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Climate shocks, maternal health and nutrition, and the protective role of maternal cash transfers

Evidence from the MAZIKO cluster-randomised controlled trial in Balaka and Ntcheu districts, Malawi

Robbie M. Parks[1], Lilia Bliznashka[2], Morgan Jackson[3], Odiche Nwabuikwu[2], Monice Kachinjika[4], Peter Mvula[4], Alister Munthali[4], Mangani Katundu[5], Natalie Roschnik[6], Brenda Phiri[7], Esnatt Gondwe-Matekesa[8], and Aulo Gelli[2]

1. Background

Climate variability and extreme weather events disrupt agri-food systems, livelihoods and health across sub-Saharan Africa (IPCC, 2022). Extreme temperatures, irregular rainfall, droughts and floods reduce agricultural productivity and worsen existing economic and health vulnerabilities among households that depend on subsistence farming (Morton, 2007). These pressures are particularly acute in Malawi, where rainfed agriculture dominates and seasonal food insecurity is widespread (Anderson et al., 2018).

Pregnant women and mothers of young children are especially vulnerable to climate-related disruption. Climate-related stressors may worsen maternal mental health (Berry et al., 2010; World Health Organization, 2022) and maternal undernutrition, which are linked to adverse pregnancy outcomes and poor long-term child growth and development (Black et al., 2013), and. In the MAZIKO study area, 25% of women reported depressive symptoms (Becker et al., 2023). Empirical evidence on how acute climate shocks affect maternal nutrition and mental health in low-income settings remains limited (Scheelbeek et al., 2021).

Cash transfer programmes have expanded widely to address poverty and food insecurity (Bastagli et al., 2016). They can improve household food access and consumption (Tiwari et al., 2016), although their effects on nutritional outcomes have varied (Ruel & Alderman, 2013). This has led to interest in cash plus approaches that combine transfers with complementary interventions such as social and behaviour change (SBC) or livelihoods programming (Little et al., 2021), which may also strengthen resilience to climate shocks by stabilising household consumption and reducing financial stress (Hidrobo et

al., 2024). Whether nutrition-targeted cash plus programmes for pregnant women and mothers of young children remain effective during acute climate shocks has not been tested.

In this study, we assessed whether maternal cash transfers with nutrition-sensitive SBC, or nutrition-sensitive SBC alone, protected women's dietary intake, dietary diversity, body mass index (BMI) and mental health from the effects of self-reported and objectively measured climate shocks in rural Malawi.

2. Methods

We analysed data from the MAZIKO trial (2022–2025), a four-arm cluster-randomised controlled trial conducted across 156 clusters in Balaka and Ntcheu districts of Malawi (Bliznashka et al., 2026; The Maziko Trial Team, 2024). Clusters were randomly allocated to one of four arms, with 39 clusters per arm: (1) standard of care (SoC), in which Care Groups delivered the government SBC curriculum (SoC arm); (2) SoC plus nutrition-sensitive SBC covering agriculture and livelihoods, village savings and loan associations, male engagement and maternal mental health (SBC arm); (3) SoC and nutrition-sensitive SBC plus a monthly cash transfer of USD 17 (low cash arm); and (4) SoC and nutrition-sensitive SBC plus a monthly cash transfer of USD 43 (high cash arm). Transfers were paid to pregnant women and mothers of children under two years of age through mobile payments to accounts registered in their names.

Women's dietary intake and diversity, BMI and mental health were pre-specified secondary outcomes of the trial, measured at baseline (May–June 2022) and endline (May–June 2025). Diets were assessed using an interactive multi-pass quantitative 24-hour recall (Gibson & Ferguson, 2008), from which we calculated total daily calorie intake and a women's dietary diversity score based on 10 food groups (FAO 2021). BMI was calculated from measured weight and height. Mental health was assessed using the WHO Self-Reporting Questionnaire-20 (SRQ-20), which has been validated against clinical diagnosis in Malawi (Stewart et al., 2009). Higher SRQ-20 scores indicate more symptoms of depression, anxiety and stress.

