RESEARCH

Does escaping the multidimensional poverty line improve family food security? Evidence from rural Vietnam

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Abstract

Background Reducing poverty and ensuring food security are critical sustainable development goals for countries like Vietnam. However, research investigating the relationship between these goals remains limited. This study seeks to explore the correlation between poverty alleviation and food security in Vietnam's rural areas, offering insights for policymakers to address both objectives simultaneously.

Methods We applied Vietnam's multidimensional poverty standard to determine if households classified as poor in 2016 had managed to escape poverty by 2018. We utilized the Household Dietary Diversity Score (HDDS) and per capita food expenditure to examine the consumption patterns and food security levels within these households. Panel data encompassing 407 low-income households, gathered from the 2016 and 2018 Vietnam Access to Resources Household Survey (VARHS), constituted the dataset for this study.

Results Among the 407 impoverished households in 2016, 244 achieved poverty alleviation by 2018. Their average monthly per capita income increased by 416.9 thousand Vietnamese Dong (17.8 USD) during this period, with wage income contributing significantly, rising by approximately 315.9 thousand Vietnamese Dong (13.4 USD) per person. Regression analysis reveals that as households escaped the multidimensional poverty line, they diversified food consumption and increased per capita food expenditure. However, the household dietary diversity score only increased by 0.166. Meanwhile, monthly per capita food expenditure surged by 85,600 Vietnamese Dong (3.63 USD) per person.

Conclusions and policy recommendations Implementing poverty eradication policies could achieve both poverty reduction and improved food security. Policymakers should focus on creating stable wage employment for poor households, as this income source significantly aids in poverty alleviation.

Keywords Household dietary diversity score, Food security, Poverty

Introduction

No poverty and zero hunger are the top two goals in the 17 Sustainable Development Goals of the United Nations [1]. Reducing poverty can contribute to achieving food security because it improves access to resources, education, and opportunities for individuals and communities, thereby enhancing their capacity to produce or acquire food [2]. Access to nutritious food is essential for sustaining life, as it provides vital nutrients crucial for maintaining good health, enhancing labor productivity, and fostering overall well-being. Consequently, when individuals have reliable access to such food, they are better equipped to pursue education, employment, and other avenues for economic empowerment, thereby aiding in their journey out of poverty.

In 2015, the Vietnamese government established a multidimensional poverty line for the 2016–2020 period,

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incorporating income and lack of access to basic social services into the criteria for measuring poverty. According to the Decision on Promulgating Multidimensional Poverty Line for the Period 2016–2020, the poverty line in rural areas was set at 700,000 Vietnamese Dong (VND) (29.7 USD) per person per month, while in urban areas, it was 900,000 VND (38.18 USD) per person per month. The lack of access to basic social services was measured by five services: health, education, housing, clean water and sanitation, and information. The degree of shortage of these basic services is measured through ten indicators: access to health services, health insurance, adult education level, school attendance of children, housing quality, housing area per capita, domestic water source, hygienic latrines, use of telecommunications services, and assets for accessing information [3]. A poor household in a rural area was defined as one that met one of two criteria: having a monthly per capita income of 700,000 VND or less; or having a per capita income between 700,000 VND and 1,000,000 VND (42.42 USD) per month and lacking three or more indicators showing a lack of access to basic services. In urban regions, a poor household was characterized by an average monthly income of 900,000 VND or less; or between 900,000 VND and 1,300,000 VND (55.15 USD) per capita, and the absence of at least three indicators that measure inadequate access to fundamental services [3].

Figure 1 presents data on the percentage of impoverished households in Vietnam as determined by the multidimensional poverty line in both urban and rural areas for 2016 and 2020. The data indicate a significant decrease in poverty levels in urban and rural areas between 2016 and 2020. In 2016, the poverty rate for the entire country was 9.2%, with urban areas reporting a poverty rate of 3.5% and rural regions reporting a poverty rate of 11.8%. In 2020, the country's poverty rate dropped to 4.8%, with urban areas reporting 1.14% and rural areas 7.06%. A comparison of poverty levels between urban and rural areas reveals that poverty was more prevalent in rural areas in both 2016 and 2020. Although poverty reduction has occurred in both urban and rural areas, the decline in poverty has been more pronounced in urban areas. These findings demonstrate the need for focused initiatives to combat poverty in rural areas so that everyone can benefit from growth and enjoy a higher standard of living.

