

## An Analysis of Macronutrient Dietary Diversity and the Desirable Dietary Pattern Score (DDP Score) in Urban Regions of West Kalimantan

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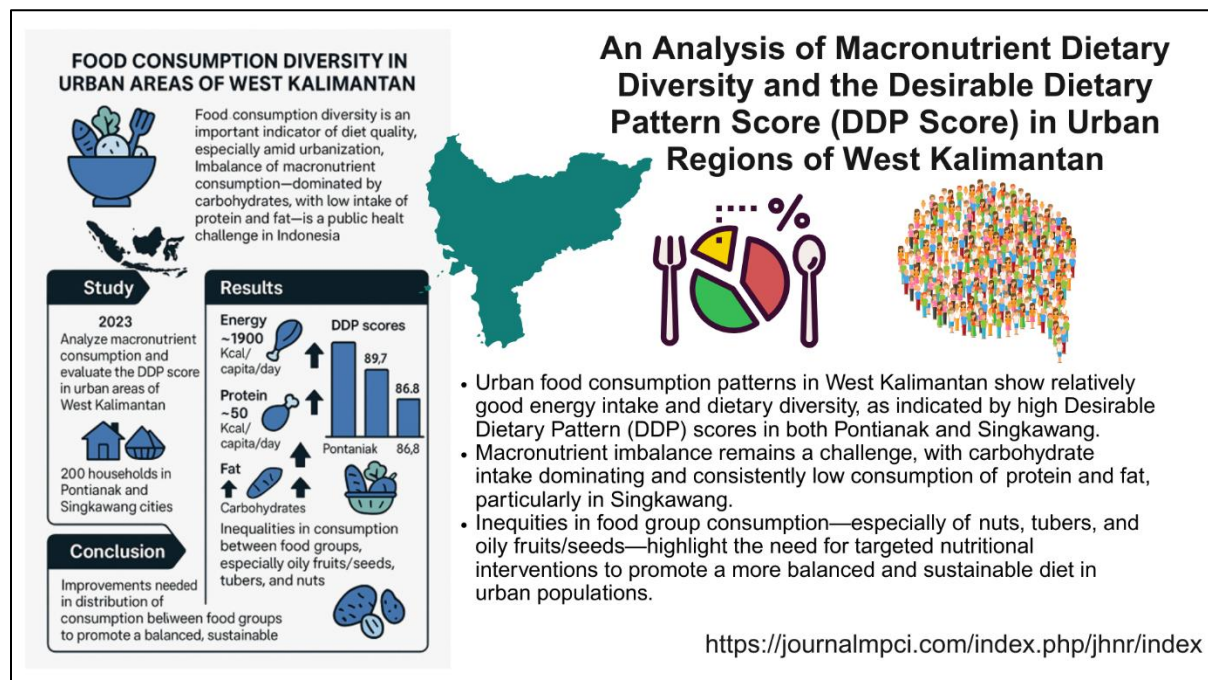
### ABSTRACT

Food consumption diversity is an important indicator for assessing the quality of people's diets, especially in the context of urbanization, which affects preferences and access to different types of food. The imbalance of macronutrient consumption, such as the dominance of carbohydrates and low protein and fat intake, is a public health challenge in Indonesia, including the West Kalimantan region. This study aimed to analyze macronutrient consumption and evaluate the Desirable Dietary Pattern (DDP) score of people in urban areas of West Kalimantan in 2023. This study used a descriptive quantitative approach involving 200 households in Pontianak and Singkawang cities. Data were collected through a food consumption survey and analyzed based on the average consumption of energy, protein, fat, and carbohydrates, as well as the DDP score. The results showed that the average energy and protein consumption in both cities were relatively similar, at approximately 1900 Kcal and 50 Kcal/capita/day, respectively. However, there were significant differences in fat and carbohydrate consumption, with Pontianak recording higher values. The DDP scores were good, at 89.7 in Pontianak and 86.8 in Singkawang. However, there are still inequalities in consumption between food groups, especially the low consumption of oily fruits/seeds, tubers, and nuts. In conclusion, although the energy consumption and food diversity of the community are relatively good, improvements are needed in the distribution of consumption between food groups to support a more balanced and sustainable diet for the community.

