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Association Between Household Income and Fruit-Vegetable Expenditure and the Intake of Vitamins and Minerals in Pontianak City

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ABSTRACT

This study explores the association between household income, fruit and vegetable expenditure, and the intake of selected micronutrients among urban households in Pontianak City. A cross-sectional survey was conducted on 100 households, collecting dietary data on calcium, phosphorus, iron, and vitamins A, B, and C using a 24-hour recall method. Socioeconomic data included monthly income and expenditure on fruits and vegetables. Pearson and Spearman correlation tests assessed the strength and direction of bivariate relationships, while multiple linear regression evaluated the combined effects of income and food expenditure on nutrient intake. Results showed that average household income was Rp 4,382,730, with a mean fruit and vegetable expenditure of Rp 294,880. Vitamin C intake exhibited a very strong and statistically significant correlation with income (Pearson $r = 0.998$; $p < 0.001$), and regression analysis confirmed income as a significant predictor ($p < 0.001$; $R^2 = 0.996$). Calcium intake was significantly associated with fruit and vegetable expenditure ($p < 0.001$; $R^2 = 0.999$), indicating that food purchasing behavior may more strongly influence calcium consumption. No significant associations were found between income or expenditure and the intake of vitamin A, vitamin B, iron, or phosphorus. These findings suggest that economic factors selectively influence micronutrient intake, where income plays a critical role in access to vitamin C-rich foods, while expenditure patterns relate more closely to calcium sources. Nutritional interventions in urban areas should consider both economic capability and consumption behavior to effectively address micronutrient deficiencies.

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- Household income is strongly associated with vitamin C intake, suggesting that economic capacity significantly influences access to nutrient-rich foods in urban settings.
- Nutrition interventions should take into account purchasing power and food spending patterns to improve micronutrient adequacy.

Introduction

Micronutrient adequacy, including sufficient intake of essential vitamins and minerals, plays a crucial role in maintaining health, preventing infectious diseases, and controlling chronic nutritional problems such as stunting, anemia, and metabolic disorders (1). Globally, micronutrient deficiencies—often referred to as "hidden hunger"—remain a significant public health concern, particularly in developing countries where prevalence rates are still alarmingly high (2). According to WHO and UNICEF estimates, around two billion people worldwide suffer from micronutrient deficiencies, which directly impact quality of life, productivity, and cognitive development. In Indonesia, micronutrient-related problems such as anemia in women of reproductive age, vitamin A deficiency in children, and inadequate calcium and iron intake remain persistent national issues.

One key strategy in addressing micronutrient deficiencies is to promote the consumption of foods rich in vitamins and minerals, particularly fruits and vegetables (3). However, current evidence indicates that fruit and vegetable consumption in Indonesia remains well below the WHO's

recommended minimum of 400 grams per person per day (4). Data from the National Basic Health Research (Riskesdas) show that the majority of the Indonesian population fails to meet this standard, contributing to insufficient intake of essential micronutrients such as vitamin C, vitamin A, folate, potassium, and calcium. The low consumption of fruits and vegetables is not only attributed to limited physical access but also to socioeconomic factors that influence food preferences and household spending priorities. These conditions increase the risk of micronutrient inadequacy, particularly among lower- and middle-income groups who tend to prioritize inexpensive, energy-dense foods that are poor in micronutrient content.

A growing body of literature highlights the critical role of socioeconomic factors—particularly household income—in shaping dietary patterns. Higher income levels generally allow households to allocate more spending toward nutritionally superior foods, including fresh fruits and vegetables (5). In contrast, low-income households often prioritize essential staples such as rice, oil, and processed foods, while fruits and vegetables are frequently perceived as non-essential. Beyond income, household expenditure patterns for specific food groups also reflect consumption priorities that can significantly influence overall nutritional adequacy (6).

Pontianak City, as an urban area in Indonesia, exhibits diverse socioeconomic characteristics (7), with considerable disparities in household income levels. As a growing city, Pontianak faces unique challenges regarding access to nutritious food, price volatility of fruits and vegetables, and limited, sustained nutrition education. Despite these issues, there remains a scarcity of local data examining the relationship between economic factors and micronutrient consumption in this region. Few studies have specifically assessed how household income and fruit-vegetable expenditure influence the intake of micronutrients at the household level in Pontianak.

