in Primary Health Care [21]. Nevertheless, the low proportion of participants who reported receiving counseling reveals persistent gaps in access to nutrition care within the SUS, even in regions with relatively strong service indicators [22].

Strengthening nutritional counseling within Primary Health Care therefore, emerges as a strategic priority. The Dietary Guidelines for the Brazilian Population (GAPB) provide a robust framework to support this process [23]. By emphasizing natural and minimally processed foods, traditional eating practices, and dietary diversity, the GAPB allows nutrition professionals to translate evidence-based recommendations into culturally appropriate daily practices. Systematic integration of these guidelines into Primary Health Care may enhance dietary diversity, promote healthy aging, and reduce the burden of chronic diseases.

Food group analysis further contextualized these findings. Diets were predominantly based on cereals, roots, tubers, and animal proteins, with limited intake of fruits, vegetables, eggs, dairy products, and nuts. The particularly low consumption of nuts and seeds aligns with evidence that high cost and limited availability restrict their intake in low-income settings [24]. Participants who achieved minimum dietary diversity consumed nutrient-dense food groups more frequently, reinforcing affordability and availability as persistent barriers to diverse and healthy diets.

Some methodological limitations should be acknowledged. Although food diaries reduce recall bias compared with 24-hour recalls, underreporting and omission of foods remain possible, particularly for snacks and foods consumed outside the home. Standardized instructions and systematic review of records likely minimized these errors. Additionally, the use of the MDD-W among adults of both sexes represents an extension beyond its original target population. While supported by previous validation studies [9], results should be interpreted with caution.

Despite these limitations, the use of multiple non-consecutive food diaries, detailed food group classification, and independent assessment by trained researchers strengthens the internal consistency of the findings. By integrating socioeconomic, occupational, and behavioral dimensions, this study advances knowledge on dietary diversity in a Primary Health Care context in Southern Brazil.

Conclusions

This study showed that dietary diversity among users of primary healthcare services in Southern Brazil is moderate and mainly influenced by socioeconomic conditions and access to nutritional counseling. Using the MDD-W indicator, higher per capita income, occupational status, age, and recent nutritional counseling were associated with achieving minimum dietary diversity, while sex, education, and body mass index were not.

A key contribution of this study is the application of the MDD-W in a primary healthcare setting using multiple non-consecutive food diaries, strengthening the assessment of usual dietary diversity. The findings highlight nutritional counseling as a central and modifiable strategy to improve diet quality within the Brazilian Unified Health System. Future studies should adopt longitudinal and intervention designs to better assess causal pathways between nutritional counseling, socioeconomic factors, and dietary diversity. Expanding research to other regions and population groups will further support the use of the MDD-W as a practical tool for monitoring dietary quality and guiding public health actions within the SUS.

References

1. Ruel MT. Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities. The Journal of Nutrition [Internet]. 2003.133(11):3911S3926S. Available from: https://academic.oup.com/jn/article/133/11/3911S/4818042

2. Arimond M, Wiesmann D, Becquey E, Carriquiry A, Daniels MC, Deitchler M, et al. Simple Food Group Diversity Indicators Predict Micronutrient Adequacy of Women's Diets in 5 Diverse, Resource-Poor Settings. The Journal of Nutrition. 2010;140(11):2059S2069S. Available from: https://doi.org/10.3945/jn.110.123414

3. Espinosa-Salas S, Gonzalez-Arias M. Nutrition: Micronutrient Intake, Imbalances, and Interventions [Internet]. PubMed. Treasure Island (FL): StatPearls Publishing; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK597352/

4. Yilmaz H, Yilmaz A. Hidden Hunger in the Age of Abundance: The Nutritional Pitfalls of Modern Staple Crops. Food Science & Nutrition. 2025. 13(2):e4610. Available from: https://doi.org/10.1002/fsn3.4610

5. World Health Organization (WHO); United Nations Children's Fund (UNICEF). Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva: WHO; 2021. Licence: CC BY-NC-SA 3.0 IGO. Available from: https://creativecommons.org/licenses/by-nc-sa/3.0/igo

6. Food and Agriculture Organization of the United Nations (FAO). Guidelines for measuring household and individual dietary diversity [Internet]. Rome: FAO; 2011 [cited 2025 Oct 14]. Available from: http://www.fantaproject.org/monitoring-and-evaluation/household-dietary-diversity-score