### Key Messages:

- Urban food consumption patterns in West Kalimantan show relatively good energy intake and dietary diversity, as indicated by high Desirable Dietary Pattern (DDP) scores in both Pontianak and Singkawang.
- Macronutrient imbalance remains a challenge, with carbohydrate intake dominating and consistently low consumption of protein and fat, particularly in Singkawang.
- Inequities in food group consumption—especially of nuts, tubers, and oily fruits/seeds—highlight the need for targeted nutritional interventions to promote a more balanced and sustainable diet in urban populations.

## GRAPHICAL ABSTRACT



## INTRODUCTION

Balanced and diverse food consumption is a key foundation for supporting nutritional status and public health (1,2). A diet that includes a variety of food groups, such as carbohydrate sources, animal and vegetable proteins, healthy fats, and vegetables and fruits, plays an important role in ensuring that the body receives optimal macro- and micronutrients (3). Diversity in consumption reflects adequate food availability and people's ability to choose quality and nutritionally valuable food. In the long run, unbalanced food consumption can contribute to the problem of dual nutrition, where under- and over-nutrition occur simultaneously in a population. Therefore, monitoring and evaluating people's consumption patterns is integral to improving public health and building national food security (4).

However, a classic problem still faced in Indonesia is the imbalance in macronutrient consumption. National data show that Indonesians tend to consume excessive amounts of carbohydrates, while protein and fat intake are still below the recommended levels. The dominance of rice as a staple food and limited access to high-quality animal protein sources are the main causes of monotonous consumption patterns (5). This imbalance can impact various aspects of health, such as metabolic disorders, decreased productivity, and increased risk of non-communicable diseases, such as diabetes and heart disease (6). Therefore, a deeper understanding of the structure of food consumption, especially in terms of macronutrients, is needed to identify potential improvements.

One important indicator used to assess the overall quality of food consumption is the Desirable Dietary Pattern (DDP), known in Indonesia as Pola Pangan Harapan (PPH) (7). The DDP score illustrates how close people's actual consumption patterns are to the recommended ideal consumption patterns based on balanced nutrition and food diversity principles. The higher the DDP score, the better the quality of food consumption in a population. This indicator considers the amount of energy consumed and the distribution of energy contributions from various food groups. Therefore, the DDP is relevant for evaluating food and nutrition programs, especially in the context of planning community-based interventions and regional food policies. In addition, DDP reflects the availability and affordability of various types of food in a region.

Food consumption conditions in urban areas tend to experience significant changes due to rapid urbanization, industrialization and modernization (8). The movement of people from villages to cities is often followed by lifestyle changes, including in terms of diet. Greater access to fast food, increased

consumption of processed foods, and decreased physical activity contribute to changes in the composition of macronutrient consumption. On the other hand, urbanization can also increase healthy food exclusion due to economic factors, market availability, and time to prepare nutritious household meals (9). This phenomenon makes urban communities vulnerable to nutritional imbalances, both in the form of under- and over-nutrition. Therefore, it is important to map and analyze the actual conditions of urban food consumption as a basis for developing evidence-based interventions (10).

To date, limited data or detailed studies specifically describe the diversity of macronutrient food consumption and DDP scores in urban areas of West Kalimantan, especially in 2023. Cities such as Pontianak and Singkawang are experiencing rapid urban development, but the portrait of their food consumption has not been fully revealed. Information on trends in energy, protein, fat, and carbohydrate consumption and the extent to which consumption patterns are close to ideal patterns is still needed. In fact, such analysis is important for designing more effective and contextualized regional food and nutrition programs. Therefore, this study aims to analyze the diversity of macronutrient consumption and evaluate the DDP scores of communities in urban areas of West Kalimantan to provide a comprehensive picture as a basis for policy recommendations and interventions based on the community's real needs.

