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PAMJ One Health

Research

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Received: 04 Jun 2024 - **Accepted:** 04 Aug 2024 - **Published:** 21 Aug 2024

Keywords: Food security, WORTH Yetu, economic empowerment, family size, disability

Cite this article: Amon Exavery et al. Significance of family size and disability in the impact of an economic empowerment intervention on household hunger among families caring for orphaned and vulnerable children in Tanzania. PAMJ-One Health. 2024;14(22). 10.11604/pamj-oh.2024.14.22.44177

Available online at: https://www.one-health.panafrican-med-journal.com/content/article/14/22/full

Significance of family size and disability in the impact of an economic empowerment intervention on household hunger among families caring for orphaned and vulnerable children in Tanzania

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Abstract

Introduction: *although previous impact evaluations of non-experimental economic empowerment interventions have addressed selection bias by accounting for common factors such as age, gender, education, marital status, household structure, and employment, crucial factors like family size and disability are often overlooked. This study examined how family size and disability influence the impact of WORTH Yetu economic empowerment intervention on household hunger among families caring for orphaned and vulnerable children (OVC) in Tanzania.* ***Methods:*** *based on longitudinal data from the USAID Kizazi Kipya project, with baseline (2016-2019) and follow-up (2019-2020), the impact of WORTH Yetu on household hunger was estimated using difference-in-differences (DiD). Regression models with and without family size and disability were compared using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Likelihood-Ratio (LR) test to establish the significance of these variables.* ***Results:*** *we analyzed 497,293 observations from 249,655 caregivers at baseline and 247,638 at the follow-up. The caregivers were aged 18+ years (average = 49.3, SD = 14.5) at baseline. The majority were women (70%). At the follow-up, 10.1% of the caregivers were participants in the WORTH Yetu intervention. The WORTH Yetu intervention reduced household hunger and improved food security among participants compared to non-participants (β = -0.624, 95% CI (-0.652, -0.592), p < 0.001). Models with family size and disability were statistically better than those without (p < 0.001), and indeed, caregivers living with disability and those in larger families were significantly less likely to experience positive gains in food security from the WORTH Yetu intervention compared to their counterparts.* ***Conclusion:*** *family size and disability adversely influenced caregivers' gains in food security post-WORTH Yetu intervention. Tailoring programmes to diverse needs, especially for disabled and larger families, is vital for maximizing inclusivity and benefits from economic empowerment interventions toward zero hunger.*

Introduction

Due to a lack of randomization, programme impacts estimated in non-experimental settings can be influenced by uncontrolled or unmeasured confounders by biasing estimates from their true values [1-3]. This may lead to inaccurate conclusions and consequently misinform policies about programme effectiveness. In this case, modelling through multivariate analysis has been recommended to minimize confounding effects. Despite this, the absence of some key variables would result in impact estimates affected by the unmeasured variables or residual confounding [4]. Therefore, the inclusion of as many independent variables as possible in the multivariate regression model reduces the variance represented by the error term and ultimately increases the precision of the estimated impact [5].

In reviewing many empirical studies which have evaluated some economic and livelihood programmes, evidence shows that even though many independent variables have been included, others are theoretically essential but have been rare or missed altogether. In studies that used multilevel models, intraclass correlation coefficients (ICC) have been always largest at the lowest level than subsequent levels, suggesting that individual-level factors have the largest influence on the outcomes, thus a need to have most of these measured and adjusted for. Common independent factors that have been accounted for in related studies include age, sex, education, marital status, living structure, and employment status [6,7]. However, in programme impact evaluation for some livelihood outcomes such as food security, and household socioeconomic status (SES), factors such as place of residence, family size, and disability status of programme beneficiaries have been rarely accounted for. In theories, these factors carry considerable weight in relation to those outcomes.

According to the Neo-Malthusian theory, food security is a function of food production, stemming from the observation that resources are limited, and rapid human population growth could outpace the provision of resources including land and food [8,9]. This may be attributed to a growing dependency the bigger the family becomes, which is likely more so in families caring for OVC. Further, the urbanization theory proposes that the root cause of food insecurity is the uneven distribution of development between urban and rural areas [10]. This may be a reason why analysis of food security should account for place of residence because of the socioeconomic inequalities between rural and urban areas.

Disability is another important factor rarely considered in many studies. One possibility for this could be related to sample size issues because the disabled population tends to be small in many settings, thus requiring large programmes to study their situations. This implies that disabled people may be the most underserved due to low visibility in communities. To realize the global goals for sustainable development, especially the zero hunger target by 2030, the United Nations (UN) emphasizes leaving no one behind in programming, especially those who are vulnerable and extremely poor [11]. Evidence reveals that disability imposes limitations on an individual due to physical, mental or sensory impairment [12]. This limits their opportunities to participate in the normal life of society on an equal level with others [12-15]. Because of this, disability status of the target programme beneficiaries should not be ignored. Disability is crucial because it is already evident that disabled women and girls are twice more likely to experience discrimination, placing them at a higher risk of gender-based violence (GBV), sexual abuse, neglect, maltreatment, and exploitation [16]. People with disabilities may be disadvantaged in many other dimensions, thus a need for a closer examination of their situations and needs.

The United Nations´ target of ending hunger by 2030 necessitates programmes to be finely tuned to the specific needs of subpopulations facing distinct barriers. Tailoring interventions to address the unique challenges of vulnerable groups will ensure that the benefits of these programmes are maximized and expanded to reach every needy individual, leaving no one behind. Without this targeted approach, ending hunger and achieving universal food security will remain unlikely. Addressing these disparities not only promotes equity, but also enhances the overall effectiveness of hunger eradication efforts, contributing to the global goals for sustainable development. It is already clear that realizing the United Nations´ zero hunger target by 2030 means leaving no one behind, especially those who are vulnerable and extremely poor. However, in 2023, the United Nations estimated that 2.4 billion of the global population were moderately or severely food insecure (i.e. inadequate food), an increase of 391 million people from the number estimated in 2019 [17]. Growing inequalities were cited as one of the major drivers [17], necessitating the urgency for targeted interventions, inclusive policies, and equitable resource distribution to individuals and subpopulations underserved.

