Improving Food Security through Financial Inclusion

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Abstract
Financial inclusion may accelerate food insecurity reduction, an issue in Indonesia's development. However, studies examining the relationship between financial inclusion and food security remain inconclusive and scarce in Indonesia. Therefore, this study aims to analyze how strong the relationship between those variables is, both in general and within specific groups. This study mainly used data from the National Socio-Economic Survey (Susenas) 2020. Food security is measured by dietary diversity score (DDS), while financial inclusion is measured by household accessibility to savings and credit. The association between those variables is examined using the Ordinary Least Square (OLS) method. The results show that financial inclusion is positively related to household food security at a significant level, in general, and according to poverty status and location category. Therefore, expanding financial inclusion may be suggested as an alternative to improve food security.

Keywords:
food security; dietary diversity score; financial inclusion

INTRODUCTION

So far, food security is still a general problem that has been worked on not only at the national level but also globally. Food security has to be improved because of its strategic role in health and productivity (Rusmawati & Hartono, 2021). Food security is a key to achieving healthy, intelligent, active, and productive human resources (Badan Ketahanan Pangan, 2019). Meanwhile, according to several previous studies, the inability to maintain food security is strongly related to health deterioration both physically (Ziliak & Gundersen, 2017) and mentally (Nagata et al., 2019), obesity increase (Brewer et al., 2010), chronic conditions increase such as cardiovascular disease (Seligman, Laraia, & Kushel, 2010) and diabetes (Billimek & Sorkin, 2012), and individual quality of life (Gyasi et al., 2019).

Food security is a state where people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that fulfills their dietary needs and food preferences for an active and healthy life (FAO, 2008). Therefore, food security is identified to be based on four dimensions, which are availability, accessibility, utilization, and stability. Availability is reflected by supply, or the availability of sufficient food which can be affected by the production, stock levels, and net trade of food. Accessibility describes the possession of sufficient resources to obtain food that meets nutritional standards. Therefore, an adequate food supply in an area does not guarantee food security at the household level. Utilization means the guarantee of a person's ability to consume food that is available according to nutritional needs. Lastly, food stability reflects the sustainability of the previous three dimensions all the time. Thus, even though a person's food consumption is sufficient at a certain time, it can be categorized as food insecure if the access is not sustainable over time or risking a deterioration of nutritional status that may be caused by various factors such as weather conditions, political instability, or economic instability (FAO, 2008).

The FAO (2021) stated that food security has continued to decline since 2014, and 720-811 million people in the world were estimated to experience hunger by 2020. If there's no acceleration to overcome this issue, the number will reach 660 million by 2030 due to the prolonged effects of the pandemic (FAO, 2021). Whereas, based on the second goal SDGs, it is expected that by 2030 all countries will end hunger and achieve food security and nutritional improvements.

Similar to global conditions, Indonesia is still experiencing food security problems. Badan Ketahanan Pangan (2019) noted that 76 out of 514 districts/cities are still experiencing food vulnerability. Meanwhile, compared to other countries, Indonesia's Global Food Security Index (GFSI) is ranked 62 out of 113 countries. This indicates that the availability, affordability, quality, and safety of food in Indonesia are still lagging behind other countries. The status of nutritional fulfillment in Indonesia is still considered less than international standards with high variations between regions (Arif et al., 2020). Therefore, Indonesia is still working on improving the resilience of food.

On the other hand, FAO (2013) stated that most of the individuals who live in rural areas and experience hunger do not have access to or are excluded from the formal

financial system. Murendo et al. (2021) stated that financial inclusion is very important for low-income and marginal groups in society. Financial inclusion is defined as accessibility to financial products and services that are useful and affordable to meet individuals' and businesses' needs such as transactions, payments, savings, credit, and insurance that are used responsibly and sustainably (Demirguc-Kunt et al., 2018). Simply put, financial inclusion is the ability to access financial products and services (King, 2013).