## METHODS

This quantitative descriptive research focused on examining the variety of macronutrient intake and assessing the attainment of the Desirable Dietary Pattern (DDP) or Pola Pangan Harapan (PPH) score among urban residents in West Kalimantan. The study specifically targeted Pontianak and Singkawang, two of the most urbanized and densely populated cities in the region. The research was conducted from June to September 2023.

The target population was all households residing in Pontianak and Singkawang. A total of 200 households (100 from each city) were selected using a simple random sampling technique. To ensure representative data, sampling was stratified based on administrative area coverage (sub-districts), socioeconomic condition, and respondent availability and willingness to participate. Households were included if they had resided in the area for at least six months and had a primary food preparer available for interview.

Primary data were collected through face-to-face structured interviews using a validated Household Food Consumption Questionnaire. The questionnaire consisted of a single 24-hour food recall conducted with the household food preparer, capturing all foods and beverages consumed by all household members within the previous day. Specific probing questions of food consumption were used to assess, including the type and quantity of each food item (using standard household measures or food models), cooking methods and ingredients used, meal timing and portion sizes for each family member. Socioeconomic and demographic information, including household income and expenditure, education level of household head, occupation, and household size. To ensure accuracy, enumerators were trained, and the questionnaire was pilot-tested on 10 households outside the study sample. The 24-hour recall method, although subject to day-to-day variation, was used due to its practical application in large household surveys and has been validated for estimating group mean intakes.

The analysis was conducted in two stages: macronutrient consumption analysis and Desirable Dietary Pattern (DDP) score calculation. In macronutrient consumption analysis, food intake data from the 24-hour recall were converted to energy and macronutrient values (carbohydrates, protein, and fat) per capita per day, using Microsoft Excel and the Indonesian Food Composition Table (In Indonesia: Table Komposisi Pangan Indonesia - TKPI) published by the Indonesian Ministry of Health. Standard portion sizes and edible portion conversion factors were applied where needed. In Desirable Dietary Pattern (DDP) score calculation, the DDP score was computed following the guidelines from the Food Security Agency of Indonesia (The Ministry of Agriculture of Indonesia), which evaluates the contribution of nine major food groups (cereals, tubers, animal protein, vegetable protein, oils/fats, vegetables, fruits, milk, and sugar) to the total daily energy intake relative to an Energy Adequacy Rate (EAR) of 2100 kcal/capita/day. The closer the actual consumption proportion of each food group is to the ideal proportion, the higher the DDP score (maximum score: 100).

Descriptive statistics were used to summarize the average macronutrient consumption and DDP scores for each city. The findings are presented in tables and comparative narratives to identify notable differences and inform urban food policy and nutrition interventions.

## RESULTS

Food consumption was assessed in 200 households in Pontianak and Singkawang, Indonesia. Table 1 presents the distribution of their demographic characteristics.

**Table 1. Demography Characteristics of Households in Pontianak and Singkawang Cities Region, 2023**

No	Characteristics	Category	Pontianak City (%)	Singkawang City (%)
1	Sex of Household Head	Male	86	96
		Female	14	4
		Total	100	100
2	Household Size Category	Small ( $\leq 4$ persons)	85	71
		Medium (5-6 persons)	14	25
		Large ( $\geq 7$ persons)	1	4
		Total	100	100
3	Education Level of Household Head	No Schooling	0	1
		Primary School	4	40
		Junior High School	2	9
		Senior High School	25	40
		Higher Education	69	10
		Total	100	100
4	Occupation of Household Head	Unemployed	8	1
		Farmer/Fisher	8	20
		Trader	7	3
		Agricultural Laborer	0	1
		Non-agricultural Laborer	30	21
		Civil	29	6
		Servant/Military/Police		
		Service Sector	3	7
		Housewife	3	1
		Others (Retired, Private Employee, Entrepreneur)	12	40
		Total	100	100
5	Monthly Household Income Category	< IDR 1 Million	2	10
		IDR 1 -2 Million	30	9
		IDR 2 – 5 Million	58	53
		IDR 5 – 10 Million	10	24
		> IDR 10 Million	2	4
		Total	100	100
6	Average Monthly Household Expenditure	Food	IDR 1,657,675	IDR 1,121,340
		Non Food	IDR 2,700,340	IDR 1,743,950