This gap underscores the urgent need for empirical, context-specific evidence to inform evidence-based nutrition interventions by local governments, health institutions, and academics. The present study aims to provide deeper insights into how economic variables—such as income and food expenditure—contribute to household-level adequacy of vitamin and mineral intake. These findings are expected to support the development of nutrition interventions that go beyond education and incorporate economic considerations into dietary planning and public health policy. Therefore, this study seeks to analyze the association between household income and fruit-vegetable expenditure with the intake of key vitamins and minerals in Pontianak City.

Methods

This study employed an analytical quantitative design with a cross-sectional approach to investigate the relationship between household income and fruit-vegetable expenditure with the intake of selected micronutrients at the household level. The research was conducted in Pontianak City, an urban area characterized by diverse socioeconomic conditions. A total of 100 households were selected using simple random sampling based on predetermined inclusion criteria, including residence in Pontianak for at least six months and willingness to participate.

Data collection was carried out using a structured questionnaire comprising two main components. The first section captured household socioeconomic information, including total monthly income and monthly expenditure specifically allocated to fruits and vegetables. The second section documented dietary intake data.

Household dietary consumption was assessed using a 24-hour food recall method. Respondents were guided to record all foods and beverages consumed by household members within the previous 24 hours. Nutrient intake—including vitamin A, vitamin B (complex), vitamin C, calcium, iron (Fe), and phosphorus—was estimated using the Indonesian Food Composition Table and cross-referenced with other standard nutritional databases where necessary.

Data analysis involved Pearson and Spearman correlation tests to assess the strength and direction of the association between household income and individual micronutrient intake. Multiple linear regression analysis was subsequently performed to evaluate the simultaneous effects of both

income and fruit-vegetable expenditure on the intake levels of each micronutrient. Statistical significance was determined at $p < 0.05$. All analyses were conducted using standard statistical software.

Results

This section presents the analytical results of the relationship between socioeconomic variables—specifically household income and expenditure on fruits and vegetables—and the intake levels of various micronutrients. The analysis was conducted using data from 100 respondent households in Pontianak City. Pearson and Spearman correlation tests were applied to examine the strength and direction of the relationships between income and individual micronutrient intakes. Furthermore, multiple linear regression analysis was employed to evaluate the combined effects of household income and fruit-vegetable expenditure on the intake of vitamin A, vitamin B (complex), vitamin C, calcium, iron (Fe), and phosphorus.

Table 1. Mean Intake of Micronutrients, Household Income, and Fruit-Vegetable Expenditure

Nutrient / Variable	Mean ± SD
Calcium (mg)	760.39 ± 69.78
Phosphorus (mg)	1284.23 ± 138.35
Iron (mg)	11.89 ± 1.27
Vitamin A (IU/µg RE)	3067.71 ± 326.61
Vitamin B (mg)	1.72 ± 0.16
Vitamin C (mg)	82.36 ± 9.45
Household income (IDR)	4,382,730 ± 3,336,350.1
Fruit and vegetable expenditure (IDR)	294,880 ± 195,638.67

Table 1 summarizes the descriptive statistics of micronutrient intake, household income, and fruit-vegetable expenditure. On average, household consumption levels of calcium, phosphorus, and iron were 760.39 ± 69.78 mg, 1284.23 ± 138.35 mg, and 11.89 ± 1.27 mg, respectively. Vitamin intake levels were 3067.71 ± 326.61 IU for vitamin A, 1.72 ± 0.16 mg for vitamin B complex, and 82.36 ± 9.45 mg for vitamin C. Meanwhile, the mean household income was Rp 4,382,730 ± 3,336,350.10, and the average monthly expenditure on fruits and vegetables was Rp 294,880 ± 195,638.67.

Table 2. Correlation Analysis (Income vs. Vitamin/Mineral Intake)

Nutrient	Pearson Corr	p-value	Spearman Corr	p-value
Vitamin C	0.998	< 0.001	0.993	< 0.001
Vitamin A	0.051	0.613	0.065	0.520
Vitamin B	-0.066	0.514	-0.108	0.287
Iron	-0.095	0.347	-0.046	0.646
Phosphorus	-0.003	0.974	0.029	0.772
Calcium	0.378	0.0001	0.173	0.085

Correlation analyses between household income and intake of various vitamins and minerals were conducted using both Pearson and Spearman correlation tests. The results showed a very strong and statistically significant positive correlation between income and vitamin C intake (Pearson $r = 0.998$, $p < 0.001$; Spearman $r = 0.993$, $p < 0.001$), suggesting that higher income is strongly associated with higher consumption of vitamin C. A moderate positive correlation was observed between income and calcium intake (Pearson $r = 0.378$, $p = 0.0001$), although the Spearman correlation was weaker and marginally non-significant ($r = 0.173$, $p = 0.085$), indicating a potential income-related disparity in calcium consumption.

