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Impact of Conflict-Related Violence and Presence of Armed Groups on Food Security

Evidence from Longitudinal Analysis in Mali

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Abstract

We assess the impact of conflict exposure on households' food security in rural areas of Mopti, Mali over the period 2012-17. Our main data source is a unique panel dataset of 1,617 households for which the baseline round was collected before the conflict broke out. We estimate the impact of conflict with a weighted difference-in-differences approach. We find that exposure to high level of conflict-related fatalities within a radius of 50km leads to a reduction of daily calorie intake per adult equivalent of 311 kcal (0.39 SD) and a reduction of dietary diversity score by one food group (0.56 SD). The presence of armed groups leads to lower dietary diversity (by 1.2 food group) but has no independent effect on calories. The negative impact of conflict on dietary diversity is concentrated on households with higher scores at baseline. We also estimate whether receiving food assistance mitigates the impact of conflict. We find that school-feeding protects households facing intense conflict by supporting calorie intake.

Keywords: Conflict, armed groups, food security, calorie intake, dietary diversity

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1 Introduction

After nearly two decades of continuous progress, the number of chronically undernourished people in the world *increased* from 777 million in 2015 to 815 million in 2016. The rise was concentrated in areas of Sub-Saharan Africa and Asia most exposed to conflict (FAO et al., 2017).[1] All the emergencies listed by the World Food Programme (WFP) are protracted conflict-affected contexts.[2] The recent GRFC (2019) report identifies conflict as the most important driver of food security, ahead of climate shocks and economic turbulence.[3] Overall, the association between conflict and food insecurity at the macro-level appears undisputed.

Yet, our understanding of the processes linking the two at the micro-level is more patchy, despite recent progress (Martin-Shields and Stojetz, 2019). And associations at the macro scale are not necessarily informative of the processes at work at the micro-level. For instance, Tandon and Vishwanath (2020) found no relation between the location of conflict events and food insecurity in Yemen, pointing out that the impact of conflict was felt countrywide, notably through the closure of ports. It is thus not necessarily true that people living in close proximity to the conflict are the most vulnerable to rising food insecurity. Furthermore, the macro-level evidence is typically based on repeated cross-sectional surveys, as opposed to panels. Tracking households over time allows for a more direct assessment of the impact of conflict on food insecurity.

In this paper, we assess the causal effect of conflict exposure on the evolution of food insecurity among rural households of Mopti, central Mali. The Mopti region is characterized by very high levels of food insecurity and has been affected by both conflict and climate shocks in the recent past (GRFC, 2019).

We add to the relatively small body of studies linking conflict and food insecurity at the micro-level [4] by using a unique panel dataset of rural households in Mopti who were

[1]FAO et al. (2017) calculated that 60% of undernourished people and 79% of stunted children in 2016 lived in conflict-affected countries.

[2]These are the Democratic Republic of Congo, Northeast Nigeria, the Sahel, South Sudan, Syria and Yemen.

[3]The report calculates that conflict has pushed 77 million into acute food insecurity against 34 million people for weather extremes and 23 million people for economic turbulence.

[4]This stands in stark contrast with the relationships between conflict and child nutrition, for which there is now an abundant literature (see e.g. Alderman et al., 2006; Akresh et al., 2007; Bundervoet et al., 2009; Guerrero-Serdan, 2009; Akresh et al., 2012; Domingues and Barre, 2013; Minoiu and Shemyakina, 2014;

interviewed prior to the outbreak of the conflict in January 2012 and then again in January 2017. We employ a weighted difference-in-differences strategy to account for time-invariant unobserved heterogeneity and selection bias. This consists in first estimating the likelihood for villages to be exposed to conflict based on baseline variables, and then to compute inverse probability weights.

D'Souza and Jolliffe (2013) show with OLS that households living in the most conflict-affected provinces in Afghanistan experienced lower levels of calorie intake despite conflict being more likely in provinces where food security was initially higher. George et al. (2020) find that the Boko Haram-related conflict intensity at the sub-regional level decreases rural households' diet diversity and other moderate forms of food insecurity in Nigeria. Also in Nigeria, Kaila and Azad (2019) find that households victimized by insurgent violence experienced lower food security and lower food consumption than non-victimized households. Dabalen and Paul (2014) rely on a difference-in-differences framework (with a pre-crisis baseline) to show that households living in conflict-affected areas of Cote d'Ivoire experienced reduced dietary diversity compared to non-exposed households. In contrast, Brück et al. (2019) do not find a reduction of food consumption and dietary diversity among households most exposed to the Israeli-led military operation "Protective Edge" in Gaza using an IV approach and Tandon and Vishwanath (2020) did not find any correlation between the number of incidents or conflict-related fatalities and food security at the regional level in Yemen.

Our study adds to the literature by providing timely evidence on the effect of the intensifying conflict in the Sahel and from a methods standpoint. Compared to previous studies, our paper has three distinctive strengths. First, we can distinguish between the impact of conflict intensity and the impact of the presence of armed groups. Prior research has shown that indirect effects of the conflict are at least as important as direct effects stemming from battles, emphasizing the importance of the sheer presence of non-state actors (e.g. Tranchant et al., ming). Yet, according to Martin-Shields and Stojetz (2019) no prior studies linked food security with presence of armed groups. Second, we have access to detailed information on the quantity and diversity of food consumed by households. We report results on calorie

Lazzaroni and Wagner, 2016; Tranchant et al., ming).

intake (volume of food consumed) *and* on the diversity of the diets. Furthermore, anthropometric data - even if imperfect - are available, enabling an investigation of food utilization in addition to food access dimension of food security. Third, our difference-in-differences framework makes use of the panel structure of the dataset and of a pre-crisis baseline (a feature shared with Dabalen and Paul (2014)), which enables a cleaner identification of conflict effects.

By way of investigating support measures, we also analyze whether receipt of food assistance and agricultural aid mitigates the impact of conflict on food security using the same weighted difference-in-differences approach with the exception that now we estimate the effect of aid separately on the samples of conflict-affected villages and comparison villages. In so doing, this paper speaks to the empirical literature on social protection in contexts of conflict and fragility.

We find that conflict exerts a large adverse adverse impact of food security. Households living in areas with above median conflict-related fatalities experienced a decline in daily calorie intake per adult equivalent of 311 kcal and consumed 1 food group less than comparison households. Households living in villages with a presence of armed groups did not experience a decrease in calorie intake but suffered from a reduction of dietary diversity by 1.2 food groups. Exposure to above median number of fatalities also caused a 28 percentage point (pp) rise in the likelihood of households being food-energy deficient, a 40pp rise in the likelihood of households being staples-dependent and a 22pp rise in the likelihood of households following a low quality diet. The presence of armed groups caused a 29pp rise in likelihood of low quality diet but had no effect on the other indicators. Exposure to high number of conflict events tend to have a similar effect as exposure to high number of fatalities but the results are less robust with this indicator.

Further investigations to shed light on the mechanisms at work reveal that fatalities are not associated with greater risk of livestock theft, lower access to aid or lower access to basic services. We argue that the effect of fatalities primarily goes through increased food prices and lower agricultural production. In contrast, the presence of armed groups is associated with much higher likelihood of cattle theft, lower access to services and to aid.

Finally, we find some evidence that access to food assistance - primarily school feeding -

mitigates the impact of conflict on calorie intake, but not dietary diversity.

The rest of the paper is structured as follows. Section 2 briefly describes the conflict situation in Mopti. Section 3 presents the data sources and empirical strategy. Section 4 presents the main results, section 5 discusses the potential mechanisms underlying the results and section 6 investigates whether access to aid mitigates the impact of conflict on food security. Section 7 concludes.

2 Brief overview of the conflict in Mopti

Mopti was engulfed by the armed conflict that broke out in northern Mali in January 2012 when the *Mouvement National Pour l'Independence de l'Azawad* (MNLA), a Tuareg independentist group, formed am alliance with various militant Islamist groups such as Al-Qaeda in Islamic Maghreb (AQIM) and Ansar Dine. This coalition evicted armed forces and occupied towns in northern Mali in January 2012 and subsequently moved southward to Mopti region where they reached the Douentza circle and occupied towns, villages and administrative buildings therein. The alliance eventually dissolved as the Islamist groups expelled their Tuareg allies from the towns they occupied. For instance, the town of Douentza was claimed by Ansar Dine after it was initially won over by the MNLA (OCDE/CSAO, 2014). The progression of Islamist groups in central Mali was stopped in April 2013 in Konna, just 70km north of the city of Mopti, by the French-led Serval military intervention. Rebels were forced to retreat in northern Mali while military forces and the Malian state retook some lost positions in Mopti (e.g. ICG, 2016). This period between January 2012 and April 2013 constitutes the first phase of the conflict in Mopti. It primarily involved Tuareg and Islamist rebel groups on the one hand, and military forces on the other hand. It led to 259 casualties, mostly in the Mopti circle.