According to Table 1, by 2023, the majority of household heads in Pontianak and Singkawang Cities will be male. Small households ( $\leq 4$  persons) dominate both regions, especially in Pontianak. In terms of education, household heads in Pontianak are generally highly educated, whereas those in Singkawang are

predominantly elementary and high school graduates. The main occupations in Pontianak are non-farm laborers and civil servants/military/police, while in Singkawang, more people work in the informal sector, such as self-employed, private employees, and pensioners. Household income is mostly in the range of IDR 2-5 million per month in both cities. However, Singkawang has a higher proportion of both very low-and very high-income groups. In terms of expenditure, households in Pontianak spent more on food and non-food items than those in Singkawang, indicating differences in purchasing power and possibly differences in the cost of living between regions.

**Table 2. Macronutrient Intake in Kcal/Capita/Day in Pontianak and Singkawang Cities, 2023**

Nutrient in Kcal/capita/day	Pontianak City	Singkawang City
Energy	1912.87±437.55	1932.09±470.75
Protein	50.47±17.92	50.01±13.18
Fat	58.9±19.9	29.29±16.20
Carbohydrate	481.77±76.68	348.45±91.5

Note: Values are presented as mean ± standard deviation (SD).

Table 2 shows the average consumption of energy and macronutrients in kilocalories per capita per day in Pontianak City and Singkawang City to facilitate the determination of the Desirable Dietary Pattern (DDP) scores for both regions. The average energy consumption in both cities was similar, with 1912.87±437.55 Kcal/capita/day in Pontianak and 1932.09±470.75 Kcal/capita/day in Singkawang. Protein consumption was also relatively balanced, with 50.47±17.92 Kcal/capita/day in Pontianak and 50.01±13.18 kcal/capita/day in However, there were significant differences in fat and carbohydrate consumption. Pontianak city recorded higher fat consumption (58.9±19.9 Kcal/capita/day) compared to Singkawang, which only reached 29.29±16.20 Kcal/cap. Similarly, in carbohydrate consumption, Pontianak had an average of 481.77±76.68 Kcal/capita/day, much higher than Singkawang which only reached 348.45±91.5 Kcal/capita/day.

These differences suggest that although total energy and protein intakes are relatively equivalent, the macronutrient composition between the two cities is different, with Pontianak showing higher fat and carbohydrate consumption patterns. This may reflect differences in diet, food preferences, and access to certain types of food between the two regions.

**Table 3. Desirable Dietary Pattern (DDP) Score Based on Food Consumption in Pontianak City, 2023**

No	Food Group	Energy Consumption Per Capita/Day		DDP Score Standard**		Achievement	
		Kcal	% RDA*	Weight	Ideal Score	% RDA×Weight	DDP Score
1	Cereals	1,059	50.4	0.5	25.0	25.2	25.0
2	Tubers	37	1.8	0.5	2.5	0.9	0.9
3	Animal-Based Foods	268	12.8	2.0	24.0	25.5	24.0
4	Oils and Fats	275	13.1	0.5	5.0	6.5	5.0
5	Fruits/Oily Seeds	30	1.4	0.5	1.0	0.7	0.7
6	Legumes	71	3.4	2.0	10.0	6.8	6.8
7	Sugar	63	3.0	0.5	2.5	1.5	1.5
8	Vegetables and Fruits	108	5.2	5.0	30.0	25.8	25.8
9	Others	15	0.1	0.0	0.0	0.0	0.0
<b>Total</b>		<b>1,927</b>	<b>91.1</b>		<b>100.0</b>		<b>89.7</b>

Notes: \*RDA: Recommended Dietary Allowance = 2,100 kcal/capita/day

\*\*Based on National Standard for Ideal DDP Score Calculation

In 2023, Pontianak City achieved a Desirable Dietary Pattern (DDP) score of 89.7. This score indicates that the diversity of daily per capita food consumption reached 89.7%, which is categorized as good. The average daily per capita energy intake (RDA) was 1,927 kcal, equivalent to 91.1% of the recommended requirement, and is considered adequate. These values suggest that the population of Pontianak City had a diverse and nutritionally adequate dietary pattern with sufficient energy intake (Table 3).

