



# Linking household access to food and social capital typologies in Phalombe District, Malawi

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## Abstract

Food security remains a major sustainability challenge in many parts of Sub-Saharan Africa. Food security has numerous determinants that are complex and interlinked, with one of them being social capital. Social capital reflects an individual's, household's, or community's social networks, social interactions, and social support systems that can be mobilized in times of need to maintain, among others, livelihoods or food security. This study aims to further understand how typologies of social capital are associated with household food security in Southern Malawi, with a focus on access to food. We unpack social capital into three typologies, namely bonding, bridging, and linking social capital, and establish which one is most strongly associated with household access to food, and whether this varies by the gender of the household head. To achieve this, we analyze secondary data from 382 households collected through the Malawian Fourth Integrated Household Survey (IHS4), using principal axis factor analysis and logistic regression analysis. Our findings demonstrate that bonding and bridging social capital are associated with better household access to food, while linking social capital was associated with lower household access to food. Bonding social capital was most strongly associated for female-headed households and linking social capital for male-headed households, highlighting that there are differences between such households. This work confirms observations from other related studies in Sub-Saharan Africa exploring the interface of social capital and food security. It also highlights the importance of both acknowledging the gender of the household head and of unpacking social capital into its typologies when considering food security.

**Keywords** Food security · Food access · Social capital · Gender · Malawi

## Introduction

Food security is a condition when “all people, at all times, have physical and economic access to sufficient, safe, nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO 2018; pg1).<sup>1</sup> Until recently, international efforts have significantly improved

food security globally, but since 2014, the proportion of severely food insecure people has been increasing globally (FAO 2018). Indeed, in 2019, 1 in 10 people in the world were severely food insecure (FAO 2020). In many developing countries, this reversal has been linked to increased inequality impacting people's ability to access food, which is relatively expensive or is traded in remote markets (FAO 2020; Oduniyi and Tekana 2020). As such, to gain a more comprehensive understanding of food security, there is a need for research that focusses explicitly on food access that complements the research focusing predominately on food availability (Connolly-Boutin and Smit 2016).

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<sup>1</sup> Food security is often defined across the four pillars of availability, access, utilization, and stability (FAO 2018). Food availability refers to levels of food production, stock levels, and net trade. Access to food refers to how food people physically or economically buy or produce food. Food utilization refers to the nutritional value and safety of food. Finally, food stability refers to how shocks, such as weather events, price shocks, or political turmoil.

Food access explores whether an individual or household has the economic and physical access to food (FAO 2022). Households in low-income countries have been estimated to spend 52% of their incomes on food, with the poorest households spending a higher percentage (FAO 2022). They are therefore the most vulnerable to increasing inequality, as increases in food prices or changes in access to food have large impacts on their food security status. The determinants of food access are complex with a set of interconnected political, social, and economic factors all contributing (Gibson 2012; Chakona and Shackleton 2017; Misselhorn and Hendriks 2017). There is a strong need for research that better understands those determinants of food security and how they drive a household's access to food to implement achievable targets to ensure food security for everyone (Gibson 2012; Keller et al. 2018).

Social capital<sup>2</sup> has been associated with food security (Lamidi 2019; Tamako and Thamaga-Chitja 2017) and described as 'the missing link' to sustainable development (Grootaert 1998). Research has found that social capital at the household level can improve income (Woolcock and Narayan 2000; Hassan and Birungi 2011), reduce poverty (Grootaert 1999; Islam and Alam 2018; Rustiadi and Nasution 2017), and aid climate change adaptation (Asfaw et al. 2016; Tamako and Thamaga-Chitja 2017) and resilience to shocks (Jordan 2015a; Misselhorn 2009; Mbiba et al. 2019). Generally, the higher an individual's or household's social capital is, the lower its vulnerability to shocks or crises (Woolcock and Narayan 2000), resulting in better food security (Sseguya 2009; Dzanja et al. 2015; Christ and Niles 2018). Social capital is particularly important when formal institutions are lacking or are underperforming and has been described as the capital of the poor (Davenport and Hassan 2020).

Social capital can exist in three forms: cognitive, relational, and structural. Structural social capital focuses on collective action, and on local groups and networks that have both informal and formal rules and set structures (Claridge 2018a). Structural social capital is perceived to be the most useful form of social capital in improving development outcomes as resources can be embedded within relationships (Bebbington 2009). Such resources may be hard to access and includes information, food or cash, thus having an influence on food access (Seferiadis et al. 2015). Meanwhile, cognitive and relational social capital concentrate on trust and belonging (Claridge 2018a) and have limited direct impacts on development outcomes and food security

as they cannot be as easily translated into improved access to food. Structural social capital can be further unpacked into bonding, bridging, and linking, a typology that has become increasingly common as a conceptual framework in recent research (Claridge 2018b). However, most of the current research on social capital and food security does not always unpack social capital into its different dimensions and typologies (Dean and Sharkey 2011; Dean et al. 2014; Dzanja et al. 2015; Forrest 2017; Lamidi 2019). Furthermore, only a handful of studies on food security have used the aforementioned social capital typologies (i.e., bonding, bridging, and linking as outlined above), but concluded that the typologies have different associations with food security (Frankenberger et al. 2016; Sseguya et al. 2018).

Despite researchers arguing the importance for unpacking social capital (Sseguya 2009; Frankenberger et al. 2016; Kansanga et al. 2020), a single social capital aggregated score is often used, which fails to capture its complexity or acknowledge the different ways the typologies influence food security (Patulny and Svendsen 2007). Despite the emerging body of research broadly linking food security with social capital (Kaiser et al. 2019; Misselhorn 2009; Dean and Sharkey 2011; Dzanja et al. 2015; Tamako and Thamaga-Chitja 2017), more research is required to further understand how food security may be linked to bonding, bridging, and linking social capital. This lack of understanding has limited the development of a theoretical framework linking food security and social capital, resulting in overlooking the role of social capital on food security in research and in practice (Rayamajhee and Bohara 2019). However, research that differentiates between social capital typologies can offer directions to empirical research and improve the conceptualisation of social capital and food security, particularly in low-income countries (Partelow 2021).

It is important to note here that the status of an individual's food security and social capital can be associated with their gender, particularly in developing countries. For example, women are less likely to receive climate-resilient seeds, access credit, and have lower food security compared to men (Kerr 2005; Agarwal 2018; FAO 2011). The type and level of an individual's social capital also varies by gender (Katungi et al. 2008; Addis and Joxhe 2017; Meinzen-Dick et al. 2014). Research in West Africa (Walther et al. 2019), Uganda (Katungi et al. 2008), and South Africa (Myroniuk 2016) found that gender and social capital are closely related. For example, male-headed households (MHHs) in Uganda have more extensive social networks and greater participation in community events than female-headed households (FHHs), while in South Africa, men and women used their bridging social capital to access different resources (Katungi et al. 2008; Myroniuk 2016). Meanwhile, female rice traders in West Africa were found to be situated in less central positions of rice trading social

<sup>2</sup> Social capital can be loosely defined as an individual's family, friends, and social networks that can be drawn upon during a crisis, to make a living or to meet shared objectives (Woolcock and Narayan 2000; Halpern 2005).

networks, which limited their ability to gain higher incomes (Walther et al. 2019). Despite evidence showing that social capital varies by gender, the relevant studies are limited and mainly focus on high-income countries (Addis and Joxhe 2017; Karhina et al. 2019). Failing to include gender in such studies ignores significant differences that are likely to influence the association between social capital and food security. Gender is therefore an important aspect in both food security and social capital (Chua et al. 2016; Solano and Rooks 2018; Tibesigwa and Visser 2016; Broussard 2019).

