



Making ends meet in refugee camps: Food distribution cycles, consumption and undernutrition

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ABSTRACT

Years after the initial settlement, food aid remains an essential component of humanitarian assistance for protracted refugees in managed camps. From data collected among refugee households in three camps in southern Chad and an exogenous variation of time between the latest food distribution and households' interviews, we draw the time path of household's consumption. Consistent with the literature on intertemporal choices in high-income countries, refugee households experience an average decline of 1.1 to 1.5 percent per day in their daily caloric intake between distributions. The short-term nutritional status of children under five also responds to the distance from food aid distribution and confirms the existence of food distribution cycles. Our results suggest that households don't smooth consumption during the interval of time between two distributions, and face regular and frequent cycles of food shortage resulting in detrimental consequences on children's health.

1. Introduction

As of 2021, Sub-Saharan Africa was hosting 6.9 million of refugees (UNHCR, 2021), most of them in a protracted situation. Thus, Devictor and Do (2017) estimated that, at the end of 2015, the average duration of exile was 10.3 years, with half the refugees worldwide living in exile for at least four years. In contrast to the rest of the world where refugees are more likely to live in individual accommodation in urban centers, a majority of refugees in Sub-Saharan Africa live in managed camps in rural locations (World Bank, 2017). In camps, refugees get access to humanitarian assistance and safety, but they often face movement restriction and lack of access to economic activities. These specificities and constraints shape the dynamics of the humanitarian response. After an emergency phase during which refugees are entirely dependent on aid, the relief effort progressively shifts to a development phase transitioning toward self-sufficiency of protracted refugee households (MacPherson and Sterck, 2021). However, movement restriction, limited income-generating activity opportunities, and constrained access to land often prevent households from being entirely self-sufficient. Therefore, years after the initial settlement and long after the emergency phase, the distribution of food aid remains the central part of the assistance and gives the tempo to the economic life of refugees (Jacobsen, 2005; Werker, 2007; Alloush et al., 2017).

In emergency contexts, food aid has proven to have an immediate positive effect on food consumption, and children's survival and growth (Quisumbing, 2003; Gilligan and Hoddinott, 2007; Abebaw et al., 2010; Tranchant et al., 2019), though poor targeting can be a major constraint to its effectiveness (Dercon and Krishnan, 2005; Yamano et al., 2005). For refugees in a protracted situation, food aid plays the role of a safety net, palliating the defaulting self-sufficiency, with the aim of avoiding poverty traps and acute food insecurity. This objective relies, at least partly, on refugee households' capacity to smooth consumption between ration distributions. The prevalence of malnutrition and deficiencies on nutrients among the refugee population observed in various settings (Toole et al., 1988; Banjong et al., 2003; Seal et al., 2005; Kelati et al., 2014; Hoddinott et al., 2020) already questions this hypothesis.

Using primary data collected among protracted refugees in camps and an exogenous variation in the time lapse between the food transfer and the interview date, we investigate whether refugee's food consumption responds to the timing of the distribution of food aid. As food consumption greatly determines nutritional outcomes and ultimately health, we take one step further to estimate to what extent the time since the last distributions affects the nutritional status of under-five children living in the camps. For this purpose, we use data collected in three refugee camps situated in Chad, nearby the border with the Central African Republic, where refugee households had been living for up to

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seven years at the time of our study. The food aid ration, which was composed of cereals and cooking oil, aimed at covering half of an adult's daily needs. At each distribution, the ration was calibrated to cover either a month or two months of consumption, depending on logistical constraints, with households being used to changes in the distribution frequency. This particular survey took place after refugees received a food ration calibrated for two months.

In this context, we observe a significant decline in consumption as days since the latest distribution elapse. In our most conservative estimates, the caloric intake from the consumption of cereals only and from all food items decreases by 1.5 and 1.1 percent per day, respectively. This result is robust to alternative specifications, enumerators fixed effects and an alternative definition of caloric intake. Moreover, as a falsification test, we show that food aid distribution cycles do not affect households of the nearby living host community. For households with limited resources and constrained access to credit, these consumption patterns lead to regular food scarcity at the end of each distribution cycle. Indeed, we observe a similar cyclical pattern in the nutritional status of refugees: short-term nutritional status of children under five, as measured by mid-upper arm circumference for height z-score, also declines over time after the distribution (at a rate of 0.025 standard deviations per day), while long-term nutritional indicators do not follow the same pattern. For both models, alternative specifications suggest that the daily decline in food consumption and children's nutritional status decline is not linear but slowly decreasing, with a turning point out of the time range of our study.

We interpret these findings as evidence against the permanent income hypothesis predicting that consumption should not respond to the timing of the receipt of paychecks or regular transfers (Hall, 1978). Instead, our results are consistent with quasi-hyperbolic discounting models, which assume that the rate at which an agent discount the future is higher in the immediate future than it is in the longer run (Laibson, 1997; O'Donoghue and Rabin, 1999; Frederick et al., 2002; DellaVigna, 2009; O'Donoghue and Rabin, 2015; Ericson and Laibson, 2019). Such models have been developed to reconcile the theory with empirical evidence of present bias and self-control problems. In the case of our study, a household head with a given stock of resources who wants to maximize the utility over calories faces a series of consumption decisions that will shape the consumption profile over time. With the goal of smoothing consumption over the interval of time between two distributions, he would set a consumption profile based on his own discount function. Intuitively, day after day, a household head with quasi-hyperbolic preferences and naive about his future preferences would consume more in the present than he had initially planned in the past (reflecting time-inconsistency), and would repeat this pattern over the cycle.

This paper falls within the scope of three strands of literature. First, we contribute to the literature dedicated to the study of intertemporal choices. Evidence of the presence of consumption cycles has been largely documented in high-income countries settings, notably with regard to paychecks and benefits cycles (Stephens, 2003, 2006; Shapiro, 2005; Mastrobuoni and Weinberg, 2009; Hastings and Washington, 2010; Todd and Gregory, 2018). Several studies observe a peak of consumption at the beginning of the cycle: Stephens (2003) measured a 13 percent increase in the consumption of food for home on the week after the paycheck is received; similarly, Hastings and Washington (2010) measured a 20 percent decrease in consumption from the week when the paycheck is received to the next. As a comparison to our results, some papers have estimated the daily rate at which consumption declines over the cycle: Todd and Gregory (2018) found a decline of 0.6 percent per day in consumption among food stamps recipients in the United States, while Shapiro (2005) estimates a decline of 0.4 percent per day. We add to this literature by documenting the presence of a consumption cycle in the context of the distribution of food aid to protracted refugee households in managed camps. In this regard, we note that our estimates (a daily declining rate of 1.1 to 1.5 percent) are higher than those observed

in high-income countries settings. In addition, we expand this literature by estimating the repercussion of the cyclical pattern of consumption on children's nutritional status, demonstrating how preference for present can have long-lasting health effects.

Secondly, our findings contribute to the debate on the timing and effectiveness of transfers to the poor. A non-negligible strand of the literature investigates the effect of transfer timing on recipients' welfare, demonstrating how sensitive recipients' consumption decisions are to variations in the structure of cash transfers (Haushofer and Shapiro, 2016; Barrera-Orsorio et al., 2011), transfers frequency (Aguila et al., 2017), or delivery delays (Bazzi et al., 2015). For instance, Haushofer and Shapiro (2016) show that beneficiaries of a lump-sum transfer are more likely to buy durable goods while beneficiaries of monthly transfers display higher level of food security. When it comes to recurring transfers, frequency also plays a key role. Analyzing the impact of a cash transfer program in a province of Mexico, Aguila et al. (2017) compare the effect of receiving a cash transfer every month or every two months (similar to the frequencies of food aid delivery in our population of interest). They find that households who receive transfer more frequently are more able to smooth their consumption. In this regard, the policy implication of our own findings is that aid recipients might benefit from a higher frequency of distribution, especially when they have a stronger preference for the present. Delays in transfer delivery also affect beneficiaries: by comparing households who received the latest installment of an unconditional cash transfer to households waiting for it at the time of the survey, Bazzi et al. (2015) show that delayed delivery temporarily reduces expenditures, while timely transfers have no effect on consumption, which they interpret as evidence of the use of cash transfers as precautionary savings.

Lastly, this paper contributes to the growing literature on refugee economies, their livelihood, and the assistance they benefit from. This literature provides a precious photography of refugees living standards in a wide range of different settings, under various types of assistance and legal framework, from managed camps similar to the ones in our study (Alloush et al., 2017; MacPherson and Sterck, 2021; Alix-Garcia et al., 2019; Hoddinott et al., 2020; Hussam et al., 2022; Beltramo et al., 2023), and informal camps of internally displaced persons (Aker, 2017), to urban settings among the host community (Hidrobo et al., 2014; Özler et al., 2021; Moussa et al., 2022; Altındağ and O'Connell, 2023). With regard to aid policies, recent studies have investigated to what extent the modalities of the assistance can shape refugees' welfare, showing evidence that cash transfers can be more effective and create less distortions than in-kind transfers or vouchers. In particular, MacPherson and Sterck (2021) shows how refugee households living under a development model approach (relying on cash transfers, instead of in-kind food rations, and promotion of agriculture) had higher caloric intake and lower rate of food insecurity than refugees living under the more traditional humanitarian model (food ration distributions). This corroborates Alloush et al. (2017) who document a positive effect on refugees' welfare of switching from in-kind to cash aid. We add to this literature by analyzing consumption patterns among protracted refugee households who have been receiving in-kind food aid for up to seven years. Our findings have important policy implications especially for agencies responsible for the distribution of food aid and other safety net programs. We highlight the need to consider the effect of each decision (frequency, quantity of ration) even when determined by logistical and contextual constraints. This is especially important noting the worrying prevalence of malnutrition observed among refugee children in our sample, echoing descriptive evidence of malnutrition in similar contexts documented in the medical literature (Banjong et al., 2003; Seal et al., 2005; Kelati et al., 2014).

