

AGE PROGRESSION, SOCIAL INTERVENTIONS AND FOOD INSECURITY IN SOUTH AFRICA: LOGISTIC REGRESSION ANALYSIS

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—Abstract—

The central philosophy of this study is guided by the perceived declining welfare package to the people as they grow older in global south economies since they are less economic active in the society. This study evaluated the impact of age progression on food insecurity since at old age less economic activities are executed by senior citizen which reduces the capacity of income earning and later food purchasing ability. The food insecurity is viewed from the angle of food inaccessibility using the “run out of money to buy food” variable as a proxy while age progression is proxied with “age of household head” and social interventions are proxied with social grants and pensions. The study employed logistic regression analysis to determine the impact of age progression on food insecurity in South Africa. The South African general household survey conducted by Statistics South Africa in 2017 forms the source of data for this study. The general household survey consists of 20,908 households in which vital information on food insecurity and socioeconomic variables are elicited from. The empirical result revealed that as household head get older, the more the level of food insecurity due to less economic activities engaged in as a result of inability. The findings

further proved that social interventions; social grants and pensions are statistically significant to food insecurity and there is strong tendency that as social grants and pensions increases, food insecurity declines in South Africa. In order to raise the level of welfare (food accessibility) of the citizenry as they get older, there should be a well channeled and purposeful social interventions by the governments (local, provincial and national) and private organisations to the senior citizen of the society.

Key Words: Age, social interventions, food insecurity, Logistic regression analysis and South Africa

JEL Classification: Z1, H55, Q18, C83, N57

1. INTRODUCTION

Food insecurity portrays the direct opposite of food security that tends to be the target of every society as captured in the objective two of sustainable development goals (SDGs) – no hunger by 2030. The goal target to end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.¹ Food and Agriculture Organisation [FAO] (2018), food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. As important as the basic need of food consumption, the attainment of optimal level of food consumption is still dystopia majorly in the global south countries in no exception of African region.

Evidence confirms a rise in global hunger as the number of people who suffer from hunger has been growing over the years, returning to levels from almost a decade ago with more than 800m people experiencing under nourishment.² Multiple forms of malnutrition are evident in many countries: adult obesity is growing even as forms of undernutrition persist. Food insecurity, or lack of consistent access to enough food to support an active, healthy life, is a major public health problem (Gundersen & Ziliak, 2015).

Studies suggest that climate variability and extremes are key drivers behind this rise, together with social unrest and economic downturns, and are

¹ <https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-2-zero-hunger.html#targets>

² <http://www.fao.org/publications/sofi/en/>

threatening to erode and reverse gains made in ending hunger and malnutrition. SOFI (2018) reveals new challenges on the road to Zero Hunger, while setting out urgent actions needed to achieve the goal by 2030.

The right to food is enshrined in the South African Constitution. The right to food requires that food be available, accessible, and adequate for everyone without discrimination. The Department of Agriculture, Forestry and Fisheries (DAFF) is responsible for developing agricultural policies and initiate support programmes to ensure that South Africans are able to produce their own food and reduce food insecurity.³ In achieving the target of food sufficiency as hindered by high level of poverty as a result of mass uneconomic situation of the populace. The vicious cycle of poverty identifies low income as a major setback for effective demand that causes demand pull food insecurity. Poor effective demand is usually countered by social interventions to improve welfare of the state. In most developing countries, social interventions are targeted at the vulnerable people like the ages and kids that are at the bottom of the pyramid and this will cushion the effect of their vulnerability and improve their social welfare. Ando and Modigliani's life cycle income theory emphasises the dissaving nature of unproductive time of man i.e. childhood and old age (Johnson & Markowitz, 2018; Lee, Scharf & DeBoer, 2018). In this period income are not received, food insecurity are bound to be triggered but with social intervention, optimal food consumption is attainable.

Statehood nurtures the priority agenda of social welfare maximization among which food security is highly itemised. Accessibility of adequate and nutritional food consumption is set at higher target of planning dues man's existence higher ratio on quality of food consumption. In the process of achieving food security, there are some cogent factors that threaten the sustainable food consumption, leading to food insecurity (Alvarez, Lantz, Sharac & Shin, 2015). These factors are largely present in global south countries including South Africa where there are low level of income, high level of unemployment, unfavourable age distribution, inefficient production of food, high rate of market imperfection and massive migration from rural area to cities in search for white collar employment. South Africa is not in exception of these factors as they hinder attainment of food security at household level.

