Migration and Nutrition of The Left-Behind Individuals: Evidence from Ghana*

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Abstract

This paper investigates the disruptive effect of migration on the nutritional outcomes of the left behind—individuals who previously cohabited with a migrant. Drawing on data from Ghana, I find that internal migration leads to reduced body weight in left-behind adults and lower BMI-for-age z-scores in left-behind children. However, a decrease in adult body weight does not necessarily indicate a deterioration in overall nutritional health. On the other hand, the decline in children's BMI-for-age z-score indicates an evident degradation in their nutritional status, which could have lasting effects on their growth trajectories. Although remittances may not consistently mitigate these adverse effects, they can potentially yield a beneficial influence in the long run, especially for left-behind children. The main channel underlying the adverse nutritional impact on left-behind children is the short-term disruptive effect caused by migration, often leading to a negative income shock.

Keywords: Migration, Nutrition, Left-behind, Ghana

JEL Codes: I14, I15, J61, O12, O15

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1 Introduction

Migration is a phenomenon that affects those who migrate, the communities they move to, and those who stay behind. The individuals who remain in the household of origin after one of their members emigrates are often referred to as left-behind individuals (Nguyen et al., 2006; Antman, 2013; Démurger, 2015). In recent decades, there has been substantial interest in the implications of migration on the health and nutrition of left-behind individuals, with findings showing mixed results (see, for instance, Gibson et al. (2011a); Carletto et al. (2011); De Brauw (2011); Böhme et al. (2015); De Brauw and Mu (2015)). While the primary motivation for migration often revolves around better income prospects (Kennan and Walker, 2011), it also serves as a strategy to diversify risks and elevate household welfare (Stark and Bloom, 1985). It is also undertaken to improve the overall living conditions of the household through income and to finance consumption, mainly through remittances (Stark and Lucas, 1988). The anticipated outcome is that migration should enhance the nutrition of left-behind individuals, especially with the additional income and remittances that positively impact the quality and quantity of food consumed (De Brauw and Mu, 2011). However, migration's disruptive nature can also usher in adverse effects. For instance, the absence of a primary caregiver can lead to children experiencing poorer dietary habits (Démurger, 2015). This open-ended issue is also observed in the literature. Indeed, despite the extensive studies on this topic, there has been no definitive evidence on the direction of the impact of migration on the nutrition of left-behind individuals (Thow et al., 2016; Fellmeth et al., 2018).

Studying the effect of migration on the outcomes of left-behind individuals is a complex issue fraught with multiple threats and challenges. Foremost, migration decisions are typically non-random, introducing substantial concerns related to reverse causality and selection bias (Antman, 2013; Gibson et al., 2013). This selection can manifest both inter-household, relating to the household's collective choice to send a migrant, and intra-household, determining which household member migrates (Murard, 2019). Other potential threats to consider include endogeneity, which can arise when unaccounted-for variables are correlated with both the decision to migrate and the outcomes of those left behind. Furthermore, endogeneity can result from reverse causality. For example, deteriorating health conditions within a household can act as a migration catalyst rather than migration influencing the health of the left behind. Given these potential issues that can emerge, it is difficult to find reliable results on the impact of migration on left-behind individuals compared to non-left-behind individuals.

To address these challenges, I adopt an approach using panel data. I utilize two survey waves of the Ghana Socioeconomic Panel Survey (GSPS) spanning 2013/2014 to 2017/2018. I employ a combination of a kernel matching procedure and the difference-in-differences (DID) method to establish two comparable groups: individuals who are left behind and those who are not. This approach enables me to address selection bias comprehensively. Matching helps control for selection bias related to observable factors, while the DID model allows me to account for this bias concerning unobservable factors. This empirical strategy significantly enhances the robustness of my findings, setting them apart from much of the existing literature.

This paper aims to identify the impact of internal migration on the nutritional status of adults and children left behind. In brief, I seek to answer the following questions: (1) Does migration have negative or positive effects on the nutrition of the individuals left behind? (2) Can these effects differ by age, gender, or nutritional status? (3) What are the transmission channels and the mechanisms involved?

Utilizing the context of Ghana, predominantly characterized by internal migration, I find that an individual's migration for work-related reasons adversely affects the nutritional status of those left behind. Adults experience a decline in body weight and children a decrease in their BMI-for-age z-score. These negative effects are heterogeneous, affecting some individuals more significantly. Notably, the most considerable weight loss is observed among men and adults who have a healthy nutritional status, while girls and overweight or obese children experience the most substantial decrease in z-score. By deepening the channels and studying the simultaneous effect of sending a migrant between the two survey waves and receiving remittances, I do not identify a positive impact of receiving remittances that could offset the decline in adults' weight. However, it appears that the most vulnerable children suffer less when households, besides having a migrant member, also receive remittances. Moreover, solely receiving remittances, probably from migrants absent for a longer duration, tends to have a favorable long-term impact on children's nutrition.

Nevertheless, the primary channel explaining the findings is the disruptive effect of internal labor migration. Essentially, I am most likely capturing the short-term effect, i.e., the impact of the onset of migration that adversely affects the nutritional status of the left behind. The migration process entails significant costs, not only in financing the migrant's journey but also in terms of the loss of their contribution to household income. In the context of Ghana, migrants are predominantly internal migrants within the country. Therefore, the financial burden on the household of origin is generally lower compared to international migration and it is likely that the negative impact stems primarily from the loss of the migrant's previous economic contribution to their household. Consequently, the departure of the migrant might result in a negative income shock. This adverse income shock, while having a somewhat moderate effect on adults' weight, has a profoundly detrimental impact on children's nutritional status. Furthermore, even though I find a positive long-term impact of remittances on children, this short-term negative effect could cast a long-lasting shadow, affecting the enduring nutritional health and growth of children who are less resilient compared to adults.

I make four distinct contributions to the extant literature. First, I seek to reconcile the mixed results found in the literature by placing a strong emphasis on understanding the mechanisms and the temporality of the effects. I contribute to the existing literature that investigates the transmission channels through which migration can impact the nutrition of left-behind individuals (see, for instance, De Brauw and Mu (2011); De Brauw (2011); Carletto et al. (2011); De Brauw and Mu (2015); Davis and Brazil (2016); Viet Nguyen (2016)). In particular, I delve into the influence of the remittances channel, aligning with prior work like Davis and Brazil (2016) and Vikram (2023), among others. Simultaneously, I explore other potential transmission channels, focusing on migration's disruptive effect. Hence, a key contribution is to comprehend the rationales behind the diverse and inconsistent effects documented in the existing literature. My findings suggest a short-term disruptive effect primarily through the negative income shock channel. However, in the long term, via the remittances channel, I also uncover the potential for positive effects of migration for children. This underscores the importance of considering the temporal dimension when studying the effects of migration. Some studies may not be incorrect in their findings, but the observed outcomes may be contingent on the specific time frame under examination. This nuanced perspective contributes to a more comprehensive understanding of migration's impact on nutrition.

Second, to fill the gaps in this strand of the literature, I not only focus on left-behind adults (Gibson et al., 2011b; Böhme et al., 2015; Liu et al., 2021; Sznajder et al., 2021; Wei, 2022) or on left-behind children (Antón, 2010; Gao et al., 2010; Carletto et al., 2011; De Brauw, 2011; De Brauw and Mu, 2011, 2015; Davis and Brazil, 2016; Viet Nguyen, 2016; Vikram, 2023) but on all household members. I also study the impact of migration by differentiating the effects according to gender and nutritional status (underweight, healthy, and overweight/obese). Furthermore, I delve into the impact of parental migration to gain a deeper understanding of the effect of migration on children left behind. Thus, this paper contributes to the literature on migration's impact on the health and nutrition of all left-behinds, investigating the results' heterogeneity.

Third, from a methodological perspective, while many prior studies rely on cross-sectional data (Antón, 2010; Carletto et al., 2011; Gibson et al., 2011b; Böhme et al., 2015; Davis and Brazil, 2016; Sznajder et al., 2021), I capitalize on the advantages of panel data to better address household-level selection bias. I also address the question of selection bias at the intra-household level, that is, who within the migrant household will be selected to migrate. I ascertain the absence of intra-household selection bias by confirming that there are no significant differences in anthropometric indicators between migrants and non-migrants, a step not commonly undertaken in the literature.

Finally, differently from other studies, this issue has not been extensively studied in sub-Saharan Africa and even less so in Ghana, as many focus on Asia (Gao et al., 2010; De Brauw, 2011; De Brauw and Mu, 2011, 2015; Viet Nguyen, 2016; Lei et al., 2018; Liu et al., 2021; Sznajder et al., 2021; Vikram, 2023) or Latin America (Antón, 2010; Carletto et al., 2011; De Brauw, 2011; Davis and Brazil, 2016).[1]

The remainder of the paper is structured as follows. Section 2 reviews the existing literature. Section 3 introduces the data. Section 4 presents the empirical strategy and Section 5 reviews the results. Section 6 discusses the remaining threats and explores some robustness and heterogeneity checks. A discussion of the results and transmission channels is presented in Section 7. Finally, Section 8 draws the main conclusions.

2 The diverse nutritional effects of migration

2.1 Migration and left-behind individuals

Existing literature primarily investigates the nutritional outcomes for children left behind while their parents migrate, revealing mixed results. A review by Zezza et al. (2011) focusing on different types of migration, including internal and international migration, reports an overall improvement in nutritional indicators for children and individuals following the migration of one family member. In Guatemala, Carletto et al. (2011) identify better height-for-age z-scores (HAZ) in children from international migrant households. Similarly, research by Vikram (2023) in India associates paternal internal migration with

[1]Only Karamba et al. (2011) have studied the impact of migration on household-level food consumption patterns in Ghana and do not address the individual (anthropometric) dimension.

improved HAZ in boys, though it adversely affects girls. In El Salvador, De Brauw (2011) notices that children in international migrant households experience much less decline in HAZ. In the context of Mexico, Hildebrandt et al. (2005) observe that children in households with migrants who went to the United States are less likely to be underweight than those in non-migrant households. Nonetheless, the literature is far from unanimous, as other studies argue that migration has positive effects on some nutritional indicators but little or no effect on others. De Brauw and Mu (2015) find that while weight-for-age z-scores (WAZ) improve following parental migration within the country, there is negligible impact on long-term nutritional indicators like HAZ. Antón (2010) corroborates these mixed outcomes, reporting improvements in WAZ and WHZ z-scores due to remittance income in Ecuador, but not in HAZ. De Brauw and Mu (2011) note that older children are more likely to be underweight in households where a parent migrates internally, but this result does not hold if a non-parent migrates. A recent review by Fellmeth et al. (2018) confirms that children in migrant households face elevated risks of wasting and stunting and have worse nutrition outcomes in general relative to their non-migrant counterparts.

Regarding the effects of migration on adults and older people, the literature is growing but remains scarcer than on children and does not concur on an explicit impact. Gibson et al. (2011b) find that in Tonga, international migration has no significant impact on the health and anthropometry of adults and older individuals left behind. Recent studies from Bangladesh and China echo this inconsistency: Sznajder et al. (2021) observe that internal and international migrant wives are less likely to be underweight but more likely to have adiposity, while Wei (2022) notes that internal migration increases the total calorie consumption of rural elders left behind, albeit without diversifying their diets. Conversely, Böhme et al. (2015) discover health improvements among the elderly left behind by international migrants in Moldova, and Liu et al. (2021) find that internal migration positively influences the nutritional status of elderly parents in China. In summary, extant literature presents an inconclusive portrait of migration's impact on the nutrition of those left behind, irrespective of age group.

2.2 Transmission channels

The most direct channel through which migration can impact the nutrition of individuals left behind is the income channel or remittance channel. Migrants are expected to send remittances, which are supposed to increase the household's available income, alleviate budgetary constraints, and increase food expenditures. Hence, the additional income should increase the quantity and/or the quality of the food consumed (De Brauw and Mu, 2011). Empirical studies corroborate this; for example, the work of De Brauw (2011) suggests a positive correlation between migration and the HAZ of children left behind, an effect likely drawn by international remittances. Similarly, Vikram (2023) highlights the role of internal transfers in improving HAZ scores among boys in Indian households, while Quartey (2006) emphasizes the critical importance of international transfers for maintaining the consumption and immediate needs of the poorest households in Ghana. By reviewing the literature, Thow et al. (2016) also report that remittances (both from domestic and international sources) favor positive effects on the nutrition of left-behind individuals. Based on this channel, migration should positively impact nutrition. However, some studies find no impact of international remittances (Ponce et al., 2011). Finally, remittances can also have indirect adverse impacts. For instance, higher income may lead to a shift in dietary structure toward higher energy and fat intake and increased consumption of meat and processed foods, leading to obesity (Guo et al., 2000). Regarding the sources of remittances, Smith and Floro (2021) demonstrate that domestic and international remittances reduce food insecurity in low- and middle-income countries. However, the impact of international remittances is significantly greater than domestic remittances.

Nevertheless, the income channel through remittances represents one among multiple mechanisms that interact to shape the nutritional outcomes of left-behind individuals. Indeed, several channels have been identified (for a detailed summary, see Zezza et al. (2011)). Carletto et al. (2011) argue that international remittances can improve child growth but are also related to a combination of different effects. For instance, there is evidence that parental migration harms child nutrition due to their absence (Gao et al., 2010; Lei et al., 2018). As a result, migration can lead to a disruptive effect on the household of origin. After migration, the household may be disorganized for a short period. Until the migrant finds a job, the household loses a working-age individual to support the family. This loss of income can harm the nutrition of those left behind. The effect can be even more significant for children, as this period coincides with their development's critical phase (Davis and Brazil, 2016). The net effect of migration thus hinges on whether the income generated from remittances can sufficiently offset the loss of labor and any increase in household expenses (Adams et al., 2008; Karamba et al., 2011).

Other channels may also have unintended consequences. One such channel is the reduction in parental oversight over children's dietary habits due to the absence of the migrant parent (De Brauw and Mu, 2015). This time effect supposes that parental absence may result in less time spent monitoring children's eating habits, adversely affecting their nutrition. Using multi-country data, Viet Nguyen (2016) conclude that parental migration implies a low frequency of contact and less care for children, which is detrimental to their nutrition. Finally, De Brauw and Mu (2015) define another channel as changes in the structure of intrahousehold bargaining and cooperation. For instance, the emigration of a male head of the household may elevate the wife to this role, and given that female household heads are generally more attentive to child nutrition (Kennedy and Peters, 1992), this shift could lead to improved nutritional outcomes. To summarize, there are multiple channels through which migration can affect the nutrition of the left behind. Some channels may have positive effects (the income effect), others may have detrimental effects (the disruption effect or time effect), and others may have undetermined effects (the impact on household structure). Therefore, the impact of migration on the nutrition of left-behind individuals remains an empirical question, characterized by an uncertain direction and context-dependence.

3 Data

3.1 Migration in Ghana

Over the last two decades, Ghana has experienced a significant rise in internal migration, with internal moves accounting for more than 90% of all migration (Ghana Statistical Service, 2013). Predominantly, these internal migrations are long-distance, with individuals relocating between regions rather than within them (International Organization for Migration, 2020). In addition, about 35% of the 2010 population census had moved from their place of birth to another location in the country (Ghana Statistical Service, 2013). Therefore, Ghana offers a pertinent context for analyzing the impact of migration, with a specific focus on internal migration. The patterns captured in the data corroborate these observations. As illustrated in Figure A.1, the vast majority of labor migration occurs within Ghana, with 59% of migrants moving to a region different from their origin. Further, as depicted in the final two figures of Appendix A, most of the work-related migrations for more than six months involve regional relocations.[2] Although migrants originate from diverse regions across Ghana (Figure A.2), a substantial proportion, exceeding 56%, choose the Accra (around 36%) or Ashanti (about 20%) regions as their destinations (Figure A.3).

[2]Migration is defined as moving outside the household and looking for a job for more than six months. For more details, see Section 3.3.2.

3.2 Ghana Socioeconomic Panel Survey Data (GSPS)

This study draws data from the last two waves of surveys from the EGC-ISSER Socioeconomic Panel Survey, also known as the Ghana Socioeconomic Panel Survey Data (GSPS). The last two waves were conducted between 2013/2014 and 2017/2018.[3] The survey's main objective is to provide a framework to study the medium- and long-term economic development processes. The survey is based on a nationally representative sample for the ten regions of Ghana, initially covering 5,010 households from 334 Enumeration Areas (EAs) selected from a master sampling frame. The sample was ensured to be representative by a two-stage stratified sample design.

The sample is restricted to individuals present in wave 2 (2013/2014) and wave 3 (2017/2018), those who did not exit a household, and those in households that did not dissolve. As I compare those left behind to those not, I do not consider new household members in wave 3. Therefore, the sample includes individuals who remained in the same household and were successfully interviewed between the two survey waves (n = 11,945). Given that I use two different outcomes for adults and children (weight and BMI-for-age), I consider individuals who were already adults in wave 2 and children who did not become adults between the two waves (556 individuals concerned, n = 11,389). Children under two are omitted as measurements are less trustworthy among this age group (518 individuals concerned, n = 10,871). I also drop pregnant women considering the weight variation during pregnancy (267 women concerned, n = 10,604). Observations with implausible information on anthropometry during at least one wave have been deleted (888 individuals concerned, n = 9,716). In the same way, observations with missing values on anthropometry during at least one wave have been deleted (1,422 individuals concerned, n = 8,294). In most cases, the missing data were due to the individual being away from home during the interview or not wanting their data to be collected.[4] Dropping these observations to build a balanced panel should not affect the results.[5] Other observations were missing for some variables and deleted (935 individuals concerned, n = 7,359).[6] I opted for a complete case analysis

[3]The GSPS is implemented by Yale University's Economic Growth Center (ECG) and the Institute of Statistical, Social and Economic Research (ISSER). Three waves are publicly available at: `https://egc.yale.edu/data/egc-isser-northwestern-ghana-panel-survey`. Last accessed: 13 September 2022.