Overall, the inclusion of commonly overlooked variables such as disability status and family size represent a significant methodological advancement, as accounting for these factors mitigates potential selection bias and enhances the validity and reliability of the estimated impact. Therefore, the present study evaluated the significance of family size and disability in the impact of an economic empowerment intervention WORTH Yetu on household hunger among caregivers of orphaned and vulnerable children (OVC) in Tanzania. The study also investigated the extent of household hunger by family size and disability status to identify the most disadvantaged segments of the caregivers who should receive priority in tailored care and support. These objectives were achieved by addressing three research questions: (1) what is the significance of family size in the impact of the WORTH Yetu economic empowerment

intervention on household hunger among OVC caregivers in Tanzania? (2) How does disability influence the impact of the WORTH Yetu economic empowerment intervention on household hunger among OVC caregivers in Tanzania? and (3) How does household hunger vary by family size and disability status among OVC caregivers in Tanzania?

Methods

Study design: this study is a longitudinal analysis of secondary data collected at baseline (2016-2019) and follow-up (2019-2020) from a cohort of caregivers of orphaned and vulnerable children (OVC) who were beneficiaries of the USAID Kizazi Kipya project in Tanzania.

Study population: orphaned and vulnerable children´s caregivers constituted the population for this study. In the USAID Kizazi Kipya project context, a caregiver referred to one person, female or male, in a household who had the greatest responsibility for caring for and rearing one or more OVC [18]. The caregiver could be any household member, not necessarily a biological parent of the OVC. In this study, we included 249,655 caregivers aged 18 years or older at baseline, with data on the primary outcome (household hunger) and other key variables. At follow-up, an average of 1.6 years later, 247,638 (99.2%) of the original cohort were reached. A very few (0.8%) caregivers with missing data were excluded from the analysis.

Study area: the caregivers in this study lived in 81 district councils in 25 regions of Tanzania. These district councils and regions geographically represented 44% and 81% of all councils and regions of Tanzania, respectively. The regions were Arusha, Dodoma, Dar es Salaam, Geita, Iringa, Kagera, Katavi, Kigoma, Kilimanjaro, Mara, Mbeya, Mjini Magharibi, Morogoro, Mtwara, Mwanza, Njombe, Pwani, Rukwa, Ruvuma, Shinyanga, Singida, Simiyu, Songwe, Tabora, and Tanga.

Variables: this study was based on one primary outcome or dependent variable, food security or level of household hunger, which was objectively measured using the Household Hunger Scale (HHS) [19]. The HHS categorized the caregivers´ households into three groups indicating the severity of household hunger: (1) little to no hunger households (food secure), (2) moderate hunger households, and (3) severe hunger households. In this study, household hunger was treated as an ordinal variable and coded accordingly, such that the higher the value of the code the higher the level of household hunger. Regarding independent variables, the main one was a binary variable that captured the caregivers´ participation status in the WORTH Yetu economic empowerment intervention. This was the intervention whose impact on food security was evaluated, accounting for the rest of the independent variables as sources of selection bias or confounders.

Other independent variables were caregiver sociodemographic characteristics: gender (female or male), age in years (18-29 years, 30-39 years, 40-49 years, 50-59 years, or 60+ years), marital status (married or living together, divorced or separated, widow or widower, or single or unmarried), education (never attended, primary, or secondary or more), HIV status (negative, positive, or unknown), mental or physical disability status (not disabled, or disabled); household characteristics: family size (2-3 people, 4-6 people, or 7+ people), health insurance status (no health insurance, or has health insurance); and geographical characteristics: place of residence (rural or urban). In this study, mental or physical disability referred to observable conditions that impaired the caregivers´ cognitive, emotional, or physical functioning. This included observable characteristics such as mobility limitations, difficulties with daily activities, and signs of cognitive or emotional challenges like confusion, forgetfulness, or difficulty in interacting.

Statistical analysis: data analysis for this study involved both descriptive and inferential

techniques of statistics. In the descriptive analysis, the frequency distribution of respondents across all the variables was computed and presented in a frequency distribution table. Then the outcome variable - level of household hunger - was cross-tabulated against each independent variable, and the degree of association between them was tested using the Chi-square (χ^2) test. In the multivariable analysis, the impact of WORTH Yetu on household hunger across all different scenarios was assessed using a multilevel mixed-effects ordinal logistic regression model, with a difference-in-differences (DiD) estimator (represented in Equation (1)). This model was used because of its inherent ability to account for the correlation of observations arising from multiple measurements or nested structures [20-23]. In this study, baseline and follow-up observations of the same caregiver were assumed to be correlated, making this model the most appropriate. The DiD estimator was included as an interaction term between caregivers´ WORTH Yetu participation status (non-member = 0, member = 1) and time (baseline = 0, follow-up = 1) to estimate the interventions´ impact on household hunger, accounting for other variables as sources of selection bias.

$$logit(P(Y_{ij} \leq \kappa) = \alpha_\kappa + \beta_{1\kappa}T_{ij} + \beta_{2\kappa}W_{ij} + \gamma_\kappa(T_{ij} \times W_{ij}) + \delta_\kappa X_{ij} + u_{0i} + \epsilon_{ij}$$

