

Online Supplementary Materials

Article title: Food security mediates the decrease in women's depressive symptoms in a participatory nutrition-sensitive agroecology intervention in rural Tanzania

doi:10.1017/S1368980021001014

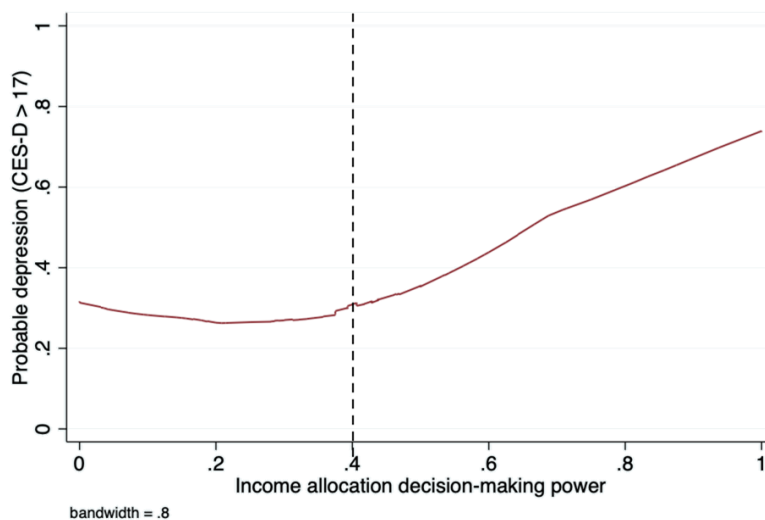


Figure S1. Lowess smoothing graph of the association between probable depression (0 or 1) and low (0-0.4) vs high (0.4-1) income allocation decision-making power scores at baseline of Singida Nutrition and Agroecology Project (January 2016), $n=548$. A linear relationship is apparent only among women with higher income allocation decision-making scores.

Table S1. Comparison of baseline characteristics between intervention and delayed intervention groups in Singida Nutrition and Agroecology Project \leq shows that randomization held for most variables besides being Muslim and income allocation decision-making power: January 2016, n=548

	Control (n=275)		Intervention (n=273)		P-value
	n / mean / median	% / sd / IQR	n / mean / median	% / sd / IQR	
Key Outcomes					
Probable Depression [†] (CES-D ^a >17)	88	32.00	87	31.87	0.97
Household Food Insecurity Access Scale [‡] (0-27)	13.58	7.78	13.91	8.09	0.63
Household Food Insecurity Categories ^{b†}					0.63
Food secure	20	7.27	25	9.16	
Mild food insecurity	16	5.82	12	4.40	
Moderate food insecurity	12	4.36	8	2.93	
Severe food insecurity	227	82.55	228	83.52	
Sociodemographics					
Pregnant [†]	0	0.00	0	0.00	--
Farming as main occupation [†] (ref: any other)	270	98.55	267	97.80	0.52
Monogamous marital status [†] (ref: polygamous)	251	91.27	251	91.94	0.78
Nyaturu ethnic group [†] (ref: other)	266	96.73	261	95.60	0.49
Muslim [†] (ref: Christian, Traditional African, none)	190	69.09	212	77.66	0.02*
Wealth Tertiles ^c					0.45
Poorest	94	34.18	80	29.30	
Middle	93	33.82	96	35.16	
Wealthiest	88	32.00	97	35.53	
Dependency Ratio ^{d†}	1.50	0.75-2.00	1.25	0.75-2.00	0.35
Age (years) [‡]	29.78	7.19	29.94	7.84	0.35
Years of education [‡]	6.89	2.68	6.82	3.11	0.09
Years lived in village [‡]	7.73	7.49	8.04	8.25	0.67
Adequate social support ^{e†} (≥ 3 out of 4)	227	82.55	210	76.92	0.10
Gender equity					
Experienced any domestic violence ^{f†}	69	25.09	78	28.57	0.42
Attitude towards domestic violence ^{g§} (0-7)	5.00	2.00-7.00	5.00	2.00-7.00	0.92
Leisure time (hours)	2.02	1.88	1.84	1.81	0.25
Agricultural decision-making power ^{h§} (0-1)	0.33	0.19-0.50	0.31	0.19-0.50	0.89
Income allocation decision-making power ^{h§} (0-1)	0.38	0.25-0.46	0.33	0.19-0.47	0.89
Low income allocation decision-making power [†] (<0.4)	161	58.54	176	64.46	0.04*
Men's involvement with household chores [†] (0-1)	0.37	0.28	0.39	0.29	0.50