This paper is organized as follows. Section two details the context of southern Chad in which refugees evolve and the type of assistance they receive. The survey design and data are presented in section three. Section four sets out the empirical strategy. The subsequent results are reported in section five and discussed in section six.

2. Background

2.1. Initial crisis, relief effort, and development policy

From fall 2002 to the overthrow of President Patassé in March 2003, the occupation of northern Central African Republic by rebel troops of General Bozizé, and the ensuing violence, have led the population to flee their villages and to find refuge, across the border, on Chadian soil where the host population share languages and ethnicity. After having been welcomed in bordering villages, refugees were settled further inland in the newly created camp of Amboko, located six kilometers away from the small town of Goré, in order to secure the frontier. This first influx of refugees was followed by two other waves after the presidential election, in June 2005 and February 2006, leading to the creation of two additional camps: Gondjé, next to Amboko in 2005, and Dosseye, 30 km north of Goré, in 2006. When surveyed in 2010, most refugee households surveyed reported not considering a return as a potential option in the short run and the situation in Central African Republic was not considered sufficiently safe by UNHCR to organize a sustainable return through a reintegration program. Indeed, a steady upsurge of violence in the north of Central African Republic since 2012 has further reduced the opportunities of coming back. As of October 2018, the border regions in the south of Chad hosted 96,000 refugees and asylum seekers.¹

Having left everything behind – only 14 percent of sampled households had luggage with them when they arrived in the camp – and without any source of livelihood, refugees were highly vulnerable in the immediate aftermath of the shock. Besides ensuring refugees' safety, the first goal of the relief effort was therefore to eradicate the prevalence of short-term malnutrition among newly arrived refugees. In Amboko, 30 percent of children under five have been suffering from acute malnutrition when the camp was established (UNHCR & WFP, 2004). In this context, the regular distribution of food aid set to cover refugees' daily nutritional needs played a crucial role in helping refugee households to cope with the displacement shock. Over the years, the aid policy shifted from the resolution of a humanitarian crisis to a development policy. Refugees got progressively access to water through tube wells, sanitation, free health care, and eventually to primary education.² As an illustration of the evolution of refugees' living standards since their arrival, years after settlement, permanent houses similar to the ones found in neighboring villages have replaced the tents initially granted. Restoring households' productive capacity and self-sufficiency was a concern from the very beginning. First, every household was allocated one hectare of cultivable land, seeds, and basic tools for agricultural production. Despite a favorable climate and fertile soils in the region, the small size of the allocated plots and the limited possibility to let the land lie fallow have reduced soil fertility, which may have deterred refugees' will to engage in agricultural work in the medium run. Secondly, refugees are free of movement in and out of the camps,³ and have the right to engage in income-generating activities. Apart from agriculture and livestock rearing (respectively practiced by 65 and 42 percent of households in the camps), the most common activities in the

camps include trade (at least one member is engaged in trade in 47 percent of households in the camps), tailoring and other craft activities (7.4 percent), and working as a day laborer (5.4 percent). Within years, the enduring presence of the three camps has shaped the local economy. In that regard, the development policy led to better integration of the camps in the host community economy, creating strong ties between refugees and the host population by sharing markets, schools, and health infrastructures.

2.2. Food aid distribution

Initially, when they first settled in camps, refugees were given a ration that equals 2100 kcal per person per day. This full ration, which aimed to cover adults' daily needs, was composed of 400 g of cereals, 70 g of pulses, 25 g of cooking oil, 5 g of salt and 50 g of corn soya blend, and was not fortified with extra micronutrients. At the end of the emergency phase, the daily ration fell to 1200 calories per person (about half of an adult daily needs), and only included cereals, cooking oil and salts. This change took place in December 2006 in Amboko and Gondjé, and in April 2010 in Dosseye, almost 4 years and 5 months respectively before the survey (see Table 1 for a timeline). Importantly, selling the food ration is common: as per our data, 55 percent of households had sold part or all of the last ration they received; 87 percent of those who sold their ration have done so in the week following the distribution. This behavior can be explained by the desire to balance diet with food items not included in the ration, and by the potential inadequacy of the distributed cereals with refugees' cultural preferences (Reed and Habicht, 1998). Indeed, anecdotal evidence from the field suggests that the rice ration was usually sold or exchanged in order to buy sorghum or non-cereal food items.

This periodic transfer of food aid provides a steady and predictable stream of income for refugee households, consistently covering half of their daily caloric needs. Nevertheless, it is worth noting that refugee households are used to slight variations in food aid delivery over time, as the food supply chain faces logistical and financial constraints that resulted sometimes in late distributions, inadequate quantity, or changes in the composition of the ration. Importantly, even though food aid was initially planned to be delivered on a monthly basis, it is not unusual for households to receive a ration calibrated to cover two

Table 1
Camp's characteristics.

	Amboko	Gondjé	Dosseye
Year of first settlement	2003	2005	2006
Date of first food distribution	Jul. 2003	Jan. 2006	Feb. 2007
Date of last distribution of the full ration	Dec. 2006	Dec. 2006	Apr. 2010
Survey date	Sep. 2010	Sep. 2010	Sep. 2010
Number of refugees (as of Oct. 2009)	11,697	11,204	9,509
Number of sampled households	323	321	333
Household size	6.6	5.9	5.6
Share of female-headed households	47.6 %	43.6 %	44.1 %
Share of working-age members in household (15–64)	49.5 %	50.3 %	47.5 %
<i>Share of ethnic groups</i>			
•Arabs	52.1 %	3.6 %	5.9 %
•Fulbe	7.1 %	6.7 %	80.5 %
•Kaba	31.3 %	55.1 %	12.4 %
Mbaye	0.7 %	29.9 %	0.1 %
•Other ethnic groups	8.8 %	4.7 %	1.1 %
Number of days between food distribution and interview date	26.6	31.1	37.5
Prevalence of stunting (children under five years old)	34.6 %	35.1 %	40.9 %

Notes: Working-age members include every member aged 15 to 64 years old. A child is considered stunted if his height-for-age z-score falls below minus two standard deviations from median height-for-age of reference population.

¹ According to UNHCR Operational Update for Chad (October 2018).

² As per our computation based on figures provided by CARE International, UNHCR, WFP and UNICEF, the average cost to get access to water, sanitation, food distribution, health care, and education was equivalent to a subsidy of 91 USD per person per year. This estimation does not include the investment costs for tube wells, schools and health center, or the transport for food distribution. While access to services was initially free for refugees, as part of an integrated development phase payments of school fees, health consultations, medicines and access to water were gradually introduced in 2010.

³ Refugees require a formal authorization from the local authority to move outside of the camp, but these authorizations are not needed for daily commuting.

months, and indeed, the survey took place after a distribution that aimed at covering two months of consumption, following a series of one-month distributions. Furthermore, the exact distribution dates were only announced a few days in advance, making it more difficult for households to anticipate the exact distribution date. Lastly, as the price of cereals largely differ from one location to another and over time, the monetary value of a ration varies depending on the type of cereal included. Imported rice, for instance, was twice as expensive as the locally produced sorghum at the time of survey.⁴

3. Data and descriptive statistics

3.1. Survey design and time variable

The present analysis is anchored on data collected among a population of refugee households in the three refugee camps of Amboko, Gondjé and Dosseye, located in the southwest region of Logone Oriental, in Chad. At the time of the survey, the three camps accommodated 32,000 refugees (Table 1). The survey was funded by CARE International and UNHCR, and implemented in September 2010, at a time of the year that usually coincides with the end of the lean season and the beginning of the harvest period. The survey aimed to assess refugee households' self-sufficiency in order to improve the targeting of aid toward the most vulnerable ones. The sample consists of 969 refugee households, randomly selected from an exhaustive list of households registered in the camps by UNHCR. Using the block of location within the camps and the ethnicity of the household head, we draw a representative stratified sample of refugees' households in each camp. When a registered household was not living in the camp at the time of our study – a common occurrence –, another household from the same block and of the same ethnic group was randomly selected as a substitute.⁵ In addition, in order to allow comparison and robustness checks, 502 households were surveyed among the host population in nine neighboring villages.

To test the existence of potential consumption cycles, the survey was designed to create an exogenous variation of time between the latest food distribution and the date of the interview. Using the list of registered refugee households, we conducted a stratified sampling to create two groups of households to be interviewed at two different times, respectively, during the first and third weeks of the survey.⁶ Table 2 shows balancing tests between the two groups. Except for the household size, there are no significant differences between the two groups with regard to household characteristics, such as the gender and age of the household head, assets and cattle ownership, the cereal production of the previous season, and the number of years spent in camp. Though the magnitude of the difference in household size is unexpected, this result is not surprising. As per the questionnaire definition, a household is composed of permanent members who live together and share the same meals. A member was considered permanent if he or she is present during the interview or if he was not absent for more than a month. The difference between the two groups is the consequence of some members being present in the camp at the time of the distribution but leaving shortly after: they were only included in the household roster when the household was interviewed in the month after they left. Importantly, there is no difference between the two groups in the number of persons

Table 2

Mean-comparison test by period of survey.