[4]In wave 2, about 42% of the individuals who were not measured were not at home at the time of the interview (57% in wave 3) and around 35% were unwilling to be measured (19% in wave 3).

[5]I analyzed the mean values of weight and BMI-for-age for the two survey waves. The results are very similar in the balanced and unbalanced samples.

[6]I compared the mean values of all variables in the balanced and unbalanced samples. These are similar.

rather than an available case analysis to compare different samples easily. Moreover, given the different heterogeneities I seek to observe, it is more appropriate to use comparable samples. Finally, the resulting balanced sample includes 7,359 individuals (4,579 adults and 2,780 children) spread over two waves, corresponding to 14,718 observations (9,158 observations for adults and 5,560 for children).

3.3 Variables

3.3.1 Anthropometric measures

I determine the nutritional status of individuals with anthropometric measurements. For children (between 2 and 18 years old), I use BMI-for-age z-scores. I categorized children into nutritional statuses: underweight when z-score $<$ -2 SD, healthy if z-score $\geq$ -2 SD and $\leq$ 1 SD, and overweight/obese when z-score $>$ 1 SD (WHO, 2006). For adults (from 19 years old), I use the body weight (in kilograms). I use weight over BMI as a weight change is easier to interpret. However, I use BMI to classify individuals according to their nutritional status. The thresholds are: underweight for BMI $<$18.5 kg/m^2; healthy if BMI $\geq$ 18.5 kg/m^2 and $<$ 25 kg/m^2; and overweight/obese for BMI $\geq$ 25 kg/m^2 (WHO, 1995).

3.3.2 Migration and left-behind individuals

The literature lacks a universally accepted definition for left-behind individuals. It commonly revolves around those who continue to reside in their original household after one of its members has emigrated, i.e., based on past co-residence with a migrant. In the questionnaire, I use the following questions: "What is the main reason [Name] is no longer considered a member of this household?" and "For how long has [Name] not been a member of this household?".[7]

Using these questions, I define two groups: left-behind individuals (the treatment group) and non-left-behind individuals (the control group). The treatment group consists of those residing in households where, between the second and third survey waves, one or more members have migrated outside the household looking for work and have been away for more than six months.[8] This focus on migrants absent for over six months is due to two

[7]These questions appear in Section 1: Household Background, Part B2: Household Roster.

[8]The average number of individuals per household who have been away looking for work for more than six months is approximately one individual (1.2 migrants per household). While most migrants are over 15 in wave 2, i.e., before their migration (85.47%), migrants under 15 are also included. It is challenging to ascertain the age of migrants at the time of their migration, as the available data do not provide the exact

considerations: first, it is improbable that migration of a lesser duration would substantially influence the nutritional status of those left behind, and second, with this time frame, I can partially overlook seasonal migration, which typically lasts less than six months.

In contrast, the control group comprises individuals who remained in the same household between the second and third survey waves without any household member leaving for work for more than six months. As indicated in Figure A.1, among labor migrants, 5.49% move abroad, 59.02% relocate outside their origin region, and 35.49% migrate within their origin region. I deliberately include all destinations of migration, encompassing international movements. Nonetheless, as previous figures suggest, the findings predominantly reflect internal migration.[9]

3.4 Descriptive statistics

Tables 1 and 2 show descriptive statistics at baseline (in wave 2), i.e., before a migration occurs in wave 3.[10] The statistics are stratified by migration status, which means splitting the sample between left-behind and non-left-behind individuals.[11] Left-behind adults represent 10.30% of all adults and left-behind children represent 11.30% of all children. Left-behind adults are slightly older and are mostly women. There are no significant differences between left-behind and non-left-behind children for BMI-for-age z-scores, age, and gender. The household heads of left-behind individuals are older and less educated than non-left-behinds. Concerning household characteristics, migrant households have more individuals and working-age members but also fewer dependent individuals. Households with migrants are more likely to live in rural areas. According to the wealth index, they also tend to be less wealthy. Consequently, there are already differences at baseline between left-behind and non-left-behind individuals, both for adults and children. It must, therefore, be considered in the empirical strategy.

migration dates. However, given that there is approximately a 3 to 4-year gap between waves 2 and 3, we can infer that children older than 12 were about 15 years old at the time of their migration. In this case, more than 89.75% of migrants are over 15 at the time of their migration. Results excluding left behind from migrants under 15 in wave 2 are available in Appendix H.8. The findings remain consistent.

[9] The robustness of this approach is ensured by checking the results for internal migration within Ghana only. For a detailed robustness check pertaining exclusively to internal migration in Ghana, see Section 6.2.1.

[10] In Appendix C, two additional tables display the descriptive statistics for both rounds of surveys (Tables C.1 and C.2).

[11] A table of descriptive statistics for the total sample at baseline and without stratification by migration status is available in Appendix C (Table C.3).

Table 1: Descriptive statistics of adults by migration status in wave 2

	Adults				
	Non Left Behind		Left Behind		*t*-test
	Mean	(SD)	Mean	(SD)	*P*-value
Individual variables					
Weight	62.951	(13.236)	61.136	(14.008)	0.005
Age	45.544	(15.675)	48.417	(15.418)	0.000
Male	0.463	(0.499)	0.394	(0.489)	0.004
Relationship to the head					
Head	0.623	(0.485)	0.464	(0.499)	0.000
Spouse	0.268	(0.443)	0.360	(0.480)	0.000
Child	0.082	(0.275)	0.132	(0.339)	0.000
Grandchild	0.007	(0.081)	0.011	(0.103)	0.316
Other relationship	0.020	(0.141)	0.034	(0.182)	0.051
Household head variables					
Age of the head	50.825	(15.256)	56.834	(12.882)	0.000
Male head	0.732	(0.443)	0.772	(0.420)	0.058
Education of the head					
Head, none or preschool	0.350	(0.477)	0.504	(0.501)	0.000
Head, primary education	0.154	(0.361)	0.102	(0.303)	0.003
Head, post-primary education	0.350	(0.477)	0.304	(0.461)	0.047
Head, secondary education	0.084	(0.278)	0.028	(0.164)	0.000
Head, tertiary education	0.062	(0.241)	0.062	(0.241)	0.992
Household variables					
Household size	4.214	(2.588)	6.504	(2.920)	0.000
Working-age members	2.330	(1.431)	3.877	(1.758)	0.000
Dependency ratio	1.121	(1.415)	0.824	(0.875)	0.000
Rural	0.624	(0.484)	0.747	(0.435)	0.000
Wealth index					
Wealth index, 1st quintile	0.260	(0.439)	0.364	(0.482)	0.000
Wealth index, 2nd quintile	0.168	(0.374)	0.177	(0.382)	0.635
Wealth index, 3rd quintile	0.193	(0.395)	0.174	(0.380)	0.333
Wealth index, 4th quintile	0.208	(0.406)	0.147	(0.354)	0.002
Wealth index, 5th quintile	0.172	(0.377)	0.138	(0.346)	0.068
Region					
Western Region	0.076	(0.266)	0.049	(0.216)	0.031
Central Region	0.078	(0.268)	0.051	(0.220)	0.038
Greater Accra Region	0.108	(0.310)	0.017	(0.129)	0.000
Volta Region	0.083	(0.275)	0.106	(0.309)	0.079
Eastern Region	0.102	(0.303)	0.085	(0.279)	0.236
Ashanti Region	0.166	(0.372)	0.123	(0.329)	0.017
Brong-Ahafo Region	0.102	(0.302)	0.115	(0.319)	0.374
Northern Region	0.183	(0.387)	0.300	(0.459)	0.000
Upper East Region	0.071	(0.257)	0.134	(0.341)	0.000
Upper West Region	0.031	(0.174)	0.019	(0.137)	0.141
Observations	4,109		470		

Table 2: Descriptive statistics of children by migration status in wave 2

	Children				
	Non Left Behind		Left Behind		*t*-test
	Mean	(SD)	Mean	(SD)	*P*-value
Individual variables					
Zbmi	-0.102	(1.793)	-0.048	(1.801)	0.611
Age	8.626	(3.732)	8.882	(3.654)	0.251
Male	0.560	(0.496)	0.561	(0.497)	0.987
Relationship to the head					
Head	0.000	(0.000)	0.000	(0.000)	0.000
Spouse	0.002	(0.045)	0.003	(0.056)	0.677
Child	0.880	(0.325)	0.850	(0.357)	0.127
Grandchild	0.085	(0.279)	0.118	(0.323)	0.052
Other relationship	0.033	(0.178)	0.029	(0.167)	0.693
Household head variables					
Age of the head	46.357	(12.272)	52.459	(11.100)	0.000
Male head	0.751	(0.432)	0.822	(0.383)	0.006
Education of the head					
Head, none or preschool	0.404	(0.491)	0.580	(0.494)	0.000
Head, primary education	0.153	(0.360)	0.124	(0.330)	0.174
Head, post-primary education	0.319	(0.466)	0.239	(0.427)	0.004
Head, secondary education	0.072	(0.259)	0.013	(0.112)	0.000
Head, tertiary education	0.051	(0.220)	0.045	(0.207)	0.620
Household variables					
Household size	6.013	(2.475)	7.997	(2.838)	0.000
Working-age members	2.668	(1.315)	3.987	(1.564)	0.000
Dependency ratio	1.502	(1.022)	1.172	(0.935)	0.000
Rural	0.690	(0.463)	0.885	(0.319)	0.000
Wealth index					
Wealth index, 1st quintile	0.316	(0.465)	0.490	(0.501)	0.000
Wealth index, 2nd quintile	0.156	(0.363)	0.178	(0.383)	0.310
Wealth index, 3rd quintile	0.180	(0.385)	0.102	(0.303)	0.000
Wealth index, 4th quintile	0.194	(0.395)	0.137	(0.344)	0.015
Wealth index, 5th quintile	0.153	(0.360)	0.092	(0.290)	0.004
Region					
Western Region	0.080	(0.271)	0.032	(0.176)	0.002
Central Region	0.070	(0.255)	0.051	(0.220)	0.203
Greater Accra Region	0.067	(0.251)	0.013	(0.112)	0.000
Volta Region	0.065	(0.246)	0.089	(0.285)	0.107
Eastern Region	0.090	(0.286)	0.041	(0.200)	0.004
Ashanti Region	0.162	(0.369)	0.089	(0.285)	0.001
Brong-Ahafo Region	0.108	(0.311)	0.131	(0.337)	0.236
Northern Region	0.259	(0.438)	0.395	(0.490)	0.000
Upper East Region	0.069	(0.253)	0.146	(0.354)	0.000
Upper West Region	0.030	(0.170)	0.013	(0.112)	0.086
Observations	2,466		314		

Notes: Zbmi refers to the BMI-for-age z-score.

4 Empirical strategy

To determine the impact of migration on the nutrition of individuals left behind, it is crucial to address concerns about the potential endogeneity and selection bias associated with migration. The main threat is self-selection, as migrants are not randomly drawn from the general population. Indeed, the migrant can self-select as the decision to migrate is a choice and is rarely random (Gibson et al., 2013). Therefore, migration might be correlated with the same factors that influence the nutrition of left-behind individuals. These factors may interfere in estimating whether migration affects nutrition or whether it is an omitted variable correlated with migration and nutrition that explains the results. Also, in studying the effects of migration on left behinds, one may capture a wrong effect because of reverse causality (Antman, 2013). The migrant can choose to migrate in response to the poor health and nutrition of individuals in the household. Conversely, having individuals in poor health may reduce the likelihood that an individual will leave. In any case, the individuals' nutritional status may drive the decision to send a migrant rather than the opposite. In this case, panel data allow us to alleviate this issue since I observe the anthropometry of the left behind before and after migration. However, even with panel data, unobservable time-varying factors may still interfere. Furthermore, according to Tables 1 and 2, at baseline, there are differences between left-behind and non-left-behind individuals, both for adults and children. These differences could lead to endogeneity and self-selection issues.

I combine propensity score matching and difference-in-differences (PSM-DID) to adress the self-selection of migration at the household level, i.e., the decision to send a migrant. The DID method is based on the existence of before-and-after periods and the availability of two groups: a treated group (left-behind individuals) and a control group (non-left-behind individuals). By using DID, one can compare trends in anthropometric indicators in left-behind and non-left-behind individuals and control for unobserved characteristics common to both groups that might be correlated with both migration and nutrition. With two survey periods, I have data on pre-period differences in nutrition indicators between treatment and control groups, which is helpful to control for pre-existing differences between the groups to address selection bias. I compare changes in anthropometric measures before and after migration among left-behind individuals to changes in anthropometric measures during the same period among non-left-behind individuals.

One central assumption is the parallel trends, which is challenging to verify as there are only three survey waves in the GSPS. As a result, if we were to test the parallel trend using data from wave 1, we could drop many individuals. For example, some individuals present in wave 2 could be new household members and not interviewed in wave 1. Moreover, the assumption cannot be tested for all the sample. Indeed, it can only be tested for a sub-sample of the permanent survey members who were successfully interviewed in all three waves. Furthermore, assessing the parallel trends assumption can only be considered relevant when there are more than two periods to observe before the treatment. These questions hinder us from proposing a relevant analysis of the common trend assumption. Nevertheless, I present the results of the common trend assumption in Appendix E.

I employ the mixed-method approach that combines matching with DID in the mindset of complementarity. Indeed, PSM allows us to control for selection bias on observable factors, while the DID model enables us to control for this bias on unobservable factors, provided that the influence of these factors on the variable of interest is constant over time. Therefore, using these methods together provides a better response to selection bias. Kernel matching is more suitable than other matching methods, as it loses fewer observations due to common support while obtaining a greater bias reduction (Liu et al., 2021). Furthermore, another advantage is the use of more observations to match the units, therefore reducing the variance. This method uses covariates to estimate the propensity score and calculate kernel weights (Heckman et al., 1997). DID combined with matching is assumed to be more appropriate than standard DID (Rosenbaum and Rubin, 1983; Khandker et al., 2009).

Firstly, I estimate selection to treatment and predict the likelihood of being treated using a probit model. Matching helps make the two groups more similar regarding baseline characteristics. It is based on a set of covariates that includes individual's covariates: age and whether the individual is a male; household head's covariates: age of the head, whether the head is a male, dummies for the head's education and household's covariates: household size, number of working-age members, dependency ratio, quintiles of a wealth index based on a Principal Component Analysis (PCA),[12] whether the household lives in a rural area and region dummies. All variables are measured at baseline, i.e., prior to the treatment, and are described in Appendix B. The choice of variables used in the matching is guided by established literature that explores the effects of migration on a range of outcomes for individuals left behind, with a particular focus on those employing matching (e.g., Tian et al. (2017); Bai et al. (2018); Yi et al. (2019); Marchetta and Sim (2021), among others). This selection is further tailored to align with the data available for our analysis. This

[12] To build the wealth index, I used housing characteristics and durable goods owned by the household. The index was standardized to fit into a 0 to 1 index. Then, I categorized households into quintiles.

process also takes into consideration the inclusion of variables that influence both the likelihood of an individual being left behind and their nutritional status (Caliendo and Kopeinig, 2008). This approach is in general alignment with the guidelines proposed by Caliendo and Kopeinig (2008). Among the variables, some might be considered endogenous, especially those related to household headship (as discussed by Bertoli and Marchetta (2014)) or household size. I address this issue in Appendix H and conclude that endogeneity is not a concern. In addition, I first considered including variables related to labor market participation. I constructed variables capturing individual and household-level labor market participation using the available data, detailed in Appendix I. However, I decided not to incorporate them into the model. This decision was due to the imperfect nature of the measures and the missing values for a portion of the sample, which compromised their use. These concerns and the rationale for their exclusion are elaborated in Appendix I. Nonetheless, I use these variables in an alternative model, which is also provided in Appendix I.

Following Villa (2016), the probit model that estimates the likelihood of being treated gives propensity scores (p_i):

$$p_i = E(Z_i = 1|X_i) \tag{1}$$

The propensity scores are then used to calculate kernel weights:

$$w_i = \frac{K(\frac{p_i - p_k}{h_n})}{\sum K \frac{p_i - p_k}{h_n}} \tag{2}$$

with $K(.)$ the kernel function and h_n the selected bandwidth parameter.[13] Then, the weights are incorporated into the DID. I restrict the analysis to the common support, ensuring that only individuals with suitable control cases within the common support region are considered to have reasonable matching and increase the internal validity. With the integration of kernel weights, the treatment effect with covariates takes the form:

$$\begin{aligned} DID = &\left\{E(Y_{i,t=1}|D_{i,t=1} = 1, Z_i = 1) - w_i \times E(Y_{i,t=1}|D_{i,t=1} = 0, Z_i = 0)\right\} \\ &- \left\{E(Y_{i,t=0}|D_{i,t=0} = 0, Z_i = 1) - w_i \times E(Y_{i,t=0}|D_{i,t=1} = 0, Z_i = 0)\right\} \end{aligned} \tag{3}$$

in which $Y_{i,t}$ is the outcome variable (weight or BMI-for-age z-score), Z_i = 1 is the treatment group, and Z_i = *0* is the control group. The treatment indicator requires the absence of any intervention in the baseline for either group $(D_{i,t=0} = 0|Z_i = 1, 0)$ and it

[13] The bandwidth parameter is set to the default value (0.06).

requires the intervention to be positive for the treated group in the follow-up $(D_{i,t=1} = 1|Z_i = 1)$. Finally, w_i are the kernel weights.[14]

5 Results

5.1 Main results

5.1.1 Adults' results

Table 3 presents the average treatment effects of migration on left-behind adults' weight.[15] Columns (1) to (4) present the estimates while progressively augmenting the set of covariates. According to the results, for all adults (Panel A), the treatment effect of migration on adults' weight ranges from -1.024 to -1.132 kilograms (kg). In other words, everything else held constant, after at least one individual in a household out-migrated looking for a job, left-behind adults experienced a weight decline. The rest of the results (Panels B to F) outline the differences by gender and baseline nutritional status. The results from Panels B and C indicate a negative and statistically significant impact of migration on the weight of left-behind men but no significant effect on left-behind women's weight. Also, the coefficients for men are higher than for the entire sample. Therefore, the negative effect of migration on the left behind is primarily driven by the negative effect on the men. Finally, splitting the adults according to their first-period nutritional status (Panels D to F), we note that the nutritional impact of migration mainly falls on healthy left-behind adults.

