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Do Food Price Subsidies Increase Nutritional Intake of Indonesian Households?

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ABSTRACT

Indonesia's economy has developed rapidly, but it has not solved undernourishment issues among low-income people. Therefore, similar to other developing countries, Indonesia has instituted a food price subsidy program known as Rice for the Poor (*RASKIN*) to help low-income families meet their needs and alleviate some of their financial burdens. This study examined how *RASKIN* affected the intake of calories and three macronutrients of Indonesian households using the representative National Socioeconomic Survey (*SUSENAS*) data. In comparison to intake without the subsidy, the estimation results based on the endogenous switching regression model suggested that receiving the subsidy raised the household calorie intake by 368.4 Kcal/day for recipients and 454.6 Kcal/day for nonrecipients. Likewise, households receiving the subsidy raised their macronutrient intake, encompassing protein, carbohydrate, and fat, compared to those not receiving it. Therefore, *RASKIN* contributed to raising the intake of calories and three macronutrients. However, a certain portion of non-poor households were found to receive *RASKIN* owing to mistargeting, suggesting that the government should rectify targeting errors to enhance the effectiveness of the subsidy and attain the key purpose of improving the well-being of people with low incomes.

Keywords: Calorie intake; Food price subsidies; Low-income people; Nutrition intake; Poor household

INTRODUCTION

Poverty generates insufficient financial resources for purchasing food, making it the primary factor of food insecurity (Barrett, 2002). Poverty is a condition when a person or household is underprivileged (Zezza & Tasciotti, 2010), including the condition of not fulfilling food needs. More than half a billion people have suffered from food shortages and malnutrition(FAO, IFAD, UNICEF, WFP, & WHO, 2017; Gonzalez, 2002), indicating that food and nutrition insecurity remains a serious problem worldwide, particularly in developing

countries (Conceição, Levine, Lipton, & Warren-Rodríguez, 2016; Yeoh, Lê, Terry, & McManameyuynh, 2014). To cope with this situation, many developing countries have implemented social protection policies in the form of food price subsidies to overcome food poverty. Lentz and Barrett (2013) indicated that the provision of food subsidies to the poor raises their income, accessibility, and availability of food, reduces malnutrition, and boosts food security. Several studies discovered a positive effect of food subsidies on nutritional intake in India (Krishnamurthy, Pathania, & Tandon, 2017; Rahman, 2016) and Indonesia (Kustianingrum & Terawaki, 2017) as well as an increment in calorie intake in China (Shimokawa, 2010) and Bangladesh (Ahmed, Quisumbing, Nasreen, Hoddinott, & Bryan, 2009).

Indonesia, a Southeast Asian country with a fast-expanding economy, depicted a consistent 6.3% drop in the Global Hunger Index from 2008 to 2017. Despite efforts to address poverty-related undernourishment, 81 regencies and seven cities in the country have low food security index scores (Indonesian Food Council, Ministry of Agriculture, & Programme, 2015). Additionally, 20.8% of households continue to suffer from food insecurity (Amrullah, Ishida, Pullaila, & Rusyiana, 2019). As a result, the government of Indonesia, following the lead of other developing countries, has implemented a food price subsidy program called the Rice for the Poor (*RASKIN*) to ensure that low-income families can purchase rice and other necessities. Despite being the second most funded public welfare program in Indonesia aimed at eradicating poverty, *RASKIN* has been accused of numerous inefficiencies. Not only poor or vulnerable households received *RASKIN*, but also non-poor ones, suggesting a serious mistargeting of the subsidy recipients (Amrullah, Kardiyono, Hidayah, & Rusyiana, 2020; Hastuti et al., 2007; Hutagaol & Asmara, 2008; Jamhari, 2012; Sutanto, Sakaguchi, Amrullah, Rusyiana, & Ishida, 2020). However, several studies have examined the effect of *RASKIN* on the improvement of calorie and nutrition intake, with one exceptional study by Kustianingrum and Terawaki (2017) unveiling that the subsidy positively affected household calorie intake. Therefore, using individual data from the nationwide household expenditure survey called *SUSENAS*, this study aims to examine the extent to which *RASKIN* improves (or decreases) the Indonesian household intake of calories and macronutrients (fat, protein, and carbohydrate) required in large quantities to remain healthy.

The financial crisis and drought during the 1997–1998 period raised food prices and food insecurity in Indonesia. The countermeasure taken at that time was to implement a social safety net program called Special Market Operation (OPK). OPK aims to ensure the availability of rice at affordable prices, reduce the burden of food expenditure, and help targeted households access food as one of their basic needs. According to Sumarto, Suryahadi, and Widyanti (2010), OPK sought to overcome temporary food insecurity and help low-income households overcome tough conditions during the crisis. In 2002, OPK changed its name to *RASKIN*, and irrespective of economic conditions, it began providing social protection for people experiencing poverty.

Initially, the target of *RASKIN* included 9.3 million of the poorest and most vulnerable households (Tabor & Sawit, 2001). Subsequently, from 2010 to 2012, the target escalated to

17.5 million households. Between 2013 and 2016, it further changed to 15.5 million households and covered around 28% of households with the lowest socioeconomic status. The amount of *RASKIN* rice provided to the target varies depending on the government budget. Originally, households received 10 kg/month at IDR 1,000/kg, changing to 15 kg/month at IDR 1,600/kg in 2015. This price was considerably lower than that of rice available in the market with the same relative quality (IDR 7,000-8,500/kg).

RESEARCH METHOD

This study utilized individual household data from the National Socioeconomic Survey (*SUSENAS*) conducted by Statistics Indonesia in March 2015. The sample consisted of 285,902 households nationwide. *SUSENAS* collected data on household socioeconomic conditions, including health, education, family planning, and housing. It also gathered household consumption data compiled into several statistics and consumption expenditures for both food and non-food. The calorie, protein, carbohydrate, and fat intake was calculated based on the conversion rates applied in (BPS-Statictics Indonesia, 2015). An intended household refers to a person or group of people inhabiting part or all of the same place and usually live together and manage food from one kitchen (BPS-Statictics Indonesia, 2015).