Considering the above, this study draws from two key gaps in the literature at the interface of social capital and food security in developing countries. The first is that social capital is not always unpacked into its typologies, and when it is unpacked, linking social capital is rarely included. The second is that gender is not usually acknowledged. This study, therefore, has two key aims. First, it seeks to understand whether bonding, bridging, and linking social capital have different associations with household food security, with the main focus being on access to food, as one of the major pillars of food security. Second, it seeks to understand whether the possible associations between bonding, bridging, and linking social capital and access to food vary depending on the gender of the household head. To achieve these aims, we use secondary data from household surveys conducted in the Phalombe District in southern Malawi, which exemplifies an area characterized by low food security, strong gender norms, and extreme weather events.

## Methodology

### Conceptual framework

In this study, we use a conceptual framework that distinguishes between the bonding, bridging, and linking aspects of social capital. This is because this conceptualisation of social capital has particular relevance to sustainable development (Seferiadis et al. 2015), with evidence suggesting that these social capital typologies are associated with food security in different ways (Lamidi 2019; Frankenberger et al. 2016).

Bonding social capital refers to relations that are based on shared identity, backgrounds, and culture, and often includes family and friends (Szreter 2002). For example, people call upon their family or close friends for food or cash to buffer periods of limited access to food (Margolies et al. 2017; Vervisch et al. 2013). Bridging social capital accounts for relationships between individuals who join forces for collective action that will benefit everyone involved (Engers et al. 2017). This can be between individuals with both homogenous and heterogenous characteristics, although power is usually equal and focuses on solidarity, group membership,

and social cohesion. Examples of bridging social capital can include farmer cooperatives or a school's Parent–Teacher Association. In terms of food access, village saving and loan groups can enable farmers to save money, which they can access at certain periods to buy food, including in emergencies (Ksoll et al. 2016; Sseguya et al. 2018). Such groups can also be used to invest into their farm which influences food availability and in turn indirectly impacts food access (Baiyegunhi and Fraser 2014; Niles et al. 2021).

Linking social capital includes relationships between people with an unequal power dynamic (Woolcock and Narayan 2000). Such an example is the relationship between community members and a non-governmental organization (NGO) (Khalil et al. 2021; Claridge 2018b). Through linking social capital, formal institutions can provide resources, information, and skills that would otherwise be inaccessible (Claridge 2018b; Jordan 2015a). Regarding food access, NGOs or governments will provide food or cash for food that would otherwise be inaccessible to people (Vervisch et al. 2013; Sseguya et al. 2018). Linking social capital is not always researched alongside bonding and bridging despite the fact that it can be key to the wellbeing and food security of poorer communities (Khalil et al. 2021; Vervisch et al. 2013).

### Study site

Malawi is a small and narrow landlocked country in Southern Africa (Fig. 1), where 83.5% of the population resides in rural areas (FAO 2017a). Its population of 18.6 million inhabitants in 2017 is rapidly growing at an annual growth rate of 2.9% (World Bank 2020b).

Over half of the land in Malawi is used for agriculture and more than 80% of the workforce is engaged within the agriculture sector. Most farmers are subsistence smallholders that rely heavily on maize production, although, pigeon peas, cassava, and sweet potatoes are also grown (Government of Malawi 2016). Agriculture is highly dependent on the weather as 90% of crops in Malawi are rain-fed (Gumma et al. 2019).

With this high dependence on rain-fed food production, food insecurity is a huge problem and over half the national population was characterized as severely food insecure in 2015–2017 (FAO 2017a). The percentage of the population in IPC3 Acute Food Security Crisis over an 8-year period can be seen in Fig. 2, suggesting high variability over time. Furthermore, there has been high food inflation in Malawi since 2005, limiting people's ability to afford (and essentially access) food. Since an estimated 84.6% of rural households are net buyers of food, it is increasingly difficult for households to access food (Benfica 2014). It is expected that the combination of accelerated climate change, decreasing maize yields, and an increasing population will increase

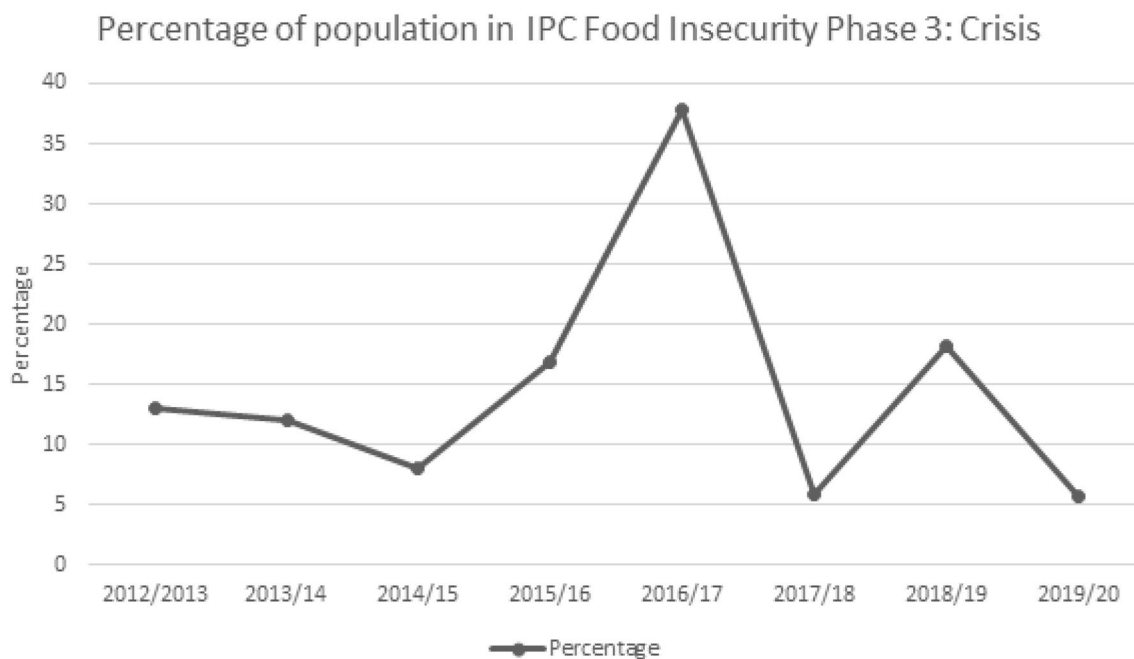


**Fig. 1** Map of Malawi and location of Phalombe District (Source: Geodatos 2020; Map Library 2008a, b, c)

the demand for food in the country (Msoyoya et al. 2016), impacting food prices and further threatening food security.