In relative terms, this weight loss is not substantial, especially considering that this 1 kg decrease is measured over four years, while the population's average weight is about 63 kg. To assess whether this decline can be interpreted as detrimental to adult health, I examine changes in nutritional status. I investigate the transitions between nutritional statuses between the waves. Table G.1 illustrates the dynamics of adult nutritional statuses in a transition matrix. According to this matrix, among individuals who were healthy in wave 2, a greater proportion of the left behind compared to the non-left behind became underweight. However, fewer healthy individuals become overweight or obese when left behind

[14]One might also consider incorporating household fixed effects to capture unobserved household-level heterogeneity. Nevertheless, I abstain from including such effects as there are changes in household composition between the survey waves. Indeed, individuals enter and exit households between the waves and imposing fixed effects would not be entirely appropriate, as, by definition, it is a constant characteristic and would not account for changes in household composition.

[15]I have ensured the quality of the matching by ascertaining that both treated and control units share the same support. Additionally, I confirmed through balance tests that, post-matching, the variables have the same distribution between treated and untreated individuals. Details of the analysis are provided in Appendix F.

compared to when they are not left behind, and slightly more individuals remain healthy when left behind. More individuals were overweight or obese in wave 2 and transitioned to a healthy status when they are left behind. Overall, the interpretation of these variations in nutritional status is that while we observe a decrease in adult weight, it does not necessarily translate into an adverse impact on adults.

Table 3: Results from PSM-DID for adults, by gender and nutritional status

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.132**	-1.024*	-1.030**	-1.050**
	(0.559)	(0.529)	(0.525)	(0.528)
Mean weight at baseline	62.765	62.765	62.765	62.765
R^2	0.001	0.122	0.136	0.136
Observations	8,754	8,754	8,754	8,754
Panel B - Males				
Left behind*Post	-1.888**	-1.826**	-1.834**	-1.842**
	(0.773)	(0.746)	(0.734)	(0.735)
Mean weight at baseline	63.633	63.633	63.633	63.633
R^2	0.004	0.094	0.127	0.128
Observations	3,826	3,826	3,826	3,826
Panel C - Females				
Left behind*Post	-0.362	-0.109	-0.117	-0.085
	(0.819)	(0.764)	(0.755)	(0.761)
Mean weight at baseline	62.036	62.036	62.036	62.036
R^2	0.004	0.152	0.174	0.174
Observations	4,560	4,560	4,560	4,560
Panel D - Underweight adults				
Left behind*Post	0.708	0.531	0.538	0.967
	(1.157)	(1.054)	(1.053)	(1.072)
Mean weight at baseline	46.819	46.819	46.819	46.819
R^2	0.143	0.332	0.346	0.351
Observations	572	572	572	572
Panel E - Healthy adults				
Left behind*Post	-1.154**	-1.116**	-1.133**	-1.210***
	(0.498)	(0.458)	(0.456)	(0.458)
Mean weight at baseline	58.998	58.998	58.998	58.998
R^2	0.009	0.178	0.188	0.189
Observations	4,764	4,764	4,764	4,764
Panel F - Overweight adults				
Left behind*Post	-1.653	-1.360	-1.351	-1.437
	(1.227)	(1.178)	(1.167)	(1.170)
Mean weight at baseline	75.279	75.279	75.279	75.279
R^2	0.032	0.134	0.156	0.156
Observations	2,506	2,506	2,506	2,506
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

5.1.2 Children's results

Columns (1) to (4) of Table 4 display the results from the kernel PSM-DID for all children, by gender and baseline nutritional status. For all children left behind, we observe a negative and statistically significant coefficient (between -0.193 and -0.259, whether additional controls are included or not). It indicates that children left behind living in migrant households have lower BMI-for-age z-scores. By splitting the sample between boys and girls (Panels B and C), the results differ from those of adults. Indeed, the coefficient suggests that migration has a negative and statistically significant effect on the z-score of girls left behind and on the z-score of boys left behind. However, the adverse effect is mainly driven by girls. Indeed, the magnitude of the coefficient is slightly higher for girls (between -0.337 and -0.402) than for boys (between -0.266 and -0.294). Based on nutritional status at baseline, migration has a negative effect on the nutrition of overweight/obese children. The effect is significantly higher for overweight/obese children than for all children.

Similar to adults, I examine the dynamics of nutritional statuses over the two waves for children. However, while weight loss for adults is not necessarily detrimental to their health, for children, a decrease in the BMI-for-age z-score over four years can be interpreted as harmful in nutritional terms. The BMI-for-age z-score is an indicator that allows us to compare a child's height and weight to the average of children of the same age and gender. A decrease in the z-score indicates that the child is losing or not gaining enough weight compared to other children. The dynamics in nutritional status are presented in Table G.2. According to this table, I observe that although fewer children remain overweight or obese among the left-behind compared to non-left-behind children, many more children transition from overweight or obese to underweight status among the left-behind (16.18% vs. 6.42%). Furthermore, a significantly higher percentage of left-behind children remain underweight compared to non-left-behind children, who are more likely to transition to a healthy status. In conclusion, while the negative effect on adult anthropometry is challenging to interpret as harmful, the decrease in the BMI-for-age z-score for children is genuinely detrimental to the health of children left behind after migration.

Table 4: Results from PSM-DID for children, by gender and nutritional status

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.193**	-0.242***	-0.228**	-0.259***
	(0.095)	(0.094)	(0.093)	(0.094)
Mean zbmi at baseline	-0.096	-0.096	-0.096	-0.096
R^2	0.002	0.053	0.074	0.075
Observations	5,054	5,054	5,054	5,054
Panel B - Males				
Left behind*Post	-0.198	-0.287**	-0.266**	-0.294**
	(0.134)	(0.131)	(0.130)	(0.131)
Mean zbmi at baseline	-0.123	-0.123	-0.123	-0.123
R^2	0.001	0.076	0.091	0.093
Observations	2,888	2,888	2,888	2,888
Panel C - Females				
Left behind*Post	-0.337**	-0.367***	-0.357***	-0.402***
	(0.139)	(0.138)	(0.136)	(0.138)
Mean zbmi at baseline	-0.063	-0.063	-0.063	-0.063
R^2	0.005	0.040	0.081	0.083
Observations	2,072	2,072	2,072	2,072
Panel D - Underweight children				
Left behind*Post	-0.255	-0.514**	-0.459*	-0.348
	(0.274)	(0.247)	(0.243)	(0.242)
Mean zbmi at baseline	-2.962	-2.962	-2.962	-2.962
R^2	0.431	0.578	0.604	0.620
Observations	450	450	450	450
Panel E - Healthy children				
Left behind*Post	-0.104	-0.130	-0.120	-0.155*
	(0.083)	(0.084)	(0.083)	(0.084)
Mean zbmi at baseline	-0.406	-0.406	-0.406	-0.406
R^2	0.005	0.033	0.044	0.048
Observations	3,240	3,240	3,240	3,240
Panel F - Overweight children				
Left behind*Post	-0.514***	-0.551***	-0.547***	-0.679***
	(0.167)	(0.163)	(0.159)	(0.160)
Mean zbmi at baseline	2.285	2.285	2.285	2.285
R^2	0.398	0.445	0.476	0.486
Observations	1,180	1,180	1,180	1,180
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

6 Potential threats and robustness checks

This section is divided into two subsections. Initially, I address potential remaining threats to identification. Subsequently, I examine the robustness of my findings and explore the heterogeneity of the results.

6.1 Remaining threats and challenges

This section explores the challenges associated with attrition, intra-household selection bias, and changes in household composition. The origins of these threats are discussed, along with their potential impact, as well as strategies to mitigate or overcome these biases.

6.1.1 Attrition

Between the two survey waves, 24.28% of individuals drop out from the sample.[16] Consequently, we need to check for potential attrition bias. Indeed, it can introduce bias into the results if the individuals who drop out are systematically different from those who remain in the survey and failure to account for these potential systematic correlations may bias the results. Notably, within our sample, a subset of the attrition is represented by migrants, mainly labor migrants for over six months, who are of particular interest in our treatment group. These individuals comprise approximately 11.40% of the attrition. In our analysis of attrition bias, we have excluded these cases.[17]

Testing for attrition bias involves examining whether the individuals who remain in the survey and those who drop out differ concerning their outcomes and various variables. To investigate the extent of attrition bias, I estimate an attrition probit model in which I explain attrition between waves 2 and 3 with a set of characteristics. The variables are the same, except that I add two additional variables at the individual level (whether the individual has been married and his education level). The results of the probits to check whether attrition is random or driven by observable characteristics are displayed in Appendix D.1.

According to the tables from Appendix D.1, the adult weight and child BMI-for-age z-score are not significant predictors of attrition. In contrast, other variables are significant for both adults and children. As a result, although the outcomes and some variables are significant predictors of attrition in these tables, the results may raise concerns that our

[16] This figure does not include individuals lost from the survey due to death or misclassification in the second wave, as I do not regard this as actual attrition given its random nature.

[17] The findings remain unchanged if migrants are included in the dropouts.

analysis suffers from attrition bias. Thus, as a precaution against attrition bias, we ensure that our main results are not biased by reweighting our observations using the inverse probability weighting procedure (Baulch and Quisumbing, 2011; Fitzgerald et al., 1998). Further details of this reweighting procedure are available in Appendix D.2. Overall, the results with the inverse probability weights are not different from the main results.

6.1.2 Intra-household selection bias before migration

Within migrant households, there may also be a self-selection about who will migrate. Indeed, migrants may have distinct characteristics and nutritional statuses compared to the left behind, potentially leading to intra-household selection bias. The longitudinal character of the data enables us to check whether, within migrant households, migrants are systematically different from non-migrants in terms of their nutritional status. In other words, to show that our results are not biased, I need to provide evidence that there is no intra-household selection bias before a migration occurs. Following Murard (2019), I estimate the following regression on a sample composed of the left behind and upcoming migrants:

$$Y_{i,w2} = \alpha + \gamma D_{i,w2-w3} + \beta X_{i,w2} + \mu_h + \varepsilon_i \quad (4)$$

where $Y_{i,w2}$ is the outcome variable (weight or BMI-for-age z-score) at baseline for individual i (in wave 2, i.e., before migration occurs), $D_{i,w2-w3}$ is a binary variable which is equal to 1 if the individual i has migrated between waves 2 and 3 and equal to 0 if the individual is left behind, $X_{i,w2}$ a set of individual, household head, and household level variables at baseline,[18] μ_h represents the fixed effects for each household, and ε_i is the error term. I estimate six different regressions: for all adults, all children, and by gender (males, females, boys, and girls). I conduct regressions separately by gender to ensure no contrasting patterns of within-household selection between males and females that might cancel each other out on average.[19]

The results of the regressions designed to detect potential intra-household selection bias related to nutritional status are available in Appendix D.3. In summary, the coefficients of

[18] These variables are the same variables used in the kernel-based PSM-DID.

[19] At the time of their migration, 89.75% of migrants are over 15 years old (and were over 12 years old in wave 2). Conversely, in the sample of children left behind, 70.32% are younger than 15 years old by wave 3. Therefore, comparing the nutritional status across different age groups may not yield the most relevant insights. Consequently, the regressions for children focus on children aged 12 to 19, as this age group is more likely to resemble the (children) migrant population in terms of age.

interest pertaining to the migrant variables for adults are generally not significant (Table D.3.1). Notable exception includes the female subgroup in regression including household fixed effects, as indicated in column (7) of Table D.3.2. However when household fixed effects are combined with additional control variables, the coefficient is not significant anymore (column (8) of Table D.3.2). Similarly, for the children's sample, coefficients are almost all not significant. Nevertheless, a marginal significance at the 10% level is observed in column (4) of Table D.3.4 for the boys' subgroup. This level of significance, while notable, is considered negligible. In the girls' subgroup of the same table, significance emerges in column (5) for the model without further control variables or household fixed effects. However, this significance dissipates with the inclusion of additional variables and household fixed effects, as demonstrated in columns (6) to (8) of Table D.3.4. It suggests that migrants and left-behind individuals are not different regarding anthropometric indicators such as weight and BMI-for-age z-score. In other words, I provide evidence that there is no intra-household selection bias, at least related to the nutritional outcomes.

6.1.3 Potential confounders of changes in household composition

I discuss the potential effects of the entries and exits of individuals on the nutrition of left-behind individuals. Usually, the literature only partially addresses the issues of changes in household composition following a migration (Bertoli and Murard, 2020). Most of the time, the further intra-household movements or variations in co-residence choices potentially generated by migration are ignored. For example, following migration, left-behind children may start co-residing with their grandparents (Bertoli et al., 2021). These changes in living arrangements may have implications for the nutrition of the left-behind individuals and may be confounded with the effects of migration.

Regarding the entries, in migrant households, 68.26% of the newcomers are children under 19. Moreover, almost 50% of these children entered because they were born. Since births occur in any household and are not specific to migrant households, they can be considered random events, unlikely to introduce bias. For these reasons, it is unlikely that there are any confounding effects of individuals entering the household. Despite these reasons, I included a variable specifying the number of entries into a household as a control variable. In particular, to control for the entry of individuals because they moved to live with relatives, which accounts for 36.59% of those who arrive in migrant households.

Concerning the exits, the main reasons for individuals leaving migrant households are to live with relatives (24.78%), to move for school (19.78%), or because the individual has died (16.09%). In this case, it is difficult to show that the individuals who leave are unrelated to previous migration. Indeed, when individuals move to live with relatives, these individuals may be joining the migrants. In addition, when individuals move for school, I cannot rule out that these people may send remittances and thus indirectly influence the nutrition of the left behind. Therefore, it is challenging to argue that further exits do not affect nutrition either. To address this potential bias, I also included the number of exits in households as a control (excluding migrants for work for more than six months).[20]

6.2 Robustness checks and heterogeneity

In this subsection, I first ensure that the results are representative of internal migration. Next, I check whether the results remain valid with an alternative definition of the control group based on migration duration. Then, I assess whether migrations from previous waves may introduce bias into my results. Additionally, I examine the impact of employing solely household-level matching variables. Finally, I investigate the heterogeneity of the results depending on the time since migration and the number of migrants.

6.2.1 Internal migration only

According to Figure A.1, 5.49% of migrants leave their household of origin to find work abroad. The individuals left behind by these international migrants are included in the treatment group, along with those left behind by internal migrants. According to the previous figure, most migrants are internal migrants, which suggests that the results should mostly be representative of internal flows. To confirm this assumption, I perform the regressions on a subsample of individuals left behind only by migrants who moved for work within the country and drop the individuals left behind by international migrants to see if it affects the results. The results are available in Tables in Appendix H.1. Whether for children or adults, the findings are similar to the main results. The main difference is the slightly higher magnitude in the estimates using only internal migration since the adverse effect of migration on the nutrition of the individuals left behind is larger. In summary, these results suggest that the sample is representative of internal migration in Ghana, although a small number of individuals are left behind by international migrants.

[20]Unfortunately, it is also difficult to ascertain that migration does not lead to further exits. Indeed, even if I can determine that there are entries and exits of individuals in households between waves 2 and 3, I cannot determine precisely when individuals left the household between waves 2 and 3.

6.2.2 Migration for less than six months

The treatment is defined as being in a household where at least one individual migrated for work for more than six months between waves 2 and 3. Nevertheless, some individuals are also in households with migrants who moved for work less than six months ago. In the main specification, these individuals are included in the control group. I investigate whether this inclusion biases the results. I removed from the sample individuals in households where an individual migrated for work less than six months ago. The results are reported in Appendix H.2 and are similar to those of Tables 3 and 4.

6.2.3 Disentangling the potential bias from previous migration

Defining individuals as either left behind or not introduces the potential that among the untreated households, some may have included cases where a former household member had already migrated. Since these households are likely the closest regarding covariates used in the matching, there is a risk of matching treated households with other treated households (considered untreated in this case). In essence, there is a concern that within the untreated group, some households might have experienced prior migration, impacting our results beyond the migration between waves 2 and 3. Therefore, I exclude from the sample the untreated households with a migrant for work for more than six months between waves 1 and 2. In this way, I aim to capture only the effect of migration between waves 2 and 3, without potential effects from past migrations.

According to Table H.3.1, the results for adults remain consistent with this new specification. The coefficients closely mirror the main findings across healthy adults and those who are overweight or obese. Remarkably, for children, while the coefficient is no longer statistically significant across all columns, it regains significance in column (4), where it encompasses all control variables (Table H.3.2). However, this significance is now only observed at a 10% threshold. The magnitude of the coefficient exhibits a slight decrease for girls but remains statistically significant. Finally, the findings are similarly robust for overweight or obese children. In general, the results are relatively similar; however, some differences persist. Nevertheless, this does not invalidate the main findings. On the contrary, if the concerns were valid and I matched treated individuals with treated individuals (considered untreated between waves 2 and 3), I would not have found results in the main tables. Therefore, the main results represent a lower bound.