Households with better financial management skills are likely to be food secure since they may optimize their food consumption and can overcome negative financial shocks, such as income decline and unexpected expenditures (Gundersen & Garasky, 2012). Those households may have some savings to serve as an emergency fund to keep the stability of their consumption. This argument is supported by Cnaan et al. (2012), who stated that financial inclusion in the form of easy access to safe and accessible banking will make money management efficient in dealing with emergencies and unstable income flow. Besides that, financial inclusion enables poor households to access affordable finance for undertaking economic activities to gain some advantages (Cnaan et al., 2012). These processes may lead to more food-secure households.

Based on that background, a comprehensive study of the relationship between financial inclusion and food security is necessary. From various previous studies, financial inclusion which is commonly measured at the micro-level through financial services accessibility is still inconclusive. The positive relationship between financial inclusion and food security is demonstrated by Annim & Frempong's (2018) study in Ghana. By applying instrumental variable techniques, Annim & Frempong (2018) concluded that access to credit contributes to an increase in the diversity of food consumed by households. On the other hand, research by Loibl et al. (2017) in the United States and Namayengo et al. (2018) in rural Uganda concluded a negative relationship between financial inclusion and food security. By applying the Tobit regression technique, Loibl et al. (2017) demonstrated that children's food insecurity was recorded higher in families who had payday loans or pawn shop loans and in families who participated in the Individual Development Account (IDA) than the general population. Along with this, Namayengo et al. (2018) with the Difference in Difference (DiD) technique concluded that food security decreased after households took credit. This could be caused by the households having difficulty in paying off the credit installment which later forced them to reduce their consumption (Augsburg et al., 2015).

Prior studies regarding financial inclusion in Indonesia mostly focused on the relationship between financial inclusion to poverty at the regional level (Erlando et al., 2020; Fauzan et al., 2020; Khoirunurrofik & Fitriatinnisa, 2021), the income gap (Khoirunurrofik & Fitriatinnisa, 2021), the development of MSMEs (Adriani & Wiksuana, 2018), and energy poverty (Widyastuti & Hartono, 2022). Most of those studies also utilize macro data available from various sources. To the best of our knowledge, studies of financial inclusion – food security nexus has never been carried out under Indonesian context. Therefore, this study aims to analyze the relationship between financial inclusion and household food security in Indonesia. Using microdata from National

Socio Economic Survey, this study also tries to extend the analysis according to poverty status and household residence location. This study contributes to the literature as a depth analysis of the important role of financial inclusion in improving food security. The findings of this study is expected to contribute as a principle for the formulation of the government policy, especially to increase food security.

METHODS

This study uses data from the National Socio-Economic Survey (Susenas) conducted by Statistics Indonesia in 2020. The data included 334,447 households samples spread across 514 districts/cities in Indonesia. Susenas data is used to obtain information about food security as the dependent variable and also financial inclusion information as the independent variable in this study. Based on the availability of the existing Susenas data, one of the food security measures, which are often used, is the dietary diversity score (DDS). DDS is one of the simplest approaches to measuring the adequacy of food consumption at the household level as an indicator of food security (Cafiero et al., 2014). DDS describes the diversity of food consumed, which is considered a key element of the diet and is measured by summing the number of food groups that households consume over a given period. According to the concept used in Susenas, the reference time used is the last week before the data collection and the calculation of the score includes 12 food groups. The food group consists of grains, tubers, fish, meat, eggs and milk, nuts, vegetables, fruits, oil and coconuts, beverages, seasonings, and other consumption. The group does not cover the consumption of alcoholic beverages, cigarettes, and tobacco.

Some academics mentioned that DDS has several advantages. First, food diversity reflects both macronutrients and micronutrients which are important components of food safety and nutrition (Ruel, 2003). Second, food diversity is considered more in accordance to capture the real conditions, where wealthier people tend to switch their consumption from high-calorie foods to more nutritious ones (Jensen & Miller, 2010). Third, food diversity also has a good performance in measuring economic status and malnutrition, is sensitive to shock, and is relatively inexpensive to implement (Headey & Ecker, 2013).

One of the disadvantages of DDS is that it is often criticized for its lack of comparison between countries. In its application, there are differences in calculating diversity, for example, based on food groups, food codes, or even food composition (Steyn et al., 2006). However, because the study does not aim to find comparisons between countries, the weakness of the DDS does not affect this research. In addition, although it can be said that DDS cannot be considered a comprehensive measure of food security, DDS can describe energy consumption at the household level. If analyzed together with information related to other measures of food security, a comprehensive picture of food security status and its impact on access to diverse diets (Cafiero et al., 2014).