**Table 4. Desirable Dietary Pattern (DDP) Score Based on Food Consumption in Singkawang City, 2023**

No	Food Group	Energy Consumption Per Capita/Day		DDP Score Standard**		Achievement	
		Kcal	% RDA*	Weight	Ideal Score	% RDA×Weight	DDP Score
1	Cereals	1,112	52.9	0.5	25.0	26.5	25.0
2	Tubers	39	1.8	0.5	2.5	0.9	0.9
3	Animal-Based Foods	283	13.5	2.0	24.0	27.0	24.0
4	Oils and Fats	220	10.5	0.5	5.0	5.2	5.0
5	Fruits/Oily Seeds	19	0.9	0.5	1.0	0.5	0.5
6	Legumes	67	3.2	2.0	10.0	6.4	6.4
7	Sugar	94	4.5	0.5	2.5	2.2	2.2
8	Vegetables and Fruits	96	4.6	5.0	30.0	22.8	22.8
9	Others	11	0.1	0.0	0.0	0.0	0.0
<b>Total</b>		<b>1,940</b>	<b>92.0</b>		<b>100.0</b>		<b>86.8</b>

Notes: \*RDA: Recommended Dietary Allowance = 2,100 kcal/capita/day

\*\*Based on National Standard for Ideal DDP Score Calculation

In 2023, Singkawang City achieved a Desirable Dietary Pattern (DDP) score of 86.8. This score indicates that the diversity of daily per capita food consumption reached 86.8%, which is categorized as good. The average daily per capita energy intake was 1,940 kcal, equivalent to 92.0% of the recommended dietary allowance, and is considered adequate. These findings suggest that the population of Singkawang City had a good level of dietary diversity with sufficient energy intake (Table 4).

## DISCUSSION

The findings of this study indicate that the average daily per capita energy consumption in Pontianak City ( $1912.87 \pm 437.55$  kcal) and Singkawang City ( $1932.09 \pm 470.75$  kcal) was generally comparable. These values approach the national recommended energy intake for adults with moderate activity levels, which ranges from 2100 to 2500 kcal/day, according to the 2019 Nutrient Adequacy Standards. However, the slightly lower-than-recommended intake observed in both cities may indicate an underlying risk of chronic energy deficiency, particularly if combined with physically demanding occupations or poor nutrient absorption. Over time, insufficient energy intake could impair work productivity, growth in adolescents, and immunity across all age groups (11).

In terms of protein intake, both cities also demonstrated similar figures, at approximately 50 kcal per capita per day. When converted to grams (based on 1 gram of protein = 4 kcal), this equates to approximately 12.5 grams per capita per day. This is well below the national average protein intake of 62.2 grams/day as reported in the national Research of Indonesia (12). Low protein consumption, especially if not compensated by high-quality amino acid sources may increase the risk of protein-energy malnutrition (13), particularly in vulnerable populations such as children, pregnant women, and the elderly. The deficiency also suggests potential inaccessibility or unaffordability of animal-source proteins like eggs, fish, and meat, or a limited dietary habit of consuming legumes and other plant-based proteins.