Mopti region did not experience conflict events between April 2013 and the end of the year 2014. However, violence resumed in 2005 with the emergence of the *Katiba Macina*, a Mopti-based militant Islamist group affiliated with Ansar Dine, and the proliferation and strengthening of political and community-based militias. This second phase of the conflict, starting from 2015 and which is still ongoing, is both more complex and more deadly than the first one. There are more types of actors involved in the conflict, including militias and self-defense groups, national and international armed forces, police, rebel groups but also criminal and bandit groups. And militias themselves are varied. Furthermore, there is an overlap between local resource-based conflicts, inter-ethnic conflicts, banditry and the wider Islamist conflict as described in (e.g. ICG, 2016; Tobie, 2017; Gaye, 2018; ICG, 2019).

Over the period 2015-2017, there were 484 casualties. As the conflict intensifies in central Mali, Mopti is now considered the epicenter of the conflict (Sangare, 2016; ICG, 2016).

The conflict in Mopti is widely held responsible for rising food insecurity. GRFC (2019) note that conflict and insecurity were the primary driver of acute food insecurity in 6 countries in the Sahel, including Mali. The report cites displacement, closure of basic services, and disruption of economic activities as the primary reasons for the conflict-induced rise in food insecurity. And the World Food Programme, using satellite imagery in Mopti, has established that exposure to violence locally was associated with a reduction in cultivated land, with probable knock-on effects on food security (Food Security Cluster, 2019).

3 Data and methods

Our primary source of data is an original panel dataset of 1,617 households in the Mopti region of Mali. The baseline round was initially collected for the evaluation of a school feeding program (Masset and Gelli, 2013) in January 2012. We returned to the same communities in January 2017 for the purpose of analyzing the interplay between conflict, aid and development outcomes. The survey covers 66 villages in 4 subdivisions, or *cercles*: Mopti, Douentza, Koro and Bandiagara. The attrition rate between the two rounds was limited to 9.5% although 4 villages from the initial survey could be not be reached due to the security situation at the time of survey. Attrition was less likely in households that were larger households, poorer, more likely to be Dogon or polygamous.

In addition to standard modules on socio-demographics of the households, education, employment, agriculture etc, the 2017 survey included modules intended to capture exposure to conflict and violence at the household and village levels. In this paper, we use information on food security of households (calorie intake, dietary diversity and children's height) and the village-level information on presence of armed groups. We supplement this data with information of the location of conflict events provided by the Armed Conflict Location & Event Data Project (ACLED) and with information on climate shocks supplied by ERA5. We used spatial analysis to calculate the extent of violence around each sampled village and we matched the European Centre for Medium-Range Weather Forecasts fifth generation reassassment (ERA5) weather grids with the sampled villages.

3.1 Measuring exposure to conflict

We use three indicators of conflict: (i) whether villages were occupied at any time by at least one armed group between 2012 and 2017, (ii) the number of conflict events within a 50km radius around sample villages between 2012 and 2017 and (iii) the number of battle-related fatalities within a 50km radius around sample villages between 2012 and 2017.

The number of events and fatalities around villages were calculated with the spatial analysis software *qgis* using data from ACLED. The information on the presence of armed groups stems from key informant interviews at village level.[5]

We have information on presence of armed groups for 64 out of 66 villages. Ten villages were reported to be affected by armed groups. Out of these, armed groups arrived in 2012 or 2013 in 7 villages and after 2015 in 3 villages. At the time of survey, armed groups were still present in 6 of these 10 villages. We have information on the precise geographic coordinates of 63 out of 66 villages. Using a radius of 50km around villages, the median number of conflict events in the sample was 9 for the entire 2012-17 period. Only 3 villages did not experience any event, the top 25th percentile of villages experienced at least 14 events, and the top 5th percentile 20 events (with a maximum of 23). Fatalities were much more geographically concentrated. 17 villages did not experience any conflict-related fatalities whereas the median village experienced 21 fatalities, the top 25th percentile 32 fatalities and the top 5th percentile 79 fatalities (with a maximum of 203 fatalities).

The median number of conflict events was roughly comparable in the first and second phases of the conflict - at 3 and 4, respectively. The conflict became much more deadly in

[5] In a companion paper (Tranchant et al., 2019b), we explore in-depth the determinants of conflict exposure and the relationships between various indicators and correlates of conflict.

the second phase, however, as the median number of fatalities jumped from 1 over 2012-13 to 16 over 2015-17. It illustrates how the conflict changed shape over time. Most conflict events in the first phase did not cause any fatality but a handful of events were very violent (the large-scale battles between rebel groups and military forces). In the second phase, conflict events were more routinely associated with fatalities although there were no longer large-scale battles causing more than 100 deaths.

In the subsequent analysis, we dichotomize the conflict variables based on the median values. We consider a village to be conflict-affected if the number of conflict events (fatalities) is greater than the median and to be non-affected otherwise.

3.2 Measuring food security

3.2.1 Food availability

In the following analysis, we will primarily use two variables of food security: (i) daily calorie intake per adult equivalent and (ii) household dietary diversity score (HDDS). Both were calculated based on the detailed household expenditure module administered in both rounds of the survey. The reference period for the food expenditures was the last 7 days.

The daily calorie intake per adult equivalent was calculated using a Mali-specific food consumption table. As per common practice, we excluded observations for which the calculated daily calorie intake per adult equivalent was lower than 400 kcal and higher than 8000 kcal. We calculated two versions of the HDDS indicators. Both are simple counts of the number of food groups consumed over the last 7 days, with equal weight for each group. HDDS-11 gives the number of food groups consumed by household members out of a total of 11.[6] We also calculated a modified HDDS-7 indicator based on the 7 food groups most commonly used in the literature.[7]

Furthermore, we created 3 dichotomous variables from these indicators based on guidance from WFP (2017). We categorized households as "food-energy deficient" if their daily calorie intake per adult equivalent was lower than 2,050 kcal, which is the threshold for individuals

[6] The food groups are: cereals; roots and tubers; legumes and pulses; vegetables; fruits; meat; fish; milk; oils; sugar and spices.

[7] These are: cereals, roots and tubers; pulses and legumes; dairy products; meats, fish and seafood and eggs; oils and fats; fruits; and vegetables.

undertaking light activity. We categorized households as "staples-dependent" if more than 75% of their daily calorie intake comes from cereals. And we categorized households as having "low diet diversity" if their HDDS-7 was 4 or lower.[8]

The median daily calorie intake in the sample decreased from 2290 kcal in 2012 to 2222 kcal in 2017, revealing the degradation of the socio-economic conditions in rural Mopti over the period. The proportion of food-energy deficient households slightly increased from 39% to 43% between 2012 and 2017.

