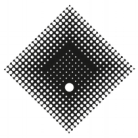
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Food Insecurity and Functional Disability Among Older Adults in Ghana: The Role of Sex and Physical Activity

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Abstract

Objectives: We examined the associations between food insecurity and functional disability among older people in Ghana and, the roles of gender and physical activity (PA) in the relationship.

Design: A cross-sectional study design was employed

Setting and participants: A total of 4,446 older people (50+ years) from WHO-SAGE Ghana Wave 2, a countrywide study, was completed between 2015.

Methods: Logistic regression models were used to examine the associations between measures of food insecurity and functional disability using data from WHO-SAGE Ghana Wave 2. Functional disability was assessed using WHO-DAS 2.0 composed of 12 items in six domains of cognition, mobility, self-care, getting along, life activities, and participation in society. Food insecurity was assessed from 12-months-food sufficiency and experience of hunger over the last 12 months.

Results: Around 11% were identified as having functional disability. The prevalence of food insecurity was 23.8% for insufficient food intake and 18.3% for hunger. Adjusting for all variables, older people who reported consuming insufficient food (OR=2.27; 95% CI: 1.57, 3.28), and those who experienced hunger (OR=2.35; 95% CI: 1.59, 3.46) had higher odds of functional disability, compared to those not reporting these issues. Gender differences modified the association between hunger and functional disability. PA served as a protective factor (OR=0.60; 95% CI: 0.38, 0.95) on the association implying that older people who engaged in PA were 40% less likely to experience hunger food insecurity-induced functional disability.

Conclusions and Implications: Food insecurity is associated with functional disability among older people. Results highlight the usefulness of tackling the social determinants of health and promoting financial/social security in older age in a changing Ghanaian society.

Introduction

Evidence on how food insecurity (FI) relates to functional disability (FD), I.e. limitation in carrying out life activities such as bathing and caring for household responsibilities (South-Paul et al., 2015), will be relevant improving quality of life and reducing long-term care (LTC) needs for older people in low- and middle-income countries, including Ghana, a sub-Saharan African Region. FI is defined as the inability to access or acquire adequate food due to insufficient money and other physical and mental resources.(U.S Department of Agriculture, 2019) FD may be exacerbated by hunger and insufficient food intake. However, evidence of this relationship is sparse in African regions, particularly in Ghana. While FI is a global phenomenon (FAO & https://doi.org/10.4060/cb4474en, 2021), it is a public health concern for Africans as about 39% of the African population living in the sub-Saharan Region is affected.(Fraval et al., 2019) FI prevalence among the Ghanaian population is of great concern with reports of approximately 1.2 million Ghanaians being food insecure.(Ministry of Food and Agriculture, 2015) In this context, the question on how many older people face food insecure and how this relate to their functional ability becomes relevant, as it can provide evidence for public and social policy, research into healthy ageing, and LTC-related policies in Ghana. These issues are particularly important for countries such as Ghana where the population is rapidly ageing.

In Ghana, evidence on the relationship between FI and FD remains scant, although there is information on this relationship in other contexts. For instance, in the United States of America (USA), FI has been shown to impact negatively on older people's physical functioning due to inadequate intake of dietary macronutrients needed for muscle strength and function.(Bartali et al., 2012; Beasley et al., 2010) Similarly, adequate diet reduces FD among older people.(Agarwal et al., 2019; Danielewicz et al., 2014) Likewise, a study in Japan reported how adequate dietary

recommendations lead to a significant reduction in risk for FD among older people.(Matsuyama et al., 2020)

Increased in physical activity (PA) tends to reduce loss of function (Miller et al., 2000; Tak et al., 2013; Taylor, 2014). Factors such as multiple chronic conditions(Ahn et al., 2014; Redmond et al., 2016; Seligman et al., 2010), marital status(Bernstein & Munoz, 2012; Han et al., 2009; Kyomuhendo & Adeola, 2021), gender(Gyasi et al., 2020), and age(Kyomuhendo & Adeola, 2021) have also shown to be important in understanding the relationship between FI and FD in different contexts.