In 2015–2016, Malawi was impacted by a severe drought driven by a strong El Niño Southern Oscillation (ENSO) event, while some districts, including Phalombe, also experienced flooding in early 2015. Across Malawi, the floods and drought resulted in a 30% annual reduction in maize production (Stevens and Madani 2016). As seen in Fig. 2, the percentage of the population in IPC Food Insecurity Phase 3 (i.e., crisis) increased substantially in the 2015/16 and 2016/17 seasons with 6.5 million people needing food aid assistance in 2016/17 (USAID 2016). Based on the Famine Early Warning System Networks (FEWNET) Food Security Outlook reports across the 2016/17 season, the worst affected districts in the Southern Region spent 7 months at IPC Phase 3.

The Phalombe district is located in the Southern Region and is the focus of this study. Phalombe has some of the highest poverty levels in Malawi, with most households relying on rain-fed subsistence farming (Phalombe District Council 2016). Phalombe experiences dry spells, droughts, and floods and is particularly vulnerable to the negative impacts of such climatic and environmental shocks (including food insecurity). However, despite the high incidence of natural disasters, Phalombe only experienced 2 months of high food insecurity during the 2015–2016 El Niño effect, suggesting that it was not as badly impacted as other regions.



**Fig. 2** Percentage of Malawian population under IPC Food Insecurity Phase 3 in 2012–2020. Source: (OCHA 2016; GoM 2020; World Bank 2020b)

In terms of gender dynamics, both matrilineality and patrilineality are present in Malawi (Kerr 2005) and gendered roles and responsibilities exist regarding livelihoods and social networks. These gendered social systems impact the type and amount of social capital that is available to men and women (Addis and Joxhe 2017). In the Southern and Central Regions (including Phalombe), matrilineality and uxorial post-marital residence is dominant. This means that inheritance and kinship are traced through women, with men moving into their wives' villages. In 2016, 30.6% of Malawi's households were female-headed, although it is not known if they follow matrilineal or patrilineal norms (World Bank 2020a). Bonding social capital is also particularly strong in Malawi, as there was a conscious push after Independence to maintain and promote African values and culture, which include tight knit community structures organized around kinship (Myroniuk and Anglewicz 2015; Forster 1994).

### Data collection

The study uses secondary data for Phalombe District derived from the Malawian Fourth Integrated Household Survey (IHS4). We undertake three logistic regressions for (a) all households, (b) MHHs only, and (c) FHHs only. The IHS4 is part of the World Bank Living Standards Measurement Study (LSMS) with national coverage and data collection occurring every 6–7 years since 1997.

In Phalombe district, a total of 382 households were sampled from 24 Enumeration Areas (EAs). All the EAs were located in rural areas as there are no major urban centers within the district. In this study, household-level data are used to compare MHH and FHH, as the available survey data does not allow us to address gendered roles within the household (see "Limitations and future research").

The IHS4 was conducted between April 2016 and April 2017 by the Malawi National Statistics Office. Some of the survey questions asked households about experiences from the previous 12 months. Depending on the date of data collection, respondents were giving responses about their experiences between April 2015 and April 2017, a period that coincides with the floods and a drought which affected both the 2015/2016 and 2016/2017 agricultural seasons. Therefore, the findings reported in this study should be understood in the context of two extreme weather events that had large impacts on household food security. Ethics approval was granted through the University of Southampton.

### Data analysis

#### Deriving the food access variable

The IHS4 includes all 8 questions from the Food Insecurity Experience Scale (FIES). FIES is a method created by

the Food and Agriculture Organisation (FAO) Voices of the Hungry project to measure certain aspects of food security at both individual and household levels. While household food security can be measured in many ways (Swindale and Bilinsky 2006; Coates et al. 2007; Maxwell et al. 2013), the FIES has been validated in 151 countries and is becoming a common method to measure the food access pillar of food security (Wambogo et al. 2018).

Questions are ordered to capture increasingly more severe food insecurity (FAO 2017b). Raw scores range from 0 to 8 with cut-off points which can be used to assess and compare a household's food security (Wambogo et al. 2018). In more detail, the food security categories include: (a) food secure and mildly food insecure (score 0–3), (b) moderately food insecure (score 4–6), and (c) severely food insecure (score 7–8).

Using the IHS4 survey responses, we computed a raw FIES score for each household by adding together the sum of all questions answered 'yes' as outlined by the FAO (2017b). The FIES variable was then recoded into the 3 categories outlined above. As the number of 'food secure and mildly food insecure' households was too low to be used for subsequent analysis, the 'food secure and mildly food insecure' and 'moderately food insecure' households were merged into a single category, as has been done in the other studies (Sseguya 2009; Malual 2014). The result was a dichotomous food security variable where "food secure and mildly food insecure" and "moderately food insecure" households were coded as '0', while "severely food insecure" households as '1'.

#### Social capital measurement: justification of proxies

There is no standardized methodology to measure social capital because of its context-specificity, as well as its different definitions, typologies, and forms (Grootaert and van Bastelaer 2002; Martikke 2017; Woolcock and Narayan 2000). Similarly, there are no set proxies to measure it. Therefore, trade-offs have to be made in the relevant literature depending on the availability of data and the research question (Healy 2002). When including all three typologies, what is classified as bridging social capital changes slightly compared to when only bonding and bridging are included (Claridge 2018b).

To standardize social capital classifications, the Social Capital Integrated Questionnaire (SC-IQ) was developed (Grootaert et al. 2004). Although the SC-IQ has not been widely adopted as the gold standard (Agampodi et al. 2015), it is used as a rough measurement that can be adapted to fit the context of the research. In this study, the SC-IQ aided in the selection of appropriate social capital proxies. The SC-IQ has 6 dimensions, with numerous proxies in each dimension that can be described as

**Table 1** Social capital variables and their relation to the SC-IQ

SC-IQ category	Variables and questions in SC-IQ	Proxies in this study	Literature examples	Typology
Groups and networks	Transfers between family and friends <i>If you suddenly needed to borrow a small amount of money are there people who would be willing and able to provide this money? (Q. 1.26)</i>	Given out food transfers to family/friends Received food transfers from family/friends Given cash to family/friends	Kaiser et al. (2019); Jordan (2015a); Pendley et al. (2020); Smith and Frankenberg (2018)	Bonding
	Groups or organizations membership <i>How many groups are you or any one in your household a member? (Q. 1.1)</i>	VSLA (village savings and loans) membership	(Sseguya et al. (2018); Tamako and Thamaga-Chitja (2017); Kiboro (2017); Ng'ang'a et al. (2016)	Bridging
Information and communication	Sources of specific items of information <i>In the past month, how many times have you made or received a phone call? (Q. 4.6)</i>	Mobile phone in household	Shema and Garcia-Murillo (2020); Bacishoga et al. (2016)	Bridging
Empowerment and political action	Filing petitions, attending public meetings and meeting with politicians <i>In the past 12 months, how often have people in the village jointly petitioned government officials or political leaders for something benefiting the community? (Q. 6.5)</i>	Received help from NGO during shock Received free maize from government Received help from NGO during shock	Frankenberger et al. (2016); Aldrich (2017); Partelow (2021)	Linking

Parentheses indicate the SC-IQ variables and questions. Source (Grootaert et al. 2004)

bonding, bridging, and linking social capital, depending on the proxy characteristics and context.