The impact of the subsidy program on the outcomes between factual and counterfactual conditions was compared to discover whether *RASKIN* provided positive benefits for its recipients, measured by the increased calorie and macronutrient intake. Moreover, since the selection bias must be lessened when the subsidy program was rarely distributed randomly (Wossen et al., 2017), endogenous switching regression was applied to obtain more accurate estimation results, performed in two steps.

The first step was to estimate the parameters in the recipient or nonrecipient selection using the following equation.

$$R_i^* = \alpha Z_i + \varepsilon_i \text{ , with } R_i = \begin{cases} 1 \text{ if } R_i^* > 0 \\ 0 \text{ if } R_i^* \leq 0 \end{cases} \quad (1)$$

R_i^* represents the unobservable potential variable of being a *RASKIN* recipient, R_i denotes whether household i is a *RASKIN* recipient, Z_i is an explanatory variable vector, α signifies a coefficient vector, and ε_i is an error term.

Although the standard of living was a crucial criterion in determining the eligibility of a household to be a *RASKIN* recipient, it was not easy to collect detailed and accurate information on household income. Therefore, the standard of living of the household was assessed based on the attributes of its head and living conditions (materials such as walls, floors, and roofs, as well as the use of water and other utilities) in line with extant literature (Akerele, Ibrahim, & Adewuyi, 2014; Amrullah, Tokuda, Rusyiana, & Ishida, 2023; Biyase & Zwane, 2018; Chen & Wang, 2015; De Silva, 2008; Deaton, 2003; Haughton & Khandker, 2009; Kochar, 2005; Sekhampu, 2013). The explanatory variables were the characteristics of the head of the household, covering age, marital status, education level, occupation, and sex; household characteristics, including water sources, defecation, cooking fuel, electricity, per

capita expenditure, household size, ownership of several assets; and physical characteristics of residential areas (urban or urban area) and regions. The occupation variable was divided into five classes: self-employed in non-agriculture, self-employed in agriculture, agricultural labor, non-agricultural labor, and other occupations. Self-employment refers to working or trying to bear economic risks by not returning production costs incurred in the business and not using paid or unpaid workers, including those whose nature of work requires technology or special skills. The probit regression was applied to estimate the parameters in the first equation. The Wald chi-squared test was run to ascertain the significance of a set of independent variables for the model.

The second step was to evaluate the effect of *RASKIN* on calorie and macronutrient intake. The specific model to be estimated is as follows.

$$\textit{Regime 1 (RASKIN-recipient)}: Y_{1i} = f(R, X, \beta_1) + \mu_{1i} \text{ if } R_i = 1 \quad (2)$$

$$\textit{Regime 2 (Non-recipient)}: Y_{2i} = f(X, \beta_2) + \mu_{2i} \text{ if } R_i = 0 \quad (3)$$

Y_{1i} represents the outcome indicator of *RASKIN* recipients, Y_{2i} signifies non-recipients, and μ_{1i} and μ_{2i} depict the error term of the outcome variables. The variable *R* demonstrates the *RASKIN* recipient, while X indicates a latent variable determined by the observed characteristics. β_1 and β_2 are the vectors of parameters to be estimated; they determined the outcome indicators for *RASKIN* recipients and non-recipients. The error term in the first to third equations was assumed to have a normal trivariate distribution with zero averages and a covariance matrix Σ as follows.

$$\Sigma = \begin{bmatrix} \sigma_\varepsilon^2 & \sigma_{1\varepsilon} & \sigma_{2\varepsilon} \\ \sigma_{\varepsilon 1} & \sigma_1^2 & . \\ \sigma_{\varepsilon 2} & . & \sigma_2^2 \end{bmatrix} \quad (4)$$

Where, σ_ε^2 = var(ε_i); σ_1^2 = var (μ_1); σ_2^2 = var (μ_2); $\sigma_{1\varepsilon}$ = cov(ε_i, μ_1); $\sigma_{2\varepsilon}$ = cov(ε_i, μ_2). σ_ε^2 is an estimable variable up to a scale factor, assumed to be equal to 1 (Maddala, 1983). The error terms in the first and second equations, depending on the sample selection criteria, were expected to have non-zero values (Di Falco, Veronesi, & Yesuf, 2011) and estimated the least squares of the coefficients $\gamma_1$and γ_2, leading to the sample selection bias (Lee, 1982). Endogenous Switching Regression (ESR) overcame this selection bias by estimating the inverse ratio (λ_{1i} and λ_{2i}), and the covariance provisions ($\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$) included additional regression in the second and third equations. If $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$ have a significant effect, the absence of selection bias are rejected.

The ESR model enabled the computation of four expected actual outcomes: calorie or macronutrient intake of the households of *RASKIN* recipients and non-recipients using the fifth and sixth equations, respectively; outcomes in counterfactual scenarios of *RASKIN* recipients if they had not been a recipient using the seventh equation; and that of nonrecipients if they had been a recipient using the eighth equation. Conditional expectations for calorie or macronutrient intake are defined as follows.

$$E(Y_{1i} \mid R_i = 1) = \gamma_1 X_{1i} + \lambda_{1i}\, \sigma_{1\varepsilon} \quad (5)$$

$$E(Y_{2i} \mid R_i = 0) = \gamma_2 X_{2i} + \lambda_{2i}\, \sigma_{2\varepsilon} \quad (6)$$

$$E(Y_{2i} \mid R_i = 1) = \gamma_2 X_{1i} + \lambda_{1i}\, \sigma_{2\varepsilon} \quad (7)$$

$$E(Y_{1i} \mid R_i = 0) = \gamma_1 X_{2i} + \lambda_{2i}\, \sigma_{1\varepsilon} \quad (8)$$

The estimated ESR model could be employed to estimate the average treatment effect on the treated (ATT) and the average treatment effect on the untreated (ATU). According to Heckman, Tobias, and Vytlacil (2001) and Di Falco et al. (2011), ATT is the difference between the fifth and seventh equations, and ATU is the difference between the eighth and sixth equations.