The mechanisms influencing the association between FI and FD among older people in Ghana can be multiple. In Africa including Ghana, malnutrition or the risk of malnutrition, undernutrition, and overnutrition have been found to limit the functional ability of older people(Alam et al., 2020; Boateng et al., 2017). In this article, the authors examined the associations between FI and FD, evaluating the moderating roles of gender and PA on the relationship. The current study is unique because it unpacked FI, examining how insufficient food intake and hunger—affect FD. This analysis is relevant to understanding the specific impact of different factors, as a way to identify LTC policies for older people in Ghana.

Methods

Design and participants

We used data from the Study on global AGEing and adult health (SAGE) Ghana Wave 2 conducted between 2014/2015. This study used a sample size of 4,446 people (+50years) who answered all 12 questions on FD. Details about the study methodology and other relevant

information can be found elsewhere.(Kowal et al., 2015) Ethical approval for this study was obtained from the WHO Ethical Research Committee.

Functional disability

FD was defined by the 12-item version of the World Health Organization Disability Assessment Schedule (WHODAS 2.0), with ordinal scale responses (none, mild, moderate, severe and extremely severe). In its full version, the WHODAS 2.0 contains 12 questions from six domains: cognition, mobility, self-care, getting along, life activities, and participation in society.(World Health Organisation, 2012). Appendix B contains the questions included in the analysis. WHODAS 2.0 was scored on a scale of 0 to 100, with a lower score implying lower disability and a higher score, high disability. Following other studies, we decided to take the top 10^{th} percentile as our cut-off point for determining the severity of the disability.(Andrews et al., 2009; Biritwum et al., 2016; Kirchberger et al., 2014) Consequently, people scoring <90.18% were considered as with "no disability" and those whose score was >=90.18% were considered as "with a disability".

Food insecurity

In this study, we measured FI using two items including sufficiency of food intake and hunger.

Insufficient food intake

To measure insufficient food intake, we used the question, "*In the last 12 months, how often did you ever eat less than you felt you should because there was not enough food?*. Alternatives for this question included: "*every month", "almost every month", "some months, but not every month", "only in 1 or 2 months",* and "*never".* A binary variable was created, with *every*

month, almost every month, some months, but not every month, only in 1 or 2 months labeled as *"Insufficient food intake"*, and *never* as *"Sufficient food intake"*.

Hunger

Hunger was assessed with the question *"In the last 12 months, were you ever hungry, but did not eat because you could not afford enough food"*. Possible answers were: *every month, almost every month, some months, but not every month, only in 1 or 2 months*; and *never.* As in the case of insufficient food intake, categorical responses were grouped into a dummy variable measuring the presence of a feeling of hunger (for responses *every month, almost every month, some months, but not every month, and only in 1 or 2 months*) or not (for response *never).*

Physical activity

The explanatory variable included in this study was work-related PA, measured through three separate items (vigorous activity, moderate activity, and walking/cycling). The three questions were measured independently and categorized as "yes" or "no" using the following questions: *"Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate, [like heavy lifting, digging or chopping wood] for at least 10 minutes continuously? Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate [such as brisk walking, carrying light loads, cleaning, cooking, or washing clothes] for at least 10 minutes continuously? Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?* These three questions were merged and categorised as "Yes" or "No", with "Yes" meaning engagement in PA and "No" meaning no engagement in PA. "Yes" represented participants who responded *yes* to at least one of the three separate items and "No" was if participant responded *No* to all the three items. The Cronbach's α of the three PA items combined was 0.61.

Covariates

Sociodemographic and health variables considered as potential confounding variables for nutritional status and FD were included in the analysis. The variables used were age, marital status, education, location of residence, and self-reported health status. Income-related variables were not available in the database.

Analysis

Descriptive analyses, including frequency and percentages, were used to describe the categorical variables, whereas mean and standard deviation were used for the continuous variable (age). Pearson's chi-square, Fisher's test, and T-test were used to test the association between independent variables and dependent variables. Bivariate and multivariate logistic regression were performed to estimate the crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for the associations between FI and FD.