³ <https://www.southafricanmi.com/south-africas-food-security-30mar2019.html>

Against this backdrop, one question that comes to mind is what are the influence of age and social intervention programs on optimal food consumption in South Africa? This research question informs the objective of this study which intends to investigate the impact of age progression and social interventions on food insecurity in South Africa.

The structural layout of this study are: section one which consists of the introduction to the research theme; while section two largely comprises of the review of literature as background search on the status quo on food insecurity as related to age and social interventions. In the section three, research methodology for achieving the set target of this study will be presented on the basis of gaps identified in the literature review. Section four will present the data and analysis on food insecurity in South Africa and lastly section five will conclude and suggests recommendations for the study.

2. LITERATURE

Food security appears, by definition, “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, IFAD, & WFP, 2015).

2.1. Food insecurity

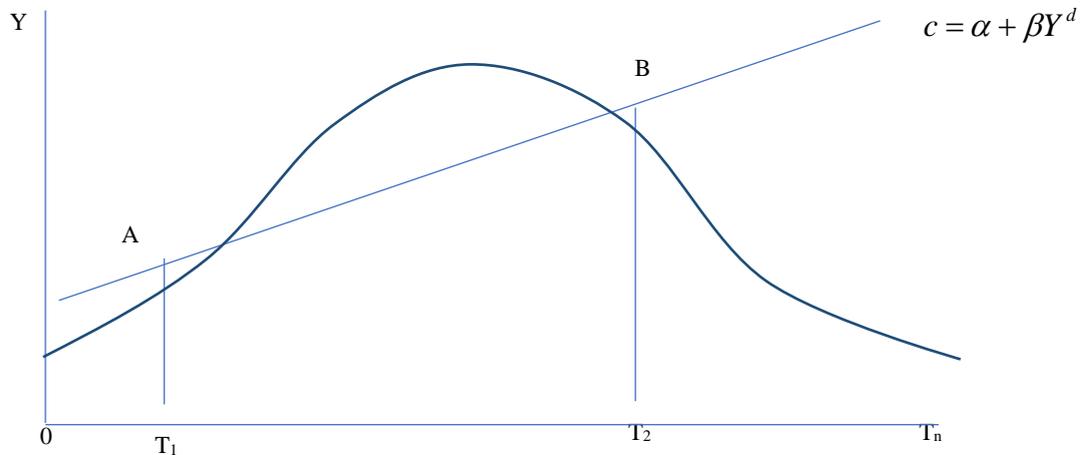
Aurino and Morrow (2018) opined that children experience has influence on food insecurity and food insecurity spurs dietary deficiency in India. The study employed longitudinal mixed-method technique to ascertain the influence of food consumption imbalance on the dietary diversities of kids living in Andhra Pradesh and Telengana, India. The evidence from this study suggested that food insecurity has negative impact on health outcome/status of children in the area. Some of the health challenges attributed to food insecurity are children over-weight, dietary deficiency and poor mental ability (Nguyen, Ford, Yaroch, Shuval & Drope, 2017).

Bishop and Wang (2018) study on food insecurity, comorbidity and mobility limitations of ages in US asserts that food insecurity tends to influence ages mobility limitations in US. The study further employed Poisson regression to detect that food insecurity is correlated with prevalence and change in mobility limitations of the ages in US. In another dimension, Frith and Loprinzi (2018) evaluates the level of association between food insecurity and cognitive functions among the older adult in

US. The study used the National Health and Nutritional Examination Survey (NHANES) data from 1999 to 2002 for people between the age of 60 and 85 years. In the course of data sorting, 1851 older adults within the age limit were identified for evaluation. The study found that inverse association exist between food insecurity and cognitive function of older adult in US. Health of the older adult are linked with food insecurity in Lisborn where the health status is captured with weight and nutritional status (Ganhao-Arranhado, Paul, Ramalho & Pereira, 2018; Nguyen, Ford, Yaroch, Shuval & Drope, 2017).