$$ATT=E(Y_{1i} \mid R_i=1)-E(Y_{2i} \mid R_i=1)=X_{1i}(\gamma_1-\gamma_2)+\lambda_{1i}(\sigma_{1\varepsilon}-\sigma_{2\varepsilon}) \quad (9)$$

$$ATU=E(Y_{1i} \mid R_i=0)-E(Y_{2i} \mid R_i=0)=X_{2i}(\gamma_1-\gamma_2)+\lambda_{2i}(\sigma_{1\varepsilon}-\sigma_{2\varepsilon}) \quad (10)$$

In addition, the estimated ESR model could also estimate the heterogeneity effect for households being *RASKIN* recipients (BH_R) and for non-recipients (BH_{NR}) (Di Falco et al., 2011). Furthermore, Carter and Milon (2005) defined the heterogeneity effect of BH_R as the difference between the fifth and eighth equations and BH_{NR} as the difference between the seventh and sixth equations.

$$BH_R=E(Y_{1i}|R_i=1)-E(Y_{1i}|R_i=0)=\gamma_1(X_{1i}-X_{2i})+\sigma_{1\varepsilon}(\lambda_{1i}-\lambda_{2i}) \quad (11)$$

$$BH_{NR}=E(Y_{2i}|R_i=1)-E(Y_{2i}|R_i=0)=\gamma_2(X_{1i}-X_{2i})+\sigma_{2\varepsilon}(\lambda_{1i}-\lambda_{2i}) \quad (12)$$

Finally, transitional heterogeneity (TH) was calculated using the method of (Di Falco et al., 2011). It looked at whether the *RASKIN* effect was greater or smaller for households receiving or not receiving *RASKIN* in counterfactual cases. It was the difference between ATT (ninth equation) and ATU (tenth equation).

RESULTS AND DISCUSSION

Descriptive Analysis

This study discussed the effect of *RASKIN* on household calorie and macronutrient intake. Table 1 displays the descriptive statistics of the outcome variables for household calorie and macronutrition intake. The proportion of *RASKIN* recipients was 37.1% (105,962) of the total sample. On average, household calorie, protein, carbohydrate, and fat intake were 2,088 kcal/day, 57.3 grams/day, 322.6 grams/day, and 50.1 grams/day, respectively. The average intake of calories, protein, and fat of *RASKIN* recipients was lower than that of nonrecipients. However, the average carbohydrate intake of *RASKIN* recipients was significantly higher than that of nonrecipients. These findings were attributed to the fact that poor households were more likely to be *RASKIN* recipients.

TABLE 1. HOUSEHOLD CALORIE AND OTHER MACRONUTRITION INTAKE

Variable	Overall (N= 285,902)		Recipient (N=105,962)		Nonrecipient (N=179,940)		Mean different	Std. err
	Mean	S.d	Mean	S.d	Mean	S.d		
Calorie (kcal/day)	2,088	626.74	2,035	616.29	2,119	632.47	-84.08***	2.421
Protein (gram/day)	57.27	22.07	53.84	21.78	59.29	22.24	-5.45***	0.085
Carbohydrate (gram/day)	322.57	98.92	323.87	97.32	321.8	99.84	2.06***	0.383
Fat (gram/day)	50.14	23.39	46.49	21.33	52.29	24.27	-5.80***	0.09

Note: *** is significant at the probability level of 1%

Furthermore, *RASKIN* recipients and non-recipients differed in many socioeconomic aspects, as displayed in Table 2. Households headed by older women who were either widowed or divorced, had only completed primary school or below and were either self-employed or laborers in the agricultural sector made up the majority of *RASKIN* recipients. A significant difference was also demonstrated in household per capita expenditure, where *RASKIN* recipients had lower expenditures than non-recipients. Furthermore, most *RASKIN* recipients lived in rural areas and originated from Java, Bali, and Nusa Tenggara. They utilized kerosene, wood, and coal as cooking fuels. Differences in housing characteristics were also observed, wherein the walls of the *RASKIN* recipients' houses were predominantly made of bamboo or wood with soil or cement floors. Additionally, the ownership of several household assets was significantly different, with *RASKIN* recipients having fewer assets than nonrecipients.

TABLE 2. DESCRIPTIVE STATISTICS OF *RASKIN* RECIPIENT AND NONRECIPIENT HOUSEHOLDS

Varible	Overall (N=285,902)		Recipient (N=105,962)		Nonrecipient (N-=179,940)		Mean difference	Std. err.
	Mean	S.d	Mean	S.d	Mean	S.d		
Household head characteristics								
Age (#)	48	13.41	49.3	13.57	47.24	13.27	2.06***	0.052
Female (=1)	0.145	0.35	0.169	0.37	0.131	0.33	0.037***	0.001
Marital status								
Never married/single (=1)	0.026	0.15	0.013	0.11	0.033	0.17	-0.020***	0.001
Married (=1)	0.817	0.38	0.801	0.4	0.827	0.37	-0.026***	0.001
Widowed (=1)	0.03	0.17	0.033	0.17	0.029	0.16	0.004***	0.001
Divorced (=1)	0.127	0.33	0.153	0.35	0.111	0.31	0.042***	0.001
Education levels								
No school (=1)	0.077	0.26	0.114	0.31	0.055	0.22	0.059***	0.001
Primary school (=1)	0.432	0.49	0.573	0.49	0.35	0.47	0.223***	0.002
Junior high school (=1)	0.17	0.37	0.17	0.37	0.17	0.37	0.000***	0.001
Senior high school (=1)	0.187	0.38	0.105	0.3	0.235	0.42	-0.130***	0.001
College (=1)	0.134	0.34	0.038	0.19	0.19	0.39	-0.152***	0.001
Main occupation								
Self-employed in non-agriculture (=1)	0.19	0.39	0.17	0.37	0.202	0.4	-0.031***	0.002
Self-employed in agriculture (=1)	0.3	0.45	0.36	0.48	0.264	0.44	0.096***	0.002
Agricultural labor (=1)	0.082	0.27	0.113	0.31	0.063	0.24	0.049***	0.001
Non-agricultural labor (=1)	0.351	0.47	0.292	0.45	0.385	0.48	-0.093***	0.002
Other occupations (=1)	0.016	0.12	0.014	0.11	0.017	0.12	-0.003***	0.000
Missing occupation (=1)	0.062	0.24	0.051	0.21	0.069	0.25	-0.018***	0.001
Household characteristics								
Per capita expenditure (log)	13.453	0.67	13.152	0.51	13.629	0.69	-0.477***	0.002
Household size (#)	3.839	1.67	3.844	1.69	3.837	1.66	0.008***	0.006
Living in the rural area (=1)	0.57	0.49	0.688	0.46	0.501	0.5	0.187***	0.002
Using a private toilet (=1)	0.725	0.44	0.625	0.48	0.784	0.41	-0.159***	0.002
Piped water into the house (=1)	0.563	0.49	0.471	0.49	0.618	0.48	-0.147***	0.002
Access to electricity (=1)	0.941	0.23	0.935	0.24	0.946	0.22	-0.011***	0.001
Kerosene, wood, and coal cooking fuel (=1)	0.408	0.49	0.49	0.49	0.359	0.47	0.131***	0.002