Results

Characteristics of study participants

Table 1 shows the descriptive statistics of the sample. The mean age of the participants was 57.6, with people with scores in FD being older than those who do not (74.1 vs 55.0 years). A majority of those with disability were women (11.6%), widowed (22.5%), and completed less than primary school education (8.36%). A little more than 50% reported their health status as bad, and nearly 53% living with no morbidity. About 75% of participants engaged in PA. A higher proportion of participants who took insufficient food (15.3%) had FD compared to their counterparts (9.15%, $p<0.001$). A high number of participants who experienced hunger (15.7%) had FD compared to their counterparts (9.50%, $p<0.001$).

[Insert Table 1 here]

The prevalence of FI is associated with individual characteristics. First, FI is higher among women compared to men, regardless of the measure used (Figure 1): insufficient food intake (55.5% vs 44.5%) and hunger (56.5% vs 43.5%). Despite these gender differences, insufficient food intake appears as the more prevalent problem in the population compared to hunger.

[Insert Figure 1 here]

When examined the distribution in terms of location of residence, Figure 2 shows that older people living in the rural areas experience a higher prevalence of FI in terms of food sufficiency, and hunger than those living in urban settings. The prevalence of insufficient food intake (70.8% vs 29.3%) whereas the prevalence of hunger was 60.1% for rural dwellers against 31.0% urban dwellers.

[Insert Table 2 here]

Finally, when looking at age groups in the sample, the proportion of FI among participants aged 18-59 years and 60+ years looked similar (Figure 3), with slightly larger among older people (60+).

[Insert figure 3 here]

Food Insecurity and Functional disability

Overall, FI variables are significantly associated with FD (Table 2).

Older people who reported taking in insufficient food were 80% more likely to experience FD at $p<0.001$ (OR=1.80; 95%CI: 1.47, 2.21) compared to those who take had sufficient food (Model 1). The significant relationship between remained when adjusted for socio-demographic characteristics, with an increase of 13% in likelihood at $p<0.001$ (OR=1.80; 95%CI: 1.47, 2.21). In Model 3, there was a 1% reduction in likelihood of association, though the significant

association between insufficient food intake and FD at p<0.001 (OR=1.80; 95%CI: 1.47, 2.21) was maintained. Similarly, in Model 4, there was a significant relationship between insufficient food intake and FD (OR, 2.27; CI: 1.57, 3.28) as compared with older people reporting content with food intake at p<0.001.

There was a significant association between those who experience hunger and FD (OR= 1.77; 95%CI: 1.42, 2.21) as compared to those who reported "No" to hunger. When adjusted for socio-demographic factors in Model 2, older people who reported experiencing hunger were 95% more likely to experience FD compared to other counterparts (OR, 1.95; CI: 1.51, 2.50) at <0.001. The independent significant association was maintained between reporting experience of hunger when adjusted for health status (OR=1.97; 95%CI: 1.38, 2.82) compared to those who reported not experiencing hunger. When adjusted for all variables, the significant association was maintained (OR=2.35; 95%CI: 1.59, 3.46) compared with those who did not experience hunger.

Finally, Table 3 (See *supplementary file Appendix A*) shows the interaction term between PA engagement and FI and their relationship with FD among older people. It revealed that PA buffered the association between hunger and FD.

The results showed a protective effect of hunger (OR= 0.60; 95%CI: 0.38, 0.95) on FD by PA engagement. That is, older people who engaged in PA were 40% less likely to suffer hunger FI induced FD compared to those who were not active. Moreover, there was gender difference in the association between FI and FD. For instance, older men who reported insufficient food intake (OR=2.06; 95%CI: 1.49, 2.88) had higher odds of FD compared to their counterparts. However,

older women who experienced hunger (OR=1.91; 95%CI: 1.45, 2.52) had higher odds of FD compared to their counters (Table 3).

Discussion

The present study is the first to use countrywide data to explore how PA and gender affect the relationship between FI and FD among the sub-Saharan region. Using a sample of 4,446 adults aged 50+years, this study revealed a higher prevalence of FD among those who consumed insufficient food (15.3%) and experienced hunger (15.7%) compared to those who do not face FI. People reporting insufficient food and experiencing hunger were 127% and 135%, respectively, more likely to have FD. Men who had insufficient food intake were more likely to experience FD compared to women. Women who experienced hunger were more likely to experience FD compared to men. Active older people were 40% less likely to experience FD when suffered from hunger.