6.2.4 Matching without individual-level variables

In the identification strategy, treatment is defined at the individual level as being left behind in a migrant-sending household. Consequently, within any given household, all children and adults are uniformly treated or untreated since I identify migrant-sending households as those where at least one member has departed to seek employment for a duration exceeding six months. While I add individual-level variables in the matching, the treatment is at the household level. It implies that members of the same household may possess different propensity scores. To ensure this discrepancy does not bias my results, I estimate the propensity score at the household level, thereby exclusively utilizing variables at the household or household head level in the matching procedure. Put differently, I ceased to include individual-level variables (age, gender, and relationship to the head) in the matching. This robustness check also demonstrates that changing the variables used in matching does not significantly alter my findings, thereby reinforcing the robustness of my identification strategy. The findings are detailed in Appendix H.4. The results are similar to the main results, hence not undermining the validity of my findings.

6.2.5 Heterogeneity in migration temporalities

I also investigate the potential for differences in the results across different migration temporalities. I define two distinct categories: those left behind by a migrant for six to twelve months and those left behind by a migrant for more than twelve months. Previously, these two categories of left-behind individuals were grouped. The results are analyzed in detail in Appendix H.5. To sum up, while the effects on adults are heterogeneous with the duration of migration, it becomes increasingly evident that children are impacted negatively as time spent since migration increases.

6.2.6 Heterogeneity by the number of migrants

The average number of migrants per household is about 1.2 individuals. In Appendix H.6, I present the results of heterogeneity based on whether the left-behind individuals are in households with one migrant or more than one migrant, both for adults and children. For adults, we observe a negative and significant effect of an individuals migration on their body weight. However, individuals in households with more than one migrant no longer exhibit a significant effect. In contrast, for children, we observe a more pronounced negative effect on the BMI-for-age z-score when there is more than one migrant in the household.

7 Transmission channels

7.1 Can remittances offset the negative effects?

I identified a negative effect of migration on the nutritional outcomes of the left behind. I now seek to investigate the channels through which migration contributes to these changes. The main channel the literature has identified is the direct effect on the income of the household of origin through remittances (Carletto et al., 2011; De Brauw, 2011; Thow et al., 2016). In the GSPS, data on received remittances were collected.[21] These remittances can bolster nutrition, for instance, by enabling increased expenditures on food, thereby improving the nutritional status of those left behind. I further investigate this issue by studying the simultaneous impact of an individual's migration outside the household and the receipt of remittances. It raises the question of whether remittances can offset the detrimental impact of the absence of an individual for those concerned by both the migration and receipt of remittances. Within the context of internal migration, financial transfers might also serve as informal insurance against adverse shocks. Consequently, these transfers could exhibit a more sporadic flow than those of international migration.

Using information on transfers received, I refine both the control and treatment groups. To study the effect of remittances in addition to the departure of a migrant, I define the control group as individuals in households in which no individual migrated between waves 2 and 3 and in which no remittances were received. I also define three treatment groups: treatment (A) includes individuals from households with a migrant but no received remittances; treatment (B) consists of those from households with remittance receipts but no migrant; treatment (C) incorporates individuals from households experiencing both migration and remittance inflows. The different treatments are meant to capture different effects. Treatment (A) is meant to capture the effect of the change in household composition, similar to the previous regressions, although the sample is not the same. Treatment (B) is designed to capture the sole effect of remittances. Finally, treatment (C) is intended to reflect the simultaneous effect of migration and remittances.

Table 5 provides the results. In column (1), adults from migrant households not receiving remittances are compared to adults from households without migrants and not receiving remittances. The magnitudes reveal a more pronounced negative impact on weight across

[21] The data does not permit the attribution of remittances to specific individuals, leaving open the possibility of other sources than migrants. Indeed, remittances may be received from a previous household member but also from a migrant who has been outside the household for longer than the baseline wave. Moreover, the sender may be a friend or relative who never belonged to the household.

all adults, healthy adults, and men compared to prior results. The results for children are displayed in Table 6. The coefficient size for girls remains consistent with previous findings. However, for overweight or obese children, the coefficient exhibits a substantial increase, although the signs and significance levels largely conform to prior results of Table 4.

Results from column (2) of Table 5 highlight that the receipt of remittances without migration has no impact on the weight of all adults and only seems to have a negative impact on healthy adults. However, from Table 6, only receiving remittances without having a migrant seems to impact the nutrition of all children and underweight children positively. It is the first observed positive impact and means that the sole receipt of remittances without having a migrant has a positive impact on vulnerable individuals, namely underweight children. However, it negatively impacts the nutrition of overweight and obese children.

Lastly, in column (3) of Table 5, for men, the decline in weight induced by the simultaneous effect of having a migrant and receiving remittances is around the same as having a migrant only but is significantly greater for healthy adults. Among children (Table 6), the combined effect of remittance receipt and migration also has a negative impact on the z-scores of all children. In contrast, the absence of an individual (column 1) had no significant effect. The same is true for boys and healthy children. Interestingly, the combination of migration and remittance receipt no longer exerts a statistically significant effect on the BMI-for-age z-scores of overweight/obese children and girls.

In summary, remittances have no protective effect on adults and even accentuate the negative effect on healthy adults weight. This finding contradicts the commonly held view that migration, often undertaken to alleviate the financial burden on the household, would yield positive effects. Conversely, for children, especially the most vulnerable, such as girls and overweight or obese children, remittances appear to partially mitigate the adverse effects stemming from the absence of migrants. Intriguingly, the isolated impact of remittances alone yields a positive impact in the z-scores for both all children and those who are underweight. Therefore, I probably capture the impact of the onset of migration. While with the time frame I use, I find a harmful impact, there may be positive effects that might counterbalance in the long run. Indeed, migration is a lengthy process as it takes time for migrants to find work, settle down, and send remittances. The positive effect is likely due to remittances from individuals who have been migrating before wave 2 and are already well settled at destination. These results may represent the long-term effects of migration.

Table 5: Results from PSM-DID for adults, by gender and nutritional status with new treatment and control groups

	Migrant	Weight Remittances	Migrant and remittances
	(1)	(2)	(3)
Panel A - All adults			
DID	-1.346*	-0.862	0.990
	(0.699)	(0.543)	(0.804)
Mean weight at baseline	63.333	62.951	63.207
R^2	0.138	0.166	0.186
Observations	4,922	8,188	4,004
Panel B - Males			
DID	-1.929*	-0.658	-1.921*
	(0.992)	(0.687)	(0.987)
Mean weight at baseline	64.225	63.650	63.966
R^2	0.118	0.146	0.205
Observations	2,322	3,796	1,436
Panel C - Females			
DID	-0.492	-0.828	-0.472
	(0.998)	(0.796)	(1.187)
Mean weight at baseline	62.415	62.348	62.442
R^2	0.194	0.196	0.241
Observations	2,392	4,362	2,146
Panel D - Underweight adults			
DID	-0.530	-0.726	-0.606
	(1.610)	(0.989)	(2.860)
Mean weight at baseline	47.545	46.728	47.537
R^2	0.510	0.359	0.516
Observations	260	756	86
Panel E - Healthy adults			
DID	-1.514***	-1.149**	-2.068***
	(0.577)	(0.464)	(0.615)
Mean weight at baseline	59.784	59.165	59.642
R^2	0.245	0.196	0.180
Observations	2,982	4,868	2,672
Panel F - Overweight adults			
DID	1.057	-0.120	-0.615
	(1.689)	(1.065)	(2.074)
Mean weight at baseline	75.557	75.316	75.480
R^2	0.207	0.128	0.260
Observations	1,386	2,506	886
Individual variables	Yes	Yes	Yes
Household head variables	Yes	Yes	Yes
Household variables	Yes	Yes	Yes
Rural dummy	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
Number of entries and exits	Yes	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 6: Results from PSM-DID for children, by gender and nutritional status with new treatment and control groups

	Zbmi		
	Migrant	Remittances	Migrant and remittances
	(1)	(2)	(3)
Panel A - All children			
DID	-0.191	0.153*	-0.453***
	(0.118)	(0.092)	(0.127)
Mean zbmi at baseline	-0.050	-0.102	-0.046
R^2	0.086	0.093	0.116
Observations	3,116	4,866	2,816
Panel B - Males			
DID	-0.071	0.028	-1.077***
	(0.204)	(0.126)	(0.159)
Mean zbmi at baseline	-0.094	-0.122	-0.082
R^2	0.119	0.114	0.265
Observations	1,146	2,724	1,866
Panel C - Females			
DID	-0.388**	0.209	-0.088
	(0.174)	(0.137)	(0.230)
Mean zbmi at baseline	0.011	-0.077	0.004
R^2	0.081	0.076	0.215
Observations	1,242	2,136	730
Panel D - Underweight children			
DID	0.221	0.579***	-0.783
	(0.477)	(0.206)	(0.719)
Mean zbmi at baseline	-2.968	-2.950	-2.983
R^2	0.681	0.565	0.675
Observations	112	580	88
Panel E - Healthy children			
DID	-0.178	0.104	-0.429***
	(0.124)	(0.085)	(0.114)
Mean zbmi at baseline	-0.385	-0.429	-0.393
R^2	0.061	0.074	0.110
Observations	1,610	3,070	1,594
Panel F - Overweight children			
DID	-1.314***	-0.342**	-0.367
	(0.267)	(0.160)	(0.228)
Mean zbmi at baseline	2.285	2.277	2.280
R^2	0.511	0.389	0.507
Observations	462	1,140	618
Individual variables	Yes	Yes	Yes
Household head variables	Yes	Yes	Yes
Household variables	Yes	Yes	Yes
Rural dummy	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
Number of entries and exits	Yes	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

7.2 The disruptive effect of migration

Since remittances do not appear to compensate for the adverse effect stemming from the absence of a migrant, I attempt to understand the other mechanisms at stake. To shed light on the other transmission channels explaining how migration impacts the nutritional status of those left behind, I examine the profile of the migrants. Indeed, the underlying dynamics may differ based on who within the household migrates.

Table J.1 in Appendix J outlines the main characteristics of migrants in comparison to those who are left behind and individuals who are not left behind. This table shows that 78% of migrants are children of the household head, predominantly aged between 15 and 24 and are slightly more male. They are also slightly more educated than both the individuals they left behind and the non-left-behind. These findings suggest a natural transition: as these young males come of age, they migrate to secure better economic prospects, with about a third heading to Accra. Fundamentally, these individuals were already predisposed to migrate over time. The migration of these young males is a natural progression, as they are the offspring of the household head growing up and leaving the family home to settle elsewhere in Ghana. These young migrants were also likely contributors to the income of their households. Indeed, 39.7% of them were workers in a farm plot, presumably generating income. Furthermore, although 51.4% were full-time students, about 32.7% of these students were also working (either as owners of a non-farm enterprise or farm plot, or as workers in non-farm enterprises or farm plots). Finally, even though 17.1% were seeking employment, approximately 63% of job seekers reported also working (either as owners of a non-farm enterprise or farm, or as workers in non-farm enterprises or farm plots). They are also significantly less likely to be retired, ill, or a full-time homemaker compared to those left behind and the non-left-behind individuals.

Therefore, the departure of these working-age individuals likely represents a loss of income for their origin households, thereby inducing a negative income shock. Coupled with the fact that the migration itself may require an initial investment (costs for transportation, food, and so forth), the households experience a double-edged financial strain.[22] Consequently, this immediate financial strain manifests most palpably in the nutritional status of the remaining children. Therefore, I believe this disruptive effect of migration is the primary driver behind my findings. Regarding the heterogeneous effects of the disruption,

[22] It is noteworthy to mention that the investment, and consequently the cost borne by the households of origin, is generally less substantial in financial terms for internal migration–the predominant form of migration in this context–compared to international migration.

while adults may possess greater resilience, children endure the harshest repercussions, which could leave lasting imprints on their long-term growth and nutritional status.

Additionally, in defining migration, I focus on migrants seeking employment who have been absent for at least six months. Given this time frame, some may have been away for longer than six months, while others might have left precisely six months prior. As a result, some migrants might be in the initial stages of their journey, possibly struggling to find stable employment and to settle in properly. During this period, their families back home might suffer income loss as they wait for financial support from these migrants. This immediate economic strain can adversely affect nutritional outcomes, especially for children at critical developmental stages. Over time, remittances may have a beneficial effect on nutrition, but the effect I identify is likely a short- to medium-term effect arising from the destabilizing influence of migration on the individuals left behind.

7.3 Other transmission channels

In addition to the disruptive effect of migration, the time effect, as identified by De Brauw and Mu (2015), may also shed light on our findings. Specifically, this effect captures how migration alters the time allocated to remaining household members in the household of origin, particularly children. Should the migrant be a parent, there could be implications for child health through reduced parental attention as they may spend less time with them (De Brauw and Mu, 2011). I explore the impact of parental migration on the BMI-for-age z-score among children left behind. I explore the impact of parental migration on the BMI-for-age z-score among children. Leveraging data on past and present co-residence with parents, I focus on instances where parents migrate for job-related reasons for more than six months.[23] Table K.1 presents the average treatment effects of parental migration for work on children's BMI-for-age z-score. The table showcases that parental migration for work has a negative and significant influence on children's BMI-for-age z-scores. Notably, the adverse effect is almost twice as pronounced when at least one biological parent migrates (Table K.1) compared to migration by any household members (Table 4).[24]

In a supplementary analysis, I extend the treatment definition to include any parental departure between waves 2 and 3, disregarding the reason or duration. The focus is on

[23] The details of the questions used in the questionnaires, as well as the definitions of the control and treatment groups, are provided in Appendix K.

[24] These findings, however, should be treated with caution given the small sample size in the treatment group (19 children).

children who were co-residents with at least one parent in wave 2 but experienced the departure of at least one parent between waves 2 and 3, irrespective of the reason. Table K.2 illustrates a consistently negative effect on children's nutritional status. Despite its lesser magnitude than Table K.1, these findings are more robust due to a larger sample size. To summarize, regardless of the underlying motive for migration, parental migration has a detrimental impact on the nutritional status of children left behind.

Additionally, as shown in Table J.1, migrants were typically the older children in their household of origin. Their departure leaves younger siblings behind. The absence of these older siblings may be particularly detrimental given their potential active involvement in essential household chores such as meal preparation, which directly affects the nutrition of their younger siblings.[25] Consequently, their departure could also contribute to the negative impact observed on the nutritional status of the remaining siblings, perhaps because the migrating siblings had previously been attentive to their younger siblings' nutritional needs.

Lastly, among the other mechanisms, migration may induce changes in household structure, including the entry and exit of individuals. Such changes, especially the entry of new, potentially dependent individuals, can further affect the nutritional status of those left behind. According to the results from the control variables, the dependency ratio has a negative effect on the weight of adults and the BMI-for-age z-score of children.[26] In addition, an increase in household entries exerts a negative and significant influence on children's anthropometric measures. Thus, household restructuring post-migration may be an auxiliary mechanism deteriorating the nutritional status of children left behind.

7.4 Food consumption patterns

In this section, I inquire how and whether the nutritional effects can be attributed to changes in food consumption. The surveys have questions about the food items households have produced, purchased, and received over the previous 30 days. Therefore, I examine if individual changes may also stem from household-level changes in dietary consumption.

[25] In Section 10: Psychology/Social Networking, Part A: Psychology, vi. Time Use; respondents were queried about the time spent on typical daily activities, including cooking and related tasks, or activities related to childcare. However, these questions are only posed to the household head, the first spouse, and one other household member over the age of 12, selected randomly. The issue here is that household heads and the spouses of household heads represent only 6.2% of the migrants (Table J.1). Furthermore, the information is often missing for the randomly selected individual over 12 years old. Due to these reasons, this data, as it stands, is unfortunately not feasible for use.

[26] The coefficients of the control variables are not displayed in the tables but are available upon request.

I delve deeper into the outcomes to discern, beyond individual-level anthropometry, the impact of migration on household-level food consumption. To enhance the robustness of the results beyond descriptive statistics, I also employ the kernel PSM-DID method. The results are in Appendix L.

First, I investigate the impact of migration on the household's food consumption over the last 30 days, including food obtained through purchases (Column 1 of Table L.1), self-produced food (Column 2 of Table L.1), food received as gifts (Column 3 of Table L.1), as well as the total household consumption (Column 4 of Table L.1). All outcomes are adjusted for household size, yielding per capita outcomes to account for variations in household composition. According to the results, there is a significant and negative effect on food consumed from purchases. In other words, when at least one household member migrates during the survey waves, the household's purchase of food items diminishes. The treatment effect of migration on per capita purchased food items equates to approximately -7.375 Ghanaian cedis. This is consistent with the hypothesized negative impact on household income; indeed, facing a negative income shock from migration, individuals reduce food purchases, which could elucidate the negative effect observed on children's anthropometry. A significant and positive result is noted for the per capita consumption of self-produced food, although not that significant. Post-migration, households appear to increase their food production, possibly as a coping strategy to become more self-reliant, perhaps in response to the income loss from the migrant's absence. However, comparing the coefficients of Columns 1 and 2, this increase is not proportional to the observed decrease in purchased food items.

Subsequently, I explore the effect of migration on per capita consumption across various food groups, considering food items that are purchased, received, and produced by the household (Table L.3). Furthermore, I assess how migration affects the composition of the household's total food consumption in terms of the share of different food groups (Table L.4). In summary, migration leads to a reduction in the consumption of fruits and vegetables, whether in terms of total consumption in Cedis (Column 4 of Table L.3) or their share of the household's total food consumption (Column 4 of Table L.4). This may suggest a decrease in the intake of often costlier or less accessible foods, in line with the short-term negative income shock. Such a trend could indicate a decline in dietary quality, particularly if the reduced food groups are those providing essential nutrients such as fruits and vegetables, as well as eggs (Column 5 of Table L.3), potentially explaining the decline in children's z-scores. Moreover, beverages (Column 12 of Table L.3) may be deemed non-essential during an income shock, leading households to curtail their consumption. Finally, according to Column (10) of Table L.4, there is a noticeable increase in the share of sugary foods following migration. If viewed through the lens of an income shock, households may prioritize calorie-dense foods over nutrition to satisfy immediate hunger. Sweetened foods, often energy-dense, provide a quick satiety at a lower cost than more nutritious but expensive options.