TABLE 2. CONTINUED

Varible	Overall (N=285,902)		Recipient (N=105,962)		Nonrecipient (N-=179,940)		Mean difference	Std. err.
	Mean	S.d	Mean	S.d	Mean	S.d		
Regional Island								
Java (=1)	0.328	0.46	0.444	0.49	0.259	0.43	0.185***	0.002
Sumatra (=1)	0.289	0.45	0.249	0.43	0.312	0.46	-0.063***	0.002
Bali and Nusa Tenggara (=1)	0.077	0.26	0.092	0.28	0.069	0.25	0.023***	0.001
Sulawesi (=1)	0.133	0.33	0.111	0.31	0.146	0.35	-0.035***	0.001
Kalimantan (=1)	0.099	0.29	0.049	0.21	0.128	0.33	-0.079***	0.001
Maluku and Papua (=1)	0.075	0.26	0.056	0.22	0.086	0.28	-0.031***	0.001
Housing characteristics								
Asbestos and zinc roof (=1)	0.546	0.49	0.438	0.49	0.609	0.48	-0.171***	0.002
Brick wall (=1)	0.617	0.48	0.548	0.49	0.657	0.47	-0.109***	0.002
Bamboo wall (=1)	0.053	0.22	0.097	0.29	0.027	0.16	0.070***	0.001
Wood wall (=1)	0.299	0.45	0.317	0.46	0.289	0.45	0.029***	0.002
Soil floor (=1)	0.064	0.24	0.111	0.31	0.036	0.18	0.075***	0.001
Cement floor (=1)	0.343	0.47	0.396	0.48	0.312	0.46	0.084***	0.002
Household Assets								
Owning a refrigerator (=1)	0.463	0.49	0.274	0.44	0.574	0.49	-0.300***	0.002
Owning an air conditioning (=1)	0.059	0.23	0.005	0.06	0.092	0.28	-0.087***	0.001
Owning a computer/laptop (=1)	0.182	0.38	0.049	0.21	0.26	0.43	-0.211***	0.001
Owning a motorcycle (=1)	0.675	0.46	0.573	0.49	0.734	0.44	-0.161***	0.002
Owning a car (=1)	0.091	0.28	0.017	0.12	0.134	0.34	-0.117***	0.001

Note: *** is significant at the probability level of 1%

Determinants of *RASKIN* Recipients

The leftmost columns (selected equation) in Tables 3, 4, 5, and 6 present the estimation results of the probit regression, providing a good estimate of the factors affecting *RASKIN* recipients. The results revealed that *RASKIN* recipients were strongly associated with socioeconomic and demographic characteristics. The positive and significant determinants suggested that several variables were more likely to be *RASKIN* recipients: female sex; widowed or divorced marital status; primary school or lower education level; agriculture as the primary occupation; household size; residence in a rural area; access to electricity, kerosene, wood, and coal cooking fuel; residence in Java, Sumatra, Bali and Nusa Tenggara, and Sulawesi; and living in houses with bamboo walls and soil and cement floors. Households without electricity were perceived as being in rural areas, which was related to the perception of RAKIN recipients and the usage of power as a source of lighting. Consequently, *RASKIN* was more commonly distributed to households with available electrical installations as a lighting source than those without. The negative and significant determinants of *RASKIN* recipients were per capita expenditure, private toilets, piped water into houses, Maluku and Papua, household assets, asbestos and zinc roofs, and brick walls. The higher the household's per capita expenditure, the less likely it was to receive *RASKIN*; likewise, households with private toilets, piped water into houses, lived in Maluku and Papua, had many assets, and houses having asbestos and zinc roofs and brick walls tended not to receive the subsidy.

TABLE 3. ENDOGENOUS SWITCHING REGRESSION FOR *RASKIN* RECIPIENTS AND ITS IMPACT ON CALORIE INTAKE

Variable	Selected equation		Calorie intake			
			Recipient		Nonrecipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Constant	3.87	0.079	-7168.75***	48.877	-6669.72***	38.655
Household head characteristics						
Age	0.00	0.000	2.22***	0.125	2.13***	0.123
Female	0.09***	0.011	75.86***	6.598	40.74***	6.407
Marital status						
Married	0.33***	0.019	-83.39***	13.094	49.44***	9.078
Widowed	0.26***	0.023	-66.99***	15.257	46.37***	11.919
Divorced	0.31***	0.02	-124.44***	13.772	-2.1	10.124
Education levels						
No school	0.53***	0.014	44.51***	9.301	-125.81***	7.539
Primary school	0.45***	0.011	61.46***	8.077	-54.37***	4.914
Junior high school	0.33***	0.011	33.72***	8.366	-9.53	5.172
Senior high school	0.13***	0.011	18.03	8.676	37.16***	4.682
Main occupation						
Self-employed in non-agriculture	0.25***	0.013	2.6	7.862	-21.89***	6.735
Self-employed in agriculture	0.14***	0.012	98.80***	7.451	94.64***	6.743
Agricultural labor	0.22***	0.014	89.09***	8.272	48.56***	8.165
Non-agricultural labor	0.24***	0.012	-25.88***	7.635	-34.61***	6.405
Other occupations	0.20***	0.023	11.71	14.107	22.51	12.341
Household characteristics						
Per capita expenditure	-0.41***	0.005	717.26***	3.635	622.11***	2.582
Household size	0.03***	0.002	-53.63***	0.983	-49.57***	0.966
Rural area	0.17***	0.006	17.68***	3.474	80.90***	3.366
Using a private toilet	-0.10***	0.006	-45.29***	3.171	34.36***	3.574
Piped water into the house	-0.07***	0.005	-10.73***	2.995	15.78***	3.029
Access to electricity	0.18***	0.009				
Kerosene, wood, and coal cooking fuel	0.05***	0.005				
Regional Island						
Java	0.64***	0.01				
Sumatra	0.33***	0.009				
Bali and Nusa Tenggara	0.36***	0.011				
Sulawesi	0.29***	0.01				
Maluku and Papua	-0.13***	0.011				
Household Assets						
Owning a refrigerator	-0.14***	0.005				
Owning an air conditioner	-0.56***	0.019				
Owning a computer/laptop	-0.24***	0.008				
Owning a motorcycle	-0.06***	0.005				
Owning a car	-0.40***	0.012				
Housing characteristics						
Asbestos and zinc roof	-0.11***	0.005				
Brick wall	-0.09***	0.011				
Bamboo wall	0.08***	0.013				
Wood wall	0.00***	0.011				
Soil floor	0.09***	0.008				
Cement floor	0.10***	0.005				