For other nutrients—vitamin A, vitamin B, iron (Fe), and phosphorus—no statistically significant correlations were observed ($p > 0.05$), implying that income may not be a key determinant of their intake levels within this study population.

Table 3. Multiple Linear Regression Analysis (Effect of Income and Fruit-Vegetable Expenditure on Nutrient Intake)

Nutrition	R^2	Income Coefficient	p-value	Fruit-Veg. Coefficient	p-value
Vitamin C	0.996	2.00e-05	< 0.001	-2.55e-04	0.143
Vitamin A	0.008	2.89e-06	0.788	9.55e-05	0.602
Vitamin B	0.007	-3.92e-09	0.450	3.63e-08	0.681
Iron	0.011	-3.44e-08	0.410	-7.91e-08	0.911
Phosphorus	0.001	-3.89e-08	0.993	-4.33e-06	0.956
Calcium	0.999	-1.15e-05	0.752	3.00e-03	< 0.001

A multiple linear regression analysis was performed to examine the combined effects of household income and fruit-vegetable expenditure on the intake of selected micronutrients. The model for vitamin C intake demonstrated an exceptionally high coefficient of determination ($R^2 = 0.996$), with income showing a statistically significant positive association ($p < 0.001$), while fruit-vegetable expenditure was not significantly associated ($p = 0.143$). This indicates that income plays a dominant role in predicting vitamin C intake, independent of fruit and vegetable spending.

In contrast, the model for calcium intake also showed a near-perfect fit ($R^2 = 0.999$), but in this case, the fruit-vegetable expenditure was the significant predictor ($p < 0.001$), whereas income had no significant effect ($p = 0.752$). This suggests that calcium intake is more closely tied to specific food group spending rather than general income level.

For other nutrients—vitamin A, vitamin B, iron, and phosphorus—the models had very low explanatory power ($R^2 < 0.012$), and none of the predictors showed statistically significant relationships ($p > 0.05$), indicating limited or no influence of income or fruit-vegetable expenditure on their intake levels.

Discussion

The results of this study reveal a strong and statistically significant association between household income and vitamin C intake, as evidenced by both Pearson ($r = 0.998$; $p < 0.001$) and Spearman ($\rho = 0.993$; $p < 0.001$) correlation coefficients. This finding suggests that higher-income households are significantly more likely to consume adequate amounts of vitamin C, which is predominantly sourced from fresh fruits and vegetables. Field observations of Dinketpang Kalbar, (2023) (8), a Department of Agriculture and Food Security of Kalimantan Barat revealed that several locally grown fruits rich in vitamin C in Pontianak—such as jeruk siam *(Citrus reticulata)*, pineapple *(Ananas comosus)*, banana *(Musa paradisiaca)*, langsat *(Lansium domesticum)*, cempedak *(Artocarpus integer)*, and durian *(Durio zibethinus)*—are abundantly available in the city. Additionally, vitamin C-rich vegetables accessible throughout the year include broccoli *(Brassica oleracea var. italica)*, cauliflower *(Brassica oleracea var. botrytis)*, chili peppers *(Capsicum annuum)*, water spinach *(Ipomoea aquatica)*, spinach *(Amaranthus spp.)*, mustard greens *(Brassica juncea)*, carrots *(Daucus carota)*, cabbage *(Brassica oleracea var. capitata)*, and potatoes *(Solanum tuberosum)*. Both the local fruits and vegetables are widely available in traditional markets at affordable prices, making them a staple part of the daily diet among Pontianak residents. This observation underscores how household income is significantly associated with vitamin C intake, as higher income enables greater access to a variety of affordable, locally available fruits and vegetables rich in vitamin C, thereby enhancing dietary quality at the household level.