It is worth mentioning that the regulations on the multidimensional poverty line in Vietnam remained unchanged from 2016 to 2020. Specifically, the poverty line for average monthly income per capita was 700,000 VND for rural areas and 900,000 VND for urban areas. However, during this period, the country experienced an inflation rate ranging from 2.66 to 3.23% [4]. Although the inflation rate was relatively low, money's purchasing power significantly declined from 2016 to 2020. Specifically, the real purchasing power of money decreased by approximately 14.8% in 2020 compared to its value in 2016. This suggests that even though households escaping poverty may have an income exceeding the poverty line, their real purchasing power may decline if their increase in revenue is lower than the inflation rate. In other words, escaping poverty does not necessarily equate to improving household members' quality of life and diet. Even if it does not cover everything about poverty, the fact that households cannot get enough food to live a healthy and active life is a big reason they are poor [5].

Despite significant progress in reducing poverty in Vietnam, no studies have explored how households' food security improves after escaping impoverishment. The question remains whether escaping poverty improves the nutritional quality of household meals. Hence, there is a need for research to examine the improvement of households' dietary diversity and food security after escaping poverty, as it is also an indicator of the quality of life. The primary objective of this study is to evaluate the status of food security and dietary diversification among poor families using panel data obtained from the Vietnam Access to Resources Household Survey (VARHS) for the years 2016 and 2018. Additionally, this study investigates how escaping poverty impacts household dietary diversity and food security. The findings of this study can serve as a foundational reference for policymakers in their efforts to mitigate poverty and enhance food security among low-income households in Vietnam.
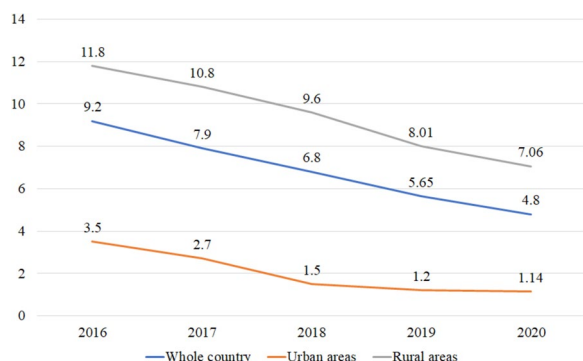

Fig. 1 Percentage of poor households according to the multidimensional poverty line in the period 2016–2020. Source: General Statistics Office of Vietnam, 2021

Research methods

Conceptual framework of food security

Food security plays a critical role in measuring household welfare and has garnered significant attention in the economic literature. Food security is achieved when people have stable and continuous access to different types of food that are of good quality, safe, affordable, and in sufficient quantity [6]. Researchers have endeavored to operationalize food security to streamline program design, implementation, and evaluation [7]. Scholars often distinguish between transitory and chronic food insecurity, denoting temporary and prolonged periods of insufficient food access, respectively [8].

However, achieving household food security does not guarantee adequate nutrition for all members. Simply having the capacity to earn a sufficient income does not necessarily lead to effective food acquisition, as households may prioritize other expenditures, such as education and housing over food. In addition, intra-household food allocation may not align with the nutritional needs of each member, resulting in cases of both underweight and obese individuals within households. Moreover, non-food factors, such as sanitation, water quality, infectious diseases, and access to healthcare, play significant roles in determining nutritional security, highlighting the limitations of food security as a comprehensive measure of well-being [7, 9, 10].

Food insecurity remains a pressing global challenge that undermines human health, productivity, and survival [9, 11]. Factors, such as conflict, drought, land degradation, deforestation, biofuel-driven increases in food prices, water stress, climate change, the extension gap, and low agricultural productivity, all contribute to limited food access and jeopardize food security [9, 12–14].

Examining the specific case of Vietnam, Molini found evidence of a shift from consuming nutrient-deficient foods to a more diverse range of options [15]. However, deficiencies in vitamins, iron, and calcium persisted among impoverished households, despite increased calorie intake. To assess household food insecurity, scholars employ various indicators, including per capita food expenditure and the household dietary diversity score [9]. Per capita food expenditure serves as a well-established indicator of food security, vulnerability, and poverty level, reflecting households' access to food [16]. Additionally, the household dietary diversity score (HDDS) serves as a viable alternative indicator for assessing nutritional sufficiency and food security within the household [17–19]. The HDDS measures the variety of foods consumed and is considered desirable for improved diet quality and potential micronutrient intake [5, 7]. No specific food group provides all essential nutrients; thus, practicing a healthy diet requires individuals to consume foods from all food groups to meet their daily nutritional needs [17, 20, 21]. The HDDS's main drawback is that it overlooks diet quantity and quality [9]. For example, consuming small amounts of various foods can boost the diversity score without enhancing nutritional and micronutrient intake [10].