2.2. Theoretical framework

Several literature consulted focused on the interaction between food (in) security, health outcomes and poverty at a particular age of human being such as childhood, youthful age and old age (Bishop & Wang, 2018; Frith & Loprinzi, 2018; Ganhao-Arranhado, Paul, Ramalho & Pereira, 2018; Nguyen, Ford, Yaroch, Shuval & Drope, 2017). The progression of the age is neglected in the analysis of most studies but life cycle hypothesis clearly explained the importance of time progression in income generation that determines consumption expenditure. Since time (age) progression is very important to income and consumption expenditure, this study draws its philosophy from the tenet of discounting and annuity principles of income-expenditure nexus for food insecurity in South Africa. It is well documented in the theories that at the early age of a man where man is not gainfully employed with no income, consumption expenditures depend solely on gifts and subsidies from relatives or government, at this period man dis-saves (Johnson & Markowitz, 2018). Once man is gainfully employed, consumption expenditure is covered by income and excess income is saved for the era where no income is earned, *ceteris paribus*. The old age time of man's life is the period in which excess savings in the past productive years are converted to consumption expenditure to cater for current consumption expenditure inclusive of food consumption (Ando & Modigliani, 1963).

Figure 1: Life cycle income hypothesis

In figure 1, it is clearly shown that consumption expenditure where food purchase falls in, linearly related with disposable income with $c = \alpha + \beta Y^d$ equation and the slope of the curve is β but the slope of the curve for life cycle income hypothesis is exponential with a bell-shaped curve. The life cycle curve shows the rising-decline state of income as one get older due to less productivity attached to age progression. The point of intersection between both curves depict the equilibrium state where income equals consumption expenditure. The positive net-saving period is captured by AB (T_1T_2) but the negative net-saving is captured by slope preceding A, ($0T_1$) and slope succeeding B, (T_2T_n). The T_1T_2 is the period that productivity and income are higher, save excess income for old age and consume the accumulated savings in future when productivity and income decline.

The major setback of this analogy is that the theory assumed that man will always be gainfully employed mostly from youthful age (14 year) to end of active service age (65year), but in reality this assumption do not hold, most especially in underdeveloped and developing countries where unemployment rate and under-utilisation of resources are conspicuously present.

2.3. Measuring food insecurity

The centrality of this study lies in the adequate evaluation of food insecurity in South Africa. Literature tend to view food (in) security from three perspectives; food availability, food accessibility and food utilisation (FAO,

2018). Food accessibility and food utilisation dissect food (in) security from the demand side perception as it relates to the consumption while food availability views food (in) security from the supply side perception as it relates to production of food (Alvarez, Lantz, Sharac & Shin, 2015). In order to attain food security, equilibrium is expected to exist in the food chain but in reality, this is not always be the case most especially global south countries where there is existence of limited resources for food production and consumption (David & Grobler, 2019).

In this study, food (in) security is viewed from the demand side because there is direct relationship between age progression, ability to work and productivity (David & Grobler, 2019). In a state of low productivity, less or no income will be earned and this leading to poor status of a household. The poverty status of a household has strong connection with high level of poverty experiencing in South Africa that restricts the demand for food. Thus, this study measured food insecurity based on the inability of the household to purchase food within a month (run out of money to buy food).

2.4. Measuring age progression

As opined in the work of Ando and Modigliani (1963) for life cycle income hypothesis that age is important in determining the active time of a man, while activeness drives productivity and productivity dictate the earning/income capacity. The traditional consumption theories relate income to consumption expenditure that food expenditure forms part of the components. Thus, as the age progresses, at the initial stage the activeness progresses, thereby yielding higher productivity and income then expenditure but once the active age attains its peak, the productivity diminishes and the income/consumption expenditure may also decline, though in exceptional case the income/consumption expenditure may continue to rise, which is the backward bending supply curve state which narrates the abnormal labour supply theory (backward bending labour supply curve).

In this study, the age progression is measured by the age of the household heads in South Africa, this study detects the impact of age of household heads on inability of a household to purchase food for a period of time.

2.5. Measuring social interventions

In the state where income continue to decline or no income to meet the daily required expenditure like food, there is need for government's social

intervention to support the household that is experiencing dwindling income in order to maintain moderate optimal food consumption status. This study measures social intervention with social grants received by the household and pensions received by the retired household members.