	First half	Second half	Difference	Obs.
	(a)	(b)	(a – b)	
Log of per adult equivalent calories from cereal	7.392	7.296	0.096***	871
Log of per adult equivalent calories from all food items	7.489	7.458	0.031	921
Days since distribution	26.2	37.3	–11.1***	956
Household's size	6.5	5.6	0.896***	956
Share of working-age members in household	0.54	0.483	0.056***	956
Years in camp	5.1	5.0	0.155	956
Gender of household head (female = 1)	0.45	0.45	0.007	956
Age of household head	40.9	40.7	0.258	956
Education of household head	2.1	1.8	0.27	956
Assets and housing index	–0.065	0.065	–0.13	956
Cattle ownership (number of cows)	0.43	0.40	0.025	956
Cereal production	3.446	3.419	0.027	956
Quantity of food ration received	72.83	66.96	5.875**	954
Number of persons during morning meal (day before visit)	7.21	6.98	0.236	956
Number of persons during midday meal (day before visit)	8.22	8.14	0.074	956
Number of persons during evening meal (day before visit)	7.77	7.33	0.436	956
Number of food items listed for all meals (day before visit)	6.56	6.56	0.004	956
MUAC-for-height z-score	–0.98	–1.25	0.275***	626
MUAC in centimeters	14.65	14.31	0.337***	719
Weight-for-height z-score	–0.39	–0.25	–0.139	647
Height-for-age z-score	–1.33	–1.45	0.121	647
Children's gender	0.47	0.44	–0.029	626
Children's age in months	31.49	31.5	–0.015	626
Children's recent illness	0.362	0.337	0.025	626
Children's handicap	0.014	0.007	0.006	626

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %. The bottom 1 % and top 1 % of consumption variables are trimmed.

present during each meal on the day preceding the interview.

The time interval variable used in the analysis measures the number of days between the latest food distribution received by the household and the date of the interview for each household. While the distribution spread over a period of 10 days (three to four days per camp successively), all three camps were surveyed at the same time, with three teams of enumerators working simultaneously. Fig. 1 illustrates the survey timeline since the distribution for each camp. The earliest and latest interviews were conducted, respectively, 17 and 46 days after the distribution. The average time interval between the distribution and the date of the interview is 31.8 days, with a standard deviation of 7.3, and a difference of 11 days on average between the two groups (26 days since the distribution on average for the first group; 37 days for the second).⁷ It is worth noting that, contrary to Stephens (2003, 2006) or Shapiro (2005), we do not observe the whole consumption cycle between two distributions and our time frame does not include the expected peak of consumption around the distribution dates.

⁴ Imported rice and sorghum respectively costed 350 FCFA and 150 FCFA per kilo in the camp market.

⁵ Nearly 54 percent of households in our sample were substitutes from a second list of randomly selected households. There are no statistical differences between households selected first and substitutes. Including a dummy variable for being a substitute in the estimations does not change the results of our analysis.

⁶ The second week was devoted to survey households from the host community in surrounding villages.

⁷ Assuming food aid is the only source of income, a household consuming 2100 kcal per member a day would run out of food after 35 days. With two groups equally divided before and after this threshold of 35 days, our design is therefore powered for testing the consumption smoothing assumption.

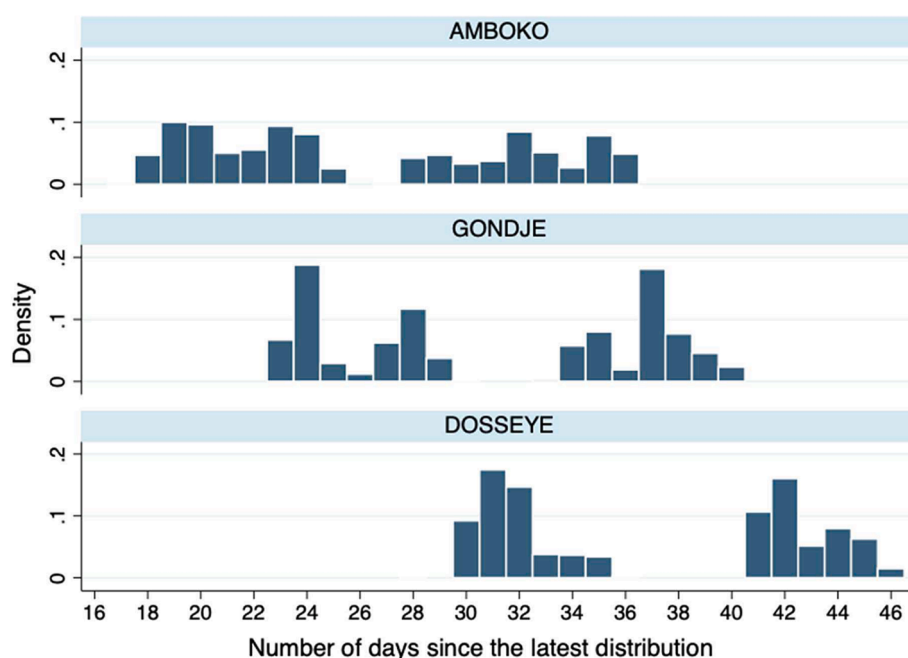


Fig. 1. Distribution of days since the latest food distribution by camps.

3.2. Food consumption

Our measure of food consumption relies on a 24-hour dietary recall survey, giving an accurate snapshot of consumption on specific days over the distribution cycle. For each of the three main meals of the day, respondents were asked to provide a description of the meal, the quantity of each food item consumed, and the number of persons sharing the meal, including a distinction between children under five and the rest of the attendees.⁸ The dietary recall referred to the day preceding the interview. Individual caloric intake out of the main meals at home, such as snacks, and food away from home were not recorded.⁹

The main outcome of interest is the log of adult-equivalent caloric intake the day before the interview, and is computed both for the consumption of all food items and the consumption of cereals only. While we present results for both outcomes, we focus primarily on the consumption of cereals throughout the paper in the interest of measurement accuracy. Indeed, despite efforts to measure consumption as accurately as possible, non-staple food items are more likely to suffer from measurement errors or misreporting. Cereal consumption, however, is less prone to measurement errors as most households use a standard cup to measure the quantity of cereals while cooking. It is also less subject to survey fatigue as it constitutes the main ingredient of most meals and was often the first listed item. Cereals are the basis of refugee households' diet: about 92 percent of households had eaten cereals the day before the interview, and caloric intake from cereal consumption

represents 78 percent of total consumption in our sample.¹⁰

Focusing on cereal consumption raises important concerns that have implications for results interpretation. Most importantly, households who didn't consume cereals differ slightly from the one who did (Table A1): they are smaller by 0.85 member on average and are more likely to count only two members or less (25 percent as compared to 10 percent for the rest of the sample). This may be explained by larger households cooking cereal-based meals more consistently or by one-member households being more likely to eat away from home or to get invited by neighbors. Secondly, households who didn't report eating cereals are significantly poorer on average and overrepresented in the poorest quartile of the wealth distribution (by 9 percentage points).

Another concern is the extent to which cereal consumption is representative of overall consumption. Specifically, a decline in cereal consumption could potentially be offset by a countercyclical consumption of an alternative to cereal and not result in a decline in caloric intake overall. The data suggests otherwise. We observe that the caloric intake from cereal is highly correlated with caloric intake overall (correlation coefficient = 0.889), which is not surprising regarding the large share of cereals in households' diet. Cereal consumption is also positively correlated with the caloric intake from other food groups, though with a smaller correlation coefficient (0.171), limiting concerns about a countercyclical consumption of food other than cereals. In the results section, we investigate in more details the impact of time on household diets and rule out the hypothesis of a countercyclical consumption of non-cereal food. Lastly, it is worth noting that the alternative to cereals appears to be melon, cassava, and groundnuts: 77 percent of households who didn't eat cereals on the day preceding the interview report having eaten one of those three food items, as compared to 36 percent in the rest of the sample (Table A2).

With regard to consumption patterns in the camps, about 59 percent of sampled households declared having eaten two meals the day before the interview, while 29 percent have eaten three. In addition, 53 percent of the households skipped lunch, which is quite common during the

⁸ Adult equivalent caloric intake was computed by weighting children under five as the equivalent of half an adult.

⁹ Recent studies have shown how neglecting food away from home could bias poverty estimates (Farfán, et al., 2017). In addition to underestimating total caloric intake, this could be problematic in the context of our analysis if households were more likely to eat away from home when they run out of the food ration. In the absence of data, we can't test to what extent food away from home could be countercyclical. However, it is important to note that options for food away from home were limited in the camps and surrounding villages at the time of the survey (no restaurant, no school meal program). Moreover, caloric intake from food away from home is usually low in rural sub-Saharan settings: for instance, Cockx, et al. (2018) estimated food away from home to account for around 2.5 percent of total caloric intake for households in rural Tanzania.

¹⁰ The two main cereals consumed were sorghum, which is locally produced, and rice, which is part of the food aid ration or can be purchased (though at a higher price than sorghum).

harvest time as agricultural laborers eat before and after farming activities. On average, individual caloric intake the day before the interview was 1,542 kcal (s.d. = 1085) when considering cereal consumption only, and 2136 kcal (s.d. = 1,405) overall (Table 5). For comparison, in the host community, households' consumption was significantly higher (1,925 kcal for cereals only and 2,595 kcal overall). Only 42 percent of refugee households had a caloric intake above the minimum daily energy intake of 2,100 kcal per capita per day, as compared to 57 percent in the host community. As illustrated by the distribution of the logarithm of per adult equivalent calories (Fig. 2a), we observe a sizeable and significant difference in cereal consumption between households interviewed on the first and third week of survey (Table 2). Moreover, a binned scatter plot and quadratic prediction of the average consumption over the days since the latest distribution present some graphical evidence that consumption declines slightly over time (Fig. 2b), motivating the following empirical analysis.

3.3. Saving and borrowing

A picture of savings and borrowing behaviors in the camps is important to keep in mind while investigating households' capacity to smooth their consumption. In that regard, our data show a substantial demand for credit in the camps but limited formal options. About a third of refugee households (34 percent) reported having borrowed either in cash or in kind in the two months prior to the survey, a significantly higher prevalence than within the host community (27 percent). In this context, borrowing is essentially motivated by food consumption: half of the borrowers have done so in kind; among those who borrowed cash, 62 percent reported buying food as the reason for borrowing money. Borrowing is done essentially through friends and family (in 82 percent of cases). Interestingly, when asked about the timing of the borrowing, households disproportionately report having borrowed money or food before the latest distribution (in 67 and 61 percent of cases, respectively). Lastly, and consistent with a degree of uncertainty in the economic life of refugees, 24 percent of refugee households reported having precautionary savings, as compared to 33 percent in the host community. The lowest prevalence of precautionary saving is found among households of the poorest quartile (19 percent). In most cases (72 percent) savings were kept informally at home, highlighting a lack of more formal savings options.