While several studies have investigated different aspects of food security and poverty, a research gap exists regarding the relationship between poverty escape and improved household dietary diversity and food security in Vietnam. Therefore, this study aims to address this gap by examining the impact of poverty alleviation on households' food security and dietary intake. The findings provide valuable insights for policymakers in designing and enhancing social welfare programs targeting dietary diversity and food insecurity among the most vulnerable populations in Vietnam. Understanding the association between poverty escape and household food security is crucial for promoting overall social welfare and sustainable development.

Data collection

The data were obtained from the Vietnam Access to Resources Household Survey (VARHS), conducted in 2016 and 2018. The VARHS used a multi-stage sampling method to collect data. This methodology ensures that the results accurately reflect the rural population of Vietnam, as represented by the selected provinces. Specifically, the VARHS collected data on rural households from 12 provinces, which represent five regions of Vietnam: the Red River Delta (Ha Tay province), the North (Lao Cai, Phu Tho, Lai Chau, and Dien Bien provinces), the Central Coast (Nghe An, Quang Nam, and Khanh Hoa provinces), the Central Highlands (Dak Lak, Dak Nong, and Lam Dong provinces), and the Mekong River Delta (Long An province). A random selection of households was made to represent the rural population of each province. The households observed in the VARHS 2016 and 2018 rounds were 2,669 and 3,807, respectively.

The VARHS questionnaire posed a series of questions to families regarding the consumption of 11 food groups within 24 h. These food groups included: (1) cereals, (2) roots/tubers, (3) vegetables, (4) fruits, (5) meat/poultry/offal, (6) eggs, (7) fish/seafood, (8) pulses/legumes/nuts, (9) milk/dairy products, (10) oil/fats, and (11) sugar/honey. We calculated the HDDS, defined as the number of different food groups consumed by family members over the 24-h reference period, based on these questions. The HDDS levels are categorized into three groups based on the number of food groups consumed: the low dietary diversity category (≤ 3 food groups), the medium dietary diversity category (4–7 food groups), and the high dietary diversity category (≥ 8 food groups) [22–24]. The

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low level of HDDS also implies food insecurity in the household [5]. It is important to highlight that this categorization diverges from the literature references found in African studies. In Africa, they divide food into nine categories, so the level of dietary diversity is divided into three groups as follows: low diversity (≤ 3 food groups), medium diversity (4–5 food groups), and high diversity (≥ 6 food groups) [17, 25–27].

Additionally, the VARHS dataset also provided the expenditure on staple foods for each household over the four weeks before the survey date, allowing for the calculation of per capita food expenditure. The 14 main foods on the VARHS questionnaire included pork, beef, chicken, fish, shrimp, fruits, candy or cookies, powdered or canned milk, liquid milk, beer, wine, coffee, industrial beverages, and eating outside. This study uses the average food expenditure as another household food security index.

The study explores the association between poverty alleviation and food security. To achieve this, the first step involved identifying households classified as poor in the 2016 VARHS. The questionnaire includes a question to determine whether the home is poor. In 2016, VARHS surveyed 2,669 households, and 427 were below the multidimensional poverty line, which indicates impoverished. Utilizing the household codes from 2016, we extracted household information for 2018. However, the filtering process for 2018 only produced results from 407 households, suggesting that the 2018 survey did not include 20 impoverished households from VARHS 2016. Therefore, we excluded these 20 households from our analytical dataset to comply with panel data requirements. Ultimately, our analysis relied on panel data comprising 407 low-income households from both 2016 and 2018. Furthermore, according to the 2018 survey, the multidimensional poverty line still classified 163 of these households as impoverished. In other words, the 244 households classified as impoverished in 2016 managed to escape poverty in 2018. In this study, these 244 escaped poverty households constituted the treatment group, while the 163 persistently impoverished households served as the control group.