In addition to food security, Susenas is also used to obtain financial inclusion data. In this case, financial inclusion is measured by access to banks and access to credit. These variables are dummy with a value of 1 if the household has access and

0 if it does not have one. Households are said to have access to a bank if there are household members who have savings accounts in financial institutions. Households are also said to have access to credit if in the past year there are household members who have received credit either from banks, unions, pawnshops, financing companies, joint business groups (KUBE / KUB), or Village-Owned Enterprises (Bumdes).

The study also used several control variables which were selected based on previous studies by Abor et al. (2018), Gyasi et al. (2021), Murendo et al. (2021). Those control variables consist of the head of the household's characteristic variables (gender, marital status, age, education, work status), the household's characteristic variables (location, household size, disability, asset ownership, and savings ownership), and characteristic variables at the district/city level (per capita gross domestic product of agricultural sector, the market ratio per 1,000 residents and the store ratio per 1,000 residents). The head of the households and household variables are obtained from Susenas data, while the characteristic variables at the district/city level are obtained from GDP publication published by Statistics Indonesia and Village Potential Data Collection.

The gender variable is valued 1 if the household head is a male and 0 if it is female. The marital status variable is valued by 1 if the household head is married, otherwise, it is valued 0. The age variable is a continuous variable of the age of the household head. The education variable consists of 5 categories, which are not graduating from elementary school, graduating from elementary school, graduating from junior high school, graduating from senior high school, and higher than senior high school. The work status variable is a dummy variable with the category of not working (reference category), working in the agricultural sector, and working in the non-agricultural. The location variable is valued 1 if the household lives in an urban area and is valued 0 if the household lives in a rural area. The household size variable is a discrete variable of the number of household members. The disability variable is valued 0 if there is a household member with a disability and is valued 1 otherwise. The assets variable is valued 1 if the household has at least 1 type of asset and is valued 0 if it has no assets at all. The personal saving variable is valued 1 if the household has at least 10 grams of gold/jewelry and is valued 0 if the household has less than 10 grams of gold/jewelry or none at all. Various control variables are incorporated into the model to reduce bias.

To answer the purpose of the study, which is to analyze the relationship between financial inclusion and food security, the Ordinary Least Square (OLS) linear regression model will be applied. This method is chosen because of its ability to examine the relationship between continuous dependent variables and some independent variables. The OLS method minimizes the square value of the difference between the observed responses in the data group to the predicted response using a linear approach. Mathematically, the research model can be written as follows:

$$DDS_i = \alpha_0 + \alpha_1 saving + \gamma_s X_i + \varepsilon_{1i} \qquad (1)$$

$$DDS_i = \beta_0 + \beta_1 credit + \gamma_c X_i + \varepsilon_{2i} \qquad (2)$$

Coefficients α_1 is the magnitude of the relationship between access to savings and household food security as measured by the dietary diversity score, coefficient β_1 is the magnitude between access to credit and household food security, and X_i is the control variable inserted into the model.

In addition to the main model estimation, the study will also conduct some follow-up analyses. First, heterogeneity analysis according to poverty status and location where the household lives. Second, perform the Oster test to ensure that possible biases in the model do not change the direction of the study variable coefficient (see Table 4).

RESULT AND DISCUSSIONS

Table 1 shows a statistical summary of each research variable. It is known that on average, households have a food diversity score of 10.47. A higher value of food diversity score indicates higher food security. In general, it can be said that the food diversity score is relatively high because it is higher than 8. This classification is based on research by Murendo et al. (2021) and Pauzé et al. (2016) which classify food diversity scores into 3 categories, namely low (score 0-5), medium (score 6-7), and high (score 8-12). Meanwhile, the average access to savings and access to credit was 0.6530 and 0.2008, respectively. In other words, about 65.30 percent of households have access to savings and 20.08 percent of households have access to credit.