3. METHODOLOGY

The life cycle hypothesis forms the economic theory rationale for this study in which importance of age factored into general consumption pattern that food consumption is a subset. Food consumption largely depends on the spending capacity of an individual while the spending capacity depends on income of the individual. The theory assumes that the older an individual becomes, up to the point of pension, the lower will be the income and perhaps food consumption capacity since income is one of the key factors of food consumption (Alvarez, Lantz, Sharac & Shin, 2015).

Food insecurity is viewed from the demand side where food intake is measured by consumption expenditure on food in South Africa. Consumption is a by-product of demand; theoretically, consumption and demand are individually functions of price of products, people, productive pay (income), place and period (Marshall, 1920). In classification, consumption theory is a macroeconomic issue while demand theory is a microeconomic issue. Since this study concerns household demand for food in South Africa, demand theory is adopted in which food intakes measured by expenditure on food is assumed to be determine by price of foods, productive pay (income), people, place and period (5Ps). For simplicity, this study assumed, place and period are constant while price of foods, productive pay (income) and people vary accordingly.

Issues of welfare of the children and old adult are usually measured by the provision of the basic needs such as food, clothes and shelter for the maximization of their social welfare. In achieving the social welfare of the senior citizen as they are called, their food security status is key to achieving optimal social welfare of the ages in South Africa. In this study, food security is inversely viewed by measuring the dropping rate of the level of food insecurity proxied by the extent to which an household run out of money to buy food within a period and this related to the demographic factors (age of household head and gender of household head), economic factors (household income, household monthly salary and current wealth status of the household) and social factors (social grant and pension).

The household survey data explored for this study are categorical in nature, applying ordinary least square (OLS) will yield bias estimation, and thus, binary logistic regression through maximum likelihood technique is employed due to the probability process of the estimation technique (David & Grobler, 2019). The centrality of this study lies in the drive of age progression of the household head and social intervention benefits on calories of food intakes (run out of money to buy food in the last one month). Thus, the model for this study in probability form is stated as:

$$P_{ri} = E\left(\text{food_insecurity}_i = \frac{1}{f_i}\right) \quad (1)$$

Where f_i is the vector of food insecurity (run out of money to buy food in the last one month) in South Africa and the drivers as suggested by literature are demographic factors (age of household head and gender of household head), economic factors (household income, household monthly salary and current wealth status of the household) and social factors (social grant and pension). f_i implies that probability of an household run out of money to buy food; 1, but if otherwise; 0. The vector of vector of determinants of food insecurity (run out of money to buy food in the last one month) in South Africa are demographic factors (age of household head and gender of household head), economic factors (household income, household monthly salary and current wealth status of the household) and social factors (social grant and pension).

The transformed form of (1) is (2):

$$e^{f_i} = e^{\eta_1 des_i + \eta_2 d_i + \xi_i} \quad (2)$$

substituting (2) in (1);

$$P_{ri} = E\left(\text{food_insecurity}_i = \frac{1}{f_i}\right) = \frac{1}{e^{\eta_1 des_i + \xi_i}} \quad (3)$$

$$\text{Assuming } y_i = \eta_1 des_i + \xi_i \quad (4)$$

$$\text{Thus, } P_{ri} = \frac{1}{1 + e^{-y_i}} = \frac{e^{y_i}}{1 + e^{y_i}} \quad (5)$$

The equation (5) represents the cumulative logistic distribution function, where P_{ri} ranges from 0 and 1 and Z_i ranges from $-\infty$ to $+\infty$.

If P_{ri} , is the probability of household run out of money to buy food, then $(1 - P_{ri})$ is the probability of otherwise. It is mathematically stated as:

$$(1 - P_{ri}) = 1 - \frac{e^{y_i}}{1 + e^{y_i}} \quad (6)$$

$$1 - P_{ri} = \frac{1}{1 + e^{y_i}} \quad (7)$$

The odd ratio of household to run out of money to buy food in South Africa is (5) divided by (7)

$$\frac{P_{ri}}{1 - P_{ri}} = \frac{e^{y_i}}{1 + e^{y_i}} \bigg/ \frac{1}{1 + e^{y_i}} \quad (8)$$

$$\frac{P_{ri}}{1 - P_{ri}} = e^{y_i} \quad (9)$$

Taking the natural log of (9) to obtain the liner probability equation for estimating household agricultural production:

$$L_i = \ln\left(\frac{P_{ri}}{1 - P_{ri}}\right) = \ln(e^{y_i}) \quad (10)$$

$$L_i = y_i \quad (11)$$

Thus,

$$L_i = \eta_1 des_i + \xi_i \quad (12)$$

Re-writing (12) in simplest form yields (13):