^aCES-D: Center for Epidemiologic Studies Depression Scale⁽¹⁾; ^bcategories from Coates, Swindale & Bilinsky⁽²⁾; ^cWealth tertile is based on asset index score, developed using principal component analysis from household's ownerships of any land, metal roof, electricity, ox plow, solar panels, cell phone, radio, modern beds, mosquito net, books, bicycle, and cattle; ^ddependency ratio calculated as number of children ($\leq 14y$) and elders ($>65y$)/number of household members between the ages of 15 and 64y; ^ecutoff from Antelman et. al.⁽³⁾; ^fin past year; ^gWorld Bank indicator⁽⁴⁾; ^hmodified Women's Empowerment in Agriculture Index⁽⁵⁾. * p<0.05, † n (%) for categorical variables; ‡ for normally distributed continuous variables; § median (IQR) for non-normally distributed continuous variables.

Table S2. Proportion of missing baseline information in Singida Nutrition and Agroecology Project is low (0-5%): January 2016, n=548

	Missing	% Missing
Key Outcomes		
Probable Depression (CES-D ^a >17)	0	0.00
Household Food Insecurity Access Scale (0-27)	0	0.00
Sociodemographics		
Pregnant	15	2.74
Farming as main occupation	1	0.18
Monogamous marital status	0	0.00
Nyaturu ethnic group	0	0.00
Muslim	0	0.00
Wealth Tertiles^b		
Poorest		
Middle		
Wealthiest	0	0.00
Experienced any domestic violence ^c	0	0.00
Dependency Ratio ^c	0	0.00
Age (years)	1	0.18
Years of education	1	0.18
Years lived in village	10	1.82
Adequate social support (≥3 out of 4) ^d	4	0.73
Gender equity		
Experienced any domestic violence ^e	0	0.00
Attitude towards domestic violence (0-7) ^f	0	0.00
Leisure time (hours)	7	1.28
Agricultural decision-making power (0-1) ^g	0	0.00
Income allocation decision-making power (0-1) ^g	30	5.47
Low income allocation decision-making power (<0.4)	0	0.00
Men's involvement with household chores (0-1)	0	0.00

^aCES-D: Center for Epidemiologic Studies Depression Scale⁽¹⁾; ^bWealth tertile is based on asset index score, developed using principal component analysis from household's ownerships of any land, metal roof, electricity, ox plow, solar panels, cell phone, radio, modern beds, mosquito net, books, bicycle, and cattle; ^cdependency ratio calculated as number of children (≤14) and elders (>65)/number of household members between the ages of 15 and 64y; ^dcutoff from Antelman et. al.⁽³⁾; ^ein past year; ^fWorld Bank indicator⁽⁴⁾; ^gmodified Women's Empowerment in Agriculture Index⁽⁵⁾.