Table 1. Research Variable Statistical Summary

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
(1)	(2)	(3)	(4)	(5)
Dependent Variables				
DDS	10.4740	1.5495	1.0000	12.0000
Independent Variables				
Access to Saving	0.6530	0.4760	0.0000	1.0000
Access to Credit	0.2008	0.4006	0.0000	1.0000
Characteristics of the Household Head				
Marital Status	0.7936	0.4047	0.0000	1.0000
Gender	0.8404	0.3662	0.0000	1.0000
Age	49.1066	13.5053	11.0000	97.0000
Education	2.9269	1.3332	1.0000	5.0000
Working in Agriculture	0.3818	0.4858	0.0000	1.0000
Working in Non-Farm	0.4967	0.4999	0.0000	1.0000
Household Characteristics				
Location	0.4128	0.4923	0.0000	1.0000
Number of Household Members	3.7648	1.7107	1.0000	26.0000
Disability Status	0.0531	0.2243	0.0000	1.0000
Asset Ownership	0.9496	0.2188	0.0000	1.0000
Personal Saving	0.1745	0.3795	0.0000	1.0000
District/City Level Characteristics				
Ln Agricultural GDP per Capita	8.3469	1.1412	3.5042	10.7350
Market Ratio	0.1790	0.1644	0.0000	1.5281
Store Ratio	7.9433	4.0749	0.0418	28.3446
Number of Observations	334,447			

Source: Susenas 2020, processed

The head of the household generally has the characteristics of married (79.36 percent), male (84.04 percent), with an average age of 49.11 years, completed a minimum of elementary/equivalent education, and worked in the non-agricultural sector (49.67). In addition, it can be seen that a household averagely has 3 to 4 members. There are 41.28 percent of households living in urban areas, 5.31 percent of households have members with disabilities, 94.96 percent of households have at least 1 type of asset and 17.45 percent of households have personal saving. At the district level, the market ratio per 1,000 residents is 0.18, while the store ratio per 1,000 residents was 7.94.

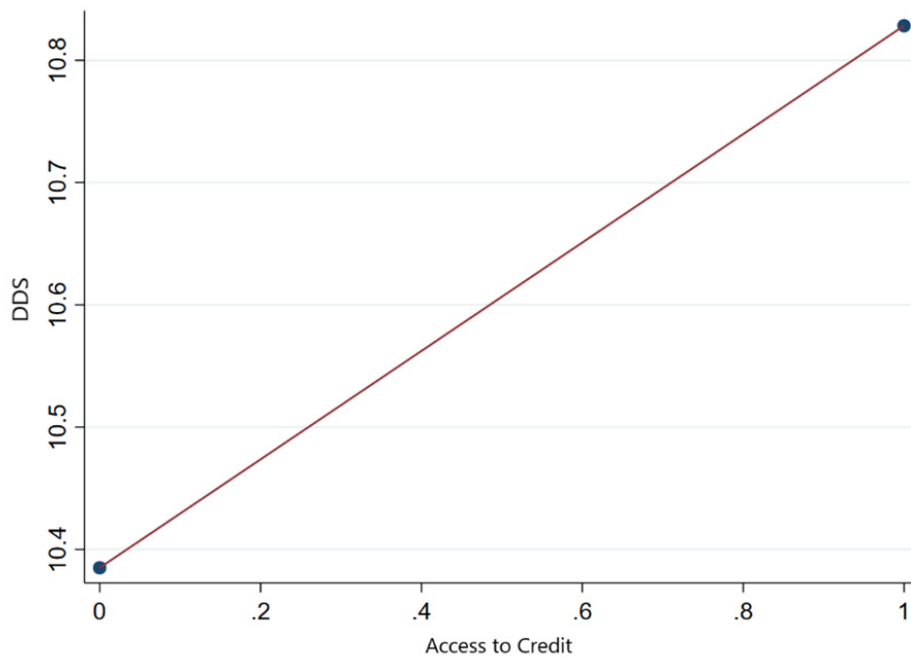**Figure 1. Access to Savings and Food Security Relationship**
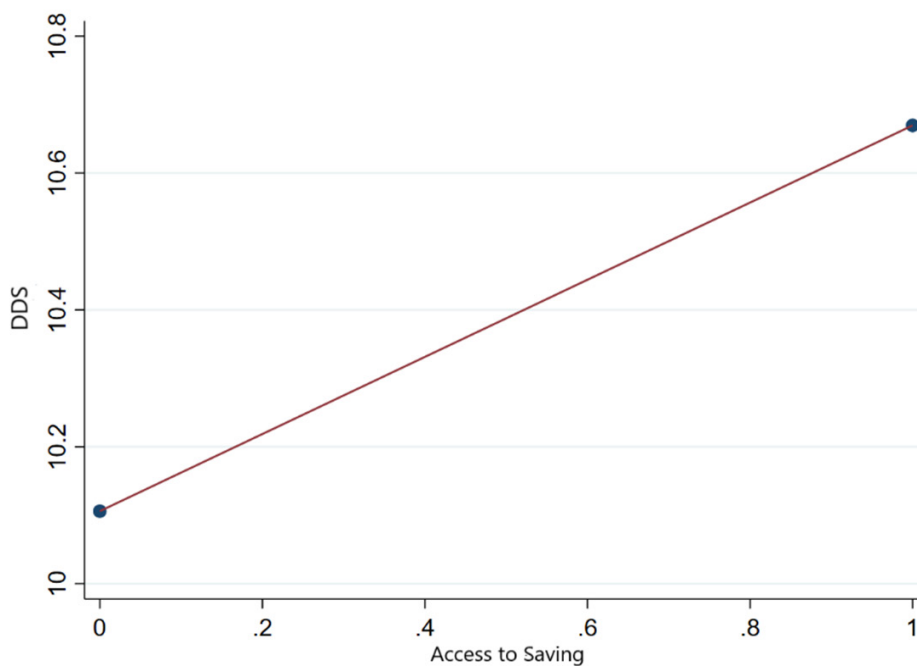
Source: Susenas 2020, processed