Where 1. $Y_{ij}$was the outcome variable for this study, representing the level of household hunger as an ordinal variable that categorized the caregivers´ households as “1 = little to hunger (food secure)”, “2=moderate hunger”, and “3=severe hunger” according to the Household Hunger Scale (HHS); 2. κrepresents a threshold at which the model predicts the probability of the outcome Y_{ij} being at or below that threshold. Each threshold κcorresponds to a cumulative probability. For example, κ=1 might represent the probability of a household experiencing 'little to no hunger,' while κ=2 would represent the probability of experiencing 'moderate hunger,' and $\kappa\alpha_\kappa$is the intercept for the κ^{th} threshold, representing the baseline log-odds of the outcome Y_{ij} being at or below κ; 4. $\beta_{1\kappa}$ represents the effect of time (baseline vs. follow-up) on the log-odds of the outcome Y_{ij} being at or below κ; 5. $\beta_{2\kappa}$ the effect of caregivers´ WORTH Yetu participation status on the log-odds of the outcome Y_{ij}being at or below κ; 6. Y_κ the difference-in-differences (DiD) estimator represented by the interaction effect of time and WORTH Yetu participation status on the log-odds of the outcome Y_{ij} being at or below κ. Y_κ quantifies how the combined effect of time and WORTH Yetu participation status influences household hunger levels compared to the individual or main effects of time and WORTH Yetu participation status alone; 7. δ_κ the effect of other covariates X_{ij} (including family size, and disability) on the log-odds of the outcome Y_{ij} being at or below κ; 8. u_{0i} denotes the random intercept for household i. The random intercept is assumed to be normally distributed with a mean of 0 and variance (i.e.). The random intercept captures the household-specific effect, assuming it varies across households but is constant within each household; 9. ε_{ij} represents the residual error for household $i$at time j. The error term is assumed to be normally distributed with a mean of 0 and variance (i.e.). The error term represents the residual variation not explained by the fixed effects and the random intercept; 10. T_{ij} (time) indicates whether the household hunger observation is at baseline (0) or follow-up (1); 11. W_{ij} represented caregivers´ WORTH Yetu participation status. ´0´ for non-participants and ´1´ for participants; 12. $T_{ij}\times W_{ij}$ captured the difference in the change in household hunger over time between the WORTH Yetu participants and non-participants.

In the estimation process, twelve (12) distinct models were estimated to evaluate the significance of family size, and disability in the impact of WORTH Yetu on household hunger. As presented in Table 1, these models were fitted by examining various scenarios, which included systematically removing one variable at a time and removing both variables. In the process, the overall model was estimated followed by gender-

specific models, considering the scenarios. The tests were performed using the log likelihood-ratio (LR) test. This statistical test compares two nested models to determine whether removing a variable (or a set of variables) from the full model significantly affects the model's fit. It is based on the Chi-square statistic which measures the difference in log-likelihood values between the two models being compared. In addition to the LR test, this study employed the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to enhance the selection of the fittest models. Akaike Information Criterion and BIC are criteria for model selection that evaluate the goodness of fit of statistical models. Smaller AIC and BIC values indicate models that provide a better fit to the data [24]. The null hypothesis in this case is that including the variable family size, disability, or both in the model does not significantly improve the model's fit compared to the model without either or both variables. In other words, the null hypothesis assumes that the variables in question have no explanatory power over the outcomes.

Ethical issues: the protocol for this study was approved by the Institutional Research Review Ethics Committee (IRREC) of the University of Dodoma in Tanzania (MA.84/261/61/57).

Results

Characteristics of respondents: the present study analyzed a total of 497,293 observations from 249,655 caregivers at baseline and 247,638 at the follow-up. The majority (70%) of the caregivers were women and the rest (30%) were men at both baseline and follow-up. The caregivers were aged at least 18 years, with an average of 49.3 years (standard deviation (SD) = 14.5) at baseline. Men were generally older than women. At the follow-up survey, 10.1% (10.4% in women, and 9.6% in men; $p < 0.001$) of all the caregivers were participating in the WORTH Yetu economic empowerment intervention. More characteristics of this population are detailed elsewhere [25].

Family size and disability:at baseline, the majority of the caregivers (62.8%) had family sizes of 2-3 people, followed by 32.8% with 4-6 people, and only 4.3% with families of 7 or more people. This distribution remained consistent at the follow-up. Caregivers who were mentally or physically disabled made up 3.2% of the total sample at baseline, and again this distribution remained unchanged at the follow-up.

Household hunger by WORTH Yetu status:overall, at the follow-up, 31.3% of the caregivers were in households with little to no hunger (food secure), 65.4% with moderate hunger, and 3.3% with severe hunger. These percentages changed significantly by WORTH Yetu participation status ($p < 0.001$). Specifically, the percentage of caregivers in food-secure households was significantly higher among WORTH Yetu participants (38.4%) compared to non-participants (30.5%); the proportion of caregivers in households with moderate hunger decreased from 66.1% among non-participants to 58.5% among WORTH Yetu participants; and severe hunger declined from 3.4% among non-members to 3.1% among participants (Figure 1).

Household hunger by family size and disability status: the percentages of caregivers in each level of household hunger by family size and WORTH Yetu membership status are presented in Figure 2. Results showed that for WORTH Yetu members, food security (caregivers in little to no hunger households) was as high as 38.9% for smallest families (2-3 people), declining to 38.1% for family sizes of 4-6 people, to as low as 36.4% for largest families (7+ people). Moderate hunger consistently increased with family size, from 58.0% for the smallest families to 60.7% for the largest families. Severe hunger remained around 3.0% across all categories of family size. For non-members of WORTH Yetu, there was no clear pattern of how household hunger related to family size. These associations were not statistically significant ($p > 0.05$) (Figure 2). The percentages of caregivers in each level of household hunger by disability and WORTH Yetu membership status are

presented in Figure 3. Results revealed that for WORTH Yetu members, food security was higher among non-disabled caregivers (38.6%) than those who were disabled (34.3%); however, both moderate and severe hunger were higher among disabled caregivers than their non-disabled counterparts (61.9% vs. 58.4%, and 3.8% and 3.0%, respectively). For non-members of WORTH Yetu, the same pattern observed for members was seen. These associations were statistically significant ($p < 0.001$) (Figure 3).

Findings from regression analysis: findings, as summarized in Table 1, revealed that in each of the 12 models (presented in Table 2, Table 3, and Table 4), the probability of obtaining a Chi-square statistic as extreme as the one observed under the null hypothesis (i.e., no significant difference between the models) was very close to zero ($p < 0.001$), leading to rejection of the null hypothesis under all the scenarios. This observation was further reinforced by the AIC and BIC, as models containing either family size, disability, or both variables consistently yielded lower AIC and BIC values than models in which either or both variables were omitted (Table 2, Table 3, and Table 4, models 1-12). In other words, eliminating either one or both variables from the model attenuated the fitness of the model. This implied that the removal of either the family size variable, the disability variable, or both variables, whether from the full model or each of the gender-disaggregated models had a significant impact on the model fit, suggesting that these variables played a crucial role as imperative factors in explaining the variability in the impact of WORTH Yetu on household hunger (Table 1).