We estimated structural social capital at the household level by looking at all three functional sub-types (i.e., bonding, bridging, and linking). We used previous research on household-level social capital (Woolcock and Narayan 2000; Grootaert et al. 2004; Engers et al. 2017; Dzanja et al. 2015; Sseguya et al. 2018) to understand which variables from the household survey were good proxies for each social capital sub-type, taking into account the Malawian context and the use of a national survey.

In the SC-IQ, linking social capital proxies focus on information, groups, and trust. However, because the IHS4 did not include these categories and are more commonly used in social capital research in high-income countries, we looked for proxies in the previous research from low-income and post-disaster settings. For example, linking social capital proxies include access to required resources to aid with post-disaster recovery (e.g., in Kyne and Aldrich 2019), or supplies made available to communities after an earthquake (Partelow 2021). Frankenberger et al. (2016) include a household's ability to access government-provided services and aid in their linking social capital score.

The selection of variables for all three forms of social capital in relation to the specific variable of food security was undertaken to reduce the number of variables in the regression (see below), so that redundant variables were removed, and the model was parsimonious. To establish the bivariate relationship between categorical independent variables and the food security variable, a Chi<sup>2</sup> test was undertaken (Freeman et al. 1983; Hosmer and Lemeshow 2000). To test the association between continuous independent variables and the food security variable, a one-way ANOVA was used (Leech et al. 2015).

It is important to emphasize that the social capital variables selected are in relation to food security, and especially the access to food pillar. Other variables that may be relevant to other aspects of sustainable development such as water security or adaptation to climate change are not included in this study. Table 1 shows (a) the final variables used in our model, (b) how they align with the SC-IQ, (c) the typology that the proxies are likely to reflect in the Malawian context, and (d) citations of previous research that have used similar social capital proxies.

## Principal axis (PA) factor analysis

To create a bonding, bridging, and linking social capital score for each household, PA factor analysis was undertaken. PA factor analysis was used instead of the principal component analysis (PCA) which has been used in the previous studies exploring social capital (Sseguya 2009; Dzanja et al. 2015). PCA does not allow for the extraction of a specific number of factors, unlike PA factor analysis.

In PA factor analysis, variables based on common variance are grouped together into new variables called factors. Variables can be “loaded” to a factor. PA factor analysis is used when there is a theory about the number of possible factors and what these factors will reflect (Leech et al. 2015). In this study, three factors were chosen to reflect bonding, bridging, and linking social capital.

Varimax rotation was used to extract the three factors, as it allows for an easier interpretation of results and assumes that each factor is explaining different underlying variance (Leech et al. 2015). Each variable is given a co-efficient for each factor, which is the correlation between the variable and the factor. Variables are assigned to the factor which corresponds to the highest co-efficient. Variables that have a co-efficient that is  $< 0.3$  for each factor are not assigned (Leech et al. 2015). Factors were saved, so that each household had three new variables which were translated into a separate score for their bonding, bridging, and linking social capital. Statistical tests were undertaken to measure the data suitability for the PA factor analysis (Table S1, Supplementary Material), with the results suggesting the data structure was adequate enough for the analysis conducted.

## Logistic regression analysis

We use logistic regression to understand the association of bonding, bridging, or linking social capital with the selected indicator of food security by the gender of household heads. Data analysis was undertaken using the Statistical Package for Social Scientists (SPSS Inc., 2017). Variables that are likely to be associated with food security but are not the main focus of the study were added as covariates. These include socio-economic variables, such as age of household head, education of household head, gender of household head, economic activity, non-food expenditure over the past 12 months, and access to credit. Covariates were selected based on data availability and existing literature finding they had an association with food security in Malawi in the previous research (Fisher and Lewin 2013; Kassie et al. 2015; Matchaya and Chilonda 2012).

The regression was then repeated separately for MHHs and FHHs to explore whether different types of social capital predict the access to food of these households differently.

The only variable excluded in the male and female models was ‘gender of household head.’

## Results

### Descriptive statistics

The socio-economic descriptive statistics of the sample can be found in Fig. 2. A total of 382 households were surveyed in Phalombe, of which a third were female-headed. Approximately 13.3% of these female heads were married and can be described as de facto FHHs, meaning that they have husbands who do not live in the community, often due to migration for work. The other 86.7% of FHHs were widowed, divorced, or separated and are de jure FHHs.

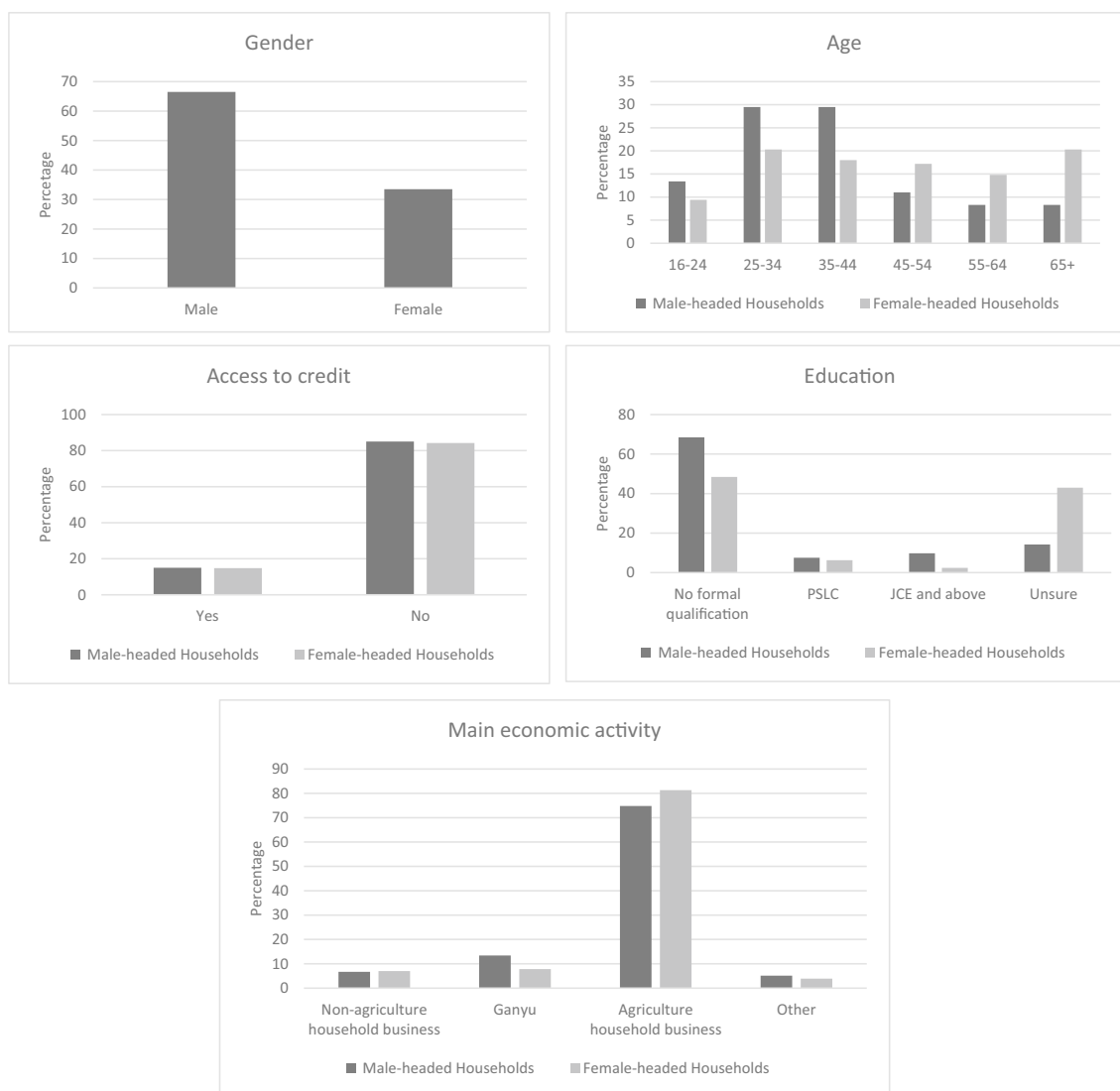
There was a range in the ages of both female and male household heads, and generally, female heads were older. Furthermore, 58.5% of household heads had no formal educational qualification, and only 13% had any educational qualification, with the remainder being unsure whether they had an educational qualification or not. A higher percentage of MHHs had an educational qualification at 17.3% compared to 8.7% of FHHs. The most common economic activity for both MHHs and FHHs was agriculture, with 77.6% of all respondents stating it was their main occupation, which is slightly lower than the national average. Matrilineal marriages accounted for 83.7% of marriage types.