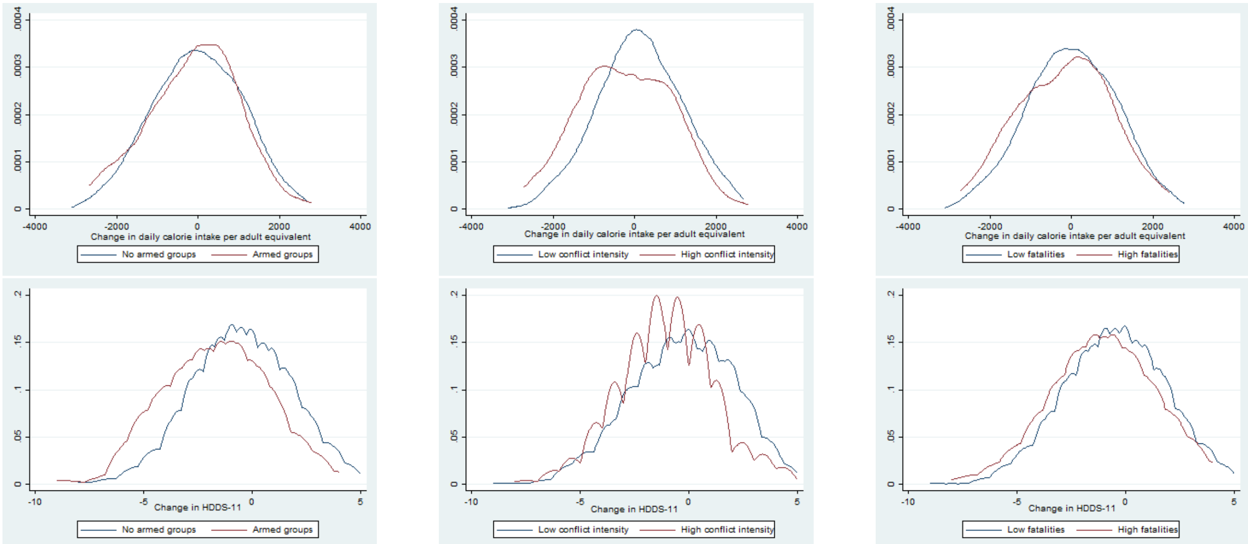
In 2012, the median number of HDDS-11 was 7. In 2017 the median dropped to 6. The median HDDS-7 also decreased from 5 to 4 between the two survey rounds. The proportion of households with low diet quality dramatically increased from 40% at baseline to 56% at follow-up.The main component of the diet was cereals, which made up 77% of consumed calories for the median household at baseline. This proportion slightly increased to 78% at follow-up. However, the proportion of households that are staples-dependent (i.e. that derive more than 75% of their calories from cereals) rose from 51% at baseline to 58% at follow-up. This signals that a section of the population switched to a lower quality diet over time. Indeed, the proportion of calories coming from most food groups other than cereals dramatically declined between 2012 and 2017. In 2017, the proportion of calories coming from roots almost vanished (from 3% at baseline to 0.6%), the proportion of calories from milk was almost divided by three (from 3.2% to 1.4%), that of legumes was cut down by half (from 8.3% to 4.1%), that of meat dropped from 2.9% to 1.8% and that of fish dropped from 4.3% to 2.7%. In contrast, the share of calories from oils and sugar increased (from 4.3% to 6.3% for the former and from 6.8% to 7.5% for the latter). There was thus a clear impoverishment of the diet across the two waves of data collection.

3.3 Bivariate associations between evolution of food security and conflict

In figure 1 we plot the distributions of change in daily calorie intake per adult equivalent, HDDS-11 and growth of children between 2 and 5 years old (in cm) across the conflict

[8]As mentioned above, we adopted the threshold of 4 food groups which is used for individual modules.

Figure 1: Evolution of food security by conflict exposure, 2012-2017



Source: author's calculations. Low conflict intensity (fatalities) refers to villages with below median number of conflict intensity (fatalities). High conflict intensity (fatalities) refers to villages with above median number of conflict events (fatalities).

variables. The top row displays results for calorie intake and the bottom row for HDDS-11. The evolution of calorie intake does not significantly vary with presence of armed groups but is clearly skewed to the left in villages affected by conflict events and fatalities. The bottom row shows that the presence of armed groups and to a lesser extent high fatalities shift the whole distribution of change to the left whereas conflict intensity mostly affects the upper end of the distribution.

In the next section, we'll set out to empirically assess the impact of conflict on food security.

3.4 Empirical strategy

We employ a difference-in-differences strategy, which compares the before-after change in the dependent variable in the group affected by conflict and in the comparison group. The estimates derive from the following household fixed-effects regression on a balanced panel of households:

$$y_{hvt} = \alpha_h + \beta T + \gamma S_{vt} + \delta C_{vt} + \epsilon_{ht} \tag{3.1}$$

where y_{hvt} is an indicator of food security for household h in village v at time t, α_h are household level fixed effects, β is the period effect, γ is the effect of climate shocks and δ is the estimated impact of conflict. We use three measures of food security y_{hvt}: calorie intake, HDDS-11 and height of children in centimeters.[9]

We consider that a conflict shock took place if (i) an armed group was present in the village over the study period, (ii) the number of conflict events were above the median for the study period, (iii) the number of conflict-related fatalities were above the median for the study period. We consider a negative rainfall shock if rainfall over the study period were at least 1 standard deviation below long term averages.

The estimations are conducted on between 1887 and 1959 observations for calorie intake and HDDS.

3.5 Threats to identification

The use of household fixed effects removes time-invariant sources of bias that could confound the impacts of climate and conflict shocks. For instance, remote villages may both be highly food insecure and prone to the presence of armed groups. Such a confounding factor is accounted for by the estimation of equation 3.1. Our empirical strategy is vulnerable, however, to the presence of shocks that would hit the group of interest and the comparison group differentially over the study period. The introduction of climate shocks in equation 3.1 controls for the possible correlation between conflict and climate shocks[10] but we cannot rule out the existence of other, unobserved, time shocks that are correlated with conflict and food security. The rolling out of food assistance and other forms of humanitarian aid is another possible source of confounding, but including aid in the model to be estimated is unwise as we know that the coverage of aid is itself influenced by conflict (Tranchant et al., 2019b).

Measuring equation 3.1 with household fixed effects is akin to a difference-in-difference framework. The identifying assumption of difference-in-difference is that the trend in food

[9] We use absolute growth in centimeters as opposed to height-for-age z-scores out of concern that the standard errors used to calculate HAZ are themselves age-dependent, rendering the use of HAZ inappropriate to assess change in children's height as they age (Leroy et al., 2014, 2015).

[10] This is important as positive temperature anomalies are positively correlated with conflict intensity.

security over the post-2012 period would have been the same in the treated and comparison groups in the absence of conflict. Although this assumption is inherently untestable, it is considered good practice to test whether the trend was parallel in the two groups on the pre-intervention period.

We do not have pre-baseline data to carry out pre-intervention test of the parallel trend but we have information on the height of children at baseline. As the height of children is indicative of the cumulative history of children's living conditions, the absence of meaningful differences in the mean height of children at baseline across groups would be supportive of the identifying assumption of parallel trends. Table 1 reports the tests of equality of means for each three dependent variables and results do not suggest that children's height was systematically different at baseline in villages more exposed to conflict and in villages less exposed. In fact, the mean height of children is not statistically different for any of the three conflict indicators. There is thus no evidence that conflict unfolded in villages that were already on a less conducive path for children development, or vice-versa.

But there were marked differences in baseline levels of calorie intake. Table 1 shows that conflict-exposed villages were characterized by substantially higher levels of mean caloric intake (by around 10%) than villages of the comparison group and these differences were statistically significant at 1%. Mean dietary diversity was slightly higher in villages affected by armed group but the difference is not statistically significant. In contrast, mean HDDS was significantly lower in villages exposed to above median number of conflict events, a difference significant at 10%.

To deal with these differences at baseline, we employ the inverse probability weighting estimation strategy pioneered by Hirano et al. (2003). We first predict the likelihood of conflict exposure (p) based on baseline characteristics of villages with a logistic regression and then construct weights as 1/p for villages exposed to conflict and 1/(1-p) for villages in the comparison group. Table A4 in appendix A displays the results of the logistic regressions. The presence of armed groups is more likely in villages with higher mean levels of tropical livestock units (TLUs), agricultural production and asset index. This suggests that armed groups targeted villages with the most potential for looting. Exposure to higher than above median number of conflict events is unrelated to all covariates, except HDDS which exerts

Table 1: Means of food security outcomes at baseline across conflict-exposed villages and non-conflict exposed villages

	Armed groups	No armed groups	p-value of difference	High conflict events	Low conflict events	p-value of difference	High Fatalities	Low Fatalities	p-value of difference
	(1)	(2)	(1) - (2)	(3)	(4)	(3) - (4)	(5)	(6)	(5) - (6)
Calorie intake (kcal)	2500.2 (789.7) [172]	2315.0 (790.6) [899]	0.01***	2479.0 (784.1) [517]	2257.8 (798.9) [607]	0.00***	2540.0 (815.9) [307]	2291.7 (783.0) [817]	0.00***
HDDS-11	6.80 (1.70) [172]	6.63 (1.71) [899]	0.25	6.57 (1.73) [517]	6.75 (1.70) [607]	0.09*	6.62 (1.68) [307]	6.68 (1.72) [817]	0.60
Height of children below 5 years (cm)	94.26 (11.52) [116]	93.80 (11.16) [711]	0.69	94.07 (11.67) [376]	93.46 (10.99) [439]	0.44	94.55 (11.60) [196]	93.48 (11.21) [619]	0.25
Height of children between 5 and 10 years (cm)	119.73 (11.23) [113]	118.13 (11.37) [927]	0.16	118.24 (11.38) [435]	118.36 (11.24) [621]	0.86	118.53 (11.63) [247]	118.25 (11.19) [809]	0.73

Notes: Conflict exposure is defined at village-level. Food security outcomes are measured at household-level (calories, HDDS) and children-level (height). Calorie intake refers to daily calorie intake per adult equivalent. HDDS-11 stands for Household Dietary Diversity Score with 11 food groups. Standard errors are in parentheses and sample sizes are in brackets.

a protective role. Villages exposed to above median number of fatalities tend to be more ethnically fragmented, have higher mean levels of agricultural production and asset index but have lower levels of TLU and HDDS. Tranchant et al. (2019b) explore more in-depth these conflict dynamics at the micro-level. Table A5 shows that all pre-existing differences disappear with the application of the weights with the exception of the mean holding of TLU which remains higher in villages affected by armed groups than in the comparison groups ($p < 0.1$).