Discussion

This study assessed the role of family size and disability in the impact of WORTH Yetu economic empowerment intervention on household hunger among families caring for OVC in Tanzania. The study observed that overall, the intervention significantly reduced household hunger and improved food security among participants compared to non-participants. However, disabled caregivers were substantially less likely to experience positive gains in food security following the WORTH Yetu intervention compared to their non-disabled counterparts. It has been observed that due to physical, mental, or sensory impairment, people with disabilities are less likely to participate in the normal life of society than their non-disabled counterparts [12-15]. Further, WHO acknowledges that people with disabilities typically experience poorer health outcomes, lower educational attainment, reduced economic opportunities, and higher poverty rates compared to those without disabilities [26]. Indeed, it is recognized that disability is often accompanied by stigma and stereotypes, which curtail access to equal rights, opportunities, and social inclusion [27].

To ensure that economic empowerment interventions effectively reduce household hunger and improve food security for people with disabilities, several considerations may be needed, including implementation of programmes in a more comprehensive and inclusive manner to ensure that individuals with disabilities benefit equally. Providing physical access to resources and services and accommodating the diverse communication needs of people with disabilities will likely help. Furthermore, providing individualized support, such as assistive technologies and tailored vocational training, is crucial, as research shows that personalized interventions significantly enhance the quality of life for individuals with disabilities [28]. Active involvement of people with disabilities in planning, implementation, and evaluation can ensure that their needs are addressed, aligning with the United Nations Convention on the Rights of Persons with Disabilities [29,30], underscoring the importance of participation and inclusion. Training for caregivers, service providers, and educators on disability awareness and inclusive practices is essential, with studies indicating that such training improves service delivery [31]. Moreover,

implementing policies that promote the economic rights and well-being of people with disabilities and advocating for systemic changes to support inclusion and accessibility, as outlined in the WHO Global Disability Action Plan 2014 - 2021 [32].

Similarly, caregivers in bigger families (more than 3 people) were less likely to experience a reduction in household hunger compared to those with smaller families (<3 people). There are many possibilities for this. Firstly, larger families often have a higher number of dependents such as OVC (in the case of this study), elderly, or disabled members, who are not contributing economically. This may increase the burden on the caregiver to provide for more non-earning members, consequently straining the household resources [33]. Secondly, in larger families, resources such as food and money are spread more thinly among more individuals, leading to a lower per capita availability of essential resources, exacerbating household hunger and food insecurity. Studies have shown that resource dilution is a significant factor in larger households, as the same amount of income must cover the needs of many people [26]. Thirdly, caregivers in larger families may be facing greater time constraining due to more people to care for in the household, which can limit their ability to engage in income generating activities (IGAs) or seek assistance and resources that could alleviate hunger. This is consistent with research showing that time poverty significantly impacts caregivers´ ability to improve their household economic situations [34]. To assist large families, especially those caring for OVC, income support and livelihood interventions, including skills building, microfinance opportunities, and employment programmes tailored to their needs, may be necessary to help increase their earnings and curb hunger.

In the statistical analyses, models with either one or both disability and family size variables were statistically better than those without. The magnitude of the estimated impact of WORTH Yetu on household hunger did not remain the same because of the omission of the two variables. These variables also influenced how other variables in the models predicted household hunger. Therefore, the study reveals a significant role that family size and disability play in the impact of WORTH Yetu economic empowerment intervention on household hunger among families caring for OVC in Tanzania. It emphasizes the need for similar programmes to account for these variables in their design, monitoring, and evaluation to ensure equitable outcomes.

Strengths and limitations: this study is based on a large sample size, wide geographical coverage, and robust statistical analysis, enhancing the precision and generalizability of its findings, which can usefully apply to other similar settings. However, despite including numerous variables in the analysis to address selection bias or confounding, residual confounding may persist due to unadjusted factors in the secondary data upon which the study relies.

Conclusion

This study identifies family size and disability as critical factors negatively impacting caregivers' food security improvements attributable to the WORTH Yetu economic empowerment intervention. Caregivers with larger families (more than three members) and those with mental or physical disabilities were more likely to experience severe forms of household hunger compared to their counterparts. Furthermore, statistical models that included family size, disability, or both variables were statistically superior to those without either of these factors in both the overall and gender-specific models. These results underscore the need to prioritize family size and disability in impact evaluations of similar interventions to enhance the precision and relevance of the evidence in the field. The results also stress the need for targeted interventions, inclusive policies, and equitable resource distribution, especially for individuals and subpopulations underserved, especially those with

disabilities and large families as observed in this study.

What is known about this topic

- *In non-experimental settings, the accuracy of programme impact estimates relies on accounting for key factors that could introduce selection bias or confounding effects;*
- *For economic empowerment or livelihood programmes, common factors commonly accounted for in estimating their impacts on different outcomes include age, gender, education level, marital status, household structure, and employment status;*
- *A recent study that analyzed how men and women compared in terms of household socioeconomic status (SES) and food security in this population, included disability and family size in the analysis but did not offer any discussion of their effects on the outcomes [25].*

What this study adds

- *This study highlights the significant impact of family size and disability on the outcomes of WORTH Yetu economic empowerment programme, factors often overlooked in other research; it demonstrates that caregivers with disabilities and those in larger families are less likely to experience positive gains from the intervention compared to their non-disabled counterparts and those in smaller families;*
- *The study provides a detailed discussion of these findings, exploring the potential causes and suggesting ways in which future interventions can be designed to ensure that individuals with disabilities or those in larger families benefit equally from the programmes;*
- *By addressing these disparities, the study emphasizes the importance of inclusive programme design to ensure no one is left behind, thereby contributing to the achievement of the United Nation's zero hunger target by 2030.*

Competing interests

The authors declare no competing interests.

Authors' contributions

Amon Exavery conceptualized and designed the study, wrote its protocol, conducted statistical analysis, interpreted the findings, and drafted the manuscript. Peter Josephat Kirigiti and Ramkumar Thandiakkal Balan participated in statistical analysis, interpretation of the findings, and manuscript review. John Charles prepared the datasets, participated in statistical analysis, and reviewed the manuscript. All the authors have read and agreed to the final manuscript.

Acknowledgments

We are grateful to Pact for generously providing the data for this research.