A notable disparity was observed in fat and carbohydrate consumption. Pontianak showed significantly higher fat intake ( $58.9 \pm 19.9$  kcal/capita/day) compared to Singkawang ( $29.29 \pm 16.20$  kcal/capita/day). This difference may be attributed to dietary habits or a greater consumption of fried foods and coconut milk-based dishes in Pontianak. When converted (1 gram of fat = 9 kcal), this corresponds to approximately 6.5 grams of fat in Pontianak and only 3.2 grams in Singkawang per day. These amounts fall far below the national average of approximately 72 grams/day (12), suggesting that fat intake in both cities may not yet meet the recommended proportion of 20–30% of total energy. Also, these low levels of fat intake, particularly in Singkawang, may reflect limited inclusion of healthy fats (e.g., nuts, seeds, avocados, and oils), potentially reducing the absorption of fat-soluble vitamins (A, D, E, and K) and impacting reproductive health, hormonal balance, and cognitive development (14). Meanwhile, carbohydrate intake was also higher in Pontianak ( $481.77 \pm 76.68$  kcal) compared to Singkawang ( $348.45 \pm 91.5$  kcal), which is equivalent to approximately 120 grams and 87 grams, respectively (1 gram of carbohydrate = 4 kcal). It suggests a carbohydrate-dominant dietary pattern (rice, noodles, and other flour-based food products), which, if not balanced with fiber and protein, may increase the risk of metabolic syndrome, type 2 diabetes, and obesity over time (15).

The analysis of Desirable Dietary Pattern (DDP) scores further highlights the imbalances. Pontianak's DDP score (89.7) and Singkawang's (86.8) are relatively high, approaching the ideal score of 100. However, both cities showed disproportionate energy contributions from just a few food groups, mainly grains, animal foods, and vegetables, while oily fruits/seeds (0.7 and 0.5) and tubers (0.9 and 0.7) were significantly under-consumed. These food groups are essential sources of unsaturated fats, fiber, antioxidants, and micronutrients, which support cardiovascular health and prevent chronic inflammation (16). The very low intake of nuts and tubers may also reflect cultural preferences or low market availability, pointing to the need for food system improvements and behavior change communication strategies.

Compared to a previous study, reported that the average DDP score in Malang City was 88.26 (17), the DDP score in Pontianak City (89.7) was higher than the average in Malang City, while Singkawang City (86.8) was slightly lower. However, the study also highlighted that an increase in DDP scores in urban areas is often accompanied by increased consumption of processed foods, which, although energy-dense, are often low in nutrient density. This suggests that high energy consumption does not always reflect a good-quality diet. Therefore, although the DDP scores in Pontianak and Singkawang are relatively good, efforts to increase the consumption of food groups that are still low, such as nuts, tubers, and oily fruits/seeds, are still needed to realize a truly balanced and sustainable diet.

This study has several limitations. The use of a single 24-hour dietary recall may not fully capture usual intake due to day-to-day dietary variation, recall bias, and seasonal effects. Although this method is practical and widely used in large surveys, future studies could improve reliability by using multiple-day recalls or food frequency questionnaires. Additionally, the cross-sectional nature of the study limits the ability to assess causality between dietary patterns and health outcomes.

## CONCLUSION

The results showed that the macronutrient consumption of people in urban areas of West Kalimantan, namely Pontianak City and Singkawang City, was relatively sufficient in terms of energy and protein, but still low for fat intake, and showed a high carbohydrate consumption pattern, especially in Pontianak City. Both cities had good Desirable Dietary Pattern (DDP) scores of 89.7 for Pontianak and 86.8 for Singkawang, reflecting a fairly good level of food diversity and adequate energy intake. However, the DDP score did not reach the ideal value owing to the low contribution of certain food groups, such as oily fruits/seeds, nuts, and tubers. These findings emphasize the need for nutritional interventions that not only increase total energy intake but also improve the balance between food groups to support healthier and more sustainable diets in urban areas of West Kalimantan.

## CONFLICTS OF INTEREST

The authors report no conflicts of interest.