Econometric model

The difference-in-difference (DID) method was used to identify the impact of poverty eradication on dietary diversity. The DID model is a standard tool in policy program evaluation [28, 29]. We regard poverty eradication as a treatment variable in this study. To apply the DID method, panel data is essential, which must reflect information over time and reflect information from numerous observed objects. This method divides the analyzed objects into two groups: escaped poverty (the treatment

group) and poverty (the control group). Assume Y_{it} is the output for the individual i at time t, where $t=0$ represents the pre-treatment period (2016), and $t=1$ represents the post-treatment period (2018). We call those individuals with $D_{it}=1$ escaped poverty and those with $D_{it}=0$ poverty. Given that individuals escaped poverty only during period $t=1$, $D_{i0}=0$ applies to all i. DID estimation is frequently derived using linear parametric models. However, dietary diversity depends not only on household income but also on many other factors, such as age, gender, ethnicity, education, illness of the household head, and household size. Therefore, including these variables as control variables will enhance the accuracy of assessing the impact of poverty eradication on the food security of households. To do this, the model combines the DID method and the multivariate regression method as follows:

$$Y_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 D_{it} + \beta_3 D_{it} T_{it} + X_{it}\beta_4 + v_i + \varepsilon_{it} \tag{1}$$

where Y_{it} are the outcome variables reflecting household dietary diversity score (HDDS) and the per capita food expenditure of household i at time t. T_{it} is a binary variable that equals 1 if households surveyed in 2018 and 0 otherwise. D_{it} is a binary variable that equals 1 if the household belongs to the escaped poverty group and 0 otherwise. X_{it} is a vector of control variables, including individual characteristics (age, gender, ethnicity, education, illness of household head) and household characteristics (household size). v_i is an unobservable time-invariant individual effect, and ε_{it} is a mean zero error term uncorrelated with D_{it} and T_{it}.

Results and discussion

Table 1 presents the statistical results of monthly per capita incomes from different sources. The results indicated that the escaped poverty group's total income significantly increased over two years. Specifically, the total monthly income for the escaped poverty group increased from 1240.3 thousand VND in 2016 to 1657.3 thousand VND in 2018, a difference of 315.9 thousand VND with a significant level of 1%. In 2016, these households exceeded the poverty line in terms of total income. However, if we subtract the amount of support households receive (private and public support), this amount is only 944.4 thousand VND in 2016. In other words, these households are poor, with incomes ranging from 700,000 to 1,000,000 VND, and lack access to at least three basic services. In 2018, these households' income, excluding subsidies, was 1,330.6 thousand VND, escaping the poverty line.

The poverty group experienced a smaller increase in their total monthly income, rising from 999.2 thousand

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Table 1 The monthly income per capita originates from various sources

Sources of income (1000 VND/person/month)	Escaped poverty			Poverty		
	2016	2018	Difference	2016	2018	Difference
Wage	389.5	705.4	315.9***	251.5	458.3	206.8***
Agricultural activities	340.7	334.8	− 5.8	301.6	226.9	− 74.7*
Common property resources	32.3	46.1	13.8	41.3	33.8	− 7.5
Economic activities	78.2	159.7	81.5	16.1	13.2	− 2.9
Rental income	32.8	5.7	− 27.1	8.3	15.2	6.8
Sales of assets	71.1	78.9	7.8	15.3	29.9	14.7
Private supports	148.8	186.4	37.7	122.3	156.2	33.8
Public supports	124.9	126.3	1.3	239.6	141.2	− 98.4
Others	22.3	13.9	− 8.3	3.2	0.7	− 2.5
Total	1,240.3	1,657.3	416.9***	999.2	1,075.3	76.1
Total without supports	944.4	1,330.6	386.2***	634.1	777.3	143.2*

The monetary value was converted to the base year of 2016; *** and * indicates significance at 1% and 10%, respectively; 1 USD equals 23,570 VND

VND in 2016 to 1075.3 thousand VND in 2018 although this difference was not statistically significant. In 2016 and 2018, their average monthly income excluding support was 634.1 thousand VND and 777.3 thousand VND, respectively. In 2016, we classified these households as impoverished due to a monthly per capita income below 700,000 VND, and in 2018, we classified them as impoverished due to an income ranging from 700,000 to 1,000,000 VND, coupled with a lack of access to at least three basic services. Therefore, according to the multidimensional poverty standard, in addition to solutions to increase income, there should be measures to help families increase their ability to access basic services to escape poverty.

Wages were the largest source of income for both groups. For the escaped poverty group, monthly wages increased from 389.5 thousand VND in 2016 to 705.4 thousand VND in 2018, an increase of 315.9 thousand VND at a significant level of 1%. Wages in the poverty group increased by 206.8 thousand VND (a significant level of 1%), from 251.5 thousand VND in 2016 to 485.3 thousand VND in 2018. Aside from that, agriculture is an important source of income for both groups. Between 2016 and 2018, income from agricultural activities remained unchanged for the escaped poverty group. However, the poor group's monthly agricultural activity income decreased by 74.7 thousand VND. Public and private support were two other crucial sources of income. However, these supports were no different between 2016 and 2018.