By plotting the variables (see Figure 1 and Figure 2), it can be seen that there is a positive relationship between financial inclusion and food security. This means that households with inclusive finances tend to have better food security. Comparing both of the graph, it can be seen that access to savings – food security nexus has a steeper slope compared to access to credit – food security nexus. This gives an early indication that access to savings has a higher effect on improving food security than access to credit. Although this plotting provides a pretty good intuition, it needs to be seen from the results of regression to find out whether the magnitude of the relationship is significant or not.

The results of the regression of access to savings and credit on food security can be seen in Table 2. The results were obtained through robust Ordinary Least Square estimates due to the issue of heteroscedasticity. Models 1 and 2 use the access to

savings as independent variables without control variables and with control variables respectively. Models 3 and 4 use the access to credit as independent variables without control variables and with control variables respectively. Models 5 and 6 use both access to savings and credit access as independent variables without control variables and with control variables respectively.

Figure 2. Access to Credit and Food Security Relationship

Source: Susenas 2020, processed

Based on Table 2, it can be seen there is a positive relationship between access to savings and access to credit in food security, with coefficients of 0.179 and 0.156, respectively. At the mean level, access to savings is associated with the improvement of food security by 1.71 percent, while access to credit is associated with the improvement of food security by 1.49 percent. Some control variables also have a positive relationship to food security, namely the marital status of the household head, age of the household head, work status of the household head, household location, household size, household asset ownership, and household personal saving. In addition, the control variables at the district/city level that are recorded to have a positive relationship with food security are agricultural GDP per capita and store ratio.

Generally, the result is similar to the research conducted by Murendo et al. (2021) in Zimbabwe, which stated that financial inclusion increased food diversity by 12 percent and food consumption by 14 percent although this study yields smaller magnitudes. The smaller magnitude of those associations, in this case, is possible because the initial DDS in Indonesia is relatively high (10.474), compared to the average DDS in Murendo et al. (2021), which is 8.06 for financially included households and 6.87 for financially excluded households.