TABLE 3. CONTINUED

Variable	Selected equation		Calorie intake			
			Recipient		Nonrecipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Σi			6.18***	0.003	6.48***	0.002
Pj			-0.32***	0.01	-1.47***	0.009
Number of observation	285908					
Log-likelihood	-2330183					
Wald chi^2 (19)	60677.09***					
Likelihood ratio test of independent equation	10399.64***					

Note: *** is significant at the probability level of 1%

The distribution of *RASKIN* recipients was examined based on the quantile of per capita expenditure. Subsequently, the probability of *RASKIN* recipients was calculated using the estimation results of the probit model in the leftmost column of Table 3.

Figure 1 displays a graph of the probability of being a *RASKIN* recipient based on the quantile per capita expenditure and area of residence. Households living in rural and urban Java had the highest probability of being *RASKIN* recipients. Regarding the quantile per capita expenditure, households in the third to fifth quartiles continued to receive *RASKIN*, demonstrating mistargeting of the program.

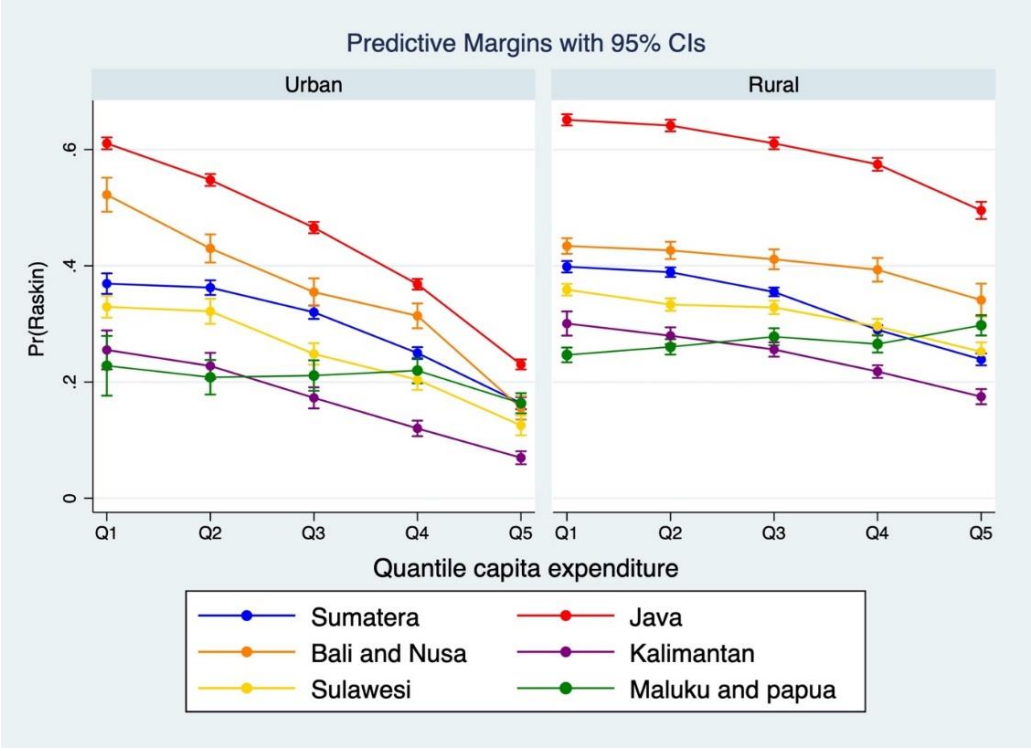

FIGURE 1. PREDICTIVE MARGINS OF *RASKIN* RECIPIENTS

The highest possibility of mistargeting occurred in rural Java, where the probability of households in the third to fifth quartiles receiving RASKIN was 61.1%, 57.5%, and 49.5%, respectively. Furthermore, households in Maluku and Papua in the third to fifth quartiles of rural areas possessed a higher probability than those in the first to second quartiles. These

findings were crucial for distributing and targeting the subsidy program in Indonesia, particularly in eastern Indonesia (Maluku and Papua). The National Socioeconomic Survey revealed that, many poor households 41.35% in the first quartile and 49.45% in the second quartile, did not receive RASKIN benefits because of mistargeting, which might worsen their conditions. These results corroborate those of previous studies (Hastuti et al., 2007; Hutagaol & Asmara, 2008; Jamhari, 2012; Sutanto et al., 2020). The downward trend in the estimated predictive margins illustrated that the group of households with high expenditure tended to decrease their access to RASKIN. The third to fifth quartiles had lower prediction margins, signifying that fewer households in those group categories received RASKIN. In short, RASKIN recipients were more targeted.

Factors Influencing Calorie and Macronutrient Intake

Tables 3, 4, 5, and 6 portray the estimates of the impact of *RASKIN* on calorie and macronutrient intake. Following the estimation results, the likelihood ratio tests of those four tables demonstrated the rejection of the null hypothesis that all coefficients of the independent variables were equal to zero, implying that the estimated model could explain calorie and macronutrient intake to some extent. In addition, the Wald test was significant, implying that the goodness of fit of the ESR model was more appropriate. Hence, it justified the use of an ESR model.