Underlying factors contributing to the insufficient food intake may be location of residence and socio-economic status.(Kyomuhendo & Adeola, 2021) Older people with low income, living in rural areas and having low levels of education are more likely to consume insufficient food and probably go hungry. Residents in the rural areas in Ghana are most often the cultivators of most foods but rather consume less than the urban dwellers. This could be due to financial constraints, which may force them to sell out their produce to fend for the needs of their family rather than consume it. This result highlights the inequality in the LTC needs of older people living in urban/rural and those with low economic status. Older people who do not meet the required food intake and experience hunger experience loss in muscle strength, function or weight. This in itself may increase the chances of developing FD(Bartali et al., 2012; Beasley et al., 2010) Malnutrition

or the risk of malnutrition or undernutrition also limit the functional ability of older people.(Alam et al., 2020; Boateng et al., 2017) A study in Japan revealed how Japanese dietary recommendations led to a significant reduction in risk for FD.(Matsuyama et al., 2020) Additional studies also reveal how diet reduces FD in the elderly.(Agarwal et al., 2019; Danielewicz et al., 2014) Even though nutrition is a very important factor for the improvement of health, knowing the recommended dietary requirements needed to achieve functional ability is paramount.

Gender variations in FI have been found across other setting (Matsuyama et al., 2020). The current study adds to this evidence by revealing that gender affects the relationship between FI and FD. The finding that men who reported FI in terms of insufficient food intake experienced FD compared to women could be due to the larger proportion of muscles men possess. Even though older women will benefit from the sufficient consumption of food intervention target on increasing the consumption among older men will be beneficial. The formal LTC insurance should give a priority to the relevance of consumption of adequate food and fruits among older people especially in older men to age well. These findings will be beneficial for caregivers of older people who will be working in LTC in providing them with foods that will promote the functional abilities of older people.

Moreover, the finding that women who reported hunger had higher FD compared to men implies that there is a gender difference in the effects of hunger on FD. This finding could result from the evidence that women are generally poor in old age making it difficult to access an adequate and quality diet(Charlton & Rose, 2001), or had nutritional deficit(Charlton & Rose, 2001) and to decrease women's ability to purchase foodstuff. (Han et al., 2009) LTC insurance in the future should increase the purchasing power of older women especially the widowed to increase the consumption of adequate foods as it will increase their functional ability. The state

and individual NGOs interested in the wellbeing of older people should invest in increasing the financial wellbeing of older people through either providing employment or cash transfers.

PA was not a preferred method in reducing FD among older people feeling any kind of FI of any food but rather served as a protective factor for active older people in developing FD when they experience hunger. This is could be because PA in itself reduces energy balance thereby increasing energy released.(Vatansever-Ozen et al., 2011) Naturally, the body requires a specific amount of calories daily important to enable one to undertake activities(Patton, 2019), and if this lacks due to hunger, the glycogen stores become depleted. This condition will not result in a state of ketosis; the body now relies on fat and later muscle for fuel, glucose level decreases leading to a decrease in performance, fatigue, decreased physical and mental function (Murray & Rosenbloom, 2018) and consequently affecting the functional ability of the older people. The finding in this current study supports other studies that reported PA to have decreasing effects on the association between FI and FD.(Garcia Meneguci et al., 2021) This current study recommends that PA may only be useful when FI issues are addressed in a bid to actualize its benefits of reducing FD, through social connections which potentially provide an avenue for social resources.(Zuo et al., 2021)

As the population of older people continues to grow, and with unreliable family caregiving, a formal LTC provision should take into consideration this inequality in providing adequate and right amount of food for older people. Public health intervention such as the provision of adequate healthcare and those to increase consumption of nutritious foods among older people in Ghana who wants to age well. The fact that FI is linked to FD in older people should turn on the alarms of policy makers in the country. The situation and the expected increase in older people in the country due to demographic change represents a huge challenge in terms of the policy. Both factors

will increase the population with LTC needs, in a country that today lacks of a comprehensive response for these demands.