### Food security status

The majority of households (78%) had a FIES score of 8, the highest score on the food insecurity scale indicating severe food insecurity. Only 5.5% of households had a FIES score that placed them in the more food secure categories (score 1–5). Approximately, 6.8% and 9.7% of households had scores of 6 and 7, respectively. The above indicate that a large proportion of households were severely food insecure between 2016 and 2017. A higher proportion of the FHHs were categorized as severely food insecure (84.4%) compared to MHHs (74.8%) (Fig. 3). A Chi<sup>2</sup> test between the FIES category and the gender of household head showed a significant association ( $p = 0.033$ ).

### Social capital variables

Figures 4 and 5 provide descriptive statistics of the social capital variables used in the regression model. Overall household transfers were low, with 14.1% and 17.5% of the surveyed households having given out cash and food to family and friends, respectively, and 25% having received food from family and friends. A higher proportion of MHHs than FHHs had given out cash. Just under a quarter of households



**Fig. 3** Descriptive statistics for main demographic and socio-economic characteristics of the head of households. *PSLC* Primary School Leaving Certificate, *JCE* Junior Certificate of Education, *Ganyu* informal short-term labor

owned a mobile phone with comparatively more MHHs owning a mobile phone than FHHs. Village savings and loans associations (VSLA) accounts were held by 14.1% of households, while 28% of households received maize or free food from the government. Only 9.5% of the surveyed households received any help from NGOs during shocks, with comparatively more FHHs having received this than MHHs.

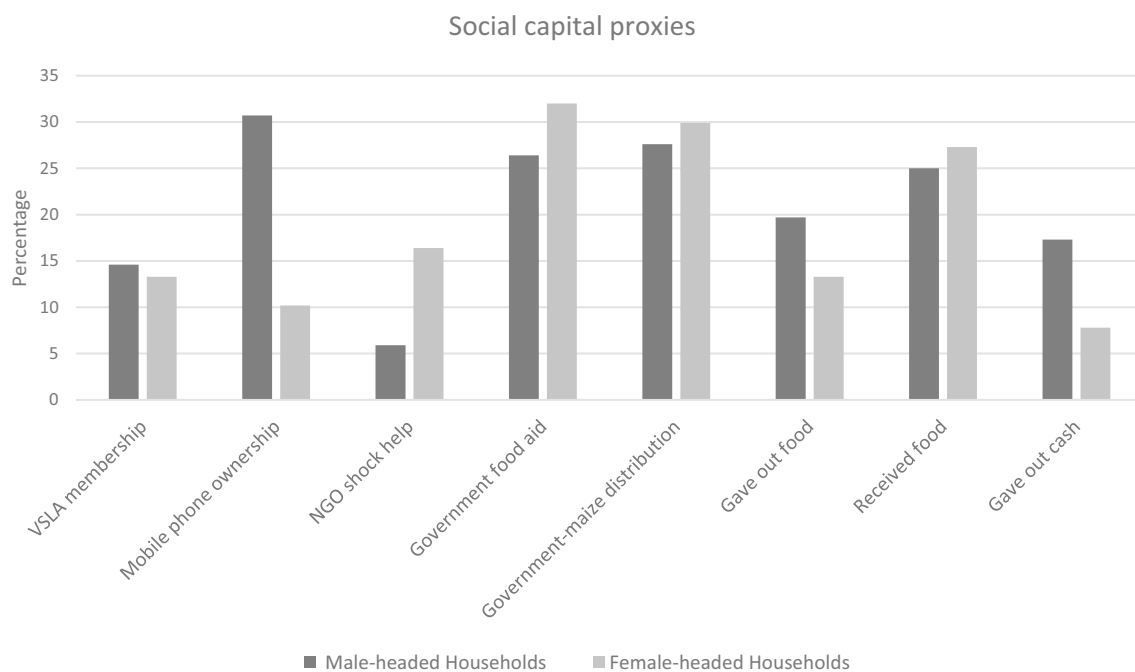
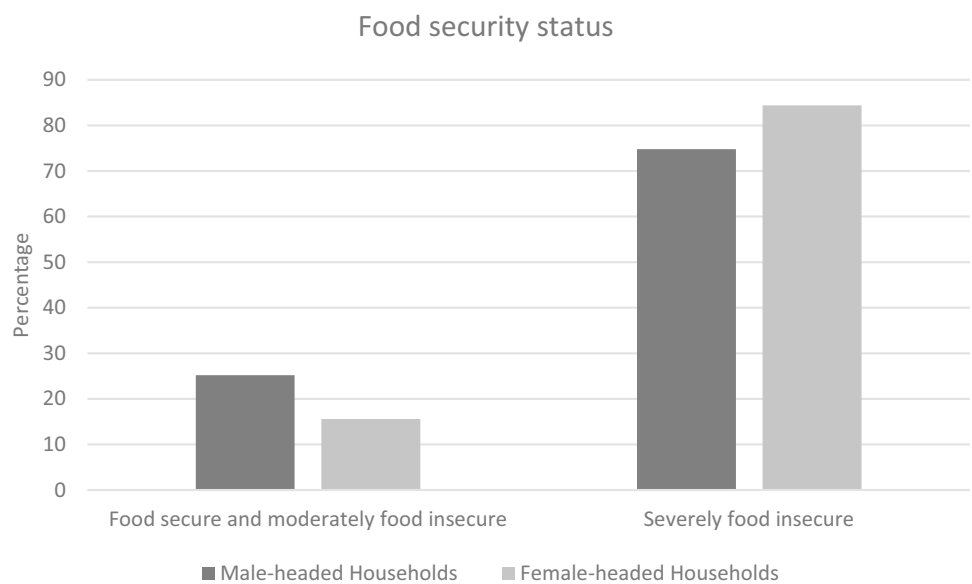
### PA rotation