Table S3. Missingness of variables included in mediation analyses across 2016-2019 ranges from 0-20%, with more missing data in later years: SNAP-Tz, n=548

	Missing	% Missing
Probable Depression (CES-D^a>17)		
2017	31	5.66
2018	61	11.13
2019	70	12.77
Household Food Insecurity Access Scale (0-27)		
2017	31	5.66
2018	62	11.31
2019	58	10.58
Adequate social support (≥3 out of 4)^b		
2016	4	0.73
2017	31	5.66
2018	64	11.68
Experienced any domestic violence^c		
2016	0	0.00
2017	31	5.66
2018	61	11.13
Income allocation decision-making power (0-1)^d		
2016	30	5.47
2017	32	5.84
2018	64	11.68
Men's involvement with household chores (0-1)		
2016	0	0.00
2017	31	5.66
2018	66	12.04

^a CES-D: Center for Epidemiologic Studies Depression Scale⁽¹⁾; ^b Antelman et. al.⁽²⁾; ^c in past year; ^d modified Women's Empowerment in Agriculture Index⁽⁵⁾

Table S4. Attrition from Singida Nutrition and Agroecology Project from 2017-2019, by baseline characteristics among participants, n=548. Attrition was significantly different by ethnic group, age, and years resident in village, such that these characteristics were included in the imputation models.

	2017					2018					2019				
	Present (n=517)		Missing (n=31)		P-value	Present (n=489)		Missing (n=59)		P-value	Present (n=487)		Missing (n=69)		P-value
	n / mean / median	% / sd / IQR	n / mean / median	% / sd / IQR		n / mean / median	% / sd / IQR	n / mean / median	% / sd / IQR		n / mean / median	% / sd / IQR	n / mean / median	% / sd / IQR	
Intervention	257	49.71	16	51.61	0.84	241	49.28	32	54.24	0.47	236	48.54	40	58.57	0.12
Key Outcomes															
Probable Depression (CES-D ^a >17) [†]	163	31.53	12	38.71	0.40	158	32.31	17	28.81	0.59	157	32.85	18	25.71	0.98
Household Food Insecurity Access Scale [‡] (0-27)	13.86	7.88	11.71	8.56	0.14	13.85	7.85	12.85	8.57	0.36	13.94	7.91	12.39	7.95	0.13
Sociodemographics															
Farming as main occupation [†] (ref: any other)	508	98.26	30	96.77	0.55	481	98.36	57	96.61	0.34	470	98.33	68	97.14	0.49
Monogamous marital status [†] (ref: polygamous)	471	91.10	31	100.00	0.08	449	91.82	53	89.83	0.60	438	91.63	40	91.43	0.95
Nyaturu ethnic group [†] (ref: other)	500	96.71	27	87.10	<0.01*	474	96.93	53	89.83	<0.01*	463	96.86	64	91.43	0.03*
Muslim [†] (ref: Christian, Traditional African, none)	382	73.89	20	64.52	0.25	360	73.62	42	71.19	0.69	350	73.22	52	74.29	0.85
Wealth Tertiles ^{bt}					0.02*					0.33					0.97
Poorest	164	31.72	10	32.26		154	31.49	20	33.90		151	31.59	23	32.86	
Middle	172	33.27	17	54.84		165	33.74	24	40.68		165	34.52	24	34.29	
Wealthiest	181	35.01	4	12.90		170	34.76	15	25.42		162	33.89	23	32.86	
Dependency Ratio ^{cs}	1.33	0.80-2.00	1.00	0.50-1.50	0.12	1.50	0.80-2.00	1.00	0.50-2.00	0.25	1.50	0.80-2.00	1.00	0.50-2.00	0.14
Age [‡] (years)	30.12	7.50	25.58	6.38	<0.01*	30.11	7.50	27.81	7.33	0.03*	30.35	7.49	26.53	6.80	<0.01*
Years of education [‡]	7.41	7.29	6.10	3.10	0.32	7.44	7.46	6.47	3.07	0.33	7.44	7.52	6.60	3.26	0.36
Years lived in village [‡]	8.07	7.97	4.68	5.22	0.02*	8.16	7.96	5.61	6.70	0.02*	8.30	8.07	5.04	5.60	<0.01*
Adequate social support (≥3 out of 4) ^d	409	79.11	28	90.32	0.13	383	78.32	54	91.53	0.02*	376	78.66	61	87.14	0.10
Gender Equity															
Experienced any domestic violence ^{et}	140	27.08	7	22.58	0.58	133	27.20	14	23.73	0.57	127	26.57	20	28.57	0.72
Attitude towards domestic violence (0-7) [§]	5.00	2.0-7.00	2.00	0.00-7.00	0.12	5.00	2.00-7.00	5.0	1.00-6.00	0.21	5.00	2.00-7.00	4.00	1.00-6.00	0.28
Leisure time [‡] (hours/day)	1.92	1.86	2.10	1.76	0.60	1.91	1.87	2.15	1.72	0.35	1.90	1.84	2.13	1.90	0.34
Agricultural decision-making power (0-1) ^{qs}	0.33	0.19-0.50	0.31	0.19-0.50	0.75	0.31	0.19-0.50	0.31	0.25-0.50	0.45	0.31	0.17-0.50	0.32	0.25-0.50	0.35
Income allocation decision-making power (0-1) ^{qs}	0.36	0.19-0.50	0.31	0.17-0.44	0.30	0.36	0.21-0.47	0.34	0.19-0.50	0.76	0.36	0.21-0.47	0.35	0.25-0.50	0.91
Men's involvement with household chores [‡] (0-1)	0.38	0.29	0.33	0.28	0.36	0.39	0.28	0.32	0.33	0.08	0.38	0.28	0.37	0.33	0.84