Tables and figures

Table 1: significance of family size and disability in the impact of WORTH Yetu on household hunger among families caring for OVC in Tanzania

Table 2: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger: the role of disability and family size variables (n = 497,293)

Table 3: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger among women: the role of family size and disability (n = 347,922)

Table 4: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger among men: the role of family size and disability (n = 149,371)

Figure 1: level of household hunger among caregivers by WORTH Yetu status at follow-up

Figure 2: percentage of caregivers in each level of household hunger by family size and WORTH Yetu membership status (n = 247,638)

Figure 3: percentage of caregivers in each level of household hunger by disability and WORTH Yetu membership status (n = 247,638)

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Table 1: significance of family size and disability in the impact of WORTH Yetu on household hunger among families caring for OVC in Tanzania

Model	**Removed variable(s)**	**DF**	**Tests**		
			AIC	**BIC**	**LR test**
All caregivers (n = 497,293)					
Model 1	-	22	770,249.4	770,494.0	-
Model 2	Family size	20	770,530.7	770,753.0	Model 2 nested within Model 1; p < 0.001
Model 3	Disability	21	770,408.9	770,642.3	Model 3 nested within Model 1; p < 0.001
Model 4	Both	19	770,697.6	770,908.8	Model 4 nested within Model 1; p < 0.001
Women (n = 347,922)					
Model 5	-	21	534,726.6	534,952.5	-
Model 6	Family size	19	535,018.3	535,222.7	Model 6 nested within Model 5; p < 0.001
Model 7	Disability	20	534,840.4	535,055.6	Model 7 nested within Model 5; p < 0.001
Model 8	Both	18	535,133.7	535,327.4	Model 8 nested within Model 5; p < 0.001
Men (n = 149,371)					
Model 9	-	21	235,142.5	235,350.7	-
Model 10	Family size	19	235,170.7	235,359.1	Model 10 nested within Model 9; p < 0.001
Model 11	Disability	20	235,185.0	235,383.3	Model 11 nested within Model 9; p < 0.001
Model 12	Both	18	235,216.5	235,395.0	Model 12 nested within Model 9; p < 0.001
DF: degrees of freedom; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; LR: Likelihood-ratio					

Table 2: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger: the role of disability and family size variables (n = 497,293)

Covariate	Model 1 (all variables)	Model 2 (removed family size)	Model 3 (removed disability)	Model 4 (removed both variables)
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
WORTH Yetu*Time				
Non-member*Endline	-0.405 (-0.417, -0.392)	-0.406 (-0.420, -0.395)	-0.405 (-0.419, -0.392)	-0.406 (-0.420, -0.395)
Member*Baseline	-0.405 (-0.417, -0.392)	-0.406 (-0.420, -0.395)	-0.405 (-0.419, -0.392)	-0.406 (-0.420, -0.395)
Member*Endline	-0.624 (-0.652, -0.592)	-0.614 (-0.644, -0.583)	-0.622 (-0.652, -0.592)	-0.612 (-0.644, -0.583)
Gender				
Female	0.000	0.000	0.000	0.000
Male	0.102 (0.085, 0.119)	0.101 (0.083, 0.117)	0.105 (0.089, 0.122)	0.104 (0.087, 0.120)
Education				
Never attended	0.000	0.000	0.000	0.000
Primary	-0.260 (-0.278, -0.242)	-0.267 (-0.285, -0.248)	-0.264 (-0.282, -0.246)	-0.270 (-0.289, -0.252)
Secondary+	-0.465 (-0.507, -0.423)	-0.476 (-0.519, -0.434)	-0.468 (-0.511, -0.426)	-0.481 (-0.523, -0.439)
Place of residence				
Rural	0.000	0.000	0.000	0.000
Urban	0.714 (0.699, 0.729)	0.711 (0.696, 0.727)	0.716 (0.701, 0.732)	0.713 (0.698, 0.729)
Marital status				
Married or living together	0.000	0.000	0.000	0.000
Divorced or separated	0.235 (0.215, 0.255)	0.233 (0.213, 0.252)	0.235 (0.216, 0.255)	0.233 (0.213, 0.253)
Widow or widower	0.147 (0.129, 0.164)	0.147 (0.129, 0.164)	0.148 (0.130, 0.165)	0.147 (0.129, 0.165)
Single or unmarried	0.222 (0.194, 0.251)	0.215 (0.186, 0.243)	0.226 (0.197, 0.254)	0.218 (0.190, 0.246)
Health insurance				
Uninsured	0.000	0.000	0.000	0.000
Insured	-0.521 (-0.540, -0.501)	-0.516 (-0.536, -0.498)	-0.519 (-0.538, -0.499)	-0.516 (-0.534, -0.496)
Age				
18-29 years	0.000	0.000	0.000	0.000
30-39 years	-0.150 (-0.185, -0.114)	-0.134 (-0.170, -0.099)	-0.151 (-0.186, -0.115)	-0.135 (-0.170, -0.099)
40-49 years	-0.217 (-0.252, -0.183)	-0.192 (-0.227, -0.158)	-0.217 (-0.252, -0.183)	-0.192 (-0.227, -0.158)
50-59 years	-0.284 (-0.320, -0.248)	-0.261 (-0.297, -0.224)	-0.284 (-0.320, -0.247)	-0.260 (-0.296, -0.224)
60+ years	-0.338 (-0.375, -0.302)	-0.317 (-0.352, -0.281)	-0.334 (-0.371, -0.298)	-0.312 (-0.348, -0.276)
HIV status				
Negative	0.000	0.000	0.000	0.000
Positive	-0.290 (-0.308, -0.274)	-0.288 (-0.304, -0.270)	-0.297 (-0.313, -0.281)	-0.293 (-0.311, -0.277)
Unknown	-0.056 (-0.075, -0.037)	-0.052 (-0.070, -0.034)	-0.056 (-0.074, -0.037)	-0.051 (-0.070, -0.033)
Disability status				
Not disabled	0.000	0.000	-	-
Disabled	0.263 (0.222, 0.304)	0.269 (0.229, 0.310)	-	-
Family size				
2-3 people	0.000	-	0.000	-
4-6 people	0.102 (0.086, 0.117)	-	0.103 (0.087, 0.119)	-
7+ people	0.230 (0.196, 0.266)	-	0.233 (0.198, 0.268)	-
ICC	0.200 (0.194, 0.205)	0.200 (0.195, 0.206)	0.200 (0.195, 0.205)	0.201 (0.196, 0.206)