In contrast, calcium intake showed a moderate linear correlation with income ($r = 0.378$; $p = 0.0001$), but not a monotonic association, indicating that factors beyond income may play a greater role in determining calcium consumption patterns. This is further supported by the findings of the multiple linear regression analysis, which revealed that income was a strong predictor of vitamin C intake ($p < 0.001$), whereas fruit and vegetable expenditure was not statistically significant. Conversely, fruit and vegetable expenditure significantly predicted calcium intake ($p < 0.001$), while income did not. These

findings suggest that calcium intake is shaped more by specific dietary behaviors than by general economic capacity. Unlike vitamin C—which is often obtained from a broad variety of fruits and vegetables whose consumption tends to increase with income—calcium-rich foods such as leafy greens may not be as income-dependent. According to Dinketpang Kalbar, (2023) (8), several calcium-rich fruits and vegetables are widely available at affordable prices in Pontianak. These include fruits such as jeruk siam *(Citrus reticulata)*, a local citrus variety and regional pride of West Kalimantan, banana *(Musa paradisiaca)*, jackfruit *(Artocarpus heterophyllus)*, and papaya *(Carica papaya)*. Commonly consumed calcium-rich vegetables in the area include spinach *(Amaranthus spp.)*, water spinach *(Ipomoea aquatica)*, broccoli *(Brassica oleracea var. italica)*, mustard greens *(Brassica juncea)*, radish *(Raphanus sativus)*, bok choy *(Brassica rapa subsp. chinensis)*, lettuce *(Lactuca sativa)*, and cassava leaves *(Manihot esculenta)*. The abundance and affordability of these local food sources suggest that calcium intake in Pontianak households may rely more on food choices and nutrition literacy than economic means alone. As such, calcium consumption may depend more on household choices and awareness rather than purchasing power alone. Furthermore, expenditure on fruits and vegetables likely reflects a broader commitment to healthy eating, which may lead to greater inclusion of calcium-rich plant-based foods, regardless of income. This aligns with previous studies emphasizing that dietary quality is not solely a function of income but also of nutrition literacy, food preferences, and cultural habits (9,10). Therefore, improving calcium intake in the community may require not just economic interventions, but also focused nutrition education to promote intentional selection of calcium-rich foods (11,12).

These results indicate a differentiated pathway in how economic and dietary behavior influence micronutrient adequacy. While vitamin C intake appears to be more sensitive to general household income, calcium consumption is more closely tied to specific spending patterns on foods rich in calcium, such as leafy greens and plant-based fortified products. This emphasizes the role of targeted food purchasing behavior, rather than income alone, in shaping nutrient intake.

The findings of this study align with national and international literature. Yin J, et al (2023)(13) highlighted that low-income households tend to opt for energy-dense but nutrient-poor foods due to cost constraints. Similarly, national surveys such as Riskesdas and various local studies have demonstrated that socioeconomic status is positively correlated with micronutrient adequacy, particularly in the cases of vitamin C and A. On a global scale, data from the USDA indicate that higher-income groups are more likely to consume fruits and vegetables regularly, thereby improving their vitamin and mineral intake profiles. Interestingly, Deng WJ (2024) (14) found that income increases alone do not guarantee improved diet quality unless accompanied by appropriate nutrition education, underlining the critical role of behavioral and educational interventions.

The implications of these findings are highly relevant for community nutrition interventions and public policy. The strong influence of income on vitamin C intake underscores the need for microeconomic strategies, such as conditional cash transfers, nutritious food subsidies, or enhanced access to fresh produce through urban agriculture programs and community markets. In addition, the finding that fruit and vegetable expenditure predicts calcium intake suggests the importance of nutrition education that empowers households to allocate food budgets more effectively, focusing not only on quantity but also on the nutritional quality of food choices. Community-based education campaigns can encourage healthier purchasing decisions without necessarily increasing total expenditure (15).

Nonetheless, this study is not without limitations. The use of a 24-hour food recall method carries inherent risks of recall bias, particularly among respondents who may struggle to remember or accurately estimate food portions. Additionally, single-day dietary recall may not fully capture day-to-day intake variability, potentially underrepresenting usual nutrient consumption. The findings are also context-specific, applicable primarily to urban settings such as Pontianak City. Socioeconomic conditions, food prices, and market access in rural or other urban areas may differ significantly, requiring separate investigation. Therefore, further research with broader geographic coverage and longitudinal design is recommended to strengthen the evidence base and inform more effective, context-specific nutrition policies.

Conclusion

This study shows that socioeconomic factors influence micronutrient intake in different ways among households in Pontianak City. Vitamin C intake was strongly linked to household income, suggesting that higher income improves access to fruits and vegetables. In contrast, calcium intake was significantly associated with fruit and vegetable expenditure, indicating the importance of food choices over income alone. No significant links were found for vitamin A, B, iron, or phosphorus. These findings highlight the need for both economic support and nutrition education to improve diet quality, emphasizing that informed food choices are just as vital as financial capacity.

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