^a CES-D: Center for Epidemiologic Studies Depression Scale(1); ^b Wealth tertile is based on asset index score, developed using principal component analysis from household's ownerships of any land, metal roof, electricity, ox plow, solar panels, cell phone, radio, modern beds, mosquito net, books, bicycle, and cattle; ^c dependency ratio calculated as number of children (<14) and elders (>65)/number of household members between the ages of 15 and 64y; ^d cutoff from Antelman et. al.(3); ^e over past year; ^f World Bank indicator(4); ^g modified from Women's Empowerment in Agriculture Index(5). *p<0.05; † n (%) for categorical variables; ‡ for normally distributed continuous variables; § median (IQR) for non-normally distributed continuous variables.

Table S5. The risk of probable depression (CES-D > 17) at baseline of Singida Nutrition and Agroecology Project (January 2016), in bivariate and multivariate models, n=548. Food insecurity, domestic violence experience, men's involvement with household chores typically done by women, and higher income allocation decision-making power are significantly associated with greater likelihood of probable depression among smallholder farmers in Tanzania in multivariable regression when modeled as a continuous variable.

	Univariable		Multivariable	
	β	95% CI	β	95% CI
Intervention	0.58	(-1.48, 2.64)	--	--
Key Outcome Variable				
Household Food Insecurity Access Scale score (0-27)	0.61**	(0.46, 0.76)	0.54**	(0.40, 0.67)
Sociodemographics				
Farming as main occupation (ref: any other)	-1.37	(-5.26, 2.53)	--	--
Monogamous marital status (ref: polygamous)	3.85*	(0.34, 7.36)	--	--
Nyaturu ethnic group (ref: other)	-1.85	(-9.11, 5.42)	--	--
Muslim (ref: Christian, Traditional African, none)	-0.27	(-2.6, 2.05)	--	--
Wealth Tertiles^a				
Poorest	Ref	--	--	--
Middle	-1.81	(-4.07, 0.45)	--	--
Wealthiest	-1.16	(-3.94, 1.61)	--	--
Dependency Ratio ^b	0.03	(-0.03, 0.09)	--	--
Age (years)	0.17*	(0.03, 0.32)	--	--
Years of education	-0.01	(-0.15, 0.13)	--	--
Years lived in village	0.12	(-0.002, 0.24)	--	--
Adequate social support (≥ 3 out of 4) ^c	-1.42	(-4.03, 1.18)	-1.79	(-3.97, 0.58)
Gender equity				
Experienced any domestic violence ^d	7.27**	(5.03, 9.50)	5.06**	(2.75, 7.36)
Attitude towards domestic violence (0-7) ^e	0.57**	(0.18, 0.96)	--	--
Leisure time (hours)	-0.12	(-0.82, 0.57)	--	--
Agricultural decision-making power (0-1) ^f	5.49*	(0.30, 10.67)	--	--
Income allocation decision-making power (0-1) ^f	4.91*	(0.06, 9.76)	--	--
Income allocation decision-making power (0-0.4]	-6.55	(-16.78, 3.67)	--	--
Income allocation decision-making power (0.4-1)	17.67**	(8.71, 26.63)	7.78*	(0.25, 15.32)
Men's involvement with household chores (0-1)	-7.02**	(-10.28, -3.76)	-3.42*	(-6.33, -0.51)