$$\begin{aligned} food_insecurity_i = & \gamma_0 + \gamma_1 age_i + \gamma_2 gender_i + \gamma_3 h_income_i \\ & + \gamma_4 hm_salary_i + \gamma_5 social_grant_i \\ & + \gamma_6 wealth_status_i + \gamma_7 pension_i + \varepsilon_i \end{aligned} \quad (13)$$

where *food_insecurity* is household run out of money to buy food, *age* is age of household head, *gender* is gender of household head, *h_income* is household income, *hm_salary* is household monthly salary, *social_grant* is household social grant benefits, *wealth_status* is current wealth status of the household (owned assets) and *pension* is pensions

The study therefore estimates the probability effect of vector of demographic factors (age of household head and gender of household head), economic factors (household income, household monthly salary and current wealth status of the household) and social factors (social grant and pension)] on food insecurity in South Africa household. Therefore, equation (13) is a binary logistic equation in which maximum likelihood techniques of estimation are applied since OLS yields bias estimates due to categorical nature of the target variable, food insecurity (run out of money to buy food).

The philosophy behind this study lies in the evaluation of the impact of age progression and social interventions on food insecurity in South Africa. The data for the assessment are primarily survey data from Statistics South Africa's General Household Survey for 2017 in which variables of interest are quantified in discrete manners so that responses are well captured and categorised. The categorical nature of the data informs the decision to employed logistic regression to ascertain the effect of age progression and social interventions on food insecurity in South Africa. The binary logistic regression analysis is employed since the expected outcomes of target variable; food insecurity (run out of money to buy food) are dichotomous in nature i.e. run out of money to buy food or otherwise. The study further established the individual significance of age progression (age of household head), social interventions (social grant and pension) to food insecurity in South Africa using chi-square techniques after cross-tabulation of the variables of interest.

4. DATA AND ANALYSIS

4.1. Logistic regression analysis

Table 2: Binary logit estimates for household running out of money to buy food in South Africa

Variable	Coefficient	Wald statistic	p – value	Odds ratio
Constant	4.468***	295.946	0.000	87.21
age	0.136***	22.075	0.000	1.146
Gender	-0.190***	27.625	0.000	0.827
h_income	0.000***	12.251	0.000	1.000
hm_salary	0.000***	176.963	0.000	1.000
social_grant	-0.150***	179.834	0.000	0.860
wealth_status	-0.473***	737.840	0.000	0.623
pension	-0.655***	34.384	0.000	0.520

N = 20,908, Nagelkerke $R^2 = 0.135$, $\chi^2 = 1928.980$ *** (0.000)

Source: Authors' computation, 2019

Note: “***”, “**” and “*” indicate at least significant at 1 percent, 5 percent and 10 percent level.

The empirical results revealed that age of the household head is having direct impact on the food insecurity in South Africa. It is clearly shown that as the household head grows older, there is tendency of higher food insecurity in South Africa since at older age the real income further declines if there is no other stream of incomes aside pension but food consumption expenditure increases due to higher need for dietary feeding diversity. Whilst the gender of the household head shows an inverse relationship with food insecurity in relation to the head of the household being female. This result clearly shows that if the head of household happens to be a female, the tendency that the level of food insecurity will decrease is higher as negative relationship exist between them. The household income and monthly salary of members of the household are directly related to food insecurity in South Africa. These positive impacts of household income and monthly salary may be as a result of each member of the household individually taking care of themselves and contributing less to the food expenditure of the whole household making the household worse-off in term

of welfare. The believe of free-rider member in the household may trigger less contribution towards food spending in the household by the working class members of the household. The household social grant, wealth and pensions have negative impacts on food insecurity in South Africa. These results validate that as the household gain more access to social benefits (grant and pensions) and increase their wealth, the problem of food insecurity declines in South Africa.

It can be deduced from the results that a unit increase in the age of the household head may result to 0.136 unit increase in food insecurity in South Africa. The social interventions depict that 1 unit increase in social grants and pensions will result to 0.15 and 0.655 unit decrease in food insecurity in South Africa. These results clearly revealed that social grant and pension are statistically significant to food insecurity and reduced level of food insecurity of senior citizens in South Africa.