Despite the relevance of the results, the study has some limitations that need to be acknowledged. Firstly, since secondary data was used, the external validity of the result is limited. However, based on evidence from other countries, we expect to observe similar results in different contexts. Second, relevant factors influencing FD in older people, such as wealth and income are missing from the analysis. Including these variables could help to improve the understanding of the relationship between food intake and functional status. Third, cross-sectional data gives a snapshot of the situation regarding FI and functional ability. Functional status is dynamic, acknowledging these dynamics is important to design and implement preventive strategies that can help reduce the expected increase in LTC needs in the country. Further research on the topic is needed to address some of these issues in the future.

Conclusions and Implications

Using the countrywide sample, FI was associated with FD among older people in Ghana, suggesting that evidence of mitigation of FI may improve functional ability. Our study indicates that PA is not recommended among older people who experience hunger as that can worsens FD. Moreover, gender difference was identified in the relationship between FI and FD.

The findings of this study provide information on the significance of the provision of sufficient food in LTC. The link between food intake and LTC needs—measured as a FD—highlights the need to address the problem of FI in the population, not only as a need in itself but also as a strategy to reduce the expected increase in demand for LTC services in the country. In this line, a future LTC system should consider these elements into consideration, to offer benefit packages that address the unique and varying needs of older people. Results highlight the

usefulness of tackling the social determinants of health and promoting financial/social security in older age in a changing Ghanaian society. Future research should embark on a qualitative and longitudinal study to enhance our understanding of how FI relates to FD in African regions. In addition, evidence on food preference and lived experiences surround adequate food will beneficial for effective LTC research and policies.

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Tables

Table 1. Descriptive statistics of the sample by functional status

Independent variables	**Overall**	**Functional disability**		**p-value**
	N (%)	Without disability, N (%)	With disability, N (%)	
Age (Mean, SD)	57.6±16.7	55.0±16.0	74.1±12.2	**<0.001**
Sex				**<0.01**
Male	1,948 (41.1)	1,658 (90.8)	168 (9.20)	
Female	2,787 (58.9)	2,315 (88.4)	305 (11.6)	
Marital status				**<0.001**
Never married	437 (9.23)	409 (98.3)	7 (1.68)	
Married/cohabiting	2, 693 (56.9)	2,366 (92.6)	189 (7.40)	

Separated/divorce	532 (11.3)	442 (88.6)	57 (11.4)	
Widowed	1,073 (22.7)	756 (77.5)	220 (22.5)	
Location of residence				0.331
Rural	2,770 (58.5)	2,335 (89.0)	289 (10.6)	
Urban	1,965 (51.5)	1,638 (89.9)	184 (11.0)	
Education				0.056
Less than primary school	653 (23.8)	559 (91.6)	51 (8.36)	
Primary education completed	701 (25.6)	629 (94.7)	35 (5.27)	
Senior high completed	1,231 (44.9)	1,106 (94.7)	62 (5.31)	
University degree/post	154 (5.62)	133 (93.7)	9 (6.34)	
Health status				<**0.001**
Good	651 (18.2)	625 (99.7)	2 (0.32)	
Moderate	2,541 (70.9)	2,366 (96.7)	82 (3.35)	
Bad	390 (10.9)	161 (47.2)	180 (52.8)	
Multi-morbidity				**<0.001**
No morbidity	2,365 (53.2)	2,193 (92.7)	172 (7.27)	
Any one morbidity	529 (11.9)	445 (84.1)	84 (15.9)	
2 or more morbidities	1,552 (34.9)	1,335 (86.0)	217 (14.0)	
Physical activity				**<0.001**
Yes	3,540 (74.8)	3,182 (93.8)	210 (6.19)	
No	1,195 (25.2)	791 (75.0)	263 (25.0)	
Food Insecurity				

Insufficient food intake				**<0.001**
Yes	1,111 (23.8)	889 (84.7)	161 **(15.3)**	
No	3,560 (76.2)	3,058 (90.9)	308 (9.15)	
Hunger				**<0.001**
Yes	853 (18.3)	674 (84.3)	126 **(15.7)**	
No	3,670 (81.7)	3,268 (90.5)	343 (9.50)	
Functional disability				
No	3,973 (89.4)	-	-	-
Yes	473 (10.6)	-	-	-

Figure 1. Distribution of older people facing food insecurity measures by sex (different measures)