^a Wealth tertile is based on asset index score, developed using principal component analysis from household's ownerships of any land, metal roof, electricity, ox plow, solar panels, cell phone, radio, modern beds, mosquito net, books, bicycle, and cattle; ^b Dependency ratio is the number of children (≤ 14 y) and elders (>65 y) divided by number of adult household members (15-64 y); ^c cutoff from Antelman et. al.⁽³⁾; ^d in the past year; ^e World Bank indicator⁽⁴⁾; ^f modified Women's Empowerment in Agriculture Index⁽⁵⁾. * p<0.05, **p<0.01.

Table S6. Sensitivity Analysis: Mediation coefficient comparisons between models with depression as (1) binary [probable depression] or (2) continuous [CES-D score] outcomes and with (a) or without (b) income-allocation decision-making power as a confounder, Singida Nutrition and Agroecology Project, January 2016 - January 2019, n=548. All models demonstrate similar effects of food insecurity as a mediator of the intervention's impact on probable depression.

	Outcome = probable depression (CES-D > 17)				Outcome = CES-D scores			
	1a		1b		2a		2b	
	OR	95% CI	OR	95% CI	β	95% CI	β	95% CI
Natural Indirect Effect Estimate	0.90	0.83, 0.95	0.89	0.85, 0.94	-0.52	-0.75, -0.27	-0.53	-0.72, -0.28
Natural Direct Effect Estimate	0.63	0.47, 0.80	0.65	0.51, 0.81	-1.92	-2.52, -1.22	-1.81	-2.66, -1.30
Total Effect Estimate	0.57	0.43, 0.70	0.58	0.46, 0.76	-2.50	-2.98, -1.76	-2.39	-3.15, -1.94
Controlling for:								
Social Support ^a	yes		yes		yes		yes	
Experienced any domestic violence ^b	yes		yes		yes		yes	
Income allocation decision-making power ^c	yes		no		yes		no	
Men's involvement with household chores	yes		yes		yes		yes	

^a cutoff from Antelman et. al.⁽³⁾; ^b modified Women's Empowerment in Agriculture Index⁽⁵⁾; ^c modelled as with spline at knot=0.4.

References

1. Radloff LS (1977) The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Appl Psychol Meas* **1**, 385–401.
2. Coates J, Swindale A & Bilinsky P (2007) *Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide*. Washington DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
3. Antelman G, Fawzi MCS, Kaaya S, et al. (2001) Predictors of HIV-1 serostatus disclosure: a prospective study among HIV-infected pregnant women in Dar es Salaam, Tanzania. *Aids* **15**, 1865–1874.
4. World Bank (2018) Women who believe a husband is justified in beating his wife when she burns the food (%). <https://data.worldbank.org/indicator/SG.VAW.BURN.ZS> (accessed December 2018).
5. Malapit HJ, Pinkstaff C, Sproule K, et al. (2017) *The Abbreviated Women's Empowerment in Agriculture Index (A-WEAI)*. 56. Washington, DC: International Food Policy Research Institute (IFPRI).