Regarding the characteristics of the head of the household, age positively impacted calorie and macronutrient intake, except for fat intake by nonrecipients. It is consistent with Iram and Butt (2004) and Amrullah et al. (2023), who discovered that the older the head of the household, the more experience he or she has in providing proper food. Households headed by females had a significant and positive impact on calorie and macronutrient intake compared with those headed by males. Other countries have depicted that female-headed households did not have a good nutritional intake status. However, in Indonesia, the elderly were often the formal head of the household, regardless of sex. Therefore, assuming that female-headed households contributed more to nutritional intake was misleading. Female-headed households tended to be lower in economic capacity than male-headed ones. Households with a female head were likely to have limited household income, limiting the household budget for food. These findings align with some previous research (Acharya, 2021; Niankara, 2023; Yovo & Gnedeka, 2023). Calorie and macronutrient intake was positively correlated with the degree of education of the household head for *RASKIN* recipients and negatively correlated with nonrecipients. A household head who was self-employed in agriculture or engaged in agricultural labor had positive coefficients for calorie and carbohydrate intake and negative coefficients for protein intake. The physical demands of agricultural work, such as tilling land, planting seeds, and watering, could lead to higher calorie and macronutrient intake in households compared to non-farming occupations (Abdulai & Aubert, 2004).

TABLE 4. ENDOGENOUS SWITCHING REGRESSION FOR *RASKIN* RECIPIENTS AND ITS IMPACT ON PROTEIN INTAKE

Variable	Selected equation		Protein intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Constant	5.30***	0.074	-232.9***	1.603	-261.4***	1.321
Household head characteristics						
Age	0.00	0.00	0.11***	0.004	0.07***	0.004
Female	0.09***	0.011	1.92***	0.217	0.19	0.221
Married	0.37***	0.018	-4.29***	0.431	-2.03***	0.316
Widowed	0.29***	0.022	-2.92***	0.502	-1.37***	0.414
Divorced	0.34***	0.019	-4.84***	0.453	-2.29***	0.352
No school	0.57***	0.013	-1.23***	0.304	-9.54***	0.259
Primary school	0.46***	0.01	0.23	0.264	-5.39***	0.17
Junior high school	0.34***	0.01	-0.3	0.274	-3.46***	0.18
Senior high school	0.15***	0.01	-0.43	0.286	-0.69***	0.164
Self-employed in non-agriculture	0.25***	0.012	-2.58***	0.259	-2.94***	0.234
Self-employed in agriculture	0.17***	0.012	-2.08***	0.245	-1.02***	0.234
Agricultural labor	0.23***	0.014	-0.75	0.272	-2.00***	0.281
Non-agricultural labor	0.24***	0.012	-3.24***	0.251	-3.15***	0.222
Other occupations	0.20***	0.022	-2.96***	0.465	-1.97***	0.428
Household characteristics						
Per capita expenditure	-0.52***	0.005	22.76***	0.118	23.27***	0.088
Household size	0.02***	0.002	-1.63***	0.032	-1.13***	0.033
Rural area	0.21***	0.006	-1.64***	0.114	-1.38***	0.116
Using a private toilet	-0.10***	0.006	-1.09***	0.104	1.89***	0.123
Piped water into the house	-0.09***	0.005	0.83***	0.099	1.67***	0.105
Access to electricity	0.27***	0.008				
Kerosene, wood, and coal cooking fuel	0.03***	0.004				
Java	0.53***	0.009				
Sumatra	0.21***	0.008				
Bali and Nusa Tengara	0.27***	0.01				
Sulawesi	0.23***	0.009				
Maluku and Papua	-0.33***	0.01				
Household Assets						
Owning a refrigerator	-0.10***	0.005				
Owning an air conditioner	-0.44***	0.018				
Owning a computer/laptop	-0.18***	0.007				
Owning a motorcycle	-0.04***	0.004				
Owning a car	-0.32***	0.011				
Housing characteristics						
Asbestos and zinc roof	-0.04***	0.005				
Brick wall	-0.08***	0.01				
Bamboo wall	0.07***	0.012				
Wood wall	-0.01	0.01				
Soil floor	0.03***	0.007				
Cement floor	0.08***	0.004				

TABLE 4. CONTINUED

Variable	Selected equation		Protein intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Σi			2.77***	0.003	3.14***	0.002
Pj			-0.32***	0.009	-1.86***	0.008
Number of obs	285908					
Log-likelihood	-1355794.3					
Wald $chi^2(19)$	55891.06***					
Likelihood ratio test of independent equations	29958.50***					

Note: *** is significant at the probability level of 1%.

TABLE 5. ENDOGENOUS SWITCHING REGRESSION FOR *RASKIN* RECIPIENTS AND ITS IMPACT ON CARBOHYDRATE INTAKE

Variable	Selected equation		Carbohydrate intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Constant	3.04***	0.078	-897.1***	8.563	-783.0***	6.538
Household head characteristics						
Age	0.00	0.000	0.35***	0.022	0.41***	0.021
Female	0.10***	0.011	3.91***	1.167	-1.49	1.074
Married	0.35***	0.019	-25.04***	2.318	-9.84***	1.52
Widowed	0.26***	0.023	-18.67***	2.699	-3.6	1.997
Divorced	0.32***	0.02	-27.29***	2.437	-12.31***	1.696
No school	0.47***	0.014	19.23***	1.646	-7.96***	1.266
Primary school	0.44***	0.011	14.81***	1.432	-4.98***	0.824
Junior high school	0.32***	0.011	7.94***	1.482	0.37	0.866
Senior high school	0.12***	0.011	4.92***	1.537	6.51***	0.783
Self-employed in non-agriculture	0.25***	0.013	1.16	1.39	-4.13***	1.128
Self-employed in agriculture	0.10***	0.012	27.87***	1.317	24.18***	1.13
Agricultural labor	0.22***	0.014	17.03***	1.462	7.11***	1.37
Non-agricultural labor	0.24***	0.012	-3.57*	1.349	-6.34***	1.073
Other occupations	0.20***	0.023	3.95	2.494	1.66	2.068
Household characteristics						
Per capita expenditure	-0.34***	0.005	94.92***	0.635	77.54***	0.437
Household size	0.02***	0.002	-6.16***	0.174	-6.12***	0.162
Rural area	0.13***	0.006	12.56***	0.613	23.83***	0.565
Using a private toilet	-0.07***	0.006	-12.39***	0.56	-0.61	0.6
Piped water into the house	-0.06***	0.005	-5.85***	0.529	0.76	0.508
Access to electricity	0.13***	0.009				
Kerosene, wood, and coal cooking fuel	0.06***	0.005				
Java	0.63***	0.01				
Sumatra	0.31***	0.009				
Bali and Nusa Tenggara	0.50***	0.011				
Sulawesi	0.36***	0.01				
Maluku and Papua	-0.06***	0.011				