4 Impact of conflict on food security

4.1 Main results

Results from table 2 show that conflict exerts a large and statistically significant negative impact on food security. Households living in villages with above median number of conflict-related fatalities have seen their daily calorie intake decrease by 310 kcal and their HDDS-11 by 1 food group on average, which correspond to decreases of 0.39 and 0.58 standard deviation of the baseline values, respectively. Both effects are statistically significant at the 5% level at least. The effect of exposure to conflict events is even larger on calorie intake (-450 kcal) but is indistinguishable from 0 on HDDS. Conversely, the presence of armed groups in the villages led HDDS to decrease by 1.3 food groups on average ($p < 0.01$) - 0.76 SD - but had no impact on mean levels of calorie intake.

Table 2: Impact of conflict on food security, weighted difference-in-differences estimates

Dependent variable	Calorie intake (kcal)			HDDS-11		
	(1)	(2)	(3)	(4)	(5)	(6)
Presence of armed groups	-74.30			-1.292**		
	(146.8)			(0.492)		
Above median conflict events		-450.3***			-0.474	
		(151.3)			(0.405)	
Above median fatalities			-310.5**			-1.018***
			(117.3)			(0.343)
Time effect	39.40	78.26	36.96	-0.471	-0.554*	-0.925***
	(110.5)	(117.0)	(83.14)	(0.336)	(0.323)	(0.309)
Observations	1887	1959	1959	1887	1959	1959
p-value of F test	0.57	0.00	0.01	0.00	0.00	0.00
Within R2	0.02	0.04	0.03	0.29	0.12	0.33

Note: difference-in-differences coefficients of separate household fixed effects regression. Cluster standard errors in parenthesis. All regressions include a dummy indicator for negative rainfall shock and a dummy indicator for positive temperature anomaly. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

The results do not hinge on the introduction of climate shocks in the estimation model nor on the specific cut-offs chosen to construct the binary conflict variables. In appendix B, we display the estimates of table 2 for conflict variables based on cut-offs ranging from the 20^{th} to the 90^{th} percentiles of the distributions of conflict events and fatalities. We see that the results are robust to a wide range of cut-offs.

Table 3: Impact of conflict on food security II, weighted difference-in-differences estimates

Dependent variable	Food-energy deficient			Staples-dependent			Low diet quality		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Presence of armed groups	-0.001			0.069			0.290***		
	(0.106)			(0.085)			(0.098)		
Above median conflict events		0.266***			0.069			0.040	
		(0.083)			(0.073)			(0.090)	
Above median fatalities			0.275***			0.397***			0.306**
			(0.068)			(0.095)			(0.129)
Time effect	0.004	-0.036	-0.002	-0.009	0.009	-0.056	0.160**	0.215***	0.233***
	(0.070)	(0.067)	(0.046)	(0.067)	(0.065)	(0.090)	(0.078)	(0.079)	(0.086)
Observations	1887	1959	1959	1887	1959	1959	1887	1959	1959
P-value of F test	0.78	0.00	0.00	0.52	0.16	0.00	0.00	0.00	0.00
Within R2	0.004	0.075	0.03	0.01	0.016	0.019	0.24	0.09	0.185

Note: difference-in-difference coefficients of separate household fixed effects regression. Cluster standard errors in parenthesis. All regressions include a dummy variable for negative rainfall shock and a dummy variable for positive temperature anomaly. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

Table 3 displays the results of estimating equation 3.1 with the dichotomous food security as dependent variables. For the sake of simplicity we use a linear probability model but the results are similar with a logistic regression. Both exposure to high number of conflict events and high number of fatalities increase the likelihood for households to be food-energy deficient by about 27 percentage point. In both cases, the effect is estimated with great precision and is statistically significant at 1%. Exposure to high number of fatalities also increases the likelihood for households to be staples-dependent by almost 40 percentage point ($p < 0.01$) while both the presence of armed groups and high number of fatalities rise the risk of households to have a low quality diet by about 30 percentage point. The former is statistically significant at 1% and the latter at 5%. Overall, exposure to above median fatalities produce a very consistent and large negative impact on all three indicators. The presence of armed groups only has an effect on diet quality (but it is large) and high number of conflict events only has an effect on the likelihood to consume less than 2,045 kcal per adult equivalent.

Table 4 investigates more in-depth the impact of conflict on dietary diversity. Panel A summarizes estimations of equation 3.1 where the dependent variable is a binary variable indicating whether the household consumed a specific food group over the last 7 days. Panel B summarizes results when the dependent variable is the proportion of calories coming from the consumption of a specific food group. Panel A can be thought of as the impact of conflict on the extensive margin of dietary diversity and panel B as the impact of conflict on the intensive margin of dietary diversity.

Results of table 4 indicate that, at the extensive margin, the presence of armed groups significantly reduces the likelihood for households to consume any root, vegetables, fish and sugar. These effects are large in magnitude, ranging from 11 percentage point for sugar to 28 percentage point for fish. At the intensive margin, the presence of armed groups is found to slightly stimulate the consumption of meat (+0.8pp) and slightly reduces that of fish (-1.6pp). This result is consistent with households consuming more their own produce (meat) while having more difficulty accessing food bought on the market (fish). It could also indicate households deciding to consume their livestock out of fear it would be seized by armed groups or stolen.

The effect of conflict events on either dependent variable is indistinguishable from zero in most cases. In contrast, exposure to above median conflict-related fatalities profoundly transform households' diets. At the extensive margin, exposure to fatalities reduces the likelihood of consumption of legumes, meat, fish and sugar. The magnitude of these effects is very large in absolute value. They range from -17pp for meat to -35pp for legumes. At the extensive margin, exposure to fatalities leads to a dramatic rise of cereals (+13pp) as a source of calories, at the expense of legumes (-6.8pp), vegetables (-1.6pp), meat (-0.6pp), fish (-1.2pp), milk (-2.5pp), oils (-1.8pp) and sugar (-3.3pp).

Presence of armed groups and violent events both limit dietary diversity through reducing the likelihood of consumption of a key food groups. But both aspects of the conflict exert a different impact on households' diets at the intensive margin. Violence causes households to rely dramatically more on cereals and dramatically less on a large number of food groups, making the diets profoundly poorer. The presence of armed groups have much less of an impact on diets and primarily causes households to slightly favor meat at the expense of fish, while leaving the calorie intake from other food groups unchanged.

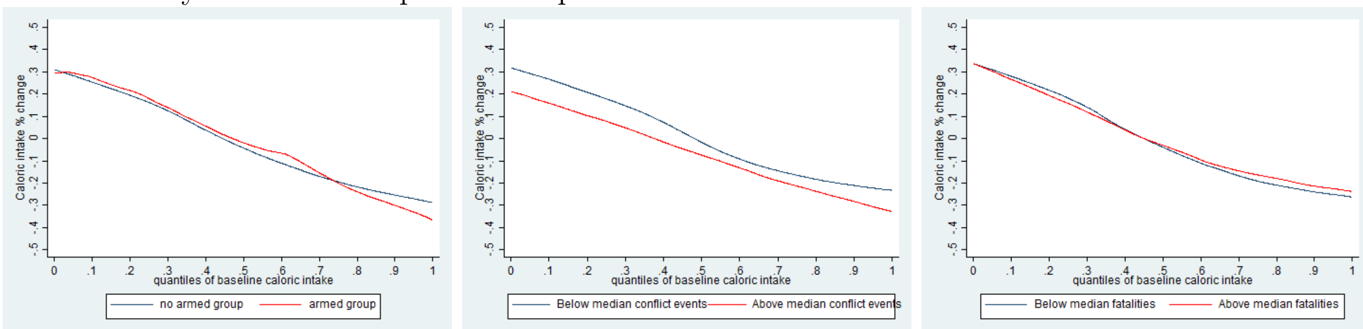
Table 4: Impact of conflict on consumption of specific food groups, weighted difference-in-differences estimates