We measured climate shocks in two ways. Self-reported shocks were based on whether the household head reported loss of crops due to drought, floods or heavy winds in the 12 months before each survey. Objectively measured shocks were derived from ERA5-Land reanalysis data (Muñoz-Sabater et al., 2021) at each household's location, using threshold-based indicators for three types of shock: acute temperature shocks, defined as daily mean air temperature above 37°C (Mora et al., 2017); acute soil moisture shocks, defined as volumetric soil water below 0.15 $m^3\ m^{-3}$ (Seneviratne et al., 2010); and chronic drought shocks, defined as at least two consecutive weeks in which evaporation exceeded precipitation (Otkin et al., 2018). Women were classified as exposed if they experienced any shock under each measure between baseline and endline.

We estimated linear regression models including indicators for trial arm, any climate shock and the interaction between the two, which gives the interaction a difference-in-differences interpretation (Wing et al., 2018). Models included district fixed effects to account for stratified randomisation. Adjusted models also controlled for baseline maternal, household and household head characteristics. Estimates are intention-to-treat and are reported as percentage changes in each outcome with 95% confidence intervals (CI). We compared each intervention arm with SoC, and the two cash arms combined with the two non-cash arms combined.

3. Results

The analytic sample comprised 2,202 women: 571 in the SoC arm, 550 in the SBC arm, 541 in the low cash arm and 540 in the high cash arm. Mean age was 26 years, 76% of women were married or living with a partner and, by design, half were pregnant at baseline. In both cash arms, more than 90% of women reported spending most of a typical transfer on food.

Exposure to climate shocks was high and balanced across arms. Between baseline and endline, 79% of households reported at least one climate shock and 52% experienced at least one ERA5-Land-derived shock, most commonly a soil moisture shock (37%), followed by temperature (15%) and chronic drought (12%) shocks. Agreement between the two measures was low (Cohen's $\kappa = 0.03$), indicating that they capture different dimensions of climate shock exposure.

In the SoC arm, self-reported climate shocks were associated with a 7.0% decrease in total daily calorie intake (95% CI: −12.4%, −1.2%) and a 25.1% increase in SRQ-20 score (95% CI: 9.9%, 42.5%), indicating worse mental health. Changes in dietary diversity and BMI were not discernible from the null. ERA5-Land-derived shocks in the SoC arm were associated with a 6.0% decrease in calorie intake (95% CI: −11.4%, −0.2%) and a 3.8% decrease in dietary diversity score (95% CI: −7.3%, −0.2%), with no discernible change in BMI or SRQ-20 score.

Following either type of shock, outcomes in the SBC arm did not differ discernibly from SoC (for example, calorie intake after a self-reported shock: −0.2%; 95% CI: −6.5%, 6.5%). Outcomes in the cash arms were better than in SoC. After a self-reported shock, dietary diversity score was 5.4% higher in the low cash arm (95% CI: 1.1%, 9.8%) and calorie intake was 10.8% higher in the high cash arm (95% CI: 3.6%, 18.4%) than in the SoC arm. SRQ-20 score was 21.6% lower in the combined cash arms than in the combined non-cash arms (95% CI: −27.9%, −14.7%). After an ERA5-Land-derived shock, the corresponding estimates were 8.5% for dietary diversity score in the low cash arm (95% CI: 3.3%, 13.9%), 10.6% for calorie intake in the high cash arm (95% CI: 1.7%, 20.2%) and −11.1% for SRQ-20 score in the combined cash arms (95% CI: −19.9%, −1.4%). BMI did not differ discernibly between arms after either type of shock. Results were similar in unadjusted models.