The PA results are shown in Table 2. The three loadings correspond well with the bonding, bridging, and linking social capital conceptualisation with factor 1 as linking

social capital, factor 2 as bridging social capital, and factor 3 as bonding social capital. All variables except the ‘given cash to family and friends’ were assigned to the anticipated factor. Based on the social capital literature and Table 1, it would be expected that ‘given cash to family and friends’ would be loaded to factor 3 (bonding) rather than to factor 2 (bridging social capital). The variable loaded for both of these factors, but was higher for factor 3 (bonding social capital). Co-efficient and communality scores for all variables are higher than the 0.3 cut-off point, so all social capital variables had a high enough co-efficient to be assigned to a factor. The Kaiser-Meyer-Olkin (KMO) test score was above the desirable threshold and Bartlett’s test was significant (Table S1, Supplementary Material).



**Fig. 4** Percentage of respondents in terms of food security status for male- and female-headed households



**Fig. 5** Percentage of households reporting social capital proxies by gender of household head

### Logistic regression

Regression results can be seen in Table 3, with logit scores and log odds computed for easier interpretation. The full models, assumption testing, and model testing are included in the Supplementary Material Tables S2–S5.

Our findings show that the odds of being food insecure decrease by 37% and 38% when bonding and bridging social capital scores, respectively, increase. Conversely, the odds of being food insecure increase by 1.43 (43%) for every unit

increase in linking social capital. These results suggest that there might be in fact a strong association between the social capital typologies and household access to food. While this does not prove causality, it can be said that households with higher bonding and bridging social capital are also likely to have better access to food. Meanwhile, households with higher linking social capital are more likely to have lower access to food.

The logistic regression model did not show that the gender of the household head is significantly associated with

**Table 2** PA rotations

Social capital variables	Factor loadings and variable coefficients			Communalities
	1	2	3	
Received free maize	0.892			0.797
Received free food from government	0.880			0.793
Received help from NGO during shock	0.687			0.497
Mobile phone in household		0.712		0.561
VSLA account in household		0.659		0.440
Given cash to family/friends		0.565	0.353	0.457
Received food transfers from family/friends			0.851	0.761
Given out food transfers to family/friends		0.397	0.714	0.669

**Table 3** Logistic regression results of the different models

Independent variables	Model 1 (all households)		Model 2 (MHHs only)		Model 3 (FHHs only)	
	$\beta$	Exp( $\beta$ )	$\beta$	Exp( $\beta$ )	$\beta$	Exp( $\beta$ )
Gender of household head						
Female	0.266	1.305				
Male (ref)						
Age of household head (years)	0.001 (0.011)	1.001	-0.010 (0.013)	0.990	0.033 (0.022)	1.034
Borrowed credit						
No	-0.962 (0.460)	0.382**	-1.443 (0.613)	0.236**	-0.694 (0.886)	0.499
Yes (ref)						
Non-food expenditure (MWK)	0.000 (0.000)	1.000	0.000 (0.000)	1.000**	0.000 (0.000)	1.000
Educational qualification of household head						
PSCE	-0.279 (0.500)	0.756	0.141 (0.618)	1.152	-1.079 (0.912)	0.340
JCE	2.697 (1.368)	14.842**	1.648 (1.141)	5.197		
MSCE and above	1.866 (0.823)	0.155**	-2.386 (1.077)	0.092**		
Don't know	0.551 (0.434)	1.735	0.620 (0.552)	1.858	0.230 (0.760)	1.259
None (ref)						
Economic activity						
	B					
Ganyu	-0.440 (0.420)	0.644	-0.322 (0.505)	0.725	-0.787 (0.851)	0.455
Household business (non-agriculture)	-1.374 (0.488)	0.253***	-0.882 (0.603)	0.414	-2.803 (1.022)	0.061***
Other	-0.024 (0.726)	0.976	0.036 (0.897)	1.036	-1.006 (1.301)	0.366
Agriculture household (ref)						
Social capital						
Linking	0.360 (0.171)	1.433**	0.593 (0.233)	1.809**	0.058 (0.279)	1.060
Bridging	-0.477 (0.153)	0.621***	-0.543 (0.181)	0.581***	-0.308 (0.366)	0.735
Bonding	-0.397 (0.139)	0.627***	-0.469 (0.182)	0.625**	-0.556 (0.265)	0.573**
Constant	2.295 (0.608)	9.928***	3.268 (0.799)	26.264***	1.235 (1.098)	3.438
Nagelkerke $R^2$	0.273		0.206		0.305	

Model 1 (all households), model 2 (MHHs only), and model 3 (FHHs only). Dependent variable is the FIES score were 0 = “food secure and mildly food insecure” and “moderately food insecure”, and 1 = “severely food insecure”

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Standard errors in parentheses

household access to food, despite a  $\chi^2$  test showing a statistical difference.

Higher bridging and bonding social capital are associated with reduced odds of being food insecure in terms of access to food for both MHHs and FHHs. The odds of being

food insecure decrease with a unit increase in bonding social capital, with the odds decreasing a similar amount for MHHs (at 38%) and FHHs (at 43%). A unit increase in bridging social capital also decreases the odds of being food insecure more for MHHs (42%) than for FHHs (27%), though the

latter association is not significant. A unit increase in linking social capital increases the odds that a household is food insecure for MHHs by 81% and FHHs by 6.0%, though the latter is not significant. The variables in the FHH model have fewer statistically significant relationships than the MHHs and Model 1, possibly due to fewer cases in the FHH model.

Age of household head, gender of household head, and non-food expenditure had no significant association with food insecurity in terms of access to food, despite these covariates having significant associations in the previous studies (see Introduction). Education of household head, economic activity, and credit were associated with food insecurity in terms of low access to food. Households that had not used any credit in the past 12 months had 62% lower odds of being food insecure, compared to those that had accessed credit. This suggests that households with no credit had better access to food than those with credit. Educational qualification of the household head had a complex association with food insecurity. Those with a Junior Certificate of Education (JCE) qualification had higher odds of food insecurity than those with no educational qualification. Meanwhile household heads with a Malawi School Certificate of Education (MSCE) had lower odds of food insecurity, compared to those with no qualifications. Finally, households with non-agricultural businesses had 75% lower odds of food insecurity compared to households with household agricultural businesses as their main economic activity.

## Discussion

### General patterns

A large proportion of Phalombe district's population was classified as severely food insecure in terms of access to food, with 87.7% of households falling in this category (Fig. 4). This highlights the food security challenges within the district, which was exacerbated by extreme weather events that occurred over the time period of data collection (Fig. 2). A higher proportion of FHHs were severely food insecure compared to MHHs, which is consistent with the other studies (Kassie et al. 2015; Mason et al. 2015; Zezza et al. 2008).