β = coefficient, CI = confidence interval ICC = intraclass correlation coefficient

Table 3: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger among women: the role of family size and disability (n = 347,922)				
Covariate	**Model 5 (all variables)**	**Model 6 (Removed family sized)**	**Model 7 (removed disability)**	**Model 8 (removed both variables)**
	β (95% CI)	**β (95% CI)**	**β (95% CI)**	**β (95% CI)**
WORTH Yetu*Time				
Non-member*Endline	-0.395 (-0.409, -0.378)	-0.396 (-0.41, -0.381)	-0.395 (-0.409, -0.378)	-0.396 (-0.412, -0.381)
Member*Baseline	-0.395 (-0.409, -0.378)	-0.396 (-0.41, -0.381)	-0.395 (-0.409, -0.378)	-0.396 (-0.412, -0.381)
Member*Endline	-0.611 (-0.646, -0.574)	-0.601 (-0.64, -0.566)	-0.611 (-0.646, -0.574)	-0.601 (-0.637, -0.566)
Gender				
Female	1	1	1	1
Male	1	1	1	1
Education				
Never attended	0.000	0.000	0.000	0.000
Primary	-0.285 (-0.307, -0.263)	-0.293 (-0.315, -0.272)	-0.289 (-0.311, -0.267)	-0.298 (-0.320, -0.276)
Secondary+	-0.496 (-0.548, -0.446)	-0.512 (-0.564, -0.462)	-0.501 (-0.552, -0.451)	-0.518 (-0.569, -0.467)
Place of residence				
Rural	0.000	0.000	0.000	0.000
Urban	0.771 (0.752, 0.788)	0.767 (0.749, 0.785)	0.772 (0.754, 0.791)	0.769 (0.750, 0.787)
Marital status				
Married or living together	0.000	0.000	0.000	0.000
Divorced or separated	0.248 (0.226, 0.271)	0.248 (0.226, 0.272)	0.249 (0.226, 0.272)	0.249 (0.226, 0.272)
Widow or widower	0.154 (0.135, 0.175)	0.158 (0.138, 0.178)	0.156 (0.136, 0.176)	0.160 (0.139, 0.179)
Single or unmarried	0.230 (0.198, 0.261)	0.222 (0.191, 0.253)	0.233 (0.202, 0.265)	0.226 (0.195, 0.257)
Health insurance				
Uninsured	0.000	0.000	0.000	0.000
Insured	-0.501 (-0.524, -0.478)	-0.498 (-0.521, -0.475)	-0.501 (-0.524, -0.478)	-0.498 (-0.519, -0.473)
Age				
18-29 years	0.000	0.000	0.000	0.000
30-39 years	-0.159 (-0.197, -0.120)	-0.137 (-0.176, -0.098)	-0.159 (-0.197, -0.120)	-0.137 (-0.176, -0.098)
40-49 years	-0.231 (-0.268, -0.192)	-0.197 (-0.236, -0.159)	-0.229 (-0.268, -0.191)	-0.197 (-0.234, -0.159)
50-59 years	-0.316 (-0.355, -0.276)	-0.288 (-0.327, -0.247)	-0.315 (-0.355, -0.274)	-0.286 (-0.327, -0.247)
60+ years	-0.365 (-0.406, -0.326)	-0.342 (-0.384, -0.302)	-0.362 (-0.403, -0.322)	-0.340 (-0.380, -0.298)
HIV status				
Negative				
Positive	-0.223 (-0.242, -0.203)	-0.224 (-0.245, -0.205)	-0.228 (-0.248, -0.209)	-0.231 (-0.250, -0.211)
Unknown	-0.039 (-0.062, -0.016)	-0.036 (-0.059, -0.013)	-0.039 (-0.062, -0.015)	-0.036 (-0.059, -0.012)
Disability status				
Not disabled	0.000	0.000	-	-
Disabled	0.286 (0.233, 0.338)	0.288 (0.236, 0.340)	-	-
Family size				
2-3 people	0.000	-	0.000	-
4-6 people	0.125 (0.106, 0.143)	-	0.125 (0.106, 0.143)	-
7+ people	0.292 (0.247, 0.336)	-	0.293 (0.248, 0.339)	-
ICC	0.200 (0.003, 0.194)	0.201 (0.195, 0.208)	0.200 (0.194, 0.207)	0.202 (0.195, 0.208)
β = coefficient, CI = confidence interval ICC = intraclass correlation coefficient				

Table 4: multilevel mixed-effects ordinal logistic regression model of the impact of WORTH Yetu on household hunger among men: the role of family size and disability (n = 149,371)