Finally, I have constructed two additional measures to assess household food diversity: the Simpson and Shannon indices. The Simpson index (Equation 5 in Appendix L), bounded between zero and one, indicates that a higher value corresponds to greater dietary diversity. Conversely, the Shannon index (Equation 6 in Appendix L) quantifies the concentration of food group consumption, assigning lower weights to subgroups with a larger share of food expenditure and higher weights to those with a smaller share. This index spans from zero to the natural logarithm of the total number of food groups, reaching its apex when expenditure is evenly distributed across all subgroups. Computational details for these indices are provided in Appendix L. Table L.2 reveals a negative and significant impact on the Simpson index, suggesting that migration tends to reduce dietary diversity. This may imply that left-behind households are likely to consume a less varied array of food items, which could affect the nutritional status of those left behind. This finding aligns with the disruptive effect and the assumption of a negative income shock. However, no significant effect is noted on the Shannon index.

Nevertheless, despite the insight gained from analyzing food consumption patterns, some limitations hinder complete confidence in these results. First, the recall period for querying a household member about consumed food items is 30 days. This extended recall period may be prone to errors: individuals might not accurately recall what the household consumed, or, concerning out-of-home food items, it may be challenging for one member to account for what all others ate, especially over the past 30 days, and so forth. Moreover, these measures are at the household, not the individual level. Hence, we lack insight into the distribution of food consumption within the household, particularly between adults and children. Given that our main finding pertains to the negative effect on children's nutritional status, the unknown intra-household distribution remains a critical gap. For these reasons, while the findings are intriguing, they should be interpreted cautiously.

8 Conclusion

Being left behind by a migrant leads to worsening nutrition, at least in the short term. Particularly, when an individual migrates for work outside the household, it negatively impacts the BMI-for-age z-scores of the children left behind and, to a lesser extent, the weight of the adults left behind. I identify more substantial effects for some individuals. The negative impact is larger on men's weight and among healthy adults. Among children, the adverse impact is greater for girls and overweight/obese children. One could argue that these overweight/obese children left behind benefit from migration since it implies that they lose weight and that obesity can be harmful. However, migration also affects food consumption at the household level. Consequently, this presumably results in a decrease in the diversity and the quantity of the food consumed and one cannot consider it to be an overall positive effect. By further exploring the mechanisms, I did not find that remittances had an offsetting effect for all individuals. In some cases, it even exacerbates the adverse effects on nutrition. However, when the household does not have a migrant between the waves and solely receives remittances, probably reflecting the long-term effects of migration, remittances have positive effects on the nutrition of children.

Most likely, the mechanism at play is linked to the disruptive effect of migration, which states that after migration, the household of origin may become disorganized. A member's migration can incur costs, whether due to the investment in migration or the loss of income resulting from the migrant's departure. Consequently, this short-term negative shock could explain the adverse impact on children's nutritional status, potentially affecting their long-term growth prospects, while adults may recover more readily.

One potential limitation is the decision not to capture individuals who might change households following migration. Indeed, the study is limited to the left behind remaining in the household of origin. However, migration can lead to the mobility of individuals and even the dissolution of households (Bertoli and Murard, 2020). Changes in living arrangements following a migration can induce individuals to join a new housing unit. For instance, children left behind can start co-residing with their grandparents (Bertoli et al., 2021). In this paper, I exclude these children as they do not fit the definition of left behind. It is also the case for individuals who may enter or leave the household of origin. This analysis, therefore, neglects these individuals who adjusted their living arrangements. Furthermore, there are also complex family dynamics post-migration in the household sending off a migrant, such as changes in marital status, especially in the context of international migration

(Bertoli et al., 2023). These changes in family dynamics and marital statuses could also influence the nutrition of those left behind, a dimension not covered in our analysis. Future research could examine the effect of migration on the nutrition of relocated individuals and the induced consequences of different living arrangements.

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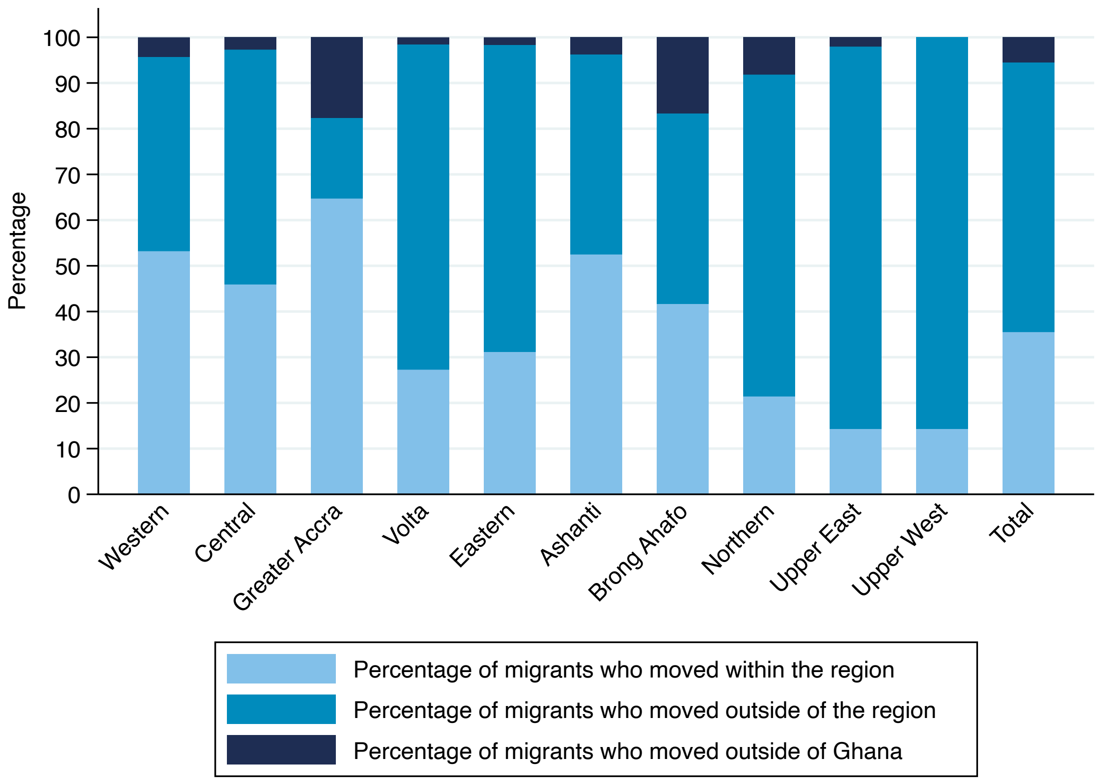
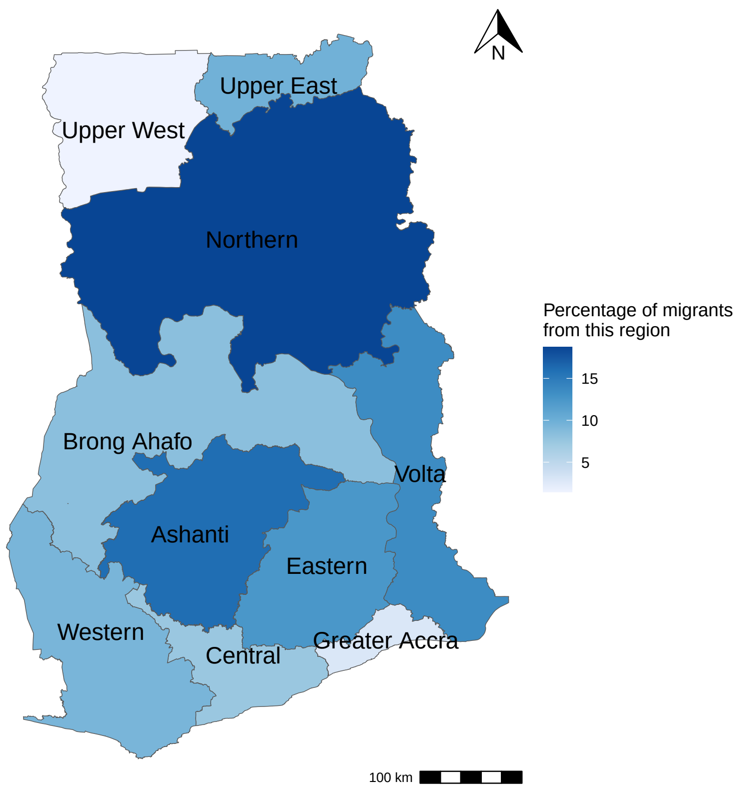
A Migrant destinations

Figure A.1: Destination of migrants according to their region of origin



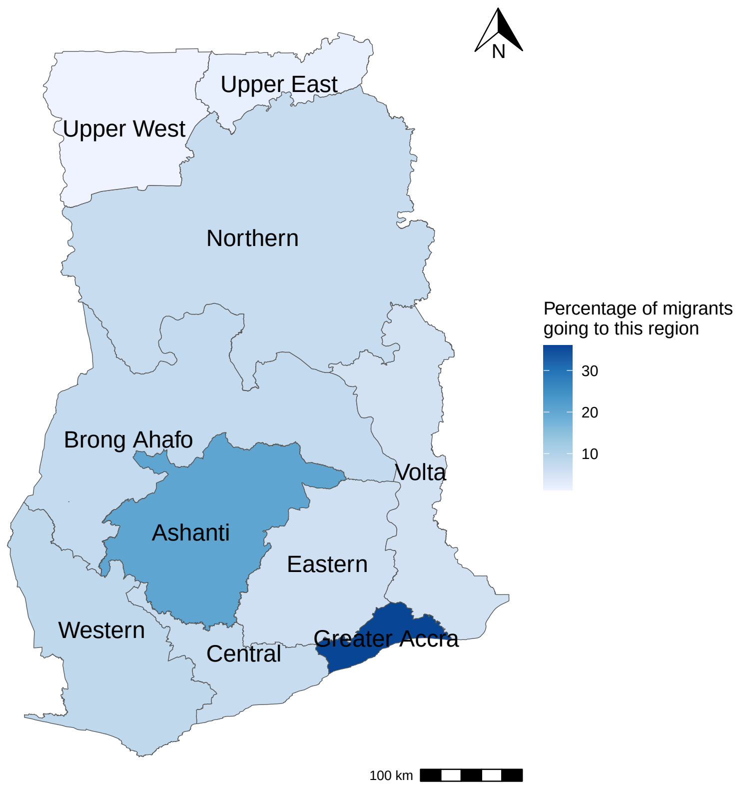
Notes: Construction by the author using the EGC-ISSER Socioeconomic Panel Survey. Migrants are here defined as individuals who moved out from their households looking for work for more than six months between waves 2 and 3.

Figure A.2: Region of origin of migrants



Notes: Construction by the author using the EGC-ISSER Socioeconomic Panel Survey. Migrants are here defined as individuals who moved out from their households looking for work for more than six months between waves 2 and 3.

Figure A.3: Region of destination of migrants



Notes: Construction by the author using the EGC-ISSER Socioeconomic Panel Survey. Migrants are here defined as individuals who moved out from their households looking for work for more than six months between waves 2 and 3. Migrants moving within the region are included.

B Variables used in the analysis

Table B.1: Definition of the variables

Variable	Definition
Anthropometric variables	
Zbmi	BMI-for-age z-score of children between 2 and 18 years old (in standard deviation)
Weight	Body weight of adults (in kilograms)
Individual level variables	
Age	Age of the individual (in years)
Male	Individual is a male (1 = yes; 0 otherwise)
Relationship to the head	Dummies of the relationship to the household head (Head; Spouse; Child; Grandchild; Other)
Household head level variables	
Head age	Age of the household head (in years)
Male head	Household head is a male (1 = yes; 0 otherwise)
Education of the head	Dummies of the education level of the household head (None or preschool; Primary education; Post-primary education, Secondary education; Tertiary education)
Household level variables	
Household size	Number of individuals in the same dwelling
Working-age members	Number of working-age members (aged 15 to 64) in the household
Dependency ratio	Number of dependents (aged 0 to 14 and over the age of 65) in the household divided by the number of working-age members. When the household is only composed of dependent individuals, the missing value is replaced by the maximum value of the sample.
Rural	Household living area (0 = urban; 1 = rural)
Wealth index	Quintiles of a wealth index based on a Principal Component Analysis (PCA) using housing characteristics and durable goods owned by the household
Region	Dummies of the household living region (Western Region; Central Region; Greater Accra Region; Volta Region; Eastern Region; Ashanti Region; Brong-Ahafo Region; Northern Region; Upper East Region; Upper West Region)
Number of entries	Number of entries of individuals in the household in wave 3
Number of exits	Number of exits of individuals from the household in wave 3 (excluding labor migrants)

C Additional descriptive statistics

Table C.1: Descriptive statistics of all sample by migration status in waves 2 and 3

	Adults				Children			
	Non LB		Left Behind		Non LB		Left Behind	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Individual variables								
Weight	63.295	(13.077)	60.821	(13.216)				
Zbmi					-0.056	(1.695)	-0.152	(1.733)
Age	47.544	(15.821)	50.654	(15.602)	10.518	(4.180)	10.750	(4.096)
Male	0.463	(0.499)	0.394	(0.489)	0.560	(0.496)	0.561	(0.497)
Relationship to the head								
Head	0.623	(0.485)	0.464	(0.499)	0.000	(0.000)	0.000	(0.000)
Spouse	0.268	(0.443)	0.360	(0.480)	0.002	(0.045)	0.003	(0.056)
Child	0.082	(0.275)	0.132	(0.339)	0.880	(0.325)	0.850	(0.357)
Grandchild	0.007	(0.081)	0.011	(0.103)	0.085	(0.279)	0.118	(0.323)
Other relationship	0.020	(0.141)	0.034	(0.181)	0.033	(0.178)	0.029	(0.167)
Household head variables								
Age of the head	52.531	(15.213)	58.529	(13.260)	48.045	(12.263)	54.303	(11.398)
Male head	0.726	(0.446)	0.743	(0.437)	0.743	(0.437)	0.791	(0.407)
Education of the head								
Head, none or preschool	0.347	(0.476)	0.506	(0.500)	0.403	(0.491)	0.583	(0.493)
Head, primary education	0.151	(0.359)	0.109	(0.311)	0.151	(0.359)	0.127	(0.334)
Head, post-primary education	0.357	(0.479)	0.289	(0.454)	0.327	(0.469)	0.231	(0.422)
Head, secondary education	0.080	(0.271)	0.031	(0.173)	0.070	(0.255)	0.013	(0.112)
Head, tertiary education	0.064	(0.246)	0.065	(0.246)	0.048	(0.213)	0.046	(0.210)
Household variables								
Household size	4.205	(2.585)	5.622	(2.807)	6.049	(2.508)	7.067	(2.852)
Working-age members	2.343	(1.478)	3.298	(1.804)	2.878	(1.410)	3.591	(1.621)
Dependency ratio	1.219	(1.658)	0.987	(1.219)	1.364	(1.048)	1.187	(1.037)
Rural	0.621	(0.485)	0.745	(0.436)	0.689	(0.463)	0.884	(0.321)
Wealth index								
Wealth index, 1st quintile	0.252	(0.434)	0.359	(0.480)	0.305	(0.460)	0.444	(0.497)
Wealth index, 2nd quintile	0.176	(0.381)	0.196	(0.397)	0.164	(0.371)	0.213	(0.410)
Wealth index, 3rd quintile	0.193	(0.395)	0.156	(0.363)	0.176	(0.381)	0.116	(0.321)
Wealth index, 4th quintile	0.201	(0.401)	0.167	(0.373)	0.191	(0.393)	0.140	(0.347)
Wealth index, 5th quintile	0.178	(0.383)	0.122	(0.328)	0.164	(0.371)	0.086	(0.281)
Number of entries	0.739	(1.156)	0.547	(1.068)	0.811	(1.143)	0.436	(0.798)
Number of exits	0.700	(1.178)	1.062	(1.412)	0.715	(1.067)	1.000	(1.313)
Region								
Western Region	0.076	(0.265)	0.049	(0.216)	0.080	(0.271)	0.032	(0.176)
Central Region	0.077	(0.267)	0.051	(0.220)	0.070	(0.255)	0.051	(0.220)
Greater Accra Region	0.109	(0.312)	0.017	(0.129)	0.068	(0.251)	0.013	(0.112)
Volta Region	0.082	(0.275)	0.106	(0.308)	0.065	(0.246)	0.089	(0.285)
Eastern Region	0.102	(0.302)	0.084	(0.278)	0.090	(0.286)	0.041	(0.199)
Ashanti Region	0.167	(0.373)	0.124	(0.330)	0.162	(0.369)	0.089	(0.285)
Brong-Ahafo Region	0.101	(0.302)	0.115	(0.319)	0.108	(0.310)	0.131	(0.337)
Northern Region	0.183	(0.387)	0.300	(0.459)	0.259	(0.438)	0.395	(0.489)
Upper East Region	0.071	(0.256)	0.134	(0.341)	0.069	(0.253)	0.146	(0.354)
Upper West Region	0.031	(0.174)	0.019	(0.137)	0.030	(0.170)	0.013	(0.112)
Observations	8,218		940		4,932		628	

Notes: Zbmi refers to the BMI-for-age z-score.