3.4. Anthropometric measurements

A total of 712 refugee children under five years old have been measured for their height, weight and mid-upper arm circumference (MUAC), allowing for an assessment of children's long and short-term nutritional status.¹¹ Long-term or chronic malnutrition, as measured by the height-for-age ratio, is expected to be stable over the distribution cycle. Short-term indicators such as weight-for-height and MUAC reflect the current nutritional status, that is the effect of recent episodes of food shortage. MUAC is often used in emergency contexts for practical reasons, as a cheap, quick and non-invasive method, but also because of its sensitivity to abrupt changes in nutritional status (Bern and Nathanail, 1995). Moreover, MUAC appears to be a complementary tool to weight-for-height in monitoring nutritional status and predicting the death of malnourished children (Berkley et al., 2005). The average growth of the arm circumference between one and five years old is low (Frisancho, 1974), but raw MUAC should nevertheless be expressed into z-score

indexes by height, as recommend by De Onis and Habicht (1996). Table A3 shows the correlations between the four nutritional status indicators. As expected, both MUAC measures and weight-for-height are strongly correlated (0.37 to 0.47) while height-for-age is not significantly correlated with MUAC-for-height and only slightly positively correlated with raw MUAC.

Summary statistics of anthropometric measurements are presented in Table 3. Despite most of them being born in camps and having lived under the food aid coverage their whole life, 37 percent of the children under five sampled in camps were considered as stunted (height-for-age < -2), with a mean height-for-age z-score of -1.38. This prevalence of stunting is similar to what was observed in the host population, a rural community relying essentially on its own agricultural production and not supported by any comparable safety net at the time of the study. It is worth noting, however, that stunting in both populations does not follow the same trend. Before 24 months, refugee children are more likely to be stunted and have lower height-for-age z-score than host children, while the opposite is true after two years old (Table 4). In both cases, the difference is significant, despite the small sample size. In other words, the decline in height-for-age as children grow up is less sharp among the refugee population, which may partly be attributed to the effectiveness of the safety net role of the food distribution on children malnutrition.¹²

With regards to short-term malnutrition, 12 percent of refugee children under five could be considered as wasted (WHZ < -2) and four percent severely wasted (WHZ < -3), with a mean weight-for-height z-score of -0.34, suggesting that their households have faced recent episodes of food shortage. Prevalence of wasting is significantly higher in Dosseye (20.6 percent), where the last arriving households have settled, than in the two other camps (6.1 and 7 percent respectively in Amboko and Gondjé), highlighting a direr situation for refugees closer to the displacement shock. MUAC indicators confirm the prevalence of short-term malnutrition. About 9 percent of the refugee children in the sample are under the cutoff used to diagnose wasting (12.5 cm), with the mean MUAC-for-height z-score being -1.10. Following the pattern observed in consumption, MUAC-for-height z-scores are significantly lower for children measured at the end of the survey and appear to decrease over time (Table 2, Fig. 3a and 3b), suggesting that food consumption cycles could translate into short-term malnutrition cycles. Finally, comparing the short-term nutrition status of children in camps and neighboring villages using the WHZ and MUAC indexes provides mixed results, despite the correlation between the two indicators. While refugee children have lower WHZ than children in the host community, the MUAC indicators suggest a higher prevalence of short-term malnutrition in the host community (Table 3).

4. Empirical strategy

4.1. Effect of time on food consumption

In order to test whether consumption responds to the timing of food aid distribution, we examine how the elapsed time since the latest distribution affects daily household consumption. Specifically, we estimate the following equation:

$$C_j = \beta_0 + \beta_1 T_j + \beta_2 H_j + \beta_3 S_j + v_k + \varepsilon_j \quad (1)$$

where C_j is the logarithm of per adult equivalent calories from food consumption (either from all food items or from cereal only) of household j from block k ; T_j is a time variable, expressed either as the number of days since the latest distribution, or as a dummy variable indicating

¹¹ The measurement protocol respects the one established by UNICEF. Children were measured with wooden height gauge (in lying or standing position depending on their age), suspended scales and measuring tape. Z-scores have been generated with the help of the World Health Organization's Anthroplus software. A total of 480 host community children have also been measured but are not included in the main econometric analysis.

¹² In addition to the monthly distribution of food aid, an emergency food transfer was provided to households when one of their children was found below malnutrition thresholds.

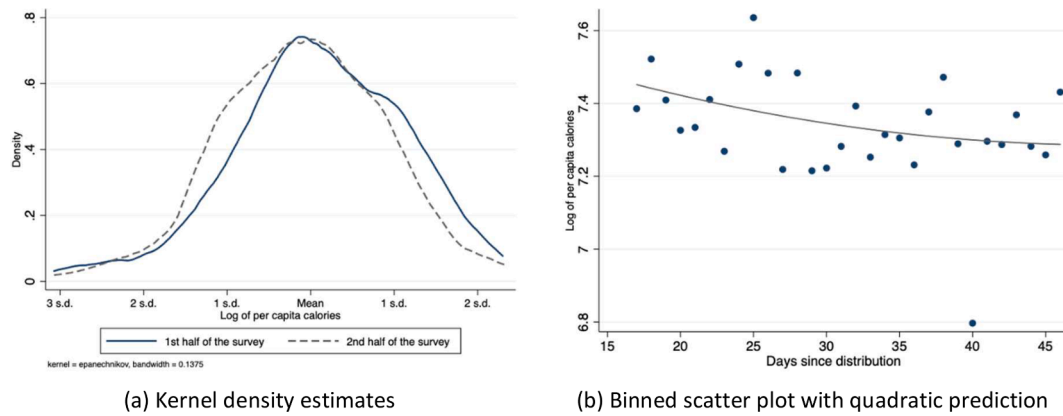


Fig. 2. Logarithm of per adult equivalent calories from cereal consumption.

Table 3

Malnutrition indexes among refugee and host community children below five years old.

	Mean	Std. Dev.	Min.	Max.	N
<i>Refugee children</i>					
•Height-for-age z-score	-1.38	1.75	-5.97	3.80	651
•Stunting (=1 if HAZ < -2)	0.372	0.484	0	1	651
•Weight-for-height z-score	-0.34**	1.50	-4.77	4.77	648
•Wasting (=1 if WHZ < -2)	0.117***	0.322	0	1	648
•MUAC-for-height z-score	-1.09*	1.17	-5.10	2.63	630
•MUAC-for-height z-score < -2	0.206	0.405	0	1	630
•MUAC in centimeters	14.51***	1.56	9.80	20	712
•MUAC < 12.5 cm	0.091***	0.288	0	1	712
<i>Native children</i>					
•Height-for-age z-score	-1.43	1.94	-5.84	3.81	429
•Stunting (=1 if HAZ < -2)	0.389	0.488	0	1	429
•Weight-for-height z-score	-0.13	1.41	-4.99	4.59	452
•Wasting (=1 if WHZ < -2)	0.066	0.249	0	1	452
•MUAC-for-height z-score	-1.22	1.17	-5.37	2.39	405
•MUAC-for-height z-score < -2	0.237	0.426	0	1	405
•MUAC in centimeters	14.15	1.64	9.30	18.5	489
•MUAC < 12.5 cm	0.149	0.357	0	1	489

Note: In the upper panel, stars display the results of comparison test between refugee and host community children. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4

Height-for-age by age categories for refugee and host community children.

	Host community children	Refugee children	Difference	Obs.
<i>Height-for-age z-score</i>	(a)	(b)	(a-b)	
[0–23] months	-0.53	-1.01	-0.48***	402
[24–59] months	-2.02	-1.58	0.44***	663

Notes: Mean-comparison test. * significant at 10%, ** significant at 5%, *** significant at 1%.

whether a household has been interviewed during the second half of the survey; H_j is a vector of households characteristics that are relatively fixed in time, S_j is a vector of household's livelihood and survival strategies, v_k is the specific block characteristics and ε_j is the term error. Household characteristics include household size, the share of working-age members (15–64 years old) in the household, the number of years spent in the camp, as well as the gender, age, level of education and ethnicity of the household head. Household livelihood and survival strategies are likely to be endogenous to consumption. Therefore, we

carefully choose control variables to be constant over medium-term and less likely to be affected by short-term food shortage. This includes the cereal production from the previous harvest (approximately 11 months before the survey), a wealth index based on assets ownership, cattle size, and the self-declared quantity of food aid ration received by the household at the latest distribution. Additionally, dummy variables for the day of the week the interview took place are included to control for diets habits or customs related to a specific day of the week. Summary statistics of the variables included in the empirical estimations are provided in Table 5.