	Cereals	Root	Legume	Fruits	Vegetables	Meat	Fish	Milk	Oils	Sugar	Spices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent variable: Household members have consumed this food group in last 7 days											
Presence of armed groups	-0.002	-0.146*	-0.114	-0.100	-0.156**	-0.095	-0.282**	-0.080	-0.090	-0.114***	-0.112
	(0.003)	(0.077)	(0.122)	(0.104)	(0.068)	(0.061)	(0.128)	(0.122)	(0.123)	(0.041)	(0.120)
Conflict events	0.015**	-0.113	-0.048	-0.030	0.065	-0.140	-0.113	-0.012	-0.024	0.004	-0.078
	(0.007)	(0.073)	(0.099)	(0.039)	(0.080)	(0.099)	(0.084)	(0.068)	(0.060)	(0.053)	(0.067)
Fatalities	0.009	-0.037	-0.347***	-0.022	-0.151	-0.172***	-0.193**	0.051	-0.037	-0.119**	0.001
	(0.006)	(0.096)	(0.113)	(0.040)	(0.108)	(0.063)	(0.085)	(0.119)	(0.058)	(0.050)	(0.071)
Dependent variable: share of calorie intake coming from this food group											
Presence of armed groups	0.028	-0.000	0.008	-0.000	0.000	0.008**	-0.016***	0.004	-0.006	-0.014	0.000
	(0.024)	(0.003)	(0.017)	(0.004)	(0.004)	(0.003)	(0.005)	(0.008)	(0.012)	(0.013)	(0.001)
Conflict events	0.020	0.007	-0.008	0.006*	-0.003	-0.003	-0.007	-0.010	-0.009	-0.001	-0.003*
	(0.021)	(0.005)	(0.013)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.010)	(0.006)	(0.002)
Fatalities	0.129***	0.002	-0.068***	0.004	-0.016**	-0.006**	-0.012**	-0.025***	-0.018**	-0.033***	0.000
	(0.027)	(0.004)	(0.022)	(0.004)	(0.007)	(0.003)	(0.005)	(0.008)	(0.008)	(0.010)	(0.001)

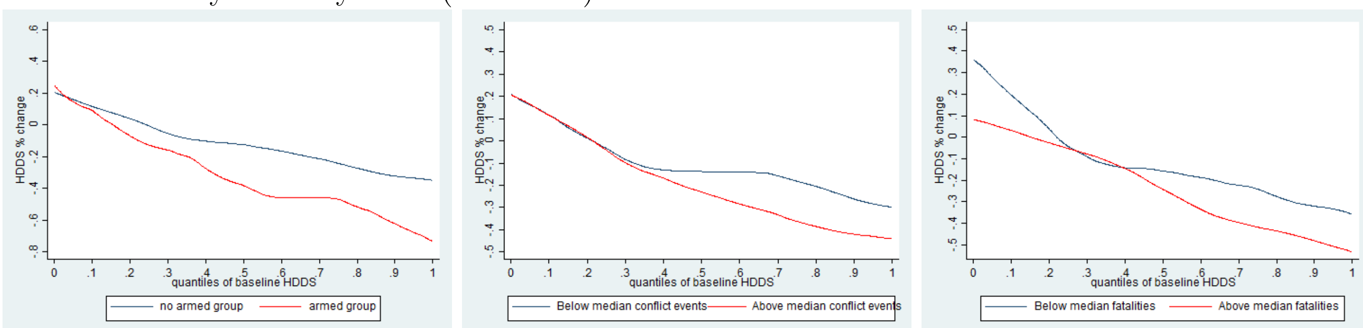
Note: difference-in-difference coefficients of separate household fixed effects regression. All regressions include a dummy indicator for negative rainfall shock and a dummy indicator for positive temperature anomaly.Cluster standard errors in parenthesis. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

Figure 2: Distributional impact of conflict on food security

Panel A: daily calorie intake per adult equivalent



Panel B: dietary diversity score (HDDS-11)



Source: author's calculations.

4.2 Distributional impact of conflict on food security

The availability of a panel dataset enables us to estimate whether the impact of conflict changes with baseline characteristics of households. We are particularly interested in testing for heterogeneous treatment effects based on initial levels of food security. This will provide information on whether conflict primarily affects the most or the least vulnerable people.

To do that, we calculated percentage changes in calorie intake and HDDS between the two rounds and plotted these changes against the baseline values of these indicators. We used a kernel-weighted local polynomial to smooth the data and we weighted the observations with the inverse probability weights of the previous analysis.

The slope of the curves in figure 2 is always negative, indicating an inverse relationship between baseline levels and subsequent evolution of food security. Regression to the mean is likely partly responsible for such a relationship as units with unusual high (low) values of food security at baseline are bound to observe a downward (upward) correction at endline. Nevertheless, comparing the curves across the conflict-affected and the non conflict-affected groups is insightful on the dynamics at play.

The impact of conflict on calorie intake is mostly visible for the number of conflict events (middle plot, upper row). In all three figures, the curves are parallel across the two groups suggesting no distributional impact of the conflict. In contrast, when we look at HDDS, we can see that the gap between the curves in the treatment and comparison groups widens as we move to the right on the x-axis. There is this a very clear indication that conflict decreases dietary diversity more among households with initial higher levels of HDDS than among households with initial low levels of dietary diversity. We believe this result is partly a reflection of the very low levels of dietary diversity observed at baseline. Households which only consumed 4 or fewer food groups to start were already at a floor level and HDDS could not diminish further even because of conflict. Conflict has more scope to cause damage among households consuming a more diverse diet. In any case, figure 2 reveals that conflict levels down the initial differences in dietary diversity.

5 Potential mechanisms

We have seen that the intensity of violent conflict and the presence of armed groups (but not the number of incidents) exerts a large, robust, statistically significant and negative impact on dietary diversity and calorie intake. We have also established that the impact of violence and presence of armed groups on households' diets is distinct. The presence of armed groups is associated with an increased reliance on meat but a lower reliance on fish as a source of calories whereas violence is associated with a dramatic increased reliance on cereals at the expense of most other food groups. And finally, we have seen that the impact of conflict on dietary diversity is most acute among households with highest baseline values of dietary diversity.

Several channels have been put forward in the literature to explain the impact of conflict on food security (e.g. FAO et al., 2017; Holleman et al., 2017). In what follows, we investigate which mechanisms are the most plausible factors behind results of the previous section in the context of rural Mopti. Following FAO et al. (2017), we separate between direct and indirect mechanisms.

5.1 Direct effects of conflict on food security

The direct effects of conflict operate through the deaths or injuries of household members, displacement, and destruction of productive assets (FAO et al., 2017). Out of these, only the destruction of productive assets has been reported in our sample. Although the conflict has become very lethal of late, at the time of the second wave of data collection in January 2017, very few respondents reported to have been personally targeted by violence or to have been displaced, even temporarily (3 household respondents reported physical harm and 6 temporary displacement).[11] Cattle theft, however, is a common occurrence in central Mali, and numerous accounts link the presence of armed groups and the conflict with heightened risks of theft.[12]

In table 5 we show the estimation of a logit model where the left-hand side variable takes the value 1 if the household has reported any cattle theft since baseline and 0 otherwise, and the right-hand side variables include one of the three conflict indicators and the presence of rainfall and temperature shocks. The observations are weighted as in the estimation of equation 3.1. Presence of armed groups is associated with an almost threefold increase in the likelihood of reported livestock theft. In contrast, the number of events and fatalities are not significantly related to thefts.

5.2 Indirect effects of conflict on food security

According to FAO et al. (2017) the indirect effects of conflict include: (i) reduced income; (ii) disruption in food systems and markets, leading to inflation; (iii) restricted mobility and access to inputs and hired labor, causing production and productivity losses; (iv) lower availability of coping strategies; (v) uptake of harmful risk management strategies, for instance when farmers switch to low-yield low-risk crops and/or selling productive assets to smooth consumption or avoid targeting by armed groups; (vi) disruption of governance and reduced access to services and aid.

In a companion paper (Masset et al., 2019), we investigate the impact of conflict on

[11] This is consistent with the low attrition rate.