In 2016, both the escaped poverty and poverty groups were impoverished households. The analysis of income sources reveals the main factor that helped the escaped poor group increase their income in 2018 and lift themselves out of poverty. The results show that most of the increase in household income came from wages. The poverty group's wages also increased, but not enough to help these households escape poverty. Furthermore, the poverty group's income from agricultural activities decreased, leaving their total income almost unchanged during 2016–2018.

The primary factor supporting sustainable poverty alleviation efforts is the diversification of economic activities, which often encompasses both agricultural and non-agricultural sectors and may occasionally entail migration from rural to urban areas [30]. However, the findings in this study show that one of the critical strategies to help households escape poverty is to help them increase their income from non-agricultural sources, specifically their monthly salaries. Nevertheless, households headed by elderly individuals frequently encounter challenges in enhancing their income through alternative non-agricultural activities [31]. Even though these households are in rural areas, strategies to make more money from farming are not possible for low-income families because they do not have enough land to grow crops. Moreover, supportive measures in risk management, such as agricultural insurance and the adoption of smart agricultural practices responsive to climate change, are necessary for policies aimed at helping poor farmers overcome poverty through income from agricultural activities [30].

Table 2 provides data on the distribution of households consuming specific food groups in 2016 and 2018. The data reveals three categories of change in food group consumption patterns: remaining, increasing, and decreasing. The consumption of cereals and vegetables remained unchanged between 2016 and 2018. Food groups that saw an increase in household

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Table 2 Distribution of the proportion of households that consumed specific food groups

Food groups (%)	2016			2018		
	Escaped poverty	Poverty	All	Escaped poverty	Poverty	All
Cereals	98.8	98.8	98.8	100.0	100.0	100.0
Roots/tubers	47.5	43.6	45.9	44.7	42.3	43.7
Vegetables	97.5	96.9	97.3	97.5	96.9	97.3
Fruits	44.7	35.0	40.8	48.8	31.3	41.8
Meat/poultry /offal	64.3	60.1	62.7	70.5	62.0	67.1
Eggs	29.9	34.4	31.7	30.7	24.5	28.3
Fish/seafood	17.2	17.2	17.2	33.2	24.5	29.7
Pulses/nuts	22.5	25.8	23.8	20.9	17.2	19.4
Milk/dairy products	11.1	7.4	9.6	18.9	11.0	15.7
Oil/fats	61.1	62.0	61.4	78.7	68.1	74.4
Sugar/honey	23.0	22.1	22.6	32.0	23.3	28.5

consumption between 2016 and 2018 include meat/poultry/offal, fish/seafood, milk/dairy products, oil/fats, and sugar/honey. Eggs and pulses/nuts experienced a decrease in household consumption.

The two most consumed foods, cereals and vegetables, showed little deviation in popularity. In 2016, 98.8% of households consumed cereal, while 97.3% consumed vegetables. In 2018, cereals remained the most consumed food, increasing to 100%, while vegetables remained unchanged at 97.3%. These findings suggest that cereals and vegetables continue to be the staple foods for poor households in Vietnam. This aligns with previous research indicating that the Vietnamese dietary pattern is characterized by a high intake of carbohydrates and a low consumption of fat [32].

The consumption of the two least consumed foods, milk/dairy products and fish/seafood, has increased significantly. In 2016, 9.6% of households consumed milk and dairy products, while 17.2% consumed fish and seafood. By 2018, there had been a significant rise in consumption of both foods, with milk and dairy products increasing by 15.7% and fish and seafood increasing by 29.7%. Nevertheless, certain scholars posit that elevated intake of meat and dairy products represents a nuanced aspect of nutrition with both positive and negative implications [33].

These findings suggest that poor households' eating habits in Vietnam have changed over time. Although cereals and vegetables remain staple foods, low-income families have gradually increased their consumption of protein-rich foods, such as milk/dairy products and fish/seafood. This trend indicates a potential improvement in dietary diversity among low-income households, reflecting shifts in consumption patterns and nutritional awareness within Vietnamese communities.

Table 3 presents household dietary diversity scores, as well as their distribution by group and year. In 2016, we classified 12.8% of the HDDS levels as low, 69.3% as medium, and 17.9% as high. In 2018, the proportions changed slightly, with 10.8% of the levels classified as low, 67.6% as medium, and 21.6% as high. As a result, the proportion of HDDS levels categorized as low and medium decreased by 2.0 and 1.7 percentage points, respectively, between 2016 and 2018. Conversely, HDDS levels classified as high increased by 3.7 percentage points during the same period.