In term of the significance of the regressors (age of household, gender of household head, household income, household monthly salary, social grant, current wealth status of the household and pensions) to the food insecurity in South Africa, the wald tests were used. The empirical results for the level of importance of the regressors (age of household, gender of household head, household income, household monthly salary, social grant, current wealth status of the household and pensions) to the food insecurity in South Africa revealed that all the regressors are statistically significant at least at 1 percent significance level to food insecurity. It is clear that age of household, gender of household head, household income, household monthly salary, social grant, current wealth status of the household and pensions are statistically significant to food intake in South Africa.

The overall significance test is conducted with the combined chi square test for age of household, gender of household head, household income, household monthly salary, social grant, current wealth status of the household and pensions with respect to food insecurity in South Africa. The result revealed that age of household, gender of household head, household income, household monthly salary, social grant, current wealth status of the household and pensions are statistically to food insecurity in South Africa at 1 percent significance level. This outcomes show that to curb food insecurity in South Africa, policy direction should be aimed at age of household, gender of household head, household income, household

monthly salary, social grant, current wealth status of the household and pensions.

4.2. Cross tabulation (chi-square tests)

Table 3: Age of household head * Run out of money to buy food

	Value	p-value
Pearson Chi-Square	8.974***	0.030
N =	20908	

Source: Authors' computation, 2019

Note: "****", "***" and "**" indicate at least significant at 1 percent, 5 percent and 10 percent level.

The cross tabulation techniques were used to estimate the chi-square tests for the independence of food insecurity, age progression, social grant and pensions in South Africa. The chi-square results of 8.974 with p-value of 0.030 revealed that age progression of the household head is statistically associated with food insecurity at least at 5 percent significance level. This implies that food insecurity level in South Africa depends on age progression of the household head.

Table 4: Social grant head * Run out of money to buy food

	Value	p-value
Pearson Chi-Square	386.521***	0.030
N =	20908	

Source: Authors' computation, 2019

Note: "****", "***" and "**" indicate at least significant at 1 percent, 5 percent and 10 percent level.

Table 5: Pension* Run out of money to buy food

	Value	p-value
Pearson Chi-Square	70.515***	0.030
N =	20908	

Source: Authors' computation, 2019

Note: “*”, “**” and “*” indicate at least significant at 1 percent, 5 percent and 10 percent level.**

The Pearson chi-square results for the test of independence between food insecurity, social grants and pensions revealed that there is dependence between food insecurity, social grants and pensions in South Africa. The chi-square results for social grants and pensions as related to food insecurity are 386.521 (0.000) and 70.515 (0.000) respectively with the p-values in the parentheses. These results suggest that social grants and pensions are statistically significant to food insecurity in South Africa. These imply that food insecurity depends on social grants and pensions in South Africa.

5. CONCLUSION AND RECOMMENDATIONS

Diversity of food security lies in the extent of daily availability and nourishment (quality) of calories intake in a society. Studies on food security in South Africa emphasised the importance of income on food accessibility with little emphasis on the importance of age progression though there were studies on social interventions on food security but few studies were carried on the inverse food security i.e. food insecurity. Among these studies, few were conducted in South Africa and this motivated for the central philosophy of this discourse. This study sets to establish the impact of age progression of household head and social intervention benefits on food insecurity in South Africa.

Therefore, this study establish the fact that age progression of household head and social intervention benefits are statistically significant to food insecurity in South Africa. The empirical results clearly show that as the head of household get older, there is tendency to experience more food insecurity since the productivity and income capacity of the household head is inversely related to age progression as opined in the life cycle income hypothesis. The social interventions (social grants and pensions) have

negative impact on food insecurity in South Africa, as transfer payment increases, the better the people become. These suggested that social interventions have the palliative effect to maintain subsistence level of social welfare of the people at the bottom of the pyramid like children from poor household, ages with insufficient savings during active years and unemployed people South Africa.

Base on the aforementioned conclusions, this study therefore recommends that; radical engagement with the people on financial literacy need to be put in place in order to imbibe the culture of more savings/investment during the active services years. This will enable adequate preparation for future food consumption and maintaining better standard of living at retirement. Also, focus should be placed on capacity building, employment creation and promoting awareness on own food production which is one way to improve food security of poor households rather than depending on purchase from the social grant benefits alone.

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