Table C.2: Descriptive statistics of all sample in waves 2 and 3

	Adults		Children	
	Mean	(SD)	Mean	(SD)
Individual variables				
Weight	63.041	(13.112)		
Zbmi			-0.066	(1.699)
Age	47.864	(15.826)	10.544	(4.171)
Male	0.456	(0.498)	0.560	(0.496)
Relationship to the head				
Head	0.606	(0.489)	0.000	(0.000)
Spouse	0.278	(0.448)	0.002	(0.046)
Child	0.087	(0.282)	0.877	(0.328)
Grandchild	0.007	(0.083)	0.088	(0.284)
Other relationship	0.022	(0.145)	0.032	(0.177)
Household head variables				
Age of the head	53.146	(15.134)	48.752	(12.327)
Male head	0.727	(0.445)	0.749	(0.434)
Education of the head				
Head, none or preschool	0.364	(0.481)	0.424	(0.494)
Head, primary education	0.147	(0.354)	0.149	(0.356)
Head, post-primary education	0.350	(0.477)	0.317	(0.465)
Head, secondary education	0.075	(0.263)	0.064	(0.244)
Head, tertiary education	0.065	(0.246)	0.047	(0.213)
Household variables				
Household size	4.351	(2.644)	6.164	(2.569)
Working-age members	2.441	(1.542)	2.958	(1.453)
Dependency ratio	1.195	(1.620)	1.344	(1.048)
Rural	0.634	(0.482)	0.711	(0.453)
Wealth index				
Wealth index, 1st quintile	0.263	(0.440)	0.320	(0.467)
Wealth index, 2nd quintile	0.178	(0.382)	0.170	(0.376)
Wealth index, 3rd quintile	0.189	(0.392)	0.169	(0.375)
Wealth index, 4th quintile	0.197	(0.398)	0.185	(0.388)
Wealth index, 5th quintile	0.173	(0.378)	0.156	(0.362)
Number of entries	0.719	(1.149)	0.769	(1.116)
Number of exits	0.737	(1.209)	0.747	(1.101)
Region				
Western Region	0.073	(0.261)	0.074	(0.263)
Central Region	0.075	(0.263)	0.068	(0.252)
Greater Accra Region	0.100	(0.299)	0.062	(0.240)
Volta Region	0.085	(0.279)	0.068	(0.251)
Eastern Region	0.100	(0.300)	0.084	(0.278)
Ashanti Region	0.163	(0.369)	0.154	(0.361)
Brong-Ahafo Region	0.103	(0.303)	0.111	(0.314)
Northern Region	0.195	(0.396)	0.274	(0.446)
Upper East Region	0.077	(0.267)	0.077	(0.267)
Upper West Region	0.030	(0.171)	0.028	(0.164)
Observations	9,158		5,560	

Notes: Zbmi refers to the BMI-for-age z-score.

Table C.3: Descriptive statistics of all sample in wave 2

	Adults		Children	
	Mean	(SD)	Mean	(SD)
Individual variables				
Weight	62.765	(13.327)		
Zbmi			-0.096	(1.794)
Age	45.839	(15.671)	8.655	(3.724)
Male	0.456	(0.498)	0.560	(0.496)
Relationship to the head				
Head	0.606	(0.489)	0.000	(0.000)
Spouse	0.278	(0.448)	0.002	(0.046)
Child	0.087	(0.282)	0.877	(0.329)
Grandchild	0.007	(0.083)	0.088	(0.284)
Other relationship	0.022	(0.145)	0.032	(0.177)
Household head variables				
Age of the head	51.442	(15.139)	47.046	(12.296)
Male head	0.736	(0.441)	0.759	(0.428)
Education of the head				
Head, none or preschool	0.366	(0.482)	0.424	(0.494)
Head, primary education	0.148	(0.355)	0.150	(0.357)
Head, post-primary education	0.345	(0.476)	0.310	(0.463)
Head, secondary education	0.078	(0.269)	0.065	(0.247)
Head, tertiary education	0.062	(0.241)	0.050	(0.219)
Household variables				
Household size	4.449	(2.715)	6.237	(2.595)
Working-age members	2.489	(1.541)	2.817	(1.409)
Dependency ratio	1.090	(1.373)	1.465	(1.018)
Rural	0.637	(0.481)	0.712	(0.453)
Wealth index				
Wealth index, 1st quintile	0.271	(0.444)	0.336	(0.472)
Wealth index, 2nd quintile	0.169	(0.375)	0.159	(0.365)
Wealth index, 3rd quintile	0.191	(0.393)	0.172	(0.377)
Wealth index, 4th quintile	0.201	(0.401)	0.187	(0.390)
Wealth index, 5th quintile	0.168	(0.374)	0.146	(0.354)
Region				
Western Region	0.074	(0.261)	0.074	(0.263)
Central Region	0.075	(0.263)	0.068	(0.252)
Greater Accra Region	0.098	(0.298)	0.061	(0.240)
Volta Region	0.085	(0.279)	0.068	(0.251)
Eastern Region	0.101	(0.301)	0.085	(0.278)
Ashanti Region	0.162	(0.368)	0.154	(0.361)
Brong-Ahafo Region	0.103	(0.304)	0.111	(0.314)
Northern Region	0.195	(0.396)	0.274	(0.446)
Upper East Region	0.077	(0.267)	0.077	(0.267)
Upper West Region	0.030	(0.171)	0.028	(0.164)
Observations	4,579		2,780	

Notes: Zbmi refers to the BMI-for-age z-score.

D Attrition and selection bias

D.1 Attrition probits

Table D.1.1: Probit for adults

	(1) Attrition probit
Weight	-0.001
	(0.002)
Age	-0.019***
	(0.003)
Male	-0.154**
	(0.073)
Spouse	0.978***
	(0.110)
Child	1.751***
	(0.125)
Grandchild	1.532***
	(0.225)
Other	2.263***
	(0.129)
Primary education	0.125
	(0.089)
Post-primary education	0.085
	(0.085)
Secondary education	0.079
	(0.105)
Tertiary education	0.506***
	(0.149)
Married	-0.027
	(0.081)
Age of the head	0.005**
	(0.002)
Male head	0.199**
	(0.078)
Head, primary education	-0.034
	(0.090)
Head, post-primary education	0.000
	(0.083)
Head, secondary education	-0.003
	(0.126)
Head, tertiary education	-0.027
	(0.132)
Household size	0.021
	(0.025)
Number of working-age members	0.027
	(0.042)
Dependency ratio	-0.026
	(0.054)
Rural	0.129*
	(0.069)
Wealth index, 2nd quintile	0.059
	(0.089)
Wealth index, 3rd quintile	0.104
	(0.084)
Wealth index, 4th quintile	0.126
	(0.090)
Wealth index, 5th quintile	-0.163
	(0.115)
Constant	-2.546***
	(0.271)
Region dummies	Yes
Log-likelihood	-1482.386
Pseudo R^2	0.344
Observations	6,430

Notes: Standard errors are in parentheses. The reference categories of the explanatory variables are: Head (relationship to the head); None or preschool (education level); Head, none or preschool and Wealth index, 1st quintile. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table D.1.2: Probit for children

	(1) Attrition probit
Zbmi	0.020
	(0.012)
Age	0.068***
	(0.007)
Male	-0.244***
	(0.039)
Spouse	-1.027**
	(0.519)
Child	-0.650***
	(0.076)
Grandchild	-0.144
	(0.102)
Primary education	-0.161***
	(0.056)
Post-primary education	-0.099
	(0.090)
Secondary education	-0.106
	(0.159)
Tertiary education	-0.324
	(0.627)
Married	-0.064
	(0.563)
Age of the head	0.000
	(0.002)
Male head	0.208***
	(0.053)
Head, primary education	0.080
	(0.063)
Head, post-primary education	0.054
	(0.059)
Head, secondary education	0.181**
	(0.092)
Head, tertiary education	0.193**
	(0.097)
Household size	-0.021
	(0.018)
Number of working-age members	0.061*
	(0.034)
Dependency ratio	0.061*
	(0.034)
Rural	0.190***
	(0.053)
Wealth index, 2nd quintile	0.102*
	(0.061)
Wealth index, 3rd quintile	-0.029
	(0.062)
Wealth index, 4th quintile	-0.135**
	(0.068)
Wealth index, 5th quintile	-0.224***
	(0.084)
Constant	-1.660***
	(0.197)
Region dummies	Yes
Log-likelihood	-2792.462
Pseudo R^2	0.080
Observations	5,289

Notes: Standard errors are in parentheses. The reference categories of the explanatory variables are: Head (relationship to the head); None or preschool (education level); Head, none or preschool and Wealth index, 1st quintile. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

D.2 Results with inverse probability weights

From the results of the attrition probit in Tables D.1.1 and D.1.2, I cannot confirm that attrition is completely random since not all of the variables are non-significant. Therefore, I implement a recognized procedure to address the attrition bias: inverse probability weighting (Baulch and Quisumbing, 2011; Fitzgerald et al., 1998). Following the procedure described in Baulch and Quisumbing (2011), I first define a variable that determines who remains in the sample. This variable is the inverse of attrition, i.e., it takes the value 1 if the individual remains in the sample between waves 2 and 3 and zero if the individual drops out of the sample.

Second, using a probit model, I regress this participation variable on the same variables used in Tables D.1.1 and D.1.2. This first model is called the unrestricted model. From this probit model, predicted probabilities are generated, which predict the probability of remaining in the sample.

Then, based on the results from the unrestricted model, I estimate another probit model (the restricted model) explaining participation, in which I only include the variables that do not affect attrition, i.e., the non-significant variables from the unrestricted model. It is equivalent to excluding variables that have a significant impact on attrition. For the adult sample, the variables in the restricted model are the individual's weight, whether the individual is married, the education level of the head, the household size, the number of working-age members, the dependency ratio, and the wealth index quintiles. For children, these are the BMI-for-age z-score, whether the individual is married, the age of the head, and the household size. Predicted probabilities are also derived from the restricted model. The ratio of the predicted values of the restricted model to the predicted values of the unrestricted model gives the inverse probability weights. These weights are then incorporated into the kernel-based PSM-DID model. The rationale is to give more weight to individuals with initial characteristics similar to those who subsequently attrit than to individuals whose characteristics make them more likely to remain in the sample (Baulch and Quisumbing, 2011). The findings are similar to the main results.

Table D.2.1: Results from PSM-DID for adults, with inverse probability weights

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.066*	-1.020*	-1.048**	-1.079**
	(0.560)	(0.530)	(0.526)	(0.529)
Mean weight at baseline	62.765	62.765	62.765	62.765
R^2	0.001	0.121	0.135	0.135
Observations	8,712	8,712	8,712	8,712
Panel B - Males				
Left behind*Post	-1.899**	-1.848**	-1.850**	-1.858**
	(0.781)	(0.754)	(0.742)	(0.744)
Mean weight at baseline	63.633	63.633	63.633	63.633
R^2	0.004	0.094	0.125	0.125
Observations	3,746	3,746	3,746	3,746
Panel C - Females				
Left behind*Post	-0.346	-0.046	-0.072	-0.047
	(0.817)	(0.762)	(0.753)	(0.758)
Mean weight at baseline	62.036	62.036	62.036	62.036
R^2	0.004	0.152	0.175	0.175
Observations	4,574	4,574	4,574	4,574
Panel D - Underweight adults				
Left behind*Post	1.000	0.683	0.662	1.167
	(1.210)	(1.098)	(1.095)	(1.116)
Mean weight at baseline	46.819	46.819	46.819	46.819
R^2	0.137	0.335	0.352	0.359
Observations	534	534	534	534
Panel E - Healthy adults				
Left behind*Post	-1.169**	-1.127**	-1.145**	-1.204***
	(0.502)	(0.462)	(0.459)	(0.461)
Mean weight at baseline	58.998	58.998	58.998	58.998
R^2	0.009	0.179	0.189	0.190
Observations	4,696	4,696	4,696	4,696
Panel F - Overweight adults				
Left behind*Post	-1.167	-0.740	-0.765	-0.814
	(1.249)	(1.206)	(1.196)	(1.198)
Mean weight at baseline	75.279	75.279	75.279	75.279
R^2	0.031	0.126	0.146	0.146
Observations	2,486	2,486	2,486	2,486
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table D.2.2: Results from PSM-DID for children, with inverse probability weights

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.201**	-0.249***	-0.236**	-0.268***
	(0.095)	(0.094)	(0.093)	(0.094)
Mean zbmi at baseline	-0.096	-0.096	-0.096	-0.096
R^2	0.002	0.053	0.074	0.075
Observations	5,056	5,056	5,056	5,056
Panel B - Males				
Left behind*Post	-0.215	-0.296**	-0.273**	-0.301**
	(0.134)	(0.131)	(0.130)	(0.131)
Mean zbmi at baseline	-0.123	-0.123	-0.123	-0.123
R^2	0.001	0.077	0.092	0.094
Observations	2,916	2,916	2,916	2,916
Panel C - Females				
Left behind*Post	-0.331**	-0.359***	-0.347**	-0.399***
	(0.139)	(0.139)	(0.136)	(0.138)
Mean zbmi at baseline	-0.063	-0.063	-0.063	-0.063
R^2	0.005	0.038	0.081	0.083
Observations	2,080	2,080	2,080	2,080
Panel D - Underweight children				
Left behind*Post	-0.250	-0.551**	-0.512**	-0.431*
	(0.257)	(0.242)	(0.240)	(0.239)
Mean zbmi at baseline	-2.962	-2.962	-2.962	-2.962
R^2	0.468	0.572	0.593	0.607
Observations	352	456	456	456
Panel E - Healthy children				
Left behind*Post	-0.110	-0.135	-0.126	-0.160*
	(0.083)	(0.084)	(0.084)	(0.084)
Mean zbmi at baseline	-0.406	-0.406	-0.406	-0.406
R^2	0.006	0.034	0.044	0.049
Observations	3,240	3,240	3,240	3,240
Panel F - Overweight children				
Left behind*Post	-0.453***	-0.490***	-0.479***	-0.624***
	(0.168)	(0.164)	(0.160)	(0.161)
Mean zbmi at baseline	2.285	2.285	2.285	2.285
R^2	0.399	0.446	0.478	0.489
Observations	1,166	1,166	1,166	1,166
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

D.3 Intra-household selection bias

Table D.3.1: OLS results for adults testing for intra-household selection bias

	Weight			
	All adults			
	(1)	(2)	(3)	(4)
Migrant	-0.362	-0.092	-1.046	-0.676
	(1.183)	(1.556)	(1.145)	(1.617)
Individual variables	No	Yes	No	Yes
Household head variables	No	Yes	No	Yes
Household variables	No	Yes	No	Yes
Rural dummy	No	No	No	Yes
Region dummies	No	No	No	Yes
Household fixed effects	No	No	Yes	Yes
R^2	0.000	0.144	0.570	0.607
Observations	663	662	663	662

Notes: Standard errors are in parentheses. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table D.3.2: OLS results for males and females testing for intra-household selection bias

	Weight							
	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Migrant	-1.511	-0.000	-1.996	-0.194	-0.693	0.047	-4.234**	0.826
	(1.615)	(2.210)	(1.967)	(2.799)	(1.823)	(2.308)	(1.903)	(2.719)
Individual variables	No	Yes	No	Yes	No	Yes	No	Yes
Household head variables	No	Yes	No	Yes	No	Yes	No	Yes
Household variables	No	Yes	No	Yes	No	Yes	No	Yes
Rural dummy	No	No	No	Yes	No	No	No	Yes
Region dummies	No	No	No	Yes	No	No	No	Yes
Household fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
R^2	0.003	0.113	0.796	0.836	0.000	0.238	0.813	0.842
Observations	304	303	304	303	359	359	359	359

Notes: Standard errors are in parentheses. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table D.3.3: OLS results for children testing for intra-household selection bias

	All children			
	(1)	(2)	(3)	(4)
Migrant	0.242	0.282	0.177	0.274
	(0.149)	(0.172)	(0.190)	(0.235)
Individual variables	No	Yes	No	Yes
Household head variables	No	Yes	No	Yes
Household variables	No	Yes	No	Yes
Rural dummy	No	No	No	Yes
Region dummies	No	No	No	Yes
Household fixed effects	No	No	Yes	Yes
R^2	0.010	0.156	0.735	0.750
Observations	274	272	274	272

Notes: Standard errors are in parentheses. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table D.3.4: OLS results for boys and girls testing for intra-household selection bias

	Zbmi							
	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Migrant	0.070	0.116	0.425	0.700*	0.451**	0.412	-0.261	-0.795
	(0.195)	(0.243)	(0.284)	(0.413)	(0.222)	(0.249)	(0.571)	(0.872)
Individual variables	No	Yes	No	Yes	No	Yes	No	Yes
Household head variables	No	Yes	No	Yes	No	Yes	No	Yes
Household variables	No	Yes	No	Yes	No	Yes	No	Yes
Rural dummy	No	No	No	Yes	No	No	No	Yes
Region dummies	No	No	No	Yes	No	No	No	Yes
Household fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
R^2	0.001	0.183	0.839	0.860	0.037	0.308	0.935	0.970
Observations	164	163	164	163	110	109	110	109

Notes: Standard errors are in parentheses. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

E Parallel trend assumption

I test for the parallel trend assumption on a sub-sample of the permanent survey members who were successfully interviewed in all three waves. This subset excludes pregnant women, those transitioning from childhood to adulthood, and individuals with missing or implausible anthropometric data. Given these constraints, we have anthropometric indicator values in all three waves for approximately 69% of the sample.

In the context of difference-in-differences analysis and the presentation of parallel trend graphs, it is typical for the temporal scope to extend beyond the confines of a mere three survey waves. As a result, these parallel graphs may be difficult to rely on. Nevertheless, in Figures E.1 and E.2, we observe trends of anthropometric indicators for the sub-sample of matched individuals observed in all three waves.[27] Within these figures, the treatment effect is supposed to happen between the second and third survey waves.