## REFERENCES

1. Bhanbhro S, Kamal T, Diyo RW, Lipoeto NI, Soltani H. Factors affecting maternal nutrition and health: A qualitative study in a matrilineal community in Indonesia. *PLOS ONE*. 16 Juni 2020;15(6):e0234545.
2. Bykowska-Derda A, Czapka-Matysik M, Kaluzna M, Ruchala M, Ziemnicka K. Diet quality scores in relation to fatness and nutritional knowledge in women with polycystic ovary syndrome: case-control study. *Public Health Nutr*. Agustus 2021;24(11):3389–98.
3. Mediratta S, Ghosh S, Mathur P. Intake of ultra-processed food, dietary diversity and the risk of nutritional inadequacy among adults in India. *Public Health Nutr*. Desember 2023;26(12):2849–58.
4. Marushka L, Batal M, Tikhonov C, Sadik T, Schwartz H, Ing A, dkk. Importance of fish for food and nutrition security among First Nations in Canada. *Can J Public Health*. 1 Juni 2021;112(1):64–80.
5. Akhter KT, Shozib HB, Islam MH, Sarwar S, Islam MM, Akanda MR, dkk. Variations in the Major Nutrient Composition of Dominant High-Yield Varieties (HYVs) in Parboiled and Polished Rice of Bangladesh. *Foods*. Januari 2023;12(21):3997.
6. Mejía-Guzmán JE, Belmont-Hernández RA, Chávez-Tapia NC, Uribe M, Nuño-Lámbarri N. Metabolic-Dysfunction-Associated Steatotic Liver Disease: Molecular Mechanisms, Clinical Implications, and Emerging Therapeutic Strategies. *Int J Mol Sci*. Januari 2025;26(7):2959.
7. Zhou C, Li M, Liu L, Zhao F, Cong W, Zhang F. Food Consumption and Dietary Patterns of Local Adults Living on the Tibetan Plateau: Results from 14 Countries along the Yarlung Tsangpo River. *Nutrients*. Juli 2021;13(7):2444.
8. Ayele A, Tarekegn K. The impact of urbanization expansion on agricultural land in Ethiopia: A review. *Environ Socio-Econ Stud*. 10 Desember 2020;8(4):73–80.
9. Kousar S, Ahmed F, Pervaiz A, Bojnec Š. Food Insecurity, Population Growth, Urbanization and Water Availability: The Role of Government Stability. *Sustainability*. Januari 2021;13(22):12336.
10. Barth-Jaeggi T, Speich C, Havugimana C, Bayisenge F, Kimenju S, Omondi W, dkk. Nutrition transition, double burden of malnutrition, and urbanization patterns in secondary cities of Bangladesh, Kenya and Rwanda. *BMC Nutr*. 4 November 2023;9(1):125.
11. Shinsugi C, Takimoto H. Trends in Mean Energy and Nutrient Intakes in Japanese Children and Adolescents: The National Health and Nutrition Survey, 1995–2019. *Nutrients*. Januari 2023;15(15):3297.
12. Riskesdas. Riset Kesehatan Dasar 2018. Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementerian RI; 2018.
13. Vissamsetti N, Simon-Collins M, Lin S, Bandyopadhyay S, Kuriyan R, Sybesma W, dkk. Local Sources of Protein in Low- and Middle-Income Countries: How to Improve the Protein Quality? *Curr Dev Nutr*. 1 February 2024;8. [https://cdn.nutrition.org/article/S2475-2991\(23\)26633-0/fulltext](https://cdn.nutrition.org/article/S2475-2991(23)26633-0/fulltext)
14. Vo HVT, Nguyen YT, Kim N, Lee HJ. Vitamin A, D, E, and K as Matrix Metalloproteinase-2/9 Regulators That Affect Expression and Enzymatic Activity. *Int J Mol Sci*. Januari 2023;24(23):17038.
15. Cho YA, Choi JH. Association between Carbohydrate Intake and the Prevalence of Metabolic Syndrome in Korean Women. *Nutrients*. September 2021;13(9):3098.
16. Alemayehu GF, Forsido SF, Tola YB, Amare E. Nutritional and Phytochemical Composition and Associated Health Benefits of Oat (*Avena sativa*) Grains and Oat-Based Fermented Food Products. *Sci World J*. 2023;2023(1):2730175.
17. Atasa D, Laily DW, Wijayanti PD. Dinamika Ketersediaan Pangan dan Alih Fungsi Lahan Pertanian Kota Malang. *J Agrinika J Agroteknologi Dan Agribisnis*. 29 Maret 2022;6(1):10–22.