[12] Conversely, several authors contend that it out of a desire to protect themselves from cattle theft that some Peulhs herders decided to join armed groups (e.g. ICG, 2016; Gaye, 2018; Sangare, 2016).

agricultural outcomes. We found a large impact of conflict on both farming and livestock production. The reduction in agricultural sales is accompanied by an increase in the use of family labor in the farms and by a drop in profits. These suggest that rural households found very little work opportunities outside of the village, causing them to work on their own farms even at a very low productivity level. The drop in production in the face of increased family labor suggest that farmers found it difficult to source inputs and to hire outside labor. These are consistent with conflict having a widespread disruptive impact on rural economies. The drop in livestock production can be directly the result of conflict (if the livestock was stolen or sold/eaten to avoid targeting from armed groups) or indirectly (e.g. for consumption smoothing). The concomitant drop in livestock production and substantial rise in the share of calories sourced from meat consumption suggest that households living in the shadow of armed groups resorted to eat their mutton and goats at a higher rate, possibly to compensate for a more difficult access to other foods and/or because the holding on to cattle is dangerous or no longer worth it economically.

There is clear evidence of disruption in food markets and ensuing difficulty for households to access foodstuffs at affordable price in Mopti. The FAO's Food Price Monitoring and Analysis (FPMA) tool shows that the wholesale price of millet at the Mopti market increased from 21,000 FCFA/100 kg in December 2011 to 29,000 FCFA/100kg in August 2012. The price subsequently went down to 18,000 FCFA/100kg in January 2013 and stabilized at this level until January 2017. The peak in millet price thus coincides with the peak of the first phase of the conflict when armed groups entered the Mopti region. A similar pattern is observed with local rice.[13] The increase in price of local staples indicates that rural households faced heightened difficulty for accessing affordable food due to the conflict.

Farmers in our sample did not benefit from higher food prices as they primarily consume their own produces instead of selling them. Our survey indicates that at baseline, less than 4% of the production of millet was sold to the market.

The presence of armed groups and a high number of conflict-related fatalities were associ-

[13]It is worth noting that the price of millet - but not of rice - was already trending upward in the months leading to the conflict outbreak. The price went from a trough of 13,000 FCFA/100kg in December 2010 to 15,000 FCFA/100kg in September 2011 to 20,500 FCFA/100kg in January 2012. This price hike is due to the drought of 2011 which already put a lot of stress on agricultural production prior to the conflict.

Table 5: Associations between conflict and potential correlates of food security

	Likelihood of livestock theft	Functioning services in village	Receipt of any food assistance	Receipt of general food distribution	Receipt of school feeding	Receipt of agricultural support
	(1)	(2)	(3)	(4)	(5)	(6)
Presence of armed groups	2.67**	-0.38*	1.10	1.57	0.49*	0.26*
	(1.06)	(0.20)	(0.32)	(0.57)	(0.20)	(0.21)
Above median conflict events	1.03	-0.08	1.79	2.04	1.52	1.00
	(0.35)	(0.21)	(0.79)	(1.02)	(0.61)	(0.36)
Above median fatalities	0.65	-0.61	1.19	0.87	2.05**	1.14
	(0.53)	(0.39)	(0.26)	(0.36)	(0.68)	(0.62)

Note: Columns 1, 3, 4, 5, and 6 show the odds-ratio of a logit regression. Column 2 shows the results of a household fixed effects regression. Weighted estimates in all columns. Cluster standard errors in parenthesis. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

ated with a substantial decline in the number of available and working public services in the village. The associated standard errors are large, however, so that only the former reaches the 10% level of statistical confidence. The presence of armed groups was also associated with a 50% reduced likelihood for households to receive school-feeding and a 75% reduced likelihood for households to receive agricultural support. Conflict events and fatalities were positively associated with receipt of aid although the associations were typically not statistically significant. However, households living in proximity to high level of fatalities were twice as likely to receive school-feeding than other households.

In summary, the available evidence supports the view that the presence of armed groups in Mopti negatively affected food security of households through direct productive losses (in the form of livestock theft), the indirect disruption of agricultural production and markets, and reduced access to aid and services. Exposure to above median fatalities only impacted food security through the disruption of agriculture as we do not find strong support for the hypotheses that fatalities were related to livestock theft, service provision, or receipt of aid. The number of conflict events is not associated with either food security or any of the potential mechanisms of table 5.

6 Does aid mitigate the impact of conflict shocks on food security?

Having seen that presence of armed groups and conflict-related fatalities exert a strong negative impact on food security, we now turn to the question of whether access to aid helped mitigate the impact of conflict.

In our sample, despite widespread insecurity, a significant minority of households did access some form of aid over the period 2015-2017. The two most common forms of aid were food aid and agricultural support. Food aid in any of its modality (GFD, school feeding, TSF, FFW) reached 36% of households (23% for GFD, 14% for school feeding, and about 2% for TSF and FFW). And 14% of households received either veterinary or agricultural aid. Tranchant et al. (2019a) show that households that received food assistance - especially school-feeding - experienced a better evolution of food consumption and some micro-nutrient consumption than other households in areas indirectly exposed to armed groups. In this paper, we update this analysis by looking at different variables of food security and more conflict indicators.

6.1 Empirical strategy

To assess the role of aid, we compare households with and without receipt of aid within each of the conflict category separately. To account for the selection bias due to the targeting of aid at village and household levels, we carry out a similar inverse probability weighting approach as in the previous section. This consists in estimating the propensity for households to receive aid over the 2015-17 period based on baseline village and household characteristics - including conflict exposure - and then to construct weights based on this propensity.

Table A6 in appendix A displays the results of the selection models. Household characteristics are mostly unrelated to any form of aid. Yet, general food distribution and food aid were more likely to reach households with higher baseline calorie intake and school feeding was more common in households with a higher dependency ratio. Dogons were 2.5 times more likely to receive agricultural aid than other ethnicities and households with higher assets index and educational attainment were slightly more likely to receive aid.

At the village level, school feeding was more common in villages with high means of assets index and agricultural production. Agricultural aid was more common in villages with bigger cultivated land sizes and mean HDDS but less common in villages with high calorie intake. General food distribution was not statistically related to village level covariates. The presence of armed groups strongly reduces likelihood to receive school feeding and agricultural aid. Agricultural aid was also more common in villages with a high number of conflict events but low fatalities.

6.2 Results

Results are summarized in table 6. While the effect of receiving any food assistance on calorie intake is close to zero on the whole sample, it is positive in the conflict-affected samples (columns 2-4). The standard errors are large so that only in column (4) - villages affected by above median fatalities - does the effect of food assistance is statistically different from 0 at the 10% level. The point estimate is large - 311 kcal - and is almost equivalent to the estimated impact of high level of fatalities on calorie intake (-331 kcal in table 2). The receipt of any food assistance is associated with higher values of dietary diversity (especially in the conflict-affected samples) but the standard errors are too large for these effects to be statistically significant. There is no evidence of any impact of food assistance on children's height.

Disaggregating food assistance into general food distribution (GFD) and school feeding poses sample size issue. The results should thus be taken with caution, especially for estimations on the sub-sample of villages affected by armed groups.[14] General food distribution does not appear to exert any impact on calorie intake as opposed to school feeding. The effects of school feeding are positive, statistically significant at conventional levels, and very large for the sample of villages affected by armed groups (1211 kcal, column 2) and affected by above median fatalities (593 kcal, column 4). These point estimates suggest that receiving school feeding completely offset the impact of fatalities on calories and more than offset the

[14] This issue is more marked than in Tranchant et al. (2019a) and Aurino et al. (2019) as we had to discard many more observations to ensure plausible values of calorie intake.

Table 6: Impact of food assistance on food security, by exposure to conflict

Sample	All villages	Villages affected by armed groups	Villages with above median conflict events	Villages with above median fatalities
	(1)	(2)	(3)	(4)
Panel A: Any food assistance				
Calorie intake	-6.55	59.94	162.43	310.59*
	(82.15)	(196.88)	(144.22)	(173.01)
HDDS-11	0.17	0.53	0.42	0.48
	(0.21)	(0.39)	(0.26)	(0.37)
Panel B: General Food Distribution				
Calorie intake	-113.78	-284.91	-12.59	184.70
	(120.77)	(183.47)	(157.66)	(233.29)
HDDS-11	0.06	0.74	0.31	0.45
	(0.24)	(0.81)	(0.32)	(0.62)
Panel C: School feeding				
Calorie intake	67.61	1211.69***	322.18	592.58*
	(141.88)	(145.04)	(256.58)	(304.52)
HDDS-11	0.38	-0.76	0.36	0.42
	(0.37)	(0.80)	(0.43)	(0.52)

Note: weighted difference-in-difference coefficients of separate household fixed effects regression. Cluster standard errors in parenthesis. Number of observations in brackets. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

impact of armed groups presence on calories.