Table 2. Financial Inclusion Regression Results on Household Food Security

	Access to Saving		Access to Credit		Access Saving and Credit	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Access to Saving	0.564***	0.201***			0.508***	0.179***
	(0.006)	(0.006)			(0.006)	(0.006)
Access to Credit			0.443***	0.187***	0.318***	0.156***
			(0.006)	(0.006)	(0.006)	(0.006)
Marital Status		0.894***		0.891***		0.885***
		(0.013)		(0.013)		(0.013)
Gender		-0.558***		-0.563***		-0.559***
		(0.014)		(0.014)		(0.014)
Age		0.00643***		0.00637***		0.00649***
		(0.000)		(0.000)		(0.000)
Education		-0.0142***		-0.00595**		-0.0142***
		(0.002)		(0.002)		(0.002)
Work in Agriculture Sector		0.126***		0.103***		0.123***
		(0.010)		(0.010)		(0.010)
Work in Non Agriculture Sector		0.323***		0.311***		0.310***
		(0.010)		(0.010)		(0.010)
Location		0.193***		0.206***		0.194***
		(0.006)		(0.006)		(0.006)
Household Size		0.143***		0.148***		0.141***
		(0.002)		(0.002)		(0.002)
Disability Status		-0.557***		-0.584***		-0.555***
		(0.016)		(0.016)		(0.016)
Asset Ownership		0.605***		0.630***		0.594***
		(0.015)		(0.015)		(0.015)
Deposits		0.334***		0.362***		0.332***
		(0.006)		(0.006)		(0.006)
Ln Agricultural GDP per Capita		0.0147***		0.0128***		0.0120***
		(0.003)		(0.003)		(0.003)
Market Ratio		-0.126***		-0.117***		-0.108***
		(0.016)		(0.016)		(0.016)
Store Ratio		0.0382***		0.0382***		0.0379***
		(0.001)		(0.001)		(0.001)
Observation	334,447	334,447	334,447	334,447	334,447	334,447

Standard errors in parentheses

* p< 0.05, **p < 0.01, ***p < 0.001

Based on the financial services type, access to savings and access to credit both associate positively with food security measured by household dietary diversity score. The positive relationship between access to savings and food security is in line with the study conducted by Baborska et al. (2020). The study found that the use of formal savings services reduces the probability of experiencing food insecurities significantly among individuals who live in rural areas of low-and middle-income countries. It implies that individuals deciding to save money at formal financial institutions enable them to accumulate and access extra money when necessary, and thus are less worried about the resources needed in obtaining food. Meanwhile, the positive relationship between access to credit and food security supports the research by Annim & Frempong (2018), which found that access to credit contributes to a more diversified diet of Ghanaian household, which is measured by food diversity index and food consumption score.

An interesting fact is seen in Table 2 where the variable coefficient of access to savings (0.201) is greater than the variable coefficient of access to credit (0.187). In other words, savings ownership has a stronger association with the increasing diversity of food consumed by households. This can be understood because taking credit for investment implies a repayment commitment that may put a burden on income and consumption when one's resources are limited (Baborska et al., 2020). However, the positive association between access to credit and food security shown in Table 2 clarifies that households are still able to balance out the burden and the advantages.

Table 3. Heterogeneity by Poverty Status and Location

(1)	Poverty Status		Location	
	Poor	Not Poor	Rural	Urban
	(2)	(3)	(4)	(5)
Access to Saving	0.148***	0.133***	0.215***	0.114***
	(0.006)	(0.021)	(0.007)	(0.010)
Access to Credit	0.131***	0.125***	0.192***	0.0824***
	(0.006)	(0.031)	(0.008)	(0.010)
Control Variables	Yes	Yes	Yes	Yes
Number of Observations	311,820	22,627	138,045	196,402

Standard errors in parentheses
* $p < 0.05$, **$p < 0.01$, ***$p < 0.001$

To analyze the difference or heterogeneity of the relationship magnitude between financial inclusion and food security, the study used regression-based on poverty status and location. Poverty status is divided into poor and not poor, while locations are categorized

into rural and urban areas. The relationship pattern in each category is similar to the main regression results, where access to savings has a stronger association with food security than access to credit does.

According to poverty status, it can be seen that access to savings has a greater influence on the food security of poor households (0.148) than non-poor households (0.133). At the mean level, access to savings has an effect of 1.41 percent on improving the food security of poor households and 1.27 percent on non-poor households. Meanwhile, access to credit had a smaller effect, 0.131 for poor households and 0.125 for non-poor households, or 1.25 percent for poor households and 1.19 percent for non-poor households at the mean level. These results are supportive of Murendo et al. (2021) research that highlights the importance of financial inclusion for low- and marginal-income groups in society.