Each of the studied social capital typologies is associated with food security in different ways and different degrees, showing the importance of splitting social capital into its bonding, bridging, and linking dimensions to understand its association with food security. For all models (Table 3), bridging and bonding social capital are associated with higher food security, while linking social capital is associated with lower food security. The covariates used in the model produced interesting results. Age, gender, and non-food expenditure had no significant association with food

security, despite the literature suggesting they are important socio-economic factors that influence food security (Kassie et al. 2015; Fisher and Lewin 2013).

Of the three social capital typologies, the strongest association with food security in terms of food access for Model 1 and MHH was linking social capital (followed by bridging and bonding social capital). Although, the association suggests higher linking social capital is associated with worse access to food (Table 3). Meanwhile, the strongest association for FHHs was for bonding social capital, followed by bridging and linking social capital, with the latter showing a negative association (Table 3). Below, we discuss in more detail some of the main patterns between social capital typologies and access to food.

### Bonding social capital

The study has shown that higher bonding social capital has a positive association with household food security status in terms of access to food, which is in agreement with the other studies (Dzanja et al. 2015; Sseguya 2009; Martin et al. 2004). The decrease in the likelihood of being severely food insecure with increases in bonding social capital was 37%, which is similar to a study in Uganda reporting food insecurity decreases of 37.9% (Sseguya 2009).

Calling upon family and friends for providing food and cash in a reciprocal way is common in rural communities in developing countries (Martikke 2017), where such transfers act as a buffer to food insecurity. In rural Malawi, households are expected to help one another through times of need, and thus, bonding social capital is an important lifeline (Margolies et al. 2017; Dzanja et al. 2015; Kita 2014). Although this is the case to some extent in Phalombe, this study suggests that the association of bonding capital is not as strong as expected. In Model 1, food security had a very similar association with bonding and bridging social capital, with the latter having a slightly stronger association (Table 3).

Given that Phalombe is both mostly rural and has highly homogenous communities in terms of culture, income, and livelihoods, it would be expected that bonding social capital would be the most strongly associated with food security in Model 1 (Hawkins and Maurer 2010; Costa and Kahn 2003) (see Table 3). However, homogenous groups characterized by high poverty rates, such as communities in Phalombe, are likely to be limited in the use of their bonding social capital. This is especially true when a covariate risk occurs such as widespread flooding and drought (Tessema et al. 2021; Jordan 2015b). If a household's family and friends have been affected by extreme weather events and are food insecure, then they might not be able to offer food transfers, because

they themselves might also suffer (Islam and Alam 2018; Jordan 2015b; Margolies et al. 2017; Wossen et al. 2016).

Nevertheless, specifically for FHHs, bonding was the most strongly associated social capital typology with household food security in terms of food access (Table 3). In general, women tend to rely more on kinship relations and bonding social capital than men (Addis and Joxhe 2017; Healy et al. 2007). As most marriages in Phalombe are matrilineal and post-marital residence is matrilineal, bonding may be even more important for FHHs there (Asfaw and Maggio 2018). Women stay in their villages for their whole life and will most likely have stronger kinship relations within their communities than their husbands will. This suggests that FHHs can rely on bonding more than they would be able to in a patrilineal system.

Bonding social capital may also show a stronger association with food security due to the time constraints of FHHs (Katungi et al. 2008). FHHs have less time to invest in forming and maintaining social capital, something that may also affect women living in MHHs. Bonding social capital can be built more easily for women compared to the other types of social capital as they can integrate it into their day-to-day tasks, such as water and firewood collection (Kerr 2005). There are often women in MHHs that share the load of farm and domestic work, and so, men have more time to invest in bridging social capital. If women in FHHs do not have the time or ability to build bridging or linking social capital, they therefore have to rely on bonding social capital. Although bonding social capital is associated with higher access to food, it can also be easily exhausted and used to ‘get by’ instead of ‘getting ahead’ (Woolcock and Narayan 2000).

### Bridging social capital

In Model 1, bridging social capital had the second strongest association with household food security in terms of access to food, where both MHHs and FHHs are included (Table 3). However, when considering only the social capital typologies that are associated with better household food access, bridging social capital has a stronger association compared to bonding social capital.

Similar results have been found elsewhere in Malawi (Dzanja et al. 2015), Uganda, Ethiopia, and Kenya (Frankenberger et al. 2016). As with bonding social capital, there is a decrease in the likelihood of being food insecure with increasing bridging social capital (38%) (Table 3), which is similar to a Ugandan study which reported decreases of 35.5% (Sseguya 2009). In this study, bridging social capital was most strongly associated with the food security status of MHHs, with a unit increase in bridging social capital having a larger effect for MHHs than for FHHs (Table 3).

The bridging social capital score in the current study considered VSLA membership, mobile phone ownership, and cash given out to family and friends. VSLAs are mutually beneficial groups operated by community members depositing money on a regular basis into a group fund, so its members can take a loan in the future. VSLAs are characterized as bridging social capital as they are formal groups with meetings, rules, and penalties. This differs from informal saving and borrowing (e.g., with a family member), which would be characterized as bonding social capital (Karlan et al. 2012) and formal credit which would be characterized as linking social capital (Baiyegunhi and Fraser 2014). VSLA membership can have direct and indirect impacts on food security as money can be used to buy food and invest in agricultural inputs that increase farm output (Ksoll et al. 2016). It has been found that VSLA membership is associated with better food security outcomes and increases in the number of meals eaten in a day (Ksoll et al. 2016).

Meanwhile, owning a working mobile phone can be a proxy for bonding or bridging social capital, depending on the context (Chan 2015; Shema and Garcia-Murillo 2020). This specific proxy loaded to the bridging social capital factor in this study (Table 2), which fits well with the study context as mobile phone ownership in Sub-Saharan African communities is important for finding short-term casual labor such as *ganyu* and accessing new markets for cash crops (Sikundla et al. 2018; Nsabimana and Funjika 2019). In this sense, if households can contact people to access work opportunities, they are more likely to access food, because they will have money to purchase it.

The bridging social capital score also includes whether cash has been given out to family and friends. Conceptually, it would be expected that this variable would load on to bonding social capital (Table 1) rather than bridging social capital (Szreter 2002). Again, context matters as cash in Malawi is not commonly shared in the same way as food (Kita 2014; Margolies et al. 2017). Instead, we consider cash as a bridging commodity that is paid in exchange for something such as labor, where both parties benefit.

Of course, the study context is important and may help to explain why bridging social capital has a slightly stronger association with food security than bonding social capital in Model 1 (Table 3). Following a covariate risk, such as the flooding and drought that occurred in Phalombe, bonding social capital may no longer be an option to households as everyone has been affected by such extreme weather events (Jordan 2015a). In times like this people cannot rely on their family and friends for risk-sharing, and instead need more formal arrangements such as bridging social capital. This is somewhat in contrast to previous studies, which were based in middle- to high-income countries, and found bonding continued to be the most important social capital typology after a disaster (Aldrich 2017; Hawkins and Maurer 2010;

Pelling 1998). Once again, this supports the idea that the availability and utilization of social capital in low-income countries is different to high-income countries and that more research at the interface of food access and social capital is required (Kansanga et al. 2020).