As mentioned above, the low level of HDDS also indicates households' food insecurity. As a result, we can analyze the food insecurity indices of families in the escaped poverty group and the poverty group over two years, 2016 and 2018. In 2016, the escaped poverty group had a lower food insecurity index (9.4%) than

Table 3 Distribution of the proportion of HDDS level

HDDS level (%)	2016			2018		
	Escaped poverty	Poverty	All	Escaped poverty	Poverty	All
Low (< 4)	9.4	17.8	12.8	5.7	18.4	10.8
Medium (4–7)	73.8	62.6	69.3	68.9	65.6	67.6
High (≥ 8)	16.8	19.6	17.9	25.4	16.0	21.6

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the poverty group (17.8%). By 2018, the escaped poverty group showed a further decrease in food insecurity (5.7%), while the poverty group showed only a slight increase (18.4%). The findings emphasize the positive relationship between lifting families out of poverty and their food security status, as well as addressing poverty to reduce food insecurity. Interestingly, these findings suggest that poor households still have more food security than ethnic minorities in Vietnam. Specifically, the proportion of low, medium, and high dietary diversity among Khmer in Vietnam in 2018 was 21.4%, 70.4%, and 8.2%, respectively [22]. Meanwhile, the percentages of low, medium, and high dietary diversity in South Africa are 40.28%, 49.86%, and 9.86%, respectively [17].

Table 4 presents the per capita expenditure on staple foods by households in the sample. From 2016 to 2018, total expenditure on staple foods per capita increased significantly. The total monthly per capita food expenditure was 231.4 thousand VND in 2016 and 316.1 thousand VND in 2018. We can determine the percentage of household food expenditure by dividing the average food expenditure by the average monthly per capita income, as shown in Table 1. In 2016, escaped poverty households allocated 24.6% of their expenditure to 14 food groups, whereas the poverty group allocated 16.9%. These food groups constituted approximately 22% of the average income for the escaped poverty group and 22.6% for the poverty group in 2018. It is important to emphasize that the expenditure mentioned does not encompass spending on cereals, roots/tubers, or vegetables.

Pork, chicken, fish, and eating outside are the four main spending foods, according to Table 4. In 2016, the most significant expenditure was on pork at 69.5 thousand VND per person per month, followed by fish at 33.9 thousand VND and chicken at 32.9 thousand VND. The payment for eating outside was 38.6 thousand VND. In 2018, the most significant expenditure was still on pork, but it had increased to 79.1 thousand VND per person per month. Chicken expenditure had increased to 38.4 thousand VND, and spending on fish had risen significantly to 49.3 thousand VND. The cost of eating outside had also increased to 63.1 thousand VND.

The items with small spending in 2016 but significant increases in 2018 were shrimp, fruits, liquid milk, and industrial beverages. In 2016, expenditures for shrimp were 4.2 thousand VND, fruits were 11.5 thousand VND, liquid milk was 5.8 thousand VND, and industrial drinks were 2.3 thousand VND. In 2018, these expenses grew to 14,100 VND for shrimp, 18,200 VND for fruits, 9,700 VND for liquid milk, and 6,400 VND for industrial beverages.

Table 5 compares the escaped poverty and poverty groups in the base year of 2016 with respect to the variables used in the econometric analysis. There were few differences among the variables, except for the per capita expenditure on food (a dependent variable) and the gender and ethnicity of the household head. Specifically, the per capita expenditure on food in the escaped poverty group was higher than that of the poverty group, with a difference of 36.34 thousand VND and a significance level of 5%. Furthermore, the proportion

Table 4 Per capita expenditure per month on household foods

Foods (1000 VND/person/month)	2016			2018		
	Escaped poverty	Poverty	All	Escaped poverty	Poverty	All
Pork	67.5	70.7	69.5	63.3	89.7	79.1
Beef	5.5	11.0	8.8	4.7	13.3	9.9
Chicken	37.2	29.9	32.9	30.6	43.5	38.4
Fish	31.7	35.4	33.9	43.3	53.3	49.3
Shrimp	1.8	5.8	4.2	6.2	19.4	14.1
Fruits	11.7	11.3	11.5	17.5	18.7	18.2
Candy/cookie	3.3	4.4	3.9	3.3	7.8	6.0
Powdered/canned milk	3.9	5.9	5.1	4.1	8.5	6.7
Liquid milk	5.2	6.3	5.8	8.4	10.6	9.7
Beer	3.4	4.5	4.1	1.8	4.6	3.5
Wine	9.5	9.4	9.4	9.9	9.0	9.4
Coffee	0.9	1.6	1.3	1.8	2.7	2.3
Industrial beverages	2.1	2.5	2.3	5.1	7.3	6.4
Eating outside	25.8	47.2	38.6	43.0	76.6	63.1
Total	246.0	209.7	231.4	364.9	243.0	316.1