We are interested in the coefficient associated with T_j . A significant and sizeable β_1 would imply that consumption responds to the timing of the distribution, contradicting predictions of the basic permanent income model. Under the permanent income hypothesis, only small and smooth variations in consumption would be observed throughout the cycle. In a calibration exercise, Shapiro (2005) showed that the daily discount rate he estimated (0.4 percent) could only be reconciled with the exponential discounting model under either a very low discount factor or an unusually high elasticity of intertemporal substitution. Following the literature on intertemporal choices, we expect consumption to peak at the time of the distribution and to decrease over the distribution cycle. Our identification strategy relies on the exogeneity of the measure of time since the distribution and the variation of time within blocks. As detailed in the data section, households of the same blocks were randomly assigned to be interviewed during the first or third week of the survey. In other words, as equation (1) is estimated with fixed effects at the block level, identification comes from the exogenous variation in time within each block.¹³

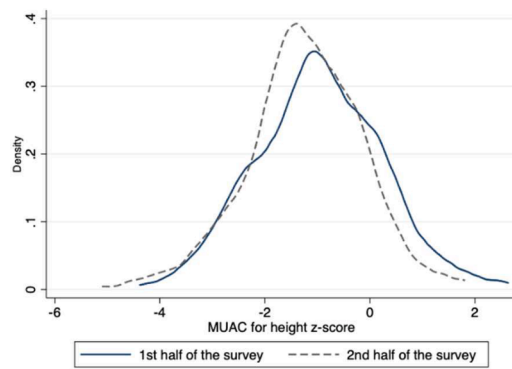
4.2. Effect of time on nutritional status of children under five

Using the same strategy of identification, we further explore to what extent the effect of the distribution cycle can be observed on the nutritional status of children under five, by estimating the following equation:

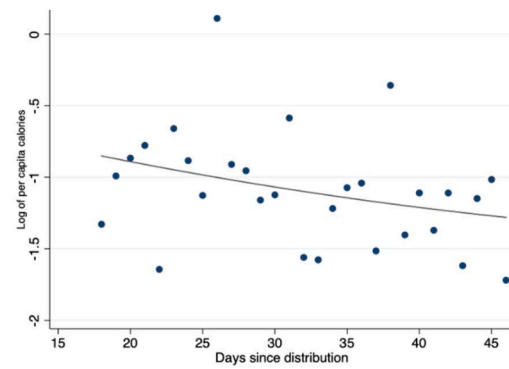
$$N_i = \beta_0 + \beta_1 T_i + \beta_2 CH_i + \beta_3 H_j + \beta_4 S_j + v_k + \varepsilon_i \quad (2)$$

where N_i is the short-term nutritional status of child i in household j ; T_i is the number of days since the latest distribution; CH_i is a vector of child characteristics; H_j is a vector of fixed household characteristics, S_j is a vector of households' survival strategies, v_k captures the block specific characteristics and ε_i is the term of error. H_j and S_j include the same

¹³ Blocks are homogeneous in terms of date of arrival in the camps, region of origin and therefore ethnicity. In order to account for the small number of clusters (10 blocks), we follow Cameron et al. (2008) to compute p-values. Adjusted p-values are reported for the time variable in regression tables.



(a) Kernel density estimates



(b) Binned scatter plot with quadratic prediction

Fig. 3. MUAC-for-height z-scores.

Table 5
Summary statistics.

Variables	Mean	Std. Dev.	Min.	Max.	Obs.
Per capita calories from cereal	1542	1085	0	10,283	948
Per capita calories from all food items	2136	1405	0	13,681	948
Per adult equivalent calories from cereal	1664	1219	0	12,340	948
Per adult equivalent calories from all food items but cereals	464	662	0	7382	948
Per adult equivalent calories from all food items	2128	1446	0	14,657	948
Log of per adult equivalent calories from cereal	7.33	0.62	3.43	9.42	865
Log of per adult equivalent calories from all food items	7.46	0.81	2.43	9.59	922
MUAC-for-height z-score	-1.09	1.17	-5.1	2.63	630
MUAC in centimeters	14.51	1.56	9.8	20	712
Weight-for-height z-score	-0.34	1.50	-4.77	4.77	648
Height-for-age z-score	-1.38	1.75	-5.97	3.8	651
Days since distribution	31.8	7.34	17	46	948
Week 3	0.09	0.28	0	1	948
Week 4	0.25	0.44	0	1	948
Week 5	0.35	0.48	0	1	948
Week 6	0.24	0.43	0	1	948
Week 7	0.07	0.26	0	1	948
2nd half dummy	0.51	0.50	0	1	948
Household size	6.02	3.07	1	27	948
Share of working-age members in household	0.49	0.24	0	1	948
Years in camp	5.07	1.57	1	7	948
Female-headed household	0.45	0.5	0	1	948
Age of household head	40.83	13.38	14	94	948
Education of household head	0.33	0.47	0	1	948
<i>Ethnicity of household head</i>					
•Arab	0.20	0.40	0	1	948
•Fulbe	0.32	0.47	0	1	948
•Kaba	0.33	0.47	0	1	948
•Mbaye	0.11	0.31	0	1	948
Wealth index	0.00	2.2	-2.93	13.09	948
Cattle ownership (number of cows)	0.41	1.28	0	11	948
Cereal production	344.17	607.31	0	8320	948
Quantity of food aid ration received	69.58	42.44	1	260	948
<i>Children's variables</i>					
•Gender	0.53	0.50	0	1	725
•Age in months	28.86	16.52	0	60	714
•Share who experienced a recent illness	0.34	0.47	0	1	733
•Share of children with handicap	0.01	0.10	0	1	733
•Share of children currently breastfed	0.33	0.47	0	1	731

control variables as the consumption model. Children's characteristics include the gender of the child, his age and ethnicity, having experienced a recent illness, being breastfed, and having a handicap. The model is estimated with fixed-effects at the block level and days of the week dummies.

5. Results

5.1. Effect of the distribution cycle on food consumption

Table 6 reports ordinary least squares estimates of equation (1) on calories from the consumption of cereals only (columns 1 to 3) and of all food items (column 4). As a benchmark, the first model only includes the number of days since the latest distribution, the days of the week the interview took place and blocks dummies. We progressively control for household composition and other relatively fixed characteristics (column 2), then household's wealth and economic activities (column 3). All other things held constant, each day away from the distribution significantly decreases the average caloric intake from cereal consumption by 1.5 percent. The coefficient and the standard errors are robust to the inclusion of covariates, with coefficients ranging from 1.1 to 1.5 percent, equivalent to a decrease in consumption of cereals of 15 to 20 percent over two weeks.^{14,15} Consistent with the literature (Stephens, 2003, 2006; Shapiro, 2005; Hastings and Washington, 2010; Todd and Gregory, 2018), these results illustrate that households do not perfectly smooth their consumption between two food distributions, as consumption respond to the timing of the distribution. It is noteworthy that the magnitude of the estimated daily rate is higher than what has been observed in high-income countries settings in Shapiro (2005) and Todd and Gregory (2018), who respectively measured a daily rate of 0.4 and 0.6 percent.

Importantly, the pattern observed in the consumption of cereals is not offset by a potential counter-cyclical consumption of other food items. This would happen, for instance, if households were more likely

¹⁴ Using wild bootstrap p-values to account for the small number of clusters, following Cameron et al. (2008), does not change the interpretation of our results in the consumption and malnutrition models.

¹⁵ The effect of some covariates is worth noting. Household's size has a negative effect on the individual caloric intake: each additional member decreases the average individual cereal consumption by four percent. Caloric intake is positively associated with the education of household head, a wealth index and the quantity of food received. Lastly, the number of years since a household has settled in a camp is associated with a lower consumption of cereals. Under the assumption that better-off households are more likely to leave the camps to find an alternative solution, this variable may partially reflect unobservable characteristics that influenced the decision to stay in the camp and translate a self-selection bias.

Table 6
Food consumption.

	(1)	(2)	(3)	(4)	(5)
	<i>Log of per adult equivalent calories from cereals</i>			<i>from all food items</i>	<i>from all food items but cereals</i>
Days since distribution	−0.011** (0.004) [0.050]	−0.014** (0.004) [0.022]	−0.015*** (0.004) [0.002]	−0.011* (0.006) [0.096]	−0.010 (0.008) [0.280]
Household size		−0.024* (0.012)	−0.043** (0.013)	−0.062*** (0.014)	−0.098** (0.038)
Share of working-age members in household		0.058 (0.091)	0.046 (0.092)	0.052 (0.142)	0.213 (0.291)
Years in camp		−0.097*** (0.024)	−0.096*** (0.024)	0.021 (0.025)	0.183* (0.098)
Female-headed household		−0.016 (0.038)	0.018 (0.038)	−0.013 (0.065)	−0.228** (0.086)
Age of household head		−0.001 (0.001)	−0.000 (0.001)	−0.002 (0.002)	−0.003 (0.003)
Education of household head		0.085** (0.035)	0.063 (0.035)	0.089 (0.061)	0.112 (0.066)
Wealth index (2nd quartile)			0.038 (0.063)	0.120 (0.072)	0.124 (0.146)
Wealth index (3rd quartile)			0.085 (0.050)	0.094 (0.063)	0.293 (0.178)
Wealth index (4th quartile)			0.134** (0.059)	0.104* (0.047)	0.281 (0.184)
Cattle ownership			0.010 (0.021)	0.003 (0.027)	0.029 (0.032)
Cereal production (2nd quartile)			0.016 (0.072)	0.009 (0.082)	−0.233* (0.127)
Cereal production (3rd quartile)			−0.048 (0.075)	−0.075 (0.073)	−0.344** (0.120)
Cereal production (4th quartile)			0.073 (0.043)	0.120 (0.068)	−0.018 (0.134)
Quantity of food aid ration received			0.001* (0.001)	0.002** (0.001)	0.001 (0.002)
Constant	7.698*** (0.118)	8.407*** (0.150)	8.345*** (0.157)	8.039*** (0.228)	5.285*** (0.623)
Number of clusters	10	10	10	10	10
Observations	846	846	846	908	883
R-squared	0.017	0.050	0.070	0.073	0.092

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Days and block dummies are included in all specifications. Ethnic group dummies are included in the last two specifications. Calories from cereal consumption and from all food items are adjusted for adult-equivalent household size.

to consume cereals right after the distribution and switch to other types of food once the stock of cereal is depleted, while keeping the caloric intake constant. Instead, our data shows a general decrease in caloric intake over the distribution cycle: using calories from all food items as the dependent variable, we estimate a decline in consumption at a daily rate of 1.1 percent over the distribution cycle (column 4 of Table 6), slightly below the estimate for cereal consumption only. Even when calories from cereal consumption are excluded, we observe a decline in caloric intake of 1.0 percent (column 5 of Table 6). However, consistent with a noisier measure of food consumption other than cereals, the coefficient is only significant at the 10 percent threshold when all food

items are considered, and no longer significant when cereals are excluded. To complete this picture, we investigate the effect of time on the composition of household's diet and show that the probability of reporting eating from one of seven food categories varies very little over the distribution cycle (Table A4), supporting the idea that the observed decline in cereal consumption is not balanced out by the consumption of other food items.¹⁶