When comparing bridging and bonding social capital, the former was most strongly associated with MHHs and the latter with FHHs (Table 3). Bridging social capital may have a male bias (Mwangi et al. 2011; Cornwall 2003; Fischer and Qaim 2012) as previous research in Malawi found that it benefits wealthier and older MHHs rather than FHHs (McCarthy and Kilic 2015). FHHs may decide there is little benefit to investing in bridging social capital as they have to deal with the double-day burden (Klasen et al. 2011) of balancing domestic and income-generating work. Studies from Rwanda (Shema and Garcia-Murillo 2020) and South Africa (Bacishoga et al. 2016) have found that mobile phones are used for bridging social capital formation and to improve employment opportunities. However, in addition to time constraints, women also have restricted movement due to social norms (Grant and Pike 2019), so may have less need for a mobile phone. Finally, women are less able to fully access the formal cash economy and are more likely to distribute food to their bonding networks (McNamara 2019). For FHHs to reap the benefits of bridging social capital at the same level as MHHs, they would have to overcome barriers that include social norms, time constraints, and asset inequality.

### Linking social capital

Out of the social capital typologies in Model 1, linking social capital was the most strongly associated with food insecurity in terms of access for all households and for MHHs (Table 3). It had the opposite association compared to bonding and bridging as, somewhat counterintuitively, higher linking social capital is associated with worse access to food (Table 3). These results are in contrast to social capital literature, as linking social capital should, in theory, improve food security by improving access to hard-to-obtain resources, including food and cash (Woolcock and Narayan 2000). Of the few studies that have explored linking social capital and food security, Frankenberger et al. (2016) in Kenya and Pendley et al. (2020) in Burkina Faso and Niger reported similar findings to our study, i.e., that linking social capital is associated with lower food security status.

Linking social capital proxies include engaging with, and accessing resources from, NGOs and the government. However, there are various ways through which a household may engage with NGOs and the government. For example, they can help and support the organizations through volunteering or lobbying or they can receive help and support from them. In this study, the variables used to create the linking

social capital index included NGO and government support to communities. Households are therefore accessing their linking social capital because they are food insecure in terms of accessing food, with linking social capital being the last resort.

Based on social capital theory, the connection between linking social capital and higher food insecurity is unexpected. Although other studies have found similar results (Frankenberger et al. 2016; Pendley et al. 2020), they have not attempted to explain why this is the case. We hypothesize that in low-income countries, the interactions between households and their linking social capital (and particularly how it is used to facilitate access to food) are very different when compared to high-income countries, which social capital theory is based on. Within linking social capital, there are differences in how people interact with outside, powerful organizations depending on the context of the study.

Of the three social capital typologies, linking social capital had the strongest association with food security access for MHHs but the weakest association for FHHs (Table 3). There is a lack of studies in food security and social capital research that include linking social capital typology or gender, so understanding this finding is challenging. Qualitative research is required to understand this result and to, more generally, develop an understanding of linking social capital in low-income countries.

### Limitations and future research

Although the results of this study have added to our emerging knowledge of the associations between the three social capital typologies and food security in a low-income country context, they raise further research questions. Furthermore, the research has certain limitations that need to be acknowledged when using the results of this study.

First, our findings do not imply causality. While there is an association between bonding, bridging, and linking social capital and food access, it is highly possible that there are many other interfering factors at play. We cannot conclusively say that social capital is driving food access, or vice versa. Instead, we can only ascertain that there are significant associations.

Second, this study only focuses on one pillar of food security, food access, mainly due to data limitations. Here, we used secondary data to create food security scores, which only reflects the access pillar of food security. Although caution must be taken when interpreting results due to the strong focus on food access, our findings can be used to establish some associations between social capital typologies and food security. Ideally, future studies should consider all other pillars of food security, such as availability, utilization, and stability, to obtain a more comprehensive picture of how social capital is linked to food security.

Third, our study included gender in the analysis, which is both challenging (Munoz Boudet et al. 2018) and often lacking in sustainability research (Khalikova et al. 2021). However there are certain challenges and uncertainties in the approach and findings. In terms of approach, this study explores gender by differentiating between male and female household heads. There is ongoing debate on the suitability of exploring gender differences in this way as it excludes women in MHHs (Munoz Boudet et al. 2018). Yet, in the absence of individual level data, comparing MHHs and FHHs is better than not acknowledging gender at all (Brown and van de Walle 2020). However, while using such data means that we cannot address the complexities of intra-household gender differences, we do show that comparing household heads significantly improves our understanding.

In terms of results, the FHH model was not significant, most likely due to the small sample size. Thus future research should aim to improve the sample size of FHHs where possible. More importantly, future studies should attempt to explore differences between de facto FHHs, and de jure FHHs, as well as men and women within a MHH, as it is likely there will be differences in household-level food security and social capital due to their gender breakdown (Brown and van de Walle 2020).

Finally, the data collection and recall period coincided with a period of major floods and droughts that impacted Phalombe. It is likely that the combination of household bonding, bridging, and linking social capital would have altered over the different stages of the disaster (Carmen et al. 2022). Bonding social capital in particular may have weakened and then re-emerged after the worst of the disaster had passed (Khalil et al. 2021; Islam and Alam 2018). We need to acknowledge that the households in this study were surveyed at various points before, during, and after the drought, resulting in a range of responses. Future multi-temporal studies exploring the changes in bonding, bridging, and linking social capital and food security in a disaster context could provide useful insights to overcome this limitation.

## Conclusion

This study has identified the association of bonding, bridging, and linking social capital with the access to food for households in the Phalombe district of Malawi, in the context of extreme weather events. As we have shown, social capital typologies are not associated with access to food in the same way. This supports the idea that studies should unpack social capital into its typologies when exploring its links with food security.

Furthermore, although a few studies at the interface of social capital and food security take gender into account, results from this study find key differences by the gender of

the household head. First, a higher proportion of FHHs were severely food insecure in terms of access to food compared to MHHs. Second, bonding social capital denotes better access to food and it was found to be most strongly associated with FHHs, who are more reliant on kin and close friends. However, the ability to access food through bonding social capital may be limited in the context of widespread extreme poverty and extreme weather events (which are characteristics of the Phalombe District), as food resources will be anyway limited within the bonding social capital network due to such external constraints. Linking social capital is the most strongly associated with access to food for MHHs out of the three social capital typologies. Yet, in this study, higher linking social capital was associated with lower access to food. Thus, our surprising results suggest that social capital needs to be disaggregated into typologies, as associations between the social capital typologies and food access may vary in direction and amount. Finally, we should point out that as the study focuses on the food access pillar of food security specifically, food availability, utilization and stability may be associated with the social capital typologies differently.

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**Availability of data and materials** Data are available to the public. Data are freely available for download from MicroData World Bank.

**Code availability** Not applicable.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

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