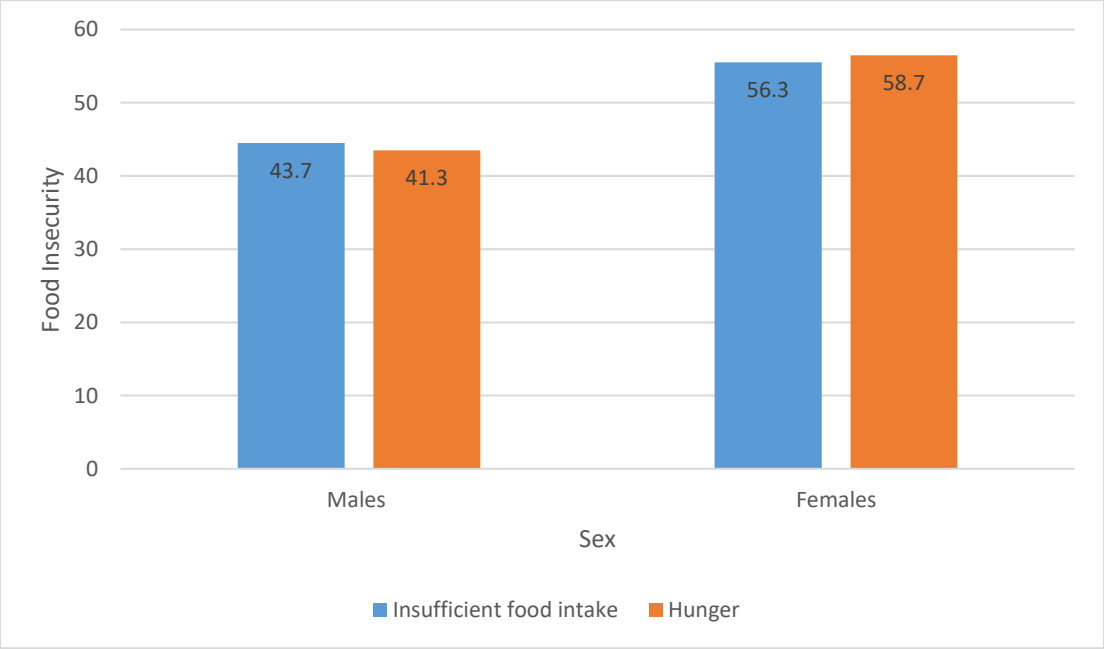

Figure 2. Distribution of older people facing food insecurity by location of residence (different measures)