With estimates on consumption from all food items being less precise, we focus on the effect of time since the latest food distribution on

¹⁶ The food categories include cereals, animal products, vegetables and fruits, pulses and tubers, sugar, cooking oil, and milk. The dependent variables take the value 1 if the reported consumption of any item of a food category on the day before the interview is positive, and 0 otherwise. Panel A presents mean-comparison tests among households interviewed in the first or second half of the survey on reporting eating items from each of seven food categories the day before the interview. Overall, the magnitude of the differences is small and not significant. In panel B, results from OLS regressions of the propensity to consume from each food groups on the time since the last distribution confirm that the composition of household's diet does not vary drastically over the cycle. All other things held constant, the likelihood to consume sugar, cooking oil and milk decreases as time goes by since the last distribution. Conversely, the probability of eating vegetables and fruits, and pulses and tuber increases, consistent with a partial substitution to compensate the loss of calories from cereal.

the consumption of cereal in the rest of the analysis.¹⁷ Table 7 presents results from alternative specifications to estimate equation (1). First, in line with our survey design, we use a dummy variable identifying households interviewed in the second half of the survey as our variable of interest. Refugee households surveyed in the second half of the survey consume 17.6 percent less cereals (and 10.8 percent less calories overall) than the ones surveyed in the first half, on average eleven days closer to the latest distribution. In the second column, a quadratic term is included to test for a non-linearity in the effect of time on consumption. The coefficients for the days since distribution and the quadratic term are jointly significant at one percent, suggesting a slowdown in the consumption decline and a turning point 69 days after the distribution, out of the time range of our study and after the expected next distribution. Following Mastrobuoni and Weinberg (2009) and Hastings and Washington (2010), we then include week dummies instead of the number of days since the latest distribution, using the third week after the distribution, i.e. the first week of the survey, as the reference. The week dummies are jointly significant. The sharpest decrease is observed between the fourth and fifth weeks, as the logarithm of per adult equivalent calories from cereal consumption is, respectively 6.6 percent and 21.9 percent lower among households visited in the fourth and fifth weeks as compared to the week of reference. Consumption decreases

Table 7
Cereal consumption – Alternative specifications.

	(1)	(2)	(3)
	Log of per adult equivalent calories intake from cereals		
2nd half of the survey	–0.176*** [0.053]		
Days since distribution		–0.028 (0.021) [0.302]	
Days since distribution – Squared ($\div 100$)		0.020 (0.029) [0.576]	
Week 4			–0.066 (0.111) [0.580]
Week 5			–0.219** (0.095) [0.090]
Week 6			–0.307** (0.118) [0.060]
Week 7			–0.319*** (0.091) [0.032]
Additional covariates	Yes	Yes	Yes
Number of clusters	10	10	10
Observations	846	846	846
R-squared	0.069	0.070	0.070
Joint significance test on the time variables (p-value)		0.010	0.021

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Calories intake from cereal consumption is adjusted for adult-equivalent household size. Days and Ethnic group dummies are included in all specifications. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production. In column (2), the quadratic term is divided by 100. In column (3), the third week after the distribution is used as the reference.

¹⁷ Complete results for consumption of all food items are presented in the appendix (Tables A5 and A6).

more slowly afterward. This confirms the pattern illustrated in Fig. 4, where the relationship between consumption and time is plotted using a local polynomial smoothing routine with 95 percent confidence intervals. Unfortunately, as our data do not cover the period of time around the food distribution, we are not able to draw a complete consumption pattern between distributions. Nevertheless, our results are consistent with the presence of a peak of consumption around the distribution date. Lastly, when interacting the time since distribution with a measure of household's wealth (assets index), we do not find any sign of heterogeneity, suggesting that the inability to smooth consumption is widespread throughout the welfare distribution (Table A7).

The results are finally checked against various robustness tests presented in Table 8. Firstly, the magnitude of the estimated effect of time is not altered when the calories from cereal variable is computed per-capita and not adjusted for adult-equivalent, that is when each individual sharing the meal has an equal weight of one irrespective of his age (column 1). Secondly, we address concerns about the potential effect of measurement errors in explaining our results. In order to control for the quality of enumerators' effort, the model is estimated with enumerators fixed effects.¹⁸ The coefficient gets slightly smaller (–1.1 percent) but remains significant at the 5 percent level. Survey fatigue could affect our results if measurement errors and omissions got worse in the course of the survey, and were therefore correlated with the number of days since the distribution. We test for this potential bias by running the estimates on a sub-sample that excludes the last three days of the survey (column 3). As shown by the larger coefficient, our results do not seem to be driven by survey fatigue.¹⁹ Lastly, we propose a falsification test by conducting the same analysis on the host population sample. As host households do not receive food aid, we attribute them the date of the second day of distribution (out of three) of the closest camp and compute an artificial time interval since this distribution for the host population. Results, presented in column 4, demonstrate that the distribution cycle has no effect on the average caloric intake from cereal consumption of the host community, a population that did not receive food aid.²⁰

5.2. Effect of the distribution cycle on malnutrition

The fact that consumption responds to the timing of food distribution leads us to explore how the distribution cycle could affect short-term malnutrition. We find that the effect of time on malnutrition mimics the pattern observed in consumption. Table 9 presents ordinary least squares estimates of the effect of the number of days since the latest distribution on the MUAC-for-height z-score of under five years children. The further away from the food distribution were children measured, the more likely they were to suffer from short-term malnutrition. Each additional day since the latest distribution reduces the MUAC-for-height z-score by 0.025 standard deviations, a substantial effect considering the sixty days between two food distributions. As for consumption, the effect of time since the latest distribution is remarkably robust to the introduction of children's and household's characteristics. This result is important as it shows how consumption patterns can affect children's malnutrition in the short-run and can be seen as

¹⁸ Enumerators had a target number of questionnaires to fill per day and in total. Less productive enumerators at the beginning of the survey tried to catch up later, but they were not forced to do so. Nevertheless, the proportion of questionnaires filled by less productive enumerators may be higher in the second half of the survey. As an additional test, we run the model excluding enumerators one at a time and found no difference in the results (available upon request).

¹⁹ Additionally, there is no difference in the number of food items reported by households interviewed in the first and second half of the survey (Table 2).

²⁰ Note that distribution cycles could have affected consumption in the host community indirectly through its effect on the price and availability of cereals in the local markets.

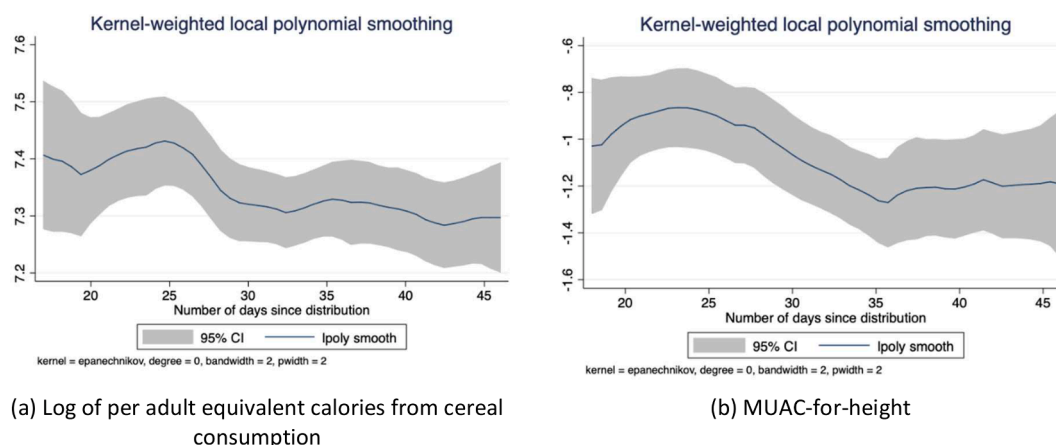


Fig. 4. Non-parametric regression of consumption and MUAC-for-height on time.

Table 8

Cereal consumption – Robustness check.

	(1)	(2)	(3)	(4)
Days since distribution	Log of per capita calories from cereal −0.014** (0.005) [0.018]	Log of per adult equivalent calories from cereal −0.011** (0.005) [0.048]	−0.020** (0.008) [0.070]	0.001 (0.020) [0.906]
Additional covariates	Yes	Yes	Yes	Yes
Consumption adjusted for adult-equivalent	No	Yes	Yes	Yes
Sample	Refugees	Refugees	Refugees	Hosts
Number of clusters	10	16	10	9
Fixed effects	Blocs	Enumerators	Blocs	Villages
Observations	846	846	663	447
R-squared	0.076	0.066	0.070	0.064

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Calories intake from cereal consumption is adjusted for adult-equivalent household size in all columns except the first one. Col. (2) displays the model estimated with enumerators fixed effects. In Col. (3) the last three days of survey are excluded from the sample. Col. (4) displays the estimates based on the host population sample (falsification test). Days and Ethnic group dummies are included in all specifications. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production.

another robustness check of the consumption cycle, anthropometric indicators being less subject to measurement errors and survey fatigue. We also note that as expected, children's age is associated with slightly better nutritional status whereas having experienced a recent illness diminishes the MUAC-for-height z-score.

Alternative specifications are presented in Table 10. First, as compared to children measured in the first half of the survey, the MUAC-for-height z-score of children measured in the second half is lower by 0.25 standard deviations, a substantial decrease for an average difference of eleven days between the visit of the two groups. The inclusion of a quadratic term provides evidence of a non-linearity in the effect of time on malnutrition, as days since distribution and its quadratic term are jointly significant (column 2). Corroborating estimates of the consumption model, this suggests that the daily rate at which the nutritional status decline over time decreases slowly over the cycle. The expected turning point is estimated at 60 days, out of the observation period. Consistently, when looking at the effect week by week (column 3), the rate at which malnutrition decreases is more pronounced between the

fourth and fifth weeks, 25 to 35 days after the distribution, as illustrated by a local polynomial smoothing (Fig. 4).