Based on the information presented in these graphs, I cannot directly support the common trend assumption. Indeed, between waves 1 and 2, an interesting pattern emerges for adults. While the average weight of adults in migrant households increases, it decreases in non-migrant households. However, this result would be more concerning and could challenge our findings if similar trends persisted in both control and treatment groups. Contrarily, subsequent observations reveal a distinct pattern. Upon implementation of the treatment, indicated by the presence of a migrant for work in the household between waves 2 and 3, the weight of adults in non-migrant households rises, while the opposite is observed in migrant households. Consequently, I assume that although the parallel trend assumption is not fully met for adults, this shift in trend mitigates the risk of undermining the use of the difference-in-differences model. Moreover, as stated before, testing the parallel trend assumption is more relevant when there are more than two pre-periods, which is not the case here. Regarding children, regardless of household migration status, a decline in children's z-scores is observed before the treatment. Additionally, a reversal of trend occurs upon the introduction of a migrant between waves 2 and 3.

[27]The graphs are almost identical using the sample not used for matching. These are available upon request.

Figure E.1: Trends in adults' body weight over the waves

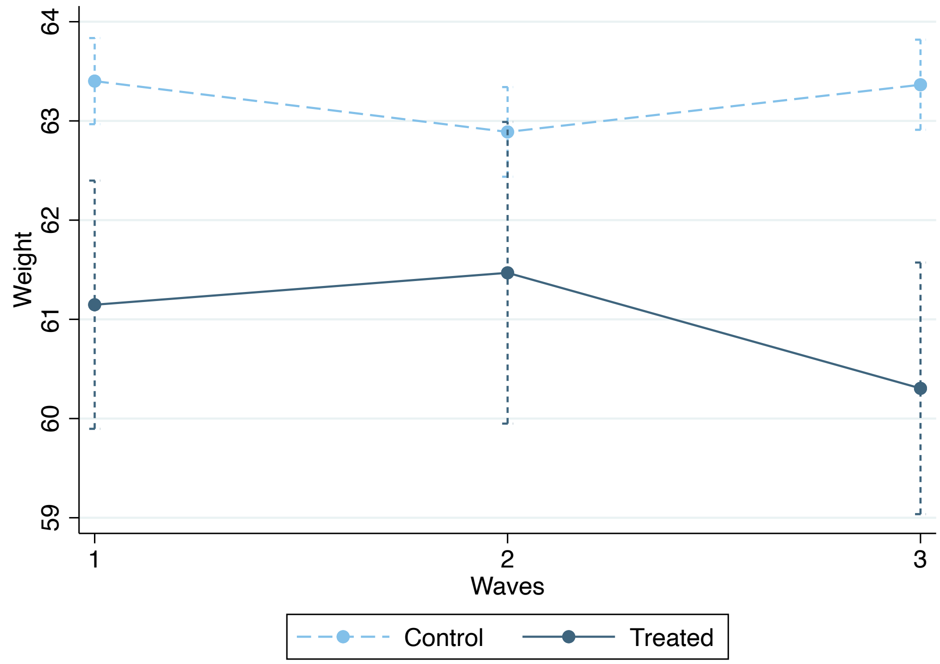
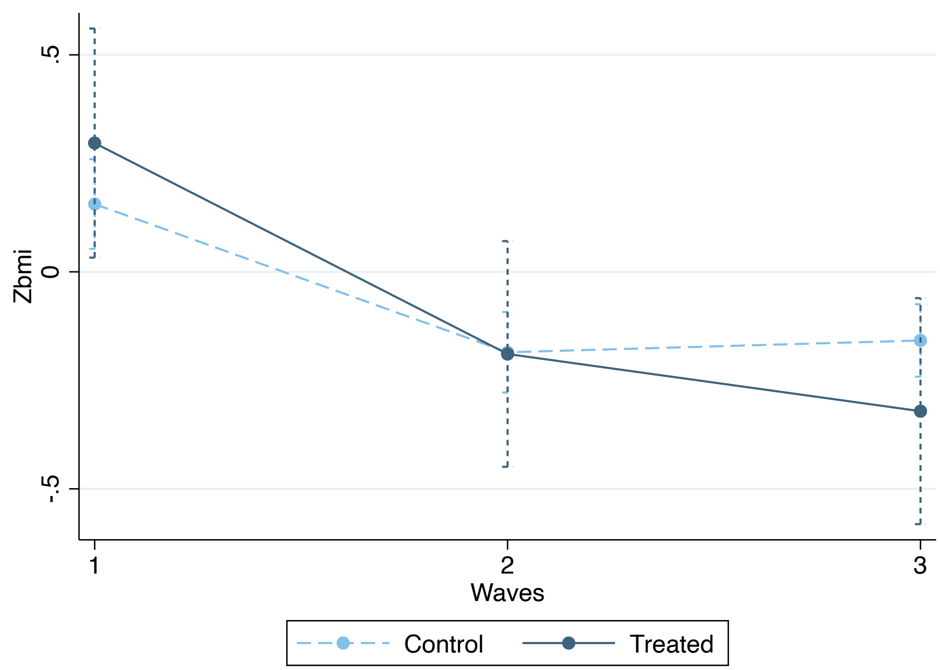


Figure E.2: Trends in children's BMI-for-age z-score over the waves



F Matching process quality

Table F.1 displays the results of the model that estimates the probability of being left behind for adults (used to create the propensity scores). The results show that the head's age and education, the number of working-age members, and the dependency ratio are critical determinants for migration and, subsequently, for an adult to be left behind. Table F.2 shows the results for children. Like adults, the head's age is a determinant of migration. However, its education is no longer significant. The household size, number of working-age members, and dependency ratio also significantly impact the probability of being left behind. Finally, wealthier households are less likely to be migrant households.

To ensure the matching process quality, I must determine if the treated and control units share the same support. Figures F.5 and F.6 display the kernel density functions of the treated and control groups based on before and post-matching. For adults and children, the kernel density functions of the two groups are different before matching. However, after matching, the right sides of these figures indicate that the kernel density functions are much more similar. The characteristics of the variables are roughly equivalent between the two groups after matching. Although the matching is supposed to overcome the selection bias, it is also necessary to check if, after matching, the variables have the same distribution between the individuals left behind and those not left behind. The results from the balance test after matching are displayed in Tables F.3 and F.4. According to these tables, almost all mean differences between the treatment and the control groups of the variables used for matching are equal to 0 and not statistically significant. Only two mean differences are significant for the adults (household size and working-age members), but only at the 5% level. Whereas for children, there are no differences between control and treated means. As explained earlier, to satisfy the common support hypothesis, I restrict the analysis to the common support, excluding the individuals' outsides of it.[28]

[28] The results are robust to non-restriction to the common support. These are available upon request.

Table F.1: Results of the probit model to estimate the probability of being left behind for adults

	(1)
	Treated
Age	0.011***
	(0.004)
Male	-0.096
	(0.113)
Head	-0.014
	(0.186)
Spouse	0.051
	(0.192)
Child	0.253
	(0.248)
Grandchild	0.332
	(0.404)
Age of the head	0.007*
	(0.004)
Male head	-0.220*
	(0.116)
Head, none or preschool	-0.117
	(0.143)
Head, primary education	-0.371**
	(0.156)
Head, post-primary education	-0.084
	(0.136)
Head, secondary education	-0.367**
	(0.183)
Household size	0.062***
	(0.022)
Number of working-age members	0.210***
	(0.039)
Dependency ratio	-0.101**
	(0.041)
Rural	0.117
	(0.077)
Wealth index, 1st quintile	0.025
	(0.120)
Wealth index, 2nd quintile	-0.052
	(0.118)
Wealth index, 3rd quintile	-0.116
	(0.111)
Wealth index, 4th quintile	-0.284***
	(0.108)
Constant	-3.094***
	(0.319)
Region dummies	Yes
Log-likelihood	-1246.559
Pseudo R^2	0.177
Observations	4,579

Notes: Standard errors are in parentheses. The reference categories of the explanatory variables are: Other (relationship to the head); Head, tertiary education and Wealth index, 5th quintile.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table F.2: Results of the probit model to estimate the probability of being left behind for children

	(1) Treated
Age	-0.007
	(0.010)
Male	-0.011
	(0.072)
Spouse	0.563
	(0.707)
Child	0.009
	(0.208)
Grandchild	0.208
	(0.240)
Age of the head	0.016***
	(0.003)
Male head	-0.256**
	(0.111)
Head, none or preschool	-0.012
	(0.203)
Head, primary education	-0.152
	(0.215)
Head, post-primary education	0.073
	(0.199)
Head, secondary education	-0.499*
	(0.297)
Household size	0.067**
	(0.031)
Number of working-age members	0.200***
	(0.064)
Dependency ratio	-0.157**
	(0.077)
Rural	0.598***
	(0.119)
Wealth index, 1st quintile	-0.091
	(0.164)
Wealth index, 2nd quintile	-0.172
	(0.166)
Wealth index, 3rd quintile	-0.514***
	(0.167)
Wealth index, 4th quintile	-0.339**
	(0.153)
Constant	-3.550***
	(0.449)
Region dummies	Yes
Log-likelihood	-787.849
Pseudo R^2	0.196
Observations	2,780

Notes: Standard errors are in parentheses. The reference categories of the explanatory variables are: Other (relationship to the head); Head, tertiary education and Wealth index, 5th quintile.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table F.3: Balance test of the matched adults sample using kernel matching

Variable	Mean control	Mean treated	Difference
Age	48.191	48.425	0.234
Male	0.394	0.392	-0.002
Head	0.463	0.466	0.003
Spouse	0.353	0.360	0.007
Child	0.142	0.129	-0.013
Grandchild	0.012	0.011	-0.001
Other	0.031	0.034	0.003
Head age	56.836	56.772	-0.065
Male head	0.764	0.769	0.005
Head, none or preschool	0.520	0.509	-0.012
Head, primary education	0.096	0.103	0.007
Head, post-primary education	0.300	0.297	-0.003
Head, secondary education	0.031	0.028	-0.003
Head, tertiary education	0.052	0.063	0.010
Household size	6.272	6.459	0.187**
Working-age members	3.681	3.815	0.134**
Dependency ratio	0.833	0.833	-0.000
Rural	0.755	0.754	-0.001
Wealth index, 1st quintile	0.380	0.369	-0.012
Wealth index, 2nd quintile	0.169	0.179	0.010
Wealth index, 3rd quintile	0.180	0.177	-0.003
Wealth index, 4th quintile	0.144	0.144	0.000
Wealth index, 5th quintile	0.128	0.131	0.004
Western Region	0.057	0.050	-0.007
Central Region	0.054	0.052	-0.002
Greater Accra Region	0.020	0.015	-0.005
Volta Region	0.100	0.099	-0.001
Eastern Region	0.082	0.086	0.005
Ashanti Region	0.126	0.125	-0.001
Brong-Ahafo Region	0.104	0.116	0.013
Northern Region	0.307	0.304	-0.003
Upper East Region	0.128	0.134	0.006
Upper West Region	0.023	0.019	-0.004

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table F.4: Balance test of the matched children sample using kernel matching

Variable	Mean control	Mean treated	Difference
Age	8.869	8.882	0.013
Male	0.572	0.561	-0.012
Spouse	0.003	0.003	0.001
Child	0.836	0.850	0.014
Grandchild	0.132	0.118	-0.014
Other	0.029	0.029	-0.001
Head age	52.416	52.459	0.043
Male head	0.815	0.822	0.007
Head, none or preschool	0.605	0.580	-0.025
Head, primary education	0.112	0.124	0.013
Head, post-primary education	0.233	0.239	0.006
Head, secondary education	0.012	0.013	0.001
Head, tertiary education	0.039	0.045	0.005
Household size	7.944	7.997	0.053
Working-age members	3.889	3.987	0.098
Dependency ratio	1.201	1.172	-0.029
Rural	0.895	0.885	-0.010
Wealth index, 1st quintile	0.495	0.490	-0.004
Wealth index, 2nd quintile	0.165	0.178	0.013
Wealth index, 3rd quintile	0.165	0.178	0.013
Wealth index, 4th quintile	0.136	0.137	0.001
Wealth index, 5th quintile	0.086	0.092	0.006
Western Region	0.036	0.032	-0.004
Central Region	0.053	0.051	-0.002
Greater Accra Region	0.011	0.013	0.001
Volta Region	0.089	0.089	0.000
Eastern Region	0.043	0.041	-0.001
Ashanti Region	0.088	0.089	0.001
Brong-Ahafo Region	0.111	0.131	0.019
Northern Region	0.425	0.395	-0.030
Upper East Region	0.131	0.146	0.016
Upper West Region	0.014	0.013	-0.001

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Figure F.5: Kernel density of the treated and control groups for adults

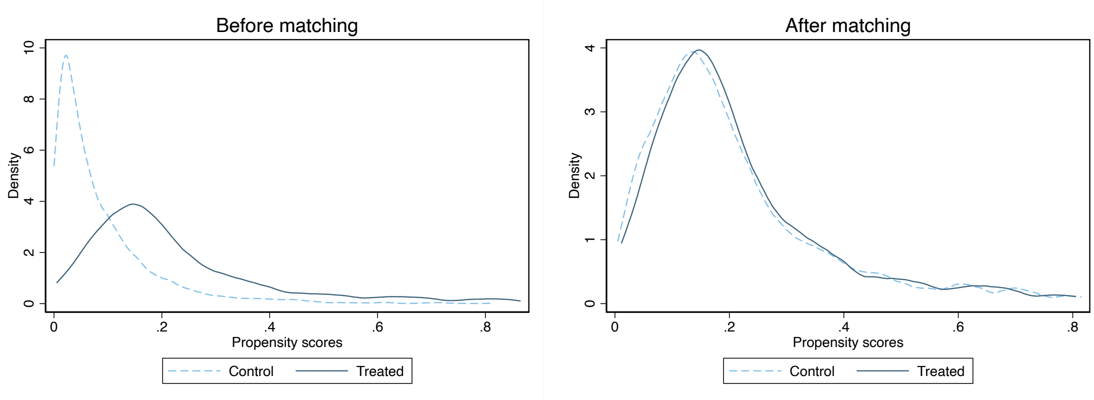
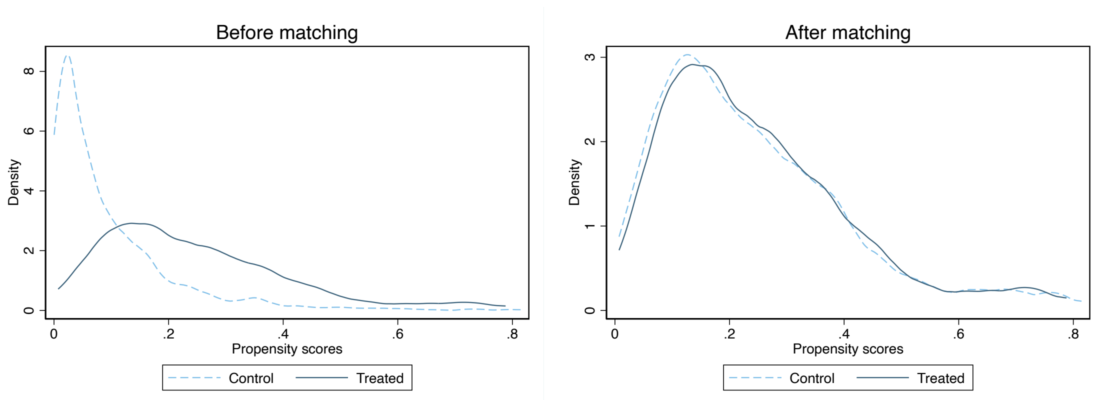


Figure F.6: Kernel density of the treated and control groups for children



G Transition matrices of individuals' nutritional statuses

Table G.1: Nutritional status transition for left-behind and non-left-behind adults

Nutritional status of adults in the first wave (wave 2)	Nutritional status in the following wave (wave 3)			
	Underweight	Healthy	Overweight/Obese	Total
Non-left-behind adults				
Underweight	33.25	57.93	8.82	100.00
Healthy	8.19	64.80	27.02	100.00
Overweight/Obese	2.99	28.76	68.24	100.00
Left-behind adults				
Underweight	28.57	67.35	4.08	100.00
Healthy	12.46	70.37	17.17	100.00
Overweight/Obese	4.03	43.55	52.42	100.00

Table G.2: Nutritional status transition for left-behind and non-left-behind children

Nutritional status of children in the first wave (wave 2)	Nutritional status in the following wave (wave 3)			
	Underweight	Healthy	Overweight/Obese	Total
Non-left-behind children				
Underweight	11.08	72.47	16.46	100.00
Healthy	8.79	72.53	18.68	100.00
Overweight/Obese	6.42	61.15	32.43	100.00
Left-behind children				
Underweight	23.81	59.52	16.67	100.00
Healthy	7.84	74.51	17.65	100.00
Overweight/Obese	16.18	64.71	19.12	100.00