Food assistance - especially school fedding - thus appears to exert a protective effect on food security amid conflict.

7 Conclusion

In this paper, we have used a unique panel dataset of households in rural Mopti, Mali, to estimate the causal impact of conflict exposure on food security. We used a difference-in-differences approach and we exploited the presence of a pre-crisis baseline to correct for any imbalances at baseline between the 'treatment' and comparison groups.

The empirical analysis uncovered five main findings. First, exposure to conflict exerts a large, robust, and statistically significant on all the aspects of food security that were considered. Conflict reduced daily calorie intake by more than 300 kcal and dietary diversity by at least 1 food group. Second, the effects of conflict on children's height are contrasted, and sharply vary with the age and sex of the children. Third, conflict exerts a multifaceted impact on food security. The presence of armed groups leads to a severe drop in dietary diversity but has no effect on calorie intake, and is even associated with positive effect on older children' height. Conflict-related violence, in the form of fatalities, has a profound effect on calorie intake and dietary diversity. The mere presence of conflict events has an effect on calorie intake, but not on dietary diversity. Fourth, the impact of conflict on dietary diversity is concentrated on households with initial higher levels of baseline diversity, causing a leveling-down of food security in affected areas. Fifth, food assistance is found to have the potential to protect food security amid conflict. This protective effect, however, is dependent upon the modality of food assistance, the food security indicator under consideration, and the conflict context. School feeding is the most effective modality for supporting calorie intake.

The effects of conflict-related violence do not appear to be mediated by direct losses, or reduced access to aid and services. Rather, it is the combination of reduced agricultural production and increased food prices borne out by the disruption of markets and production that seem to drive the results. The presence of armed groups exerts a more nuanced effect on households. On the one hand, this presence did not further impede households' limited access to calories. And it has a less profound impact on households' diets than violence. On the other hand, the presence of armed groups led to heightened risk of livestock theft and reduced access to aid and services.

These results show that the association between food security and conflict observed at the macro-scale in the Sahel is also true at the micro-level. Exposure to conflict locally does profoundly and negatively impact households' food security status. This echoes results of George et al. (2020) in Nigeria and Dabalen and Paul (2014) in Cote d'Ivoire, for instance. Our results underscore the critical need for a timely and scaled implementation of food assistance to vulnerable population amid conflict. There remains much uncertainty over the precise, causal, impact of aid and over the form that aid should take.

The results also call for more work to understand the linkages between food availability and food utilization in contexts of conflict. While many studies have investigated the impact of conflict on children's height, and a more limited number of studies have looked at food security, very few have jointly considered both sets of outcomes. Our paper shows there is surprisingly little overlap between the two in context of Mopti, and that height and food availability have sometimes responded in opposite fashion to the conflict.

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A Appendix A: Summary statistics and balance of covariates

Table A1: Summary statistics at baseline

Variable	Mean	Std. Dev.	Min.	Max.	N
Daily calorie intake per adult equivalent	2352.436	793.665	806.838	3998.598	1173
HDDS-11	6.681	1.712	1	11	1173
HDDS-7	4.792	1.09	1	7	1173
Food-energy deficient	0.391	0.488	0	1	1173
Staples-dependent	0.515	0.5	0	1	1172
Low diet quality	0.4	0.49	0	1	1173

Table A2: Summary statistics at follow-up

Variable	Mean	Std. Dev.	Min.	Max.	N
Daily calorie intake per adult equivalent	2280.94	813.775	801.174	3992.172	966
HDDS-11	5.944	2.029	1	11	966
HDDS-7	4.315	1.254	1	7	966
Food-energy deficient	0.427	0.495	0	1	966
Staples-dependent	0.578	0.494	0	1	966
Low diet quality	0.559	0.497	0	1	966
Presence of armed groups in village	0.15	0.357	0	1	1359
Above median conflict events	0.462	0.499	0	1	1363
Above median fatalities	0.244	0.43	0	1	1363
Negative rainfall shock	0.289	0.453	0	1	1357
Positive temperature anomaly	0.448	0.497	0	1	1357

Table A3: Correlation matrix

	Height-for-age z-score	Calorie intake	HDDS-11	HDDS-7	food-energy deficient	staples-dependent	low diet quality
Height-for-age z-score	1						
Calorie intake	0.0400	1					
HDDS-11	0.0322	0.179***	1				
HDDS-7	0.0268	0.194***	0.870***	1			
Food-energy deficient	-0.0489	-0.823***	-0.147***	-0.179***	1		
Staples-dependent	0.0381	0.132***	-0.383***	-0.380***	-0.0955***	1	
Low diet quality	-0.0485	-0.153***	-0.714***	-0.829***	0.141***	0.347***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A4: Determinants of conflict exposure at the village level, Logit odds-ratios estimates

Dependent variable	Presence of Armed groups	Above median Conflict events	Above median Fatalities
Connectedness index	0.62	1.30	0.36**
	(0.29)	(0.35)	(0.17)
Ethnic Fractionalization index	0.23	0.29	1883.0**
	(0.71)	(0.63)	(6205.4)
Mean TLU	1.39**	1.17	0.55**
	(0.20)	(0.15)	(0.14)
Mean cultivated land size	0.53	0.92	0.89
	(0.29)	(0.21)	(0.25)
Mean agricultural production	1.55**	1.16	2.72*
	(0.29)	(0.15)	(1.52)
Mean assets index	3.16	2.04	7.04**
	(2.28)	(0.93)	(6.04)
Mean caloric intake	0.55	1.02	1.16
	(0.50)	(0.48)	(0.88)
Mean HDDS	0.36	0.25***	0.33*
	(0.25)	(0.12)	(0.21)
Observations	64	63	63
Adjusted R2	0.29	0.18	0.47
Chi-2 statistic	15.9	15.7	33.7

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

Table A5: Test of balance of village-level covariates, before and after weighting

	Armed groups before	Armed groups after	conflict events before	conflict events after	Fatalities before	Fatalities after
Connectedness index	0.14	-0.13	0.20***	0.05	-0.30***	0.41
	(0.10)	(0.36)	(0.07)	(0.48)	(0.07)	(0.43)
Ethnic fractionalization index	0.07***	0.02	0.04***	-0.03	0.11***	0.09
	(0.01)	(0.08)	(0.01)	(0.05)	(0.01)	(0.06)
Mean TLU	1.93***	1.20*	0.72***	-0.56	-0.91***	0.42
	(0.17)	(0.64)	(0.12)	(0.88)	(0.13)	(0.78)
Mean cultivated land size	0.25**	-0.34	0.15**	0.28	1.07***	-0.84
	(0.11)	(0.55)	(0.08)	(0.53)	(0.08)	(1.10)
Mean agricultural production	3.19***	0.29	1.01***	0.11	2.32***	0.73
	(0.25)	(0.82)	(0.18)	(0.45)	(0.19)	(0.80)
Mean assets index	0.27***	0.12	0.03	0.04	-0.58***	-0.22
	(0.06)	(0.42)	(0.05)	(0.27)	(0.05)	(0.35)
Mean calorie intake	-0.09	-0.03	0.12***	-0.03	-0.04	-0.24
	(0.05)	(0.16)	(0.03)	(0.26)	(0.03)	(0.29)
Mean HDDS-11	-0.07	-0.07	-0.47***	0.05	0.02	-0.02
	(0.06)	(0.26)	(0.04)	(0.27)	(0.74)	(0.27)
Mean height of children under 5	0.45	-0.44	0.62	0.52	1.06	0.19
	(1.19)	(1.41)	(0.83)	(0.84)	(0.89)	(1.14)
Mean height of children between 5 and 10	1.72*	1.64	-0.21	-0.32	0.27	-2.84
	(0.87)	(1.25)	(0.85)	(0.89)	(1.07)	(2.97)

Note: baseline differences in averages before and after weighting by the inverse of the propensity score. Standard errors in parentheses. Three stars (***) is statistical significance at 1%, two stars (**) is 5%, and one star (*) is 10%.