The monetary value was converted to the base year of 2016; 1 USD equals 23,570 VND

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Table 5 The differences in mean values of variables used in the econometric model in 2016

Variables	Escaped poverty		Poverty		Difference	
	Mean	S.D	Mean	S.D	Mean	S.E
Dependent variables						
HDDS	5.18	1.58	5.03	1.60	0.15	0.16
Per capita expenditure on food (1,000 VND/person/month)	246.00	200.29	209.66	148.98	36.34**	18.36
Independent variables						
Male headed households	0.76	0.43	0.66	0.48	0.10**	0.05
Kinh ethnicity	0.46	0.50	0.36	0.48	0.10*	0.05
Household head age (year)	53.86	16.15	52.84	17.18	1.02	1.68
Schooling years of household head (year)	5.71	3.92	5.17	4.09	0.54	0.40
The household head got an illness	0.23	0.42	0.18	0.39	0.05	0.04
Household size (people)	4.34	2.04	4.28	1.99	0.06	0.20

The monetary value was converted to the base year of 2016; ** and * indicates significance at 5% and 10%, respectively

of male household heads and households of Kinh ethnicity was slightly higher in the escaped poverty group, with significance levels of 5% and 10%, respectively. These results show that the escaped poverty and poverty groups are similar in some ways, which is a good reason to compare them using the DID method.

Table 6 presents the DID results that examined the relationship between poverty escape and the HDDS index. The study employs two models. The first model includes only treatment variables, and the results indicate that the impact coefficient of the Escaped*Year variable was 0.166 with a 5% significance level. The second model incorporates additional control variables that represent household characteristics. The results of this model demonstrate that escaping poverty increased by

0.169 points in the HDDS index, at the 5% significance level.

Previous studies have identified a positive relationship between household income and dietary diversity [34–36]. Similar to the previous study, this one examines the impact of escaping poverty on household dietary diversity. The results demonstrate that as households move out of poverty, they tend to consume a more diverse range of foods. These findings have implications for policymakers and practitioners working toward reducing poverty and improving food security. Interventions can simultaneously reduce poverty and increase diversified diets.

Examining the effects of demographic variables on dietary diversity reveals significant positive relationships at the 1% significance level for Kinh ethnicity, the household

Table 6 The impact of poverty escape on HDDS

Variables	Model 1		Model 2	
	Coefficient	Robust S.E	Coefficient	Robust S.E
Escaped	0.055	0.058	0.023	0.058
Year	− 0.043	0.061	− 0.033	0.061
Escaped*Year	0.166**	0.074	0.169**	0.075
Male headed households			0.021	0.051
Kinh ethnicity			0.168***	0.050
Household head age			0.000	0.002
Schooling years of household head			0.018***	0.005
The household head got an illness			0.047	0.057
Household size			0.028**	0.012
Constant	2.018***	0.048	1.713***	0.118
Number of observations	814		814	
Prob > F	0.000		0.000	
R-squared	0.023		0.065	

*** and ** indicates significance at 1% and 5%, respectively

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head's years of education, and the number of household members. Specifically, the coefficients for the household head's years of education and the number of household members are 0.018 and 0.028, respectively, indicating marginal increases in dietary diversity. The higher dietary diversity associated with more years of education may be due to better-educated household heads having greater awareness of nutritional needs and access to a variety of foods [37, 38]. Similarly, larger households might exhibit more diverse diets due to the collective variety of food preferences and consumption patterns. However, previous studies indicate that larger household sizes negatively impact food security [39, 40]. The coefficient for Kinh ethnicity is 0.168, suggesting that Kinh households exhibit significantly greater dietary diversity compared to other ethnic groups. These findings align with Le's research on the dietary diversity of the Khmer ethnic group in Vietnam, which found lower dietary diversity among Khmer households [22]. Consequently, food security policies should prioritize impoverished ethnic minority households to substantially enhance food security outcomes in Vietnam.

Table 7 presents the results of the DID model, with the dependent variable being per capita food expenditure. The findings suggest that poverty escape has a positive effect on per capita household food expenditure. In Model 1, the coefficient for the interaction term Escaped*Year was 85.6, which was significant at the 1% level, indicating robust effects of escaping poverty on per capita food expenditure. In Model 2, the coefficient for this interaction term decreased to 74.709 but remained significant at the 1% level after accounting for additional control variables. This result further confirms the significant association between poverty escape and per capita food expenditure.