TABLE 5. CONTINUED

Variable	Selected equation		Carbohydrate intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Household Assets						
Owning a refrigerator	-0.18***	0.005				
Owning an air conditioner	-0.52***	0.019				
Owning a computer/laptop	-0.26***	0.008				
Owning a motorcycle	-0.06***	0.005				
Owning a car	-0.37***	0.012				
Housing characteristics						
Asbestos and zinc roof	-0.12***	0.005				
Brick wall	-0.11***	0.012				
Bamboo wall	0.10***	0.014				
Wood wall	0.01	0.012				
Soil floor	0.11***	0.009				
Cement floor	0.09***	0.005				
Σi			4.44***	0.003	4.69***	0.002
Pj			-0.28***	0.011	-1.41***	0.009
Number of obs	285908					
Log-likelihood	-1828549.3					
Wald chi2(19)	37430.50***					
Likelihood ratio test of independent equations	6754.77***					

Note: * and *** are significant at the probability level of 10 and 1%, respectively.

TABLE 6. ENDOGENOUS SWITCHING REGRESSION FOR *RASKIN* RECIPIENTS AND ITS IMPACT ON FAT INTAKE

Variable	Selected equation		Fat intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Constant	5.91***	0.074	-260.9***	1.819	-283.9***	1.426
Household head characteristics						
Age	0.00	0.000	0.02***	0.005	-0.01**	0.005
Female	0.06***	0.011	3.35***	0.247	1.82***	0.239
Married	0.17***	0.018	2.31***	0.488	4.73***	0.342
Widowed	0.14***	0.022	1.52*	0.569	3.26***	0.447
Divorced	0.18***	0.019	0.09	0.514	2.07***	0.38
No school	0.55***	0.013	-3.06***	0.344	-10.29***	0.279
Primary school	0.45***	0.01	-0.37	0.298	-5.63***	0.183
Junior high school	0.32***	0.01	-0.41	0.31	-2.95***	0.194
Senior high school	0.13***	0.01	-0.41	0.323	0.04	0.177
Self-employed in non-agriculture	0.21***	0.012	0.31	0.294	-0.84***	0.252
Self-employed in agriculture	0.15***	0.012	-0.5	0.279	-0.27	0.252
Agricultural labor	0.19***	0.014	0.97**	0.309	-0.1	0.303
Non-agricultural labor	0.20***	0.012	-0.13	0.285	-1.17***	0.24
Other occupations	0.17***	0.022	-0.37	0.528	0.22	0.462

TABLE 6. CONTINUED

Variable	Selected equation		Fat intake			
			Recipient		Non-recipient	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Household characteristics						
Per capita expenditure	-0.55***	0.005	24.13***	0.133	23.92***	0.095
Household size	0.02***	0.002	-1.65***	0.037	-0.93***	0.036
Rural area	0.21***	0.006	-2.68***	0.13	-2.49***	0.125
Using a private toilet	-0.15***	0.006	0.38***	0.119	3.35***	0.132
Piped water into the house	-0.07***	0.005	1.25***	0.112	1.55***	0.113
Access to electricity	0.21***	0.008				
Kerosene, wood, and coal cooking fuel	0.00	0.004				
Java	0.59***	0.008				
Sumatra	0.26***	0.007				
Bali and Nusa Tenggara	0.05***	0.009				
Sulawesi	0.09***	0.008				
Maluku and Papua	-0.20***	0.01				
Household Assets						
Owning a refrigerator	-0.06***	0.004				
Owning an air conditioner	-0.44***	0.018				
Owning a computer/laptop	-0.13***	0.007				
Owning a motorcycle	-0.02***	0.004				
Owning a car	-0.28***	0.011				
Housing characteristics						
Asbestos and zinc roof	-0.06***	0.004				
Brick wall	-0.04***	0.009				
Bamboo wall	0.04***	0.011				
Wood wall	-0.03*	0.009				
Soil floor	0.02*	0.007				
Cement floor	0.08***	0.004				
Σi			2.90***	0.003	3.22***	0.002
Pj			-0.38***	0.008	-1.93***	0.009
Number of obs	285908					
Log-likelihood	-1828549.3					
Wald chi2(19)	37430.50***					
Likelihood ratio test of independent equations	28338.06***					

Note: *, **, and *** are significant at the probability level of 10, 5, and 1%, respectively.

Regarding household characteristics, per capita expenditure had a significant positive influence on calorie and macronutrient intake, meaning that higher household expenditure led to higher nutritional intake. The majority of Indonesian households spent their income on food. Hence, inadequate household income declined food expenditure and impacted household members' nutritional status. Household size had a negative effect on calorie and macronutrient intake for both *RASKIN* recipients and nonrecipients. As discovered by Akerele et al. (2014), it was probably attributable to the fact that a greater number of household members led to lower calorie intake because many household members did not

contribute to household income. Residing in rural areas had a positive effect on calorie and carbohydrate intake and a negative effect on protein and fat intake in both *RASKIN* recipients and nonrecipients. In other words, rural dwellers were more dependent on carbohydrates, and their protein intake was considered to be more inadequate than that of those living in urban areas in Indonesia, where protein intake was generally inadequate.