Table A6: Targeting of aid, Logit odds-ratios estimates

	Any food assistance (1)	General food distribution (2)	School feeding (3)	Any agricultural aid (4)
Connectedness index	1.02	1.05	0.95	0.99
	(0.15)	(0.17)	(0.18)	(0.14)
Ethnic fractionalization index	1.64	0.85	5.77	1.13
	(1.68)	(1.16)	(7.33)	(0.94)
Mean TLU	1.06	1.05	1.00	1.03
	(0.070)	(0.079)	(0.097)	(0.069)
Mean cultivated land size	0.88	0.90	0.80	1.26**

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	(0.094)	(0.14)	(0.11)	(0.12)
Mean agricultural production	1.00	0.93	1.10*	0.96
	(0.055)	(0.073)	(0.063)	(0.058)
Mean assets index	1.49*	1.22	1.55*	0.81
	(0.32)	(0.36)	(0.40)	(0.19)
Mean caloric intake	0.97	0.95	0.99	0.75*
	(0.031)	(0.050)	(0.026)	(0.13)
Mean HDDS	0.70	0.82	0.63	1.76**
	(0.18)	(0.28)	(0.18)	(0.41)
Armed groups	0.79	1.01	0.30***	0.38**
	(0.33)	(0.57)	(0.13)	(0.16)
Above median conflict events	1.32	2.13	0.91	0.42***
	(0.47)	(1.02)	(0.40)	(0.12)
Above median fatalities	0.96	0.67	0.84	2.40**
	(0.35)	(0.37)	(0.38)	(0.82)
HH characteristics				
Cultivated land size	1.00	1.00	1.01	0.98
	(0.013)	(0.016)	(0.017)	(0.023)
Agricultural production	1.00	1.00	1.00	1.00
	(6.6e-09)	(9.6e-09)	(0.000000010)	(5.7e-09)
Asset index	0.97	1.03	1.08	1.16*
	(0.047)	(0.061)	(0.086)	(0.099)
Caloric intake	1.00**	1.01***	1.00	1.01*
	(0.0021)	(0.0010)	(0.0028)	(0.0062)
HDDS	1.03	1.03	1.01	1.06
	(0.031)	(0.034)	(0.042)	(0.058)
Peulh	0.88	1.10	1.36	1.74
	(0.44)	(0.66)	(0.80)	(0.80)

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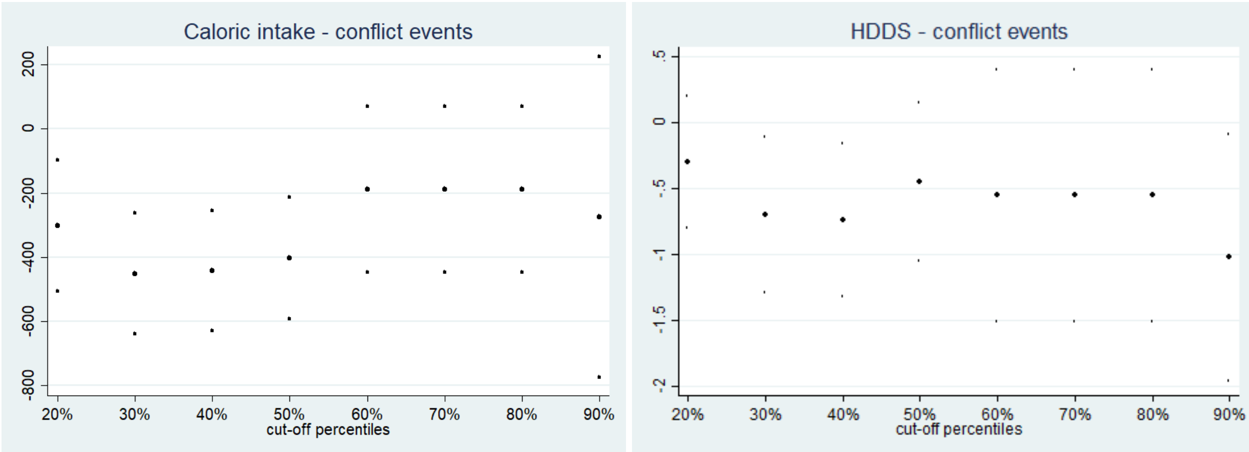
Dogon	0.61	0.51	1.83	2.52***
	(0.25)	(0.29)	(0.90)	(0.64)
Household head's education attainment	0.99	1	1.34	1.64*
	(0.29)	(.)	(0.34)	(0.45)
Expenditure quantile (ref=1)				1
2nd quantile	1.24	1.25	1.07	0.73
	(0.21)	(0.30)	(0.22)	(0.18)
3rd quantile	1.00	1.16	0.64	0.89
	(0.22)	(0.30)	(0.19)	(0.24)
4th quantile	1.21	1.47	0.86	0.80
	(0.28)	(0.44)	(0.28)	(0.26)
5th quantile	1.32	1.29	1.23	0.88
	(0.34)	(0.42)	(0.45)	(0.31)
Household size	1.00	0.99	1.04	1.04
	(0.027)	(0.032)	(0.036)	(0.030)
Dependency ratio	1.12	1.09	1.21*	1.06
	(0.083)	(0.12)	(0.12)	(0.13)
Observations	1379	1267	1270	1379
R"	0.037	0.063	0.056	0.14
Chi-2 statistic	56.5	164.1	56.3	224.2

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

B Appendix B: Sensitivity analysis

So far we have used the median of the distribution as the cut-off to categorize observations as conflict-affected or not. Here, we show how the results change when we use different cut-offs, ranging from the 20^{th} to the 80th percentile of the distribution of conflict events

Figure B1: Sensitivity to cut-off of impact of conflict events on food security



Left: Calorie intake, Right: HDDS-11
Source: author's calculations.

and fatalities. The results are displayed in Figure B.

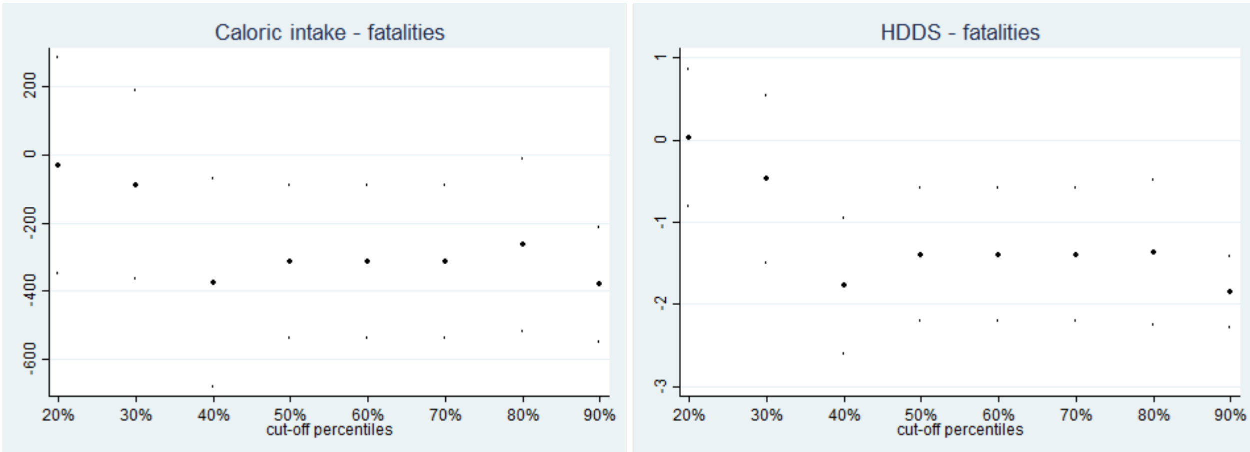
Surprisingly, the effect of conflict events on calorie intake is larger in magnitude and more precisely estimated when the cutoff is between the 20th and the 50th percentile of conflict events. Above the 50th percentile, the effect of conflict events become indistinguishable from 0. The estimated effect of conflict events is similar if we use for cutoff the 20th, 30th, 40th or 50th percentile.

In contrast, the effect of fatalities on calorie intake is larger in absolute value and statistically significant at the 5% when the cutoff is above or equal to the 40th percentile, and up to the 80th percentile. The size of the estimated effect is very similar throughout the 40th-80th percentile range.

The effect of conflict events on HDDS is negative and statistically significant no matter which cutoff is used, with the exception of the 20th and 90th percentile. The size of the estimated effect does not meaningfully vary with the cutoff neither. The effect of fatalities on HDDS is negative and statistically significant with cutoff greater or equal than the 40th percentile. The size of the effect does not change much as the cutoff increases.

Overall, these sensitivity checks strongly support the robustness of the findings, as these do not hinge on the particular cutoffs used to categorize conflict exposure.

Figure B2: Sensitivity to cut-off of impact of fatalities on food security



Left: Calorie intake, Right: HDDS-11

Source: author's calculations.

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