This finding aligns with the basic economic intuition that, as income levels rise, households tend to allocate more resources toward basic needs such as food [41]. The observed increase in per capita food spending following poverty escape underscores the critical link between poverty reduction efforts and household food security. When households are able to lift themselves out of poverty, they not only enhance their economic well-being but also improve their ability to access an adequate and nutritious diet. This aligns with the broader literature on poverty alleviation and its multidimensional impacts, including improvements in health outcomes and overall welfare [42–44].

The coefficient of the Kinh ethnicity variable is 58.663 at the 1% significance level, indicating that Kinh people spend about 58,663 thousand VND more on food per person per month than other ethnic groups. This higher expenditure could be due to differences in dietary preferences, higher income levels, or greater access to diverse food options among the Kinh population. Furthermore, the household head's years of schooling have a positive impact on the household's average food expenditure, with a coefficient of 4.939 at the 5% significance level. This suggests that better-educated household heads may prioritize spending on food due to increased awareness of nutritional needs and health benefits [37, 38]. Conversely, the number of household members negatively impacts per capita food expenditure, with a coefficient of -24.163. This implies that as household size increases, the per-person expenditure on food decreases by 24,163 VND per month, likely due to the need to distribute

Table 7 The impact of poverty escape on the per capita food expenditure of households

Variables	Model 1		Model 2	
	Coefficient	Robust S.E	Coefficient	Robust S.E
Escaped	36.336**	17.346	31.647**	15.244
Year	33.299**	14.785	42.003***	15.113
Escaped*Year	85.600***	23.950	74.709***	24.279
Male headed households			− 26.403	19.230
Kinh ethnicity			58.663***	18.746
Household head age (year)			0.864	0.539
Schooling years of household head (year)			4.939**	1.944
The household head got illness			− 9.607	24.892
Household size (people)			− 24.163***	3.922
Constant	209.662***	11.669	239.658***	40.685
Number of observations	814		814	
Prob > F	0.000		0.000	
R-squared	0.023		0.268	

The monetary value was converted to the base year of 2016; *** and ** indicates significance at 1% and 5%, respectively

limited resources among more individuals. This result aligns with previous studies that have found a negative relationship between the number of household members and household food security [39, 40]. Interestingly, the results of this study reveal that while the number of household members has a negative impact on per capita food expenditure, it has a positive influence on household dietary diversity in Vietnam.

Conclusions

The study aimed to explore the relationship between poverty escape and household food security in rural Vietnam. We collected panel data from 407 low-income families from the 2016 and 2018 VARHS. We used the HDDS and per capita food expenditure to identify households' consumption patterns and food security status. We used the difference-in-differences approach to examine the relationship between poverty escape, dietary diversification, and household food security. The findings showed that as households escaped the multidimensional poverty line, they diversified their food consumption and increased per capita food expenditure. This highlights the importance of poverty reduction to improve household food security. The results of this study contribute to the literature on the intersection of poverty and food security by demonstrating the link between poverty escape and household dietary diversity in a developing country context.

We propose several recommendations based on these findings. First, the Vietnamese government should prioritize poverty reduction efforts to enhance household food security. This entails implementing targeted policies and programs aimed at rural areas, where poverty and hunger are most prevalent. In addition to increasing income, improving access to essential services is crucial for lifting households above the multidimensional poverty line. Increasing income sources, particularly through employment opportunities, is crucial for impoverished rural families. Additionally, addressing the dietary disparities among ethnic minorities compared to the Kinh population requires targeted support from the government to break the cycle of poverty and ensure access to nutritious food. Moreover, strengthening educational development initiatives within marginalized communities is essential to uplift household income levels and improve food security outcomes. Facilitating access to quality education and vocational training empowers households to expand their earning potential and afford a wider range of nutritious foods. Lastly, providing accessible family planning and reproductive health services is vital to mitigate the negative impact of larger household sizes on per capita food expenditure. Supporting family planning initiatives enables households to manage resources more effectively, alleviating the strain of increased food demand associated with larger family sizes.

In conclusion, the findings suggest that poverty reduction is a crucial component of efforts to achieve the United Nations' Sustainable Development Goals of No Poverty and Zero Hunger. By prioritizing poverty reduction and investing in rural development, the Vietnamese government has the potential to improve the food security and dietary diversity of its citizens.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no conflict of interest.

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