According to the location, access to savings is associated with increasing the food security of households living in rural areas by 0.215 points or 2.05 percent (see Table 3). This magnitude is higher than those living in urban areas, which is about 0.114 or 1.09 percent. Along with this, access to credit was also associated with an increase in the food security of households living in rural areas by 0.192 or 1.83 percent. This number is more than twice the association magnitude in households living in urban areas, which was 0.0824 points or 0.79 percent. Intuitively, the impact of financial inclusion is expected to be greater for rural areas than urban areas. It can be estimated that rural environments have limited financial services facilities. Therefore, some previous studies only focused on the issue of financial inclusion in more vulnerable groups, namely households living in rural areas, as done by Murendo et al. (2021) and Baborska et al. (2020).

Table 4. Oster Test Results

	Independent Variables	
	Access to Savings	**Access to Credit**
(1)	**(2)**	**(3)**
Delta	1.305	2.122
Beta	0.121	0.141
Uncontrolled Coefficient	0.564	0.443
Controlled Coefficient	0.201	0.187
Uncontrolled R-squared	0.030	0.013
Controlled R-squared	0.155	0.153

A comparison of financial inclusion coefficients on the estimation results using the OLS method with and without control variables can be seen in Table 2. The results indicate that the estimation model is robust since the coefficients are quite consistent on various specifications. However, without considering the R-squared movement, the stability of the coefficient is less informative (Oster, 2019). Therefore, to ensure the consistency

of regression results will be carried out robustness is checked by running Oster test (see Table 4). By applying the Oster test, we can see whether the unobserved bias causes a change in the coefficient direction or not.

The delta value indicates the bound estimate or degree of selection on the unobservables relative to the observables. A delta value of 1.3 in a model that uses access to savings as an independent variable means that the unobservables must be 1.3 times more meaningful than the observables to produce a beta of zero or to express the absence of effects from treatment. A delta value of 2.1 in a model that uses access to credit as an independent variable means that the unobservables must be 2.1 times more meaningful than the observables to produce a beta of zero or to express the absence of effects from treatment. Meanwhile, the beta value indicates the magnitude of the bias-adjusted treatment effect. The beta value on the model that uses the independent variable access to savings is 0.121 and the one that uses access to credit is 0.141. From the coefficient comparison between models with and without control variables, it can be seen that all of them have the same direction. This means that the bias in the OLS model does not cause the coefficient to change direction and indicates that the estimated results are quite robust as well.

CONCLUSION

Food insecurity is still a problem that needs to be addressed in Indonesia. On the other hand, financial inclusion is believed to be one of the alternatives to accelerate the handling of various problems in economic development, including food insecurity. However, empirical evidence of the impact of financial inclusion on food security in Indonesia is still scarce. To meet that knowledge gap and contribute to the growing literature on the important role of financial inclusion, the study aims to analyze whether financial inclusion has an impact on improving food security at household level. This study utilized Susenas 2020 data and several other supporting data. Using the OLS method, the study produced several findings that could provide some policy implications. Financial inclusion as measured by access to savings and access to credit was significantly associated with improved household food security as measured by a dietary diversity score (DDS). Based on poverty status and location, financial inclusion significantly improves food security in both poor and non-poor households. Based on these results, if the government wants to improve household food security, then one alternative that can be taken is to increase household financial inclusion. Financial inclusion is significantly associated with improved food security both in households in all economic conditions and across the region. Thus it can be said that the policy of increasing financial inclusion can be applied in general to all households.

Although the results of the estimate are fairly consistent, it should be noted that this study has some limits. First, is the use of cross-section data in the model estimation. This results in the unknown relationship of financial inclusion to food security varying between times. Second, the variable of financial inclusion is measured by household access to

formal financial services so it cannot describe how those financial services are utilized by households. This is due to the unavailability of data that can measure the use or utilization of financial services by households. Future research on financial inclusion and food insecurity may be able to improve some of those limitations, for example by using panel data or finding other variables that can better reflect whether or not a household is inclusive in its finances.

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