Comparison of Estimated Effect of *RASKIN* on Calorie and Macronutrients

After estimating the parameters of the ESR model, the ATT, ATU, and HT were calculated, depicting the impact of *RASKIN* on calorie and macronutrient intake under actual and counterfactual conditions. Table 7 presents the estimates and results. The results revealed that *RASKIN* significantly enhanced the calorie intake for both *RASKIN* recipients and nonrecipients. The causal effect was 368.4 kcal/day for *RASKIN* recipients and 454.6 kcal/day for nonrecipients. Likewise, there was an estimated 14 grams/day increase in protein intake, 61.6 grams/day rise in carbohydrate intake, and 14.4 grams/day growth in fat intake among *RASKIN* recipient households. In addition, *RASKIN* increased the intake of protein by 20.0 grams/day, carbohydrate by 75.1 grams/day, and fat by 19.9 grams/day for nonrecipient households.

TABLE 7. IMPACT OF *RASKIN* ON CALORIE AND OTHER MACRONUTRIENTS INTAKE USING ESR

Outcome variable		Prediction		Treatment
	RASKIN status	Recipient	Nonrecipient	Effect
Calorie (Kcal/day)	ATT (*RASKIN* recipient)	2034.64	1666.25	368.38***
	ATU (non-recipient)	2119.54	1664.92	454.63***
	Heterogeneity effect	-84.91	1.34	-86.24***
Protein (gram/day)	ATT (*RASKIN* recipient)	53.82	39.81	14.01***
	ATU (non-recipient)	59.87	39.59	20.28***
	Heterogeneity effect	-6.06	0.22	-6.27***
Carbohydrate (gram/day)	ATT (*RASKIN* recipient)	323.84	262.29	61.55***
	ATU (non-recipient)	322.07	246.95	75.12***
	Heterogeneity effect	1.77	15.34	-13.57***
Fat (gram/day)	ATT (*RASKIN* recipient)	46.45	32.09	14.36***
	ATU (non-recipient)	52.77	32.87	19.89***
	Heterogeneity effect	-6.32	-0.79	-5.53***

Note: *** is significant at the probability level of 1%.

Table 7 lists the transitional heterogeneity effect of -86.2 kcal/day for calories, -6.3 g/day for protein, -13.6 g/day for carbohydrates, and -5.5 g/day for fat intake. It demonstrated that the effect of receiving *RASKIN* on calorie and macronutrient intake was more likely to be higher for nonrecipients if they were selected as *RASKIN* beneficiaries. The estimation results unveiled that *RASKIN* had a positive and significant relationship with increased household calorie and three macronutrient intake. It is consistent with previous studies in India (Krishnamurthy et al., 2017; Rahman, 2016), China (Shimokawa, 2010), and Indonesia (Kustianingrum & Terawaki, 2017), where food price subsidies escalated household nutritional intake. *RASKIN* effectively raised calorie and other micronutrient intake because

poor households, being the target of the subsidy, had a diet with two types of food: staple and luxury. Subsidy recipients could consume large amounts of staple foods to meet their basic needs, obtain enough calories and other nutrients, and use the remaining money to buy calorie-rich luxury foods such as meat. The subsidy provided funds to spend on nutrient-rich foods, where households could substitute the types of foods consumed, switch to nutritious staple foods, and substitute low-quality foods for high-quality ones to add variety to the menu.

CONCLUSION

Using household-level data from a national socioeconomic survey, this study sought to build empirical evidence about the determinants and effect of *RASKIN* on household calorie and three macronutrient intake in Indonesia. The ESR model estimators were utilized to achieve the goal. This study had made empirical and methodological contributions. Empirically, the study discussed the role of *RASKIN* in raising household calorie and three macronutrient intake. Besides, the status of *RASKIN* recipient households had a heterogeneous effect, and understanding the potential role of heterogeneity was key to increasing household calorie intake to reduce poverty and food insecurity.

Age, gender, education level, the main occupation in the agricultural sector of the household head, expenditure, and living in rural areas were some of the socioeconomic and demographic factors influencing significantly higher calorie intake of *RASKIN* recipients. Moreover, the calorie intake of *RASKIN* nonrecipients was positively and significantly impacted by characteristics such as age, gender, marital status, education level, the main occupation in the agricultural sector of the household head, expenditure, living in rural areas, using private toilets, and piped water into houses. In addition, the household size and main occupation in the non-agricultural sector possessed a negative and significant effect.

Household eligibility for *RASKIN* was influenced by socioeconomic and demographic factors, serving as the proxy of poverty. Despite using poverty data to determine the eligibility of recipient households, this study discovered that the government mistargeted *RASKIN* recipients. Non-poor households (third to fifth quantiles of expenditures) had a high probability of becoming *RASKIN* recipients. Additionally, most mistargeting occurred in rural Java, even in eastern Indonesia (Maluku and Papua). Non-poor households received *RASKIN* at a higher rate than those of poor households. This study should serve as a reminder to policymakers to pay close attention to target recipients of the subsidy, especially in eastern Indonesia, given the prevalence of food insecurity and low-calorie intake. The ESR model yielded several results. To begin with, it discovered a consistent and statistically significant positive effect of *RASKIN* on household calorie and three macronutrient intake. ESR estimation results revealed actual and counterfactual scenarios in household calorie intake. The results disclosed that *RASKIN* recipients would significantly consume fewer calories, protein, fat, and more carbohydrates if they did not receive the subsidy. Furthermore, nonrecipients would consume more calories, protein, and fat and fewer carbohydrates if they

obtained the subsidy. In other words, *RASKIN* was significantly related to the intake of calories and three other macronutrients.

Policymakers should consider the long-term viability of *RASKIN* for low-income families in light of the positive and statistically significant effect on the intake of calories and macronutrients. They should address irregularities, especially in rural Java and eastern Indonesia (Maluku and Papua). *RASKIN* aims to alleviate food insecurity and poverty. However, Indonesia should not solely rely on *RASKIN*, necessitating additional programs focusing on food security issues, such as food vouchers and cash transfers. Therefore, when considering the policy mix for poverty reduction, the combined effect of multiple policies must be considered. Indonesia has provided many subsidy models for people experiencing poverty. To discover the effectiveness of several subsidies, it is necessary to carry out an in-depth study of each subsidy and a combination of subsidies to determine the most effective one for increasing the nutritional intake and zero hunger of specific households in Indonesia.

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