4. Discussion

In rural Malawi, maternal cash transfers combined with nutrition-sensitive SBC buffered women's diets and mental health against climate shocks. Compared with women receiving the standard of care alone, women in the cash arms had higher calorie intake and dietary diversity and lower SRQ-20 scores after both self-reported and ERA5-Land-derived shocks. Women spent most of their transfers on food, which suggests a direct pathway through which cash supported diets after shocks, with likely benefits for mental health (Firth et al., 2019). These findings support the use of nutrition-sensitive social protection as a climate adaptation strategy in rainfed agricultural settings, building on evidence that social protection and smallholder agriculture can reinforce each other (Tirivayi et al., 2016).

There was some evidence that protection depended on transfer size. Higher-value transfers were generally more protective than lower-value transfers, although confidence intervals overlapped and the trial was not designed to detect differences between them. Both transfer levels were substantial relative to household budgets: USD 17 and USD 43 per month compare with the lowest statutory minimum wage in Malawi, for domestic workers, of 83,720 MWK (about USD 48) per month from June 2026 (Chitsulo,

2026). This is consistent with evidence that larger transfers have larger effects on consumption and psychological wellbeing (Bastagli et al., 2016; Haushofer & Shapiro, 2016).

Nutrition-sensitive SBC without cash did not protect against climate shocks, possibly because its tangible components, such as agricultural inputs, were too small or poorly timed relative to shock onset to buffer acute losses. Cash transfers, by contrast, were regular and predictable, features linked to larger food security gains in other African cash transfer programmes (Tiwari et al., 2016), which allows households to smooth consumption and avoid costly coping strategies when shocks occur. Where cash and nutrition-sensitive SBC were combined, cash likely eased immediate financial constraints and stabilised food access, while SBC reinforced caregiving practices, social norms and community support.

The self-reported measure asked specifically about crop losses and therefore captured impacts operating through agricultural production and income, whereas the ERA5-Land-derived measures captured meteorological exposure regardless of whether losses occurred, which may explain the low agreement between them. The consistency of the cash arm results across both measures strengthens confidence in the findings.

This study has limitations. Diet and mental health were self-reported and may be subject to recall and social desirability bias. Gridded environmental data may not fully capture conditions at the household level. Such misclassification is unlikely to differ systematically between randomised arms and would tend to bias estimates towards the null. All arms received the Care Group platform, so we could not assess whether nutrition SBC itself was protective. The follow-up period may have been too short to capture resilience to repeated shocks, we did not examine effects on children, and findings from rural Malawi may not apply directly to urban settings or to other institutional and climatic contexts.

As climate change intensifies, social protection systems will need to play a larger role in safeguarding diets, nutrition and health in climate-vulnerable settings (IPCC, 2022). Impact evaluations of cash transfer programmes typically estimate average effects under stable conditions (Bastagli et al., 2016). Incorporating climate shock exposure and resilience into programme design and evaluation, including coverage, transfer value and targeting, will help governments and implementers protect maternal nutrition and health in a changing climate, and can inform climate adaptation, loss and damage policy. Further studies should separate the contributions of cash, the nutrition SBC platform and each nutrition-sensitive component, and examine effects on children.

ABOUT THE AUTHORS

Robbie M. Parks[1], Lilia Bliznashka[2], Morgan Jackson[3], Odiche Nwabuikwu[2], Monice Kachinjika[4], Peter Mvula[4], Alister Munthali[4], Mangani Katundu[5], Natalie Roschnik[6], Brenda Phiri[7], Esnatt Gondwe-Matekesa[8], and Aulo Gelli[2]

[1] Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, New York, NY, USA
[2] International Food Policy Research Institute (IFPRI), Washington, DC, USA
[3] Data Science Institute, Columbia University, New York, NY, USA
[4] Palm Consulting Ltd, Malawi
[5] University of Malawi, Zomba, Malawi
[6] Save the Children UK, London, UK

[7] Save the Children Malawi, Lilongwe, Malawi
[8] GiveDirectly Malawi

Corresponding author: Robbie M. Parks (robbie.parks@columbia.edu)

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1201 Eye Street, NW, Washington, DC 20005 USA | T. +1-202-862-5600 | F. +1-202-862-5606 | Email: ifpri@cgiar.org | www.ifpri.org | www.ifpri.info

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