7. FAO; FHI 360. Minimum Dietary Diversity for Women (MDD-W): A guide to measurement. 2nd ed. Rome: FAO; 2021.

8. FAO; FHI 360. Minimum Dietary Diversity for Women (MDD-W): A guide for measurement. Rome: FAO; 2016.

9. Gómez G, Monge-Rojas R, Rulamán Vargas-Quesada, Agatha Nogueira Previdelli, Quesada D, Kovalskys I, et al. Exploring the FAO Minimum Dietary Diversity Indicator as a Suitable Proxy of Micronutrient Adequacy in Men and Women Across Reproductive and Non-reproductive Ages in 8 Latin American Countries. Food and Nutrition Bulletin. 2024; 45(2_suppl):S55-S65. Available from: https://doi.org/10.1177/03795721241242920

10. Norde MM, Sabri Bromage, Marchioni L, Ana Carolina Vasques, Deitchler M, Arsenaut J, et al. The global diet quality score as an indicator of adequate nutrient intake and dietary quality – a nation-wide representative study. Nutrition Journal. 2024;23(1):42. Available from: https://doi.org/10.1186/s12937-024-00949-x

11. Corona LP, Silva GM, Freiria CN. Factors Associated with Dietary Diversity in Community-Dwelling Brazilian Older Adults. Foods [Internet]. 2024 Oct 29 [cited 2024 Dec 11];13(21):3449–9. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11545754/

12. Dietbox. Software de Nutrição para Nutricionistas [Internet]. Dietbox | Software de Nutrição para nutricionistas com aplicativo para o paciente. Available from: https://dietbox.me/pt-BR

13. Google Sheets [Internet]. Mountain View (CA): Google LLC; 2024 [cited 2025 Oct 14]. Available from: https://sheets.google.com

14. Food and Agriculture Organization of the United Nations (FAO); World Health Organization (WHO). Codex Alimentarius [Internet]. Rome: FAO/WHO; 2023 [cited 2025 Oct 23]. Available from: https://www.fao.org/fao-who-codexalimentarius/en/

15. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-381. Available from: https://doi.org/10.1016/j.jbi.2008.08.010

16. RStudio Team. RStudio: Integrated development for R [software]. Boston (MA): Posit Software, PBC; 2024. Available from: https://posit.co

17. Observatório de Saúde Pública; Umane. Mais dados, mais saúde [Internet]. Brasília: Observatório de Saúde Pública; 2025 [cited 2025 Oct 24]. Available from: https://observatoriosaudepublica.com.br/pesquisas/mais-dados-mais-saude/atencao-primaria-saude/

18. Keil J, Brendler V, Sachse C, Zülke A, Zeynalova S, Engel C, et al. Gender-specific differences in the utilization of health care services in an urban population sample. Gesundheitswesen. 2019;81(11):e128-e135. Available from: https://doi.org/10.1055/a-0820-3584

19. Mapa da Obesidade - Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica [Internet]. Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica. 2024. Available from: https://abeso.org.br/mapa-da-obesidade/

20. Barazzoni R, Gortan Cappellari G. Double burden of malnutrition in persons with obesity. Reviews in Endocrine and Metabolic Disorders. 2020;21(3):307–313. Available from: https://doi.org/10.1007/s11154-020-09578-1

21. Sartorelli DS, Sciarra EC, Franco LJ, Cardoso MA. Beneficial effects of short-term nutritional counselling at the primary health-care level among Brazilian adults. Public Health Nutrition. 2005;8(7):820–5. Available from: https://doi.org/10.1079/phn2005737

22. Machado PM de O, Lacerda JT de, Colussi CF, Calvo MCM. Estrutura e processo de trabalho para as ações de alimentação e nutrição na Atenção Primária à Saúde no Brasil, 2014. Epidemiologia e Serviços de Saúde. 2021;30(2). Available from: https://doi.org/10.1590/S1679-49742021000200015

23. Ministério da Saúde (BR). Guia Alimentar para a População Brasileira. 2ª ed. Brasília: Ministério da Saúde; 2014. Available from: https://www.gov.br/saude/pt-br/assuntos/saude-brasil/publicacoes-para-promocao-a-saude/guia_alimentar_populacao_brasileira_2ed.pdf/view

24. Neale EP, Tran G, Brown RC. Barriers and Facilitators to Nut Consumption: A Narrative Review. International Journal of Environmental Research and Public Health. 2020;17(23):9127. Available from: https://doi.org/10.3390/ijerph17239127