We then test the robustness of our results to alternative measures of malnutrition and specifications (Table 11). Using the raw MUAC in centimeters yields similar results: a ten-day difference in the time since the distribution is estimated to decrease the MUAC by 0.31 cm, which corresponds to 0.19 standard deviations. The alternative short-term malnutrition indicator, weight-for-height z-score, which is less sensitive to short-term changes in a child's diet, is not significantly determined by the elapsed time since the distribution (column 2). Additionally, results are robust to the use of enumerators fixed effects, though the estimate loses precision, and to survey fatigue (columns 3 and 4). As for consumption, we perform a falsification test by assigning households in the neighboring villages the date of distribution of the closest camp (column 5). Contrary to refugees, the timing of the distribution does not significantly determine the short-term nutritional status of children in the host population.

Finally, if children with poor short-term nutritional status at the time of the survey were more likely to suffer from long-term malnutrition, our results might be driven by long-term dynamics rather than being the consequence of the present household's consumption. We rule out this interpretation by implementing a second falsification test, using a long-term malnutrition indicator (height-for-age z-score) as the dependent variable. The estimated coefficient is small and non-significant (column 6), dismissing concerns about a correlation between the time variable and long-term malnutrition.

6. Discussion and policy implications

The periodic distribution of food aid received by refugee households in rural camps aimed at providing a safety net for households that rely, at least partly, on agricultural production, which follows a yearly cycle, and limited economic activities to complement it. Despite this regular food transfer, the prevalence of malnutrition remained worryingly high in camps at the time of our study, with 37.2 percent of children under five considered as stunted, a rate similar to what was observed at the end of the lean season in the rural host community whose consumption pattern is driven by the seasonality of agricultural production in the absence of assistance. The high prevalence of malnutrition in camps despite extensive assistance and food distributions has motivated this study. Our findings demonstrate that food consumption and short-term malnutrition among children under five respond to the timing of food aid delivery, questioning refugees' ability to smooth their consumption over time. Knowing that catch-up growth is limited (Hoddinott and Kinsey, 2001; Rieger and Wagner, 2014), we can expect these regular and frequent food shortage cycles to have a permanent impact on children's long-term nutritional status and health.

Table 9
Children malnutrition.

	(1)	(2)	(3)
	MUAC-for-height z-score		
Days since distribution	−0.026*** (0.005) [0.002]	−0.026*** (0.006) [0.002]	−0.025*** (0.007) [0.002]
Gender (male=1)		−0.101 (0.109)	−0.079 (0.109)
Age in months		0.004 (0.003)	0.005 (0.003)
Presently breastfed		−0.269* (0.121)	−0.267** (0.105)
Recent illness		−0.262** (0.107)	−0.249** (0.102)
Handicap		−0.840 (0.612)	−0.912 (0.640)
Household size		0.018 (0.021)	0.034 (0.023)
Share of working-age members in household		0.290	0.149
		(0.328)	(0.339)
Years in camp		0.027 (0.088)	0.011 (0.077)
Female-headed household		0.144 (0.112)	0.158 (0.133)
Age of household head		−0.001 (0.007)	−0.001 (0.007)
Education of household head		−0.112 (0.159)	−0.116 (0.152)
Wealth index (2nd quartile)			−0.298 (0.264)
Wealth index (3rd quartile)			−0.182 (0.252)
Wealth index (4th quartile)			0.019 (0.207)
Cattle ownership			−0.038 (0.046)
Cereal production (2nd quartile)			0.109 (0.134)
Cereal production (3rd quartile)			0.137 (0.112)
Cereal production (4th quartile)			0.197 (0.189)
Quantity of food aid ration received			−0.002 (0.001)
Constant	−0.254 (0.163)	−0.513 (0.621)	−0.327 (0.696)
Number of clusters	10	10	10
Observations	590	590	590
R-squared	0.017	0.079	0.099

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Days and block dummies are included in all specifications. Ethnic group dummies are included in the last two specifications.

While this study is not fit to answer the critical question of why refugee household do not smooth their food consumption between distributions, we expose potential reasons that would be worth exploring in future research. Firstly, we note that, despite humanitarian assistance, protracted refugees remain poor and vulnerable, with food aid designed to cover only about half of their individual daily needs at the time of the survey, and limited possibilities to complement food aid with other sources of income (World Bank, 2017). In the same vein, the nature of their situation in the camps, especially the uncertainties about the duration of the settlement, might also play a role by making any substantial investment in small businesses or agricultural assets insecure. In other words, evaluating their own long-term permanent income might prove to be more challenging than for households in the host community. Secondly, another aspect to keep in mind is that food aid is an in-kind transfer which is perishable and can lose its value over time. Households might also anticipate the risk of being stolen, being asked by neighbors for support, or intra-household competition for resources.

Table 10
Children malnutrition – Alternative specifications.

	(1)	(2)	(3)
	MUAC-for-height z-score		
2nd half of the survey	−0.249*** (0.059) [0.002]		
Days since distribution		−0.053 (0.043) [0.222]	
Days since distribution – Squared (÷100)		0.044 (0.068) [0.486]	
Week 4			−0.102 (0.143) [0.586]
Week 5			−0.327** (0.131) [0.112]
Week 6			−0.484** (0.172) [0.084]
Week 7			−0.640*** (0.183) [0.040]
Additional covariates	Yes	Yes	Yes
Number of clusters	10	10	10
Observations	590	590	590
R-squared	0.095	0.099	0.100
Joint significance test on the time variables (p-value)		0.020	0.007

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Clustered standard errors are in parentheses. Days and Ethnic group dummies are included in all specifications. Additional covariates include gender, age in months, recent illness, handicap, breastfeeding, household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production. In column (3), the third week after the distribution is used as the reference.

Refugee decision makers may respond to those risks by consuming more at the beginning of the period to ‘store’ food that would otherwise be lost. In that regard, the high propensity of households selling their ration (55 percent) may be interpreted as way to protect against such risks. Lastly, despite the periodic delivery of food aid, the absence of proper credit market and lack of durable goods to sell likely limit the possibility for refugee to smooth consumption when they experience a negative shock.

Our analysis does not go without limitations. Firstly, the survey took place within a two months’ interval between distributions after several one-month periods. Our results could, therefore, be interpreted as the transition from a one-month period to a two-month period, with households having temporary trouble adjusting for the new frequency. Even though we cannot rule out this assumption entirely as we only observe the situation within a single period identical to every household, it should be noticed that refugees in the three camps had already experienced rations calibrated to cover two months of consumption. In addition, with the planning being mainly driven by logistical issues and prices fluctuations on the global cereal market, the composition of the ration and the frequency of the distribution often varied in the previous years. A second limitation is that the time frame of the study does not include the consumption pattern around the day of the distribution, the expected peak observed in Stephens (2003, 2006) and Shapiro (2005). Further studies relying on panel data and other experiments such as Aguila et al. (2017) could investigate the dynamics of refugee recovery and their consumption behavior under different time intervals between distributions. Thirdly, as households receive the same amount of food aid per capita, we cannot properly distinguish between the effect of hyperbolic preferences and the effect of sub-optimal ration quantities on the inability to smooth food consumption. In other words, it is unclear to

Table 11
Children malnutrition – Robustness checks.

	MUAC in centimeters	Weight-for-height z-score	MUAC-for-height z-score		Height-for-age z-score	
Days since distribution	−0.031 *** (0.008) [0.022]	0.012 (0.009) [0.296]	−0.025 (0.016) [0.172]	−0.023 ** (0.009) [0.066]	0.046 (0.031) [0.106]	−0.005 (0.011) [0.680]
Additional covariates	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Refugees	Refugees	Refugees	Refugees	Hosts	Refugees
Number of clusters	10	10	16	10	9	10
Observations	611	576	590	493	364	594
R-squared	0.253	0.063	0.104	0.099	0.109	0.058

Notes: significant at 10%, significant at 5%, significant at 1%. Clustered standard errors are in parentheses. Col. (1) and (2) respectively presents the results for the raw MUAC measurement in centimeters and Weight-for-height z-scores. Col. (3) displays the model estimated with enumerators fixed effects. In Col. (4) the last three days of survey are excluded from the sample. Col. (5) displays the estimates based on the host population sample (falsification test). Col. (6) presents the results for the Height-for-age z-scores. Days and Ethnic group dummies are included in all specifications. Additional covariates include gender, age in months, recent illness, handicap, breastfeeding, household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production.

what extent increasing frequency would improve the welfare of the most vulnerable households without an increase of the ration quantity. Nevertheless, the absence of heterogeneity by household's wealth in the effect of time on consumption implies that the inability to smooth consumption is prevalent throughout the welfare distribution. Finally, we cannot rule out that the uncertainty regarding the exact distribution date or the content of the ration for the next could also shape the consumption profile over the cycle. For households who would like to minimize the risk of food shortage at the end of the cycle, a rational response to uncertainty would be to save food by consuming less over the cycle.

Despite these acknowledged limitations, the findings of this study have important implications and argue for a set of policy recommendations. While the results of this study are tied to the specific context of protracted refugees in managed camps, they nevertheless shed light on the impact of social assistance on household consumption and highlight the need to design cash and in-kind transfer programs carefully. Echoing [Aguila et al. \(2017\)](#), a first recommendation is to increase the frequency of food aid delivery to help household to smooth their consumption. A shorter interval between ration distributions makes the food stock management easier and would reduce the maximum duration of potential food shortage and its detrimental effect on child nutrition. As the logistical implication of such a change may be a critical constraint, switching to a voucher strategy could relieve the pressure on the delivery date. Nevertheless, the impact of the timing of the distribution should not overshadow the fact that the level of food aid may be inappropriate for the most vulnerable, as reflected by prevalence of malnutrition and low level of caloric intake per person. As our findings suggest a large dependency on food aid, the main challenge remains to support self-sufficiency and livelihoods strategies in the medium to long term by promoting integration in the economic network of host communities and sustainable agricultural practices. Thirdly, failure to smooth consumption is often associated with limited access to the credit market. The higher occurrence of borrowing in the two months prior to the survey, mainly for food, among the refugee population is consistent with this interpretation of our results. Better access to credit and the guarantee of future aid could help households better manage their resources over time.