Covariate	Model 9 (all variables)	Model 10 (removed family size)	Model 11 (Removed disability)	Model 12 (removed both variables)
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
WORTH Yetu*Time				
Non-member*Endline	-0.431 (-0.454, -0.408)	-0.432 (-0.456, -0.409)	-0.432 (-0.456, -0.408)	-0.434 (-0.457, -0.411)
Member*Baseline	-0.431 (-0.454, -0.408)	-0.432 (-0.456, -0.409)	-0.432 (-0.456, -0.408)	-0.434 (-0.457, -0.411)
Member*Endline	-0.644 (-0.699, -0.587)	-0.637 (-0.693, -0.582)	-0.642 (-0.699, -0.587)	-0.637 (-0.693, -0.580)
Gender				
Female	-	-	-	-
Male	-	-	-	-
Education				
Never attended	0.000	0.000	0.000	0.000
Primary	-0.213 (-0.247, -0.179)	-0.218 (-0.252, -0.184)	-0.217 (-0.251, -0.183)	-0.222 (-0.256, -0.188)
Secondary+	-0.396 (-0.473, -0.320)	-0.403 (-0.480, -0.327)	-0.399 (-0.475, -0.322)	-0.405 (-0.483, -0.329)
Place of residence				
Rural	0.000	0.000	0.000	0.000
Urban	0.581 (0.552, 0.609)	0.578 (0.550, 0.607)	0.583 (0.554, 0.612)	0.581 (0.552, 0.610)
Marital status				
Married or living together	0.000	0.000	0.000	0.000
Divorced or separated	0.204 (0.165, 0.243)	0.200 (0.160, 0.238)	0.205 (0.166, 0.244)	0.200 (0.160, 0.239)
Widow or widower	0.151 (0.113, 0.188)	0.146 (0.109, 0.183)	0.152 (0.114, 0.189)	0.147 (0.109, 0.184)
Single or unmarried	0.191 (0.122, 0.259)	0.184 (0.116, 0.252)	0.191 (0.122, 0.259)	0.184 (0.115, 0.252)
Health insurance				
Uninsured	0.000	0.000	0.000	0.000
Insured	-0.557 (-0.591, -0.523)	-0.553 (-0.587, -0.519)	-0.555 (-0.589, -0.521)	-0.552 (-0.585, -0.518)
Age				
18-29 years	0.000	0.000	0.000	0.000
30-39 years	-0.093 (-0.185, 0.000)	-0.090 (-0.183, 0.003)	-0.093 (-0.186, -0.001)	-0.090 (-0.183, 0.003)
40-49 years	-0.130 (-0.221, -0.040)	-0.121 (-0.212, -0.030)	-0.131 (-0.222, -0.041)	-0.121 (-0.212, -0.031)
50-59 years	-0.151 (-0.242, -0.060)	-0.140 (-0.231, -0.049)	-0.150 (-0.241, -0.059)	-0.138 (-0.229, -0.047)
60+ years	-0.217 (-0.308, -0.127)	-0.205 (-0.296, -0.114)	-0.212 (-0.302, -0.122)	-0.198 (-0.289, -0.108)
HIV status				
Negative	0.000	0.000	0.000	0.000
Positive	-0.448 (-0.480, -0.419)	-0.440 (-0.470, -0.409)	-0.456 (-0.486, -0.426)	-0.446 (-0.478, -0.417)
Unknown	-0.086 (-0.118, -0.052)	-0.081 (-0.114, -0.049)	-0.084 (-0.117, -0.051)	-0.080 (-0.113, -0.048)
Disability status				
Not disabled	0.000		-	-
Disabled	0.220 (0.155, 0.285)	0.228 (0.163, 0.293)	-	-
Family size				
2-3 people	0.000		0.000	
4-6 people	0.059 (0.031, 0.088)	-	0.063 (0.035, 0.092)	-
7+ people	0.136 (0.078, 0.194)	-	0.141 (0.083, 0.198)	-
ICC	0.197 (0.188, 0.207)	0.197 (0.188, 0.207)	0.197 (0.188, 0.207)	0.198 (0.188, 0.207)

β = coefficient, CI = confidence interval ICC = intraclass correlation coefficient

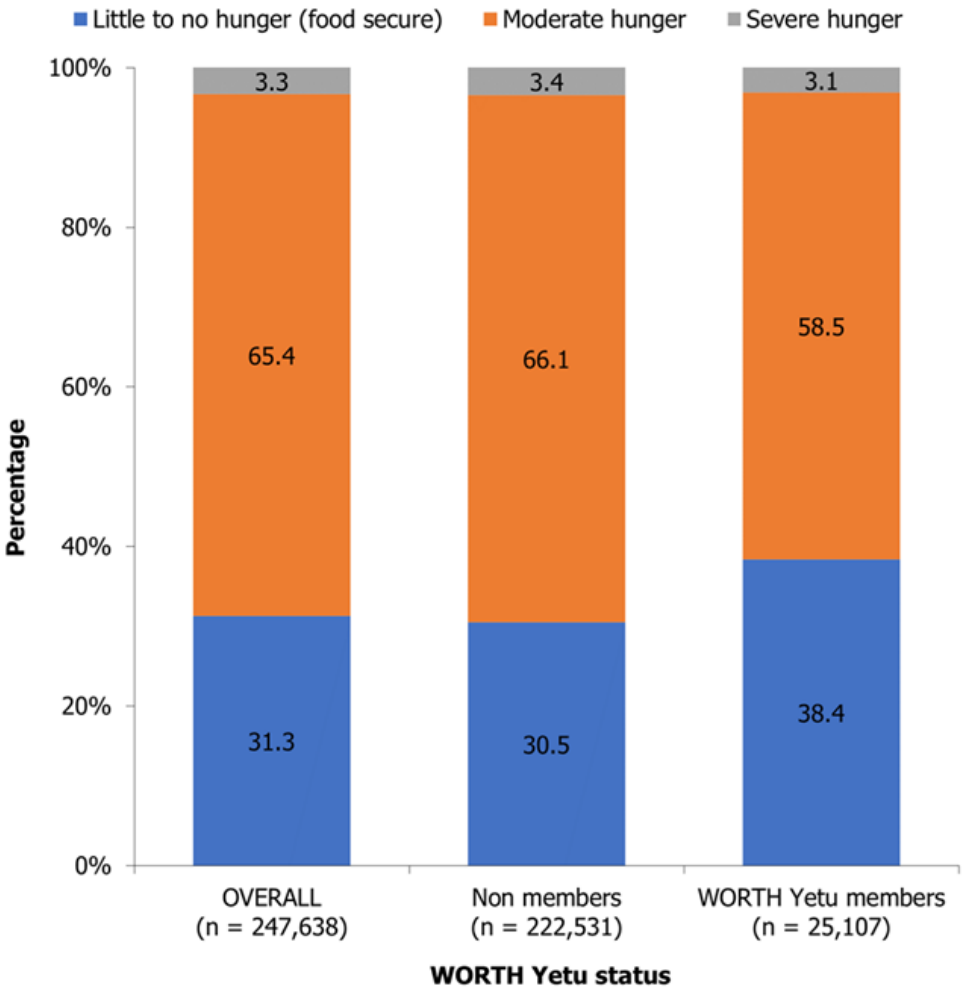

Figure 1: level of household hunger among caregivers by WORTH Yetu status at follow-up