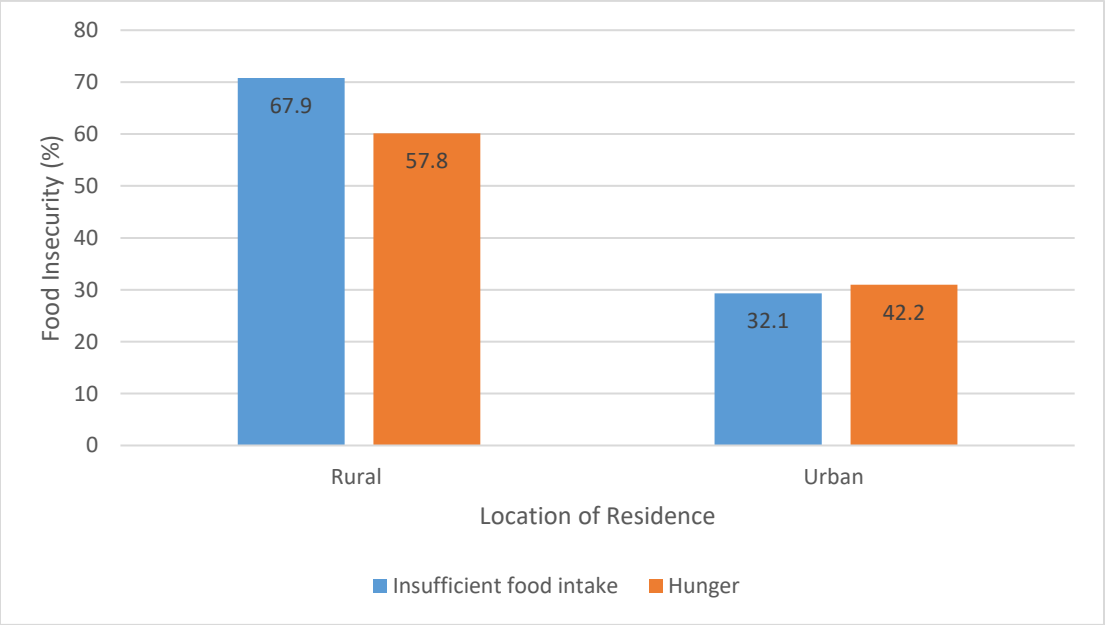

Figure 3. Distribution of older people facing food insecurity by age group (different measures)

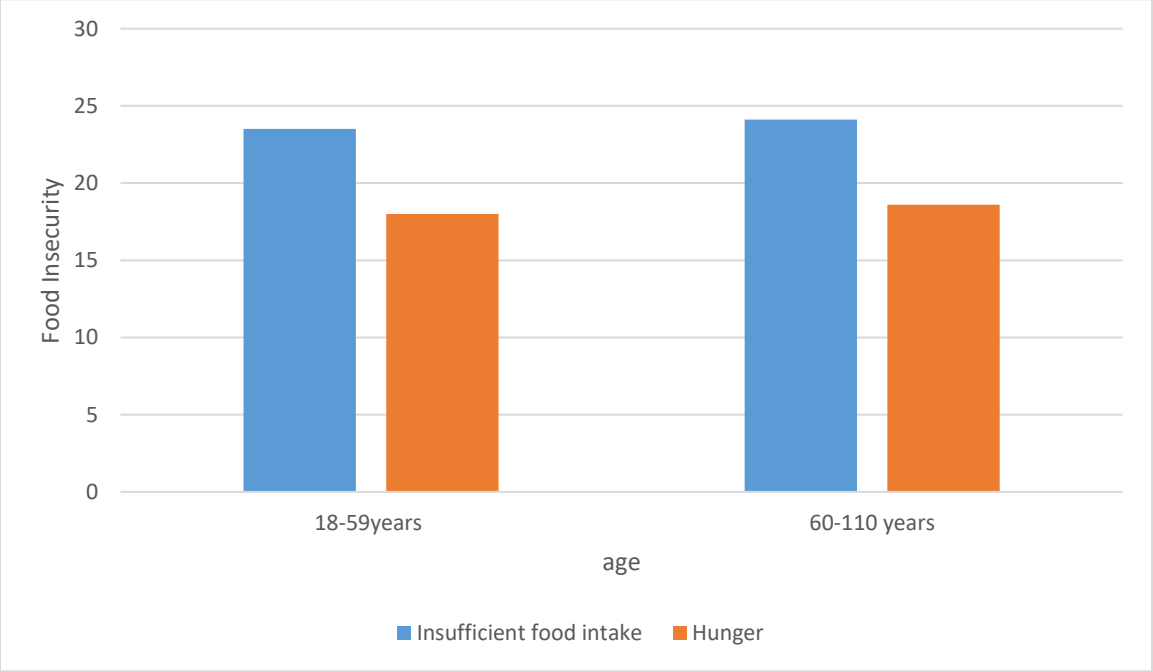

Table 2. Result of the multiple logistic regression analysis assessing the association between food insecurity and functional disability

Functional disability	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Unadjusted odds (95% CI)	**Adjusted odds (95% CI)**	**Adjusted odds (95% CI)**	**Adjusted odds (95% CI)**
Food Insecurity				
Insufficient food intake				
Yes (vs No)	**1.80 (1.47, 2.21)*****	**1.93 (1.53, 2.43)*****	**1.92 (1.37, 2.69)*****	**2.27 (1.57, 3.28)*****
Hunger				

Yes (vs No)	**1.77 (1.42, 2.21)*** **	**1.95 (1.51, 2.50)*** **	**1.97 (1.38, 2.82)** **	**2.35 (1.59, 3.46)*** **

Note: ***= p<0.001; **p<0.01; *p<0.05

Model 1- Unadjusted model; Model 2 – Adjusted for socio-demographic variables; Model 3 – Adjusted for health variables; Model 4 – Adjusted for Socio-demographics and health variables.