7. Concluding remarks

This analysis aimed at investigating the consumption patterns of refugee households and test their ability to smooth consumption between distributions of food aid. Consistent with studies set in high-income countries ([Stephens, 2003, 2006](#); [Shapiro, 2005](#); [Mastrobuoni](#)

and [Weinberg, 2009](#); [Hastings and Washington, 2010](#); [Todd and Gregory, 2018](#)), our results indicate that the average household consumption declines at the rate of 1.1 to 1.5 percent per day, demonstrating that consumption responds to the timing of the distribution, in contradiction to the permanent income hypothesis. Instead, this consumption pattern is consistent with hyperbolic preferences ([Laibson, 1997](#); [O'Donoghue and Rabin, 1999](#); [Frederick et al., 2002](#)). For households that are highly dependent on food aid, we argue that this can lead to frequent food shortage at the end of each distribution cycle when households cannot make ends meet, with detrimental consequences on children's malnutrition. Indeed, we observe a similar cyclic pattern in short-term nutritional status of children under five, as the MUAC-for-height z-score decreases by 0.024 standard deviations per day between two distributions. These findings highlight the importance of taking the frequency of transfer delivery into account, the need for reducing uncertainties around food distributions and for strengthening access to credit to diversify consumption smoothing tools.

CRedit authorship contribution statement

Frederic Aubery: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.
Marie-Charlotte Buisson: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1

Mean-comparison test between households who ate cereals and those who did not.

	Households who ate cereals	Households who did not eat cereals	Difference
	(a)	(b)	(a-b)
Number of days since distribution	32.0	29.6	2.403***
Household size	6.09	5.24	0.854**
<i>Household size by age categories</i>			
•Number [0–4] years old	0.85	0.98	–0.129
•Number [5–16] years old	2.80	2.04	0.763***
•Number [16+] years old	2.36	2.06	0.299**
Share of working-age members in household	0.49	0.52	–0.038
Quantity of food ration received	70.0	64.9	5.151
Years in camp	5.04	5.38	–0.347*
Female-headed household	0.45	0.46	–0.009
Age of household head	40.8	41.4	–0.575
Education of household head	0.32	0.46	–0.140**
Wealth index (standardized)	0.05	–0.47	0.514**
•Wealth index (poorest households)	0.24	0.33	–0.090*
•Wealth index (2nd quartile)	0.25	0.26	–0.008
•Wealth index (3rd quartile)	0.25	0.20	0.054
•Wealth index (richest households)	0.25	0.21	0.044
Cattle ownership	0.42	0.36	0.058
Cereal production	350.4	277.5	72.888
<i>Ethnicity of household head</i>			
•Arab	0.21	0.07	0.132***
•Fulbe	0.34	0.09	0.256***
•Kaba	0.30	0.61	–0.303***
•Mbaye	0.10	0.16	–0.060*
<i>Day of the week interview took place</i>			
•Monday	0.15	0.12	0.025
•Tuesday	0.13	0.07	0.053
•Wednesday	0.14	0.19	–0.044
•Thursday	0.15	0.17	–0.026
•Friday	0.18	0.22	–0.047
•Saturday	0.15	0.19	–0.035
<i>Camp</i>			
•Amboko	0.33	0.38	–0.055
•Gondje	0.32	0.43	–0.113**
•Dosseye	0.35	0.19	0.168***
Cereals producers	0.65	0.68	–0.025
Income generating activity	0.46	0.37	0.089
Obs.	867	81	

Table A2

Mean-comparison test between households who ate cereals and those who did not.

	Households who ate cereals	Households who did not eat cereals	Difference	Households who did not eat cereals	Difference
	(a)	(b)	(a-b)	(c)	(a-c)
Animal products	0.240	0.074	0.166***	0.100	0.140**
•Meat	0.128	0.049	0.079**	0.067	0.061
•Fish	0.121	0.037	0.084**	0.050	0.071*
Vegetables and fruits	0.857	0.568	0.289***	0.767	0.090*
•Tomatoes	0.083	0.037	0.046	0.050	0.033
•Gombo	0.481	0.148	0.333***	0.200	0.281***
•Sorrel	0.151	0.062	0.089**	0.083	0.068
•Molokhia	0.138	0.025	0.114***	0.033	0.105**
•Onions	0.292	0.111	0.181***	0.150	0.142**
•Melon	0.122	0.309	–0.186***	0.417	–0.294***
•Nere	0.138	0.062	0.077*	0.083	0.055
Pulses and tubers	0.241	0.222	0.019	0.300	–0.059
•Cassava	0.023	0.111	–0.088***	0.150	–0.127***
•Sweet Potatoes	0.045	0.025	0.02	0.033	0.012
•Ground nuts	0.270	0.309	–0.039	0.417	–0.147**
Oil	0.814	0.259	0.555***	0.350	0.464***
•Cooking oil	0.624	0.173	0.451***	0.233	0.391***
•Karite oil	0.219	0.111	0.108**	0.150	0.069
Milk	0.033	0.012	0.021	0.017	0.017
Sugar	0.313	0.185	0.127**	0.250	0.063
Melon, cassava, and groundnuts	0.363			0.767	–0.403***
Observations	867	81		60	

Note: In column (c), households who reported no consumption at all are excluded.

Table A3

Correlation between anthropometric measures.

	MUAC-for-height z-score	MUAC (in cm)	Weight-for-height z-score
MUAC (in cm)	0.9126***		
Weight-for-height z-score	0.4735***	0.3675***	
Height-for-age z-score	0.0369	0.184***	−0.1599***

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %.

Table A4

Consumption from each food group over the distribution cycle.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Food groups	Cereals	Animal products	Vegetables and fruits	Pulses, tubers	Sugar	Oil	Milk
Panel A: Percent of households reporting eating items from this food category							
First half of the survey (a)	0.906	0.221	0.818	0.242	0.322	0.783	0.041
Second half of the survey (b)	0.923	0.230	0.846	0.237	0.282	0.751	0.023
Difference (b-a)	0.018	0.009	0.029	−0.006	−0.04	−0.032	−0.018
Panel B: OLS							
Days since distribution	0.0021 (0.0017)	−0.0018 (0.0023)	0.0049** (0.0021)	0.0035 (0.0028)	−0.0059** (0.0027)	−0.0047* (0.0024)	−0.0016* (0.0007)
Observations	948	948	948	948	948	948	948

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %. Panel A displays mean-comparison tests between households interviewed in the first and second half of the survey. Panel B displays results from OLS regressions. The dependent variables take the value 1 if the reported consumption of any item of a food group is positive, and 0 otherwise. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Days and Ethnic group dummies are included in all specifications. Fixed effects at the block level. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production.

Table A5

Consumption from all food items – Alternative specifications.

	(1)	(2)	(3)
Log of per adult equivalent calories intake from all food items			
2nd half of the survey	−0.108 (0.066) [0.146]		
Days since distribution		−0.047 (0.044) [0.416]	
Days since distribution – Squared (÷100)		0.057 (0.067) [0.464]	
Week 4			0.116 (0.210) [0.724]
Week 5			−0.080 (0.199) [0.726]
Week 6			−0.103 (0.214) [0.718]
Week 7			−0.052 (0.199) [0.824]
Additional covariates	Yes	Yes	Yes
Number of clusters	10	10	10
Observations	908	908	908
R-squared	0.072	0.075	0.076
Joint significance test on the time variables (p-value)		0.166	0.055

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Calories intake from all food items is adjusted for adult- equivalent household size. Days and Ethnic group dummies are included in all specifications. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production. In column (3), the third week after the distribution is used as the reference.

Table A6

Consumption from all food items – Robustness checks.

	(1)	(2)	(3)
	Log of per capita calories from all food items	Log of per adult equivalent calories from all food items	
Days since distribution	−0.011* (0.005) [0.116]	−0.007 (0.006) [0.206]	−0.010 (0.010) [0.440]
Additional covariates	Yes	Yes	Yes
Consumption adjusted for adult-equivalent	No	Yes	Yes
Sample	Refugees	Refugees	Refugees
Number of clusters	10	16	10
Fixed effects	Blocs	Enumerators	Blocs
Observations	908	908	710
R-squared	0.095	0.060	0.062

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %. Clustered standard errors are in parentheses. Wild bootstrap p-values in brackets. Calories intake from consumption of all food items is adjusted for adult-equivalent household size in all columns except the first one. Col. (2) displays the model estimated with enumerators fixed effects. In Col. (3) the last three days of survey are excluded from the sample. Days and Ethnic group dummies are included in all specifications. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, a wealth index, cattle ownership, and cereal production.

Table A7

Consumption model – Interaction between days since distribution and wealth.

	(1)	(2)
	<i>Log of per adult equivalent calories</i>	
	From cereals	From all food items
Days since distribution	−0.015*** (0.004)	−0.011* (0.006)
Wealth index	0.021 (0.035)	−0.021 (0.049)
Days since distribution * wealth index	−0.000 (0.001)	0.001 (0.001)
Observations	846	908
R-squared	0.065	0.070
Number of clusters	10	10

Notes: * significant at 10 %, ** significant at 5 %, *** significant at 1 %. Clustered standard errors are in parentheses. Days and block dummies are included in all specifications. Days and Ethnic group dummies are included in all specifications. Additional covariates include household size, the share of working-age members, quantity of food aid received, number of years in camp, gender, age and education of household head, cattle ownership, and cereal production.

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