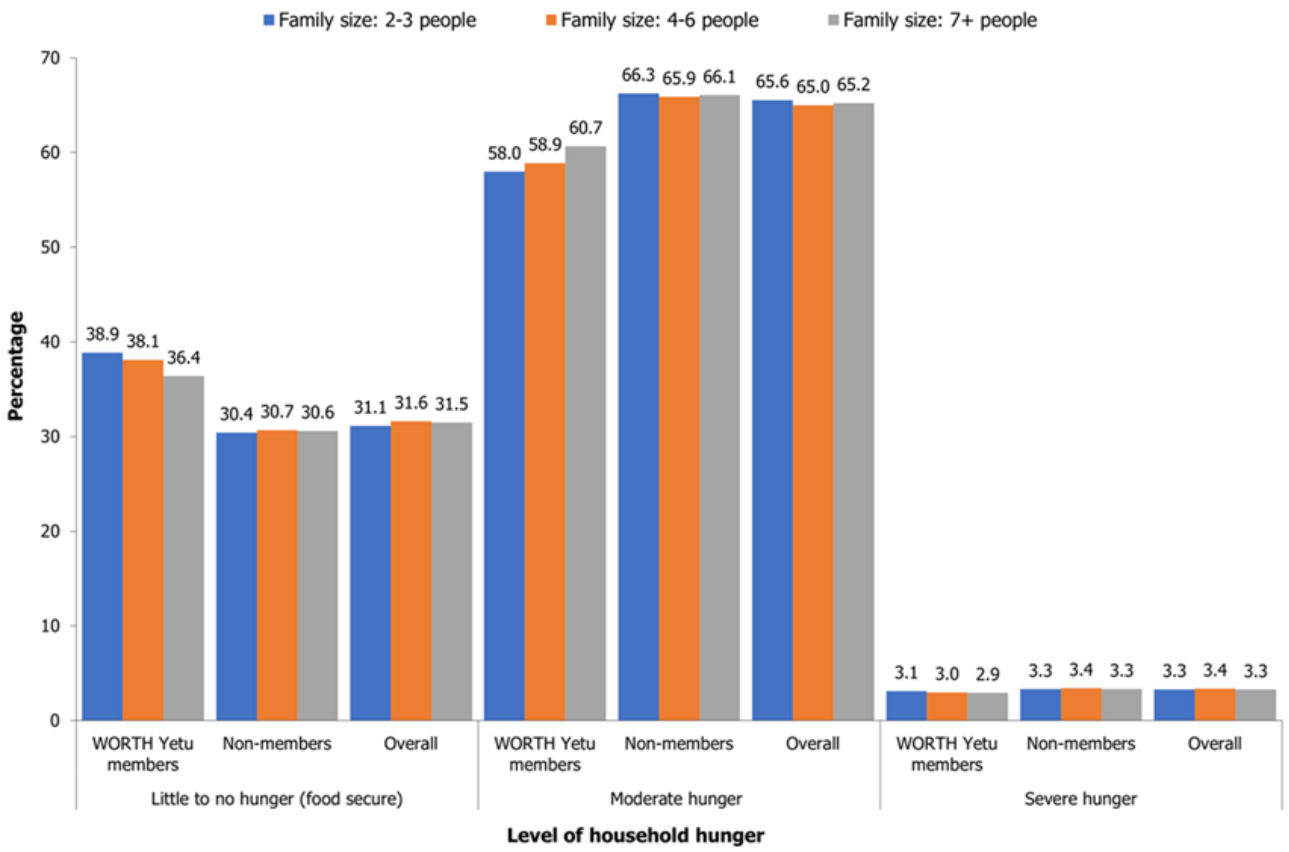

Figure 2: percentage of caregivers in each level of household hunger by family size and WORTH Yetu membership status (n = 247,638)

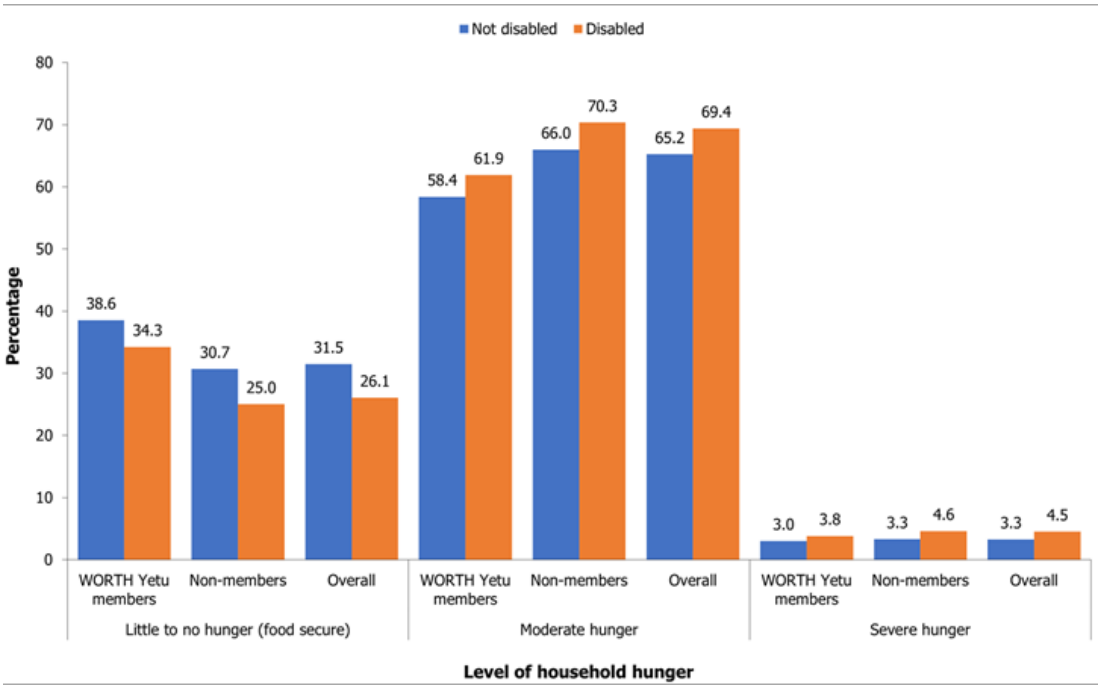

Figure 3: percentage of caregivers in each level of household hunger by disability and WORTH Yetu membership status (n = 247,638)