H Robustness checks and heterogeneity

H.1 Internal migration only

Table H.1.1: Results from PSM-DID for adults, internal migration only

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.162**	-1.054*	-1.051*	-1.061*
	(0.582)	(0.550)	(0.546)	(0.548)
Mean weight at baseline	62.781	62.781	62.781	62.781
R^2	0.001	0.122	0.136	0.136
Observations	8,254	8,254	8,254	8,254
Panel B - Males				
Left behind*Post	-2.099***	-1.996**	-2.000***	-2.008***
	(0.812)	(0.782)	(0.769)	(0.771)
Mean weight at baseline	63.625	63.625	63.625	63.625
R^2	0.005	0.097	0.130	0.131
Observations	3,504	3,504	3,504	3,504
Panel C - Females				
Left behind*Post	-0.415	-0.081	-0.071	0.008
	(0.828)	(0.772)	(0.762)	(0.766)
Mean weight at baseline	62.072	62.072	62.072	62.072
R^2	0.003	0.153	0.177	0.177
Observations	4,510	4,510	4,510	4,510
Panel D - Underweight adults				
Left behind*Post	0.315	0.345	0.309	0.738
	(1.234)	(1.115)	(1.113)	(1.158)
Mean weight at baseline	46.776	46.776	46.776	46.776
R^2	0.141	0.338	0.352	0.356
Observations	502	502	502	502
Panel E - Healthy adults				
Left behind*Post	-1.108**	-1.113**	-1.124**	-1.192**
	(0.527)	(0.485)	(0.482)	(0.484)
Mean weight at baseline	58.991	58.991	58.991	58.991
R^2	0.009	0.176	0.188	0.189
Observations	4,260	4,260	4,260	4,260
Panel F - Overweight adults				
Left behind*Post	-1.316	-1.033	-1.006	-1.072
	(1.238)	(1.191)	(1.179)	(1.182)
Mean weight at baseline	75.279	75.279	75.279	75.279
R^2	0.031	0.130	0.152	0.153
Observations	2,532	2,532	2,532	2,532
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.1.2: Results from PSM-DID for children, internal migration only

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.249**	-0.312***	-0.295***	-0.325***
	(0.098)	(0.097)	(0.096)	(0.097)
Mean zbmi at baseline	-0.094	-0.094	-0.094	-0.094
R^2	0.003	0.053	0.073	0.074
Observations	4,796	4,796	4,796	4,796
Panel B - Males				
Left behind*Post	-0.262*	-0.345***	-0.320**	-0.335**
	(0.136)	(0.133)	(0.132)	(0.133)
Mean zbmi at baseline	-0.121	-0.121	-0.121	-0.121
R^2	0.002	0.082	0.097	0.098
Observations	2,812	2,812	2,812	2,812
Panel C - Females				
Left behind*Post	-0.301**	-0.325**	-0.317**	-0.358**
	(0.143)	(0.143)	(0.140)	(0.142)
Mean zbmi at baseline	-0.059	-0.059	-0.059	-0.059
R^2	0.006	0.036	0.073	0.075
Observations	1,904	1,904	1,904	1,904
Panel D - Underweight children				
Left behind*Post	-0.330	-0.649**	-0.596**	-0.482*
	(0.319)	(0.282)	(0.275)	(0.271)
Mean zbmi at baseline	-2.962	-2.962	-2.962	-2.962
R^2	0.429	0.601	0.635	0.656
Observations	352	352	352	352
Panel E - Healthy children				
Left behind*Post	-0.130	-0.165*	-0.154*	-0.179**
	(0.085)	(0.086)	(0.086)	(0.086)
Mean zbmi at baseline	-0.407	-0.407	-0.407	-0.407
R^2	0.005	0.034	0.044	0.049
Observations	3,132	3,132	3,132	3,132
Panel F - Overweight children				
Left behind*Post	-0.462***	-0.537***	-0.534***	-0.639***
	(0.171)	(0.167)	(0.164)	(0.164)
Mean zbmi at baseline	2.283	2.283	2.283	2.283
R^2	0.392	0.444	0.473	0.483
Observations	1,130	1,130	1,130	1,130
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.2 Removing migration for less than six months

Table H.2.1: Results from PSM-DID for adults, without migration for less than six months

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.095*	-1.025*	-1.073**	-1.108**
	(0.572)	(0.541)	(0.537)	(0.539)
Mean weight at baseline	62.778	62.778	62.778	62.778
R^2	0.001	0.123	0.137	0.137
Observations	8,538	8,538	8,538	8,538
Panel B - Males				
Left behind*Post	-2.093***	-1.992***	-1.971***	-1.939***
	(0.783)	(0.755)	(0.745)	(0.746)
Mean weight at baseline	63.702	63.702	63.702	63.702
R^2	0.005	0.097	0.124	0.124
Observations	3,780	3,780	3,780	3,780
Panel C - Females				
Left behind*Post	-0.409	-0.127	-0.175	-0.176
	(0.837)	(0.783)	(0.774)	(0.779)
Mean weight at baseline	62.002	62.002	62.002	62.002
R^2	0.005	0.148	0.171	0.171
Observations	4,412	4,412	4,412	4,412
Panel D - Underweight adults				
Left behind*Post	0.737	0.557	0.543	0.893
	(1.196)	(1.080)	(1.079)	(1.105)
Mean weight at baseline	46.790	46.790	46.790	46.790
R^2	0.143	0.340	0.354	0.357
Observations	536	536	536	536
Panel E - Healthy adults				
Left behind*Post	-1.240**	-1.219***	-1.244***	-1.296***
	(0.506)	(0.466)	(0.464)	(0.465)
Mean weight at baseline	58.998	58.998	58.998	58.998
R^2	0.008	0.179	0.190	0.191
Observations	4,600	4,600	4,600	4,600
Panel F - Overweight adults				
Left behind*Post	-0.957	-0.518	-0.550	-0.616
	(1.262)	(1.219)	(1.208)	(1.212)
Mean weight at baseline	75.336	75.336	75.336	75.336
R^2	0.036	0.129	0.149	0.151
Observations	2,464	2,464	2,464	2,464
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.2.2: Results from PSM-DID for children, without migration for less than six months

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.204**	-0.254***	-0.240**	-0.268***
	(0.097)	(0.096)	(0.095)	(0.096)
Mean zbmi at baseline	-0.091	-0.091	-0.091	-0.091
R^2	0.003	0.054	0.076	0.077
Observations	4,900	4,900	4,900	4,900
Panel B - Males				
Left behind*Post	-0.239*	-0.308**	-0.289**	-0.311**
	(0.135)	(0.133)	(0.132)	(0.133)
Mean zbmi at baseline	-0.115	-0.115	-0.115	-0.115
R^2	0.002	0.076	0.092	0.093
Observations	2,810	2,810	2,810	2,810
Panel C - Females				
Left behind*Post	-0.211	-0.263*	-0.244*	-0.277*
	(0.144)	(0.143)	(0.140)	(0.142)
Mean zbmi at baseline	-0.060	-0.060	-0.060	-0.060
R^2	0.006	0.050	0.095	0.096
Observations	1,996	1,996	1,996	1,996
Panel D - Underweight children				
Left behind*Post	-0.117	-0.474*	-0.464*	-0.417*
	(0.256)	(0.242)	(0.242)	(0.242)
Mean zbmi at baseline	-2.958	-2.958	-2.958	-2.958
R^2	0.452	0.563	0.578	0.590
Observations	440	440	440	440
Panel E - Healthy children				
Left behind*Post	-0.098	-0.121	-0.111	-0.141*
	(0.084)	(0.085)	(0.085)	(0.085)
Mean zbmi at baseline	-0.405	-0.405	-0.405	-0.405
R^2	0.005	0.032	0.042	0.048
Observations	3,154	3,154	3,154	3,154
Panel F - Overweight children				
Left behind*Post	-0.408**	-0.446***	-0.450***	-0.530***
	(0.171)	(0.167)	(0.164)	(0.164)
Mean zbmi at baseline	2.293	2.293	2.293	2.283
R^2	0.405	0.450	0.480	0.487
Observations	1,148	1,148	1,148	1,148
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.3 Disentangling the potential bias from previous migration

Table H.3.1: Results from PSM-DID for adults, without migration between waves 1 and 2

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.016*	-1.009*	-1.023*	-1.075*
	(0.583)	(0.551)	(0.547)	(0.551)
Mean weight at baseline	62.887	62.887	62.887	62.887
R^2	0.001	0.122	0.135	0.135
Observations	8,058	8,058	8,058	8,058
Panel B - Males				
Left behind*Post	-1.863**	-1.837**	-1.837**	-1.874**
	(0.800)	(0.769)	(0.757)	(0.759)
Mean weight at baseline	63.724	63.724	63.724	63.724
R^2	0.004	0.101	0.133	0.134
Observations	3,546	3,546	3,546	3,546
Panel C - Females				
Left behind*Post	-0.361	-0.133	-0.144	-0.113
	(0.856)	(0.801)	(0.793)	(0.799)
Mean weight at baseline	62.174	62.174	62.174	62.174
R^2	0.005	0.148	0.168	0.168
Observations	4,156	4,156	4,156	4,156
Panel D - Underweight adults				
Left behind*Post	0.902	0.784	0.804	1.204
	(1.299)	(1.200)	(1.203)	(1.243)
Mean weight at baseline	46.944	46.944	46.944	46.944
R^2	0.147	0.315	0.327	0.330
Observations	496	496	496	496
Panel E - Healthy adults				
Left behind*Post	-1.163**	-1.120**	-1.128**	-1.244***
	(0.515)	(0.475)	(0.472)	(0.474)
Mean weight at baseline	58.047	58.047	58.047	58.047
R^2	0.009	0.177	0.187	0.189
Observations	4,416	4,416	4,416	4,416
Panel F - Overweight adults				
Left behind*Post	-1.801	-1.521	-1.521	-1.607
	(1.276)	(1.227)	(1.216)	(1.220)
Mean weight at baseline	75.305	75.305	75.305	75.305
R^2	0.032	0.132	0.152	0.153
Observations	2,316	2,316	2,316	2,316
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.3.2: Results from PSM-DID for children, without migration between waves 1 and 2

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.121	-0.164*	-0.149	-0.182*
	(0.099)	(0.098)	(0.096)	(0.097)
Mean zbmi at baseline	-0.096	-0.096	-0.096	-0.096
R^2	0.002	0.049	0.073	0.074
Observations	4,710	4,710	4,710	4,710
Panel B - Males				
Left behind*Post	-0.082	-0.173	-0.149	-0.178
	(0.138)	(0.135)	(0.134)	(0.135)
Mean zbmi at baseline	-0.123	-0.123	-0.123	-0.123
R^2	0.001	0.074	0.091	0.092
Observations	2,692	2,692	2,692	2,692
Panel C - Females				
Left behind*Post	-0.298**	-0.322**	-0.309**	-0.349**
	(0.144)	(0.144)	(0.141)	(0.143)
Mean zbmi at baseline	-0.063	-0.063	-0.063	-0.063
R^2	0.005	0.039	0.085	0.086
Observations	1,924	1,924	1,924	1,924
Panel D - Underweight children				
Left behind*Post	-0.031	-0.333	-0.291	-0.232
	(0.273)	(0.260)	(0.259)	(0.256)
Mean zbmi at baseline	-2.985	-2.985	-2.985	-2.985
R^2	0.463	0.565	0.585	0.599
Observations	398	398	398	398
Panel E - Healthy children				
Left behind*Post	-0.034	-0.052	-0.042	-0.075
	(0.087)	(0.087)	(0.087)	(0.087)
Mean zbmi at baseline	-0.403	-0.403	-0.403	-0.403
R^2	0.005	0.035	0.047	0.050
Observations	2,994	2,994	2,994	2,994
Panel F - Overweight children				
Left behind*Post	-0.546***	-0.585***	-0.581***	-0.690***
	(0.172)	(0.168)	(0.164)	(0.165)
Mean zbmi at baseline	2.288	2.288	2.288	2.288
R^2	0.399	0.447	0.481	0.489
Observations	1,092	1,092	1,092	1,092
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.4 Matching without individual-level variables

Table H.4.1: Results from PSM-DID for adults, matching without individual-level variables

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.305**	-1.195**	-1.172**	-1.158**
	(0.559)	(0.532)	(0.528)	(0.530)
Mean weight at baseline	62.765	62.765	62.765	62.765
R^2	0.002	0.116	0.130	0.130
Observations	8,718	8,718	8,718	8,718
Panel B - Males				
Left behind*Post	-2.011***	-1.972***	-1.991***	-1.992***
	(0.777)	(0.751)	(0.739)	(0.741)
Mean weight at baseline	63.633	63.633	63.633	63.633
R^2	0.004	0.093	0.124	0.124
Observations	3,792	3,792	3,792	3,792
Panel C - Females				
Left behind*Post	-0.624	-0.312	-0.250	-0.199
	(0.812)	(0.760)	(0.751)	(0.755)
Mean weight at baseline	62.036	62.036	62.036	62.036
R^2	0.005	0.147	0.172	0.172
Observations	4,626	4,626	4,626	4,626
Panel D - Underweight adults				
Left behind*Post	0.026	0.019	0.030	0.522
	(1.149)	(1.042)	(1.042)	(1.061)
Mean weight at baseline	46.819	46.819	46.819	46.819
R^2	0.145	0.342	0.353	0.359
Observations	604	604	604	604
Panel E - Healthy adults				
Left behind*Post	-1.140**	-1.171**	-1.171***	-1.271***
	(0.496)	(0.457)	(0.454)	(0.455)
Mean weight at baseline	58.998	58.998	58.998	58.998
R^2	0.011	0.180	0.191	0.193
Observations	4,796	4,796	4,796	4,796
Panel F - Overweight adults				
Left behind*Post	-1.684	-1.470	-1.472	-1.538
	(1.208)	(1.163)	(1.152)	(1.155)
Mean weight at baseline	75.279	75.279	75.279	75.279
R^2	0.029	0.128	0.149	0.150
Observations	2,562	2,562	2,562	2,562
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.4.2: Results from PSM-DID for children, matching without individual-level variables

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.184*	-0.227**	-0.213**	-0.239**
	(0.095)	(0.094)	(0.093)	(0.094)
Mean zbmi at baseline	-0.096	-0.096	-0.096	-0.096
R^2	0.002	0.049	0.070	0.071
Observations	5,040	5,040	5,040	5,040
Panel B - Males				
Left behind*Post	-0.163	-0.261**	-0.238*	-0.262**
	(0.130)	(0.128)	(0.127)	(0.128)
Mean zbmi at baseline	-0.123	-0.123	-0.123	-0.123
R^2	0.001	0.075	0.089	0.091
Observations	2,910	2,910	2,910	2,910
Panel C - Females				
Left behind*Post	-0.356**	-0.387***	-0.377***	-0.427***
	(0.138)	(0.138)	(0.135)	(0.138)
Mean zbmi at baseline	-0.063	-0.063	-0.063	-0.063
R^2	0.005	0.041	0.081	0.083
Observations	2,076	2,076	2,076	2,076
Panel D - Underweight children				
Left behind*Post	-0.180	-0.462**	-0.424*	-0.358
	(0.246)	(0.234)	(0.232)	(0.231)
Mean zbmi at baseline	-2.962	-2.962	-2.962	-2.962
R^2	0.476	0.576	0.597	0.609
Observations	466	466	466	466
Panel E - Healthy children				
Left behind*Post	-0.130	-0.161*	-0.152*	-0.183**
	(0.083)	(0.083)	(0.083)	(0.083)
Mean zbmi at baseline	-0.406	-0.406	-0.406	-0.406
R^2	0.007	0.035	0.045	0.049
Observations	3,294	3,294	3,294	3,294
Panel F - Overweight children				
Left behind*Post	-0.653***	-0.687***	-0.677***	-0.797***
	(0.170)	(0.166)	(0.162)	(0.164)
Mean zbmi at baseline	2.285	2.285	2.285	2.285
R^2	0.383	0.436	0.466	0.474
Observations	1,134	1,134	1,134	1,134
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.5 Heterogeneity in migration temporalities

From the tables below, it appears that, for adults overall, the initial stages of migration have a significant and negative impact on their body weight, as indicated by the negative and statistically significant coefficient in Panel A of Table H.5.1. However, this effect seems to dissipate after twelve months of migration (Panel A of Table H.5.3). Regarding gender, women are more affected during the early stages of migration (between six and twelve months), but this effect vanishes after twelve months. In contrast, men are impacted more significantly after twelve months. Regarding nutritional status, healthy adults are primarily affected during the first six to twelve months of migration but less so afterward. On the other hand, undernourished adults exhibit a positive effect on weight as time since migration progresses.

Overall, adults are less dependent on the duration of a member's migration compared to children. For children, we observe increasingly positive and significant effects as the duration of migration extends, and the magnitude of these effects also rises (Tables H.5.2 and H.5.4). For instance, while the coefficient increases noticeably for all children, it becomes distinctly negative and significant for both boys and girls (comparing Panels B and C).

Table H.5.1: Results from PSM-DID for adults, migration between six and twelve months

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.709***	-1.857***	-1.695***	-1.830***
	(0.591)	(0.555)	(0.547)	(0.550)
Mean weight at baseline	62.875	62.875	62.875	62.875
R^2	0.008	0.142	0.170	0.170
Observations	7,644	7,644	7,644	7,644
Panel B - Males				
Left behind*Post	-1.655	-1.460	-1.294	-1.670*
	(1.061)	(0.976)	(0.963)	(0.971)
Mean weight at baseline	63.620	63.620	63.620	63.620
R^2	0.004	0.189	0.218	0.224
Observations	1,468	1,468	1,468	1,468
Panel C - Females				
Left behind*Post	-1.927**	-1.797**	-1.770**	-1.878**
	(0.867)	(0.797)	(0.772)	(0.778)
Mean weight at baseline	62.241	62.241	62.241	62.241
R^2	0.009	0.186	0.239	0.239
Observations	4,192	4,192	4,192	4,192
Panel D - Underweight adults				
Left behind*Post	0.078	-0.242	-0.253	-0.401
	(1.952)	(1.807)	(1.794)	(1.890)
Mean weight at baseline	46.733	46.733	46.733	46.733
R^2	0.102	0.337	0.364	0.364
Observations	212	212	212	212
Panel E - Healthy adults				
Left behind*Post	-2.193***	-2.500***	-2.415***	-2.759***
	(0.514)	(0.471)	(0.464)	(0.467)
Mean weight at baseline	59.111	59.111	59.111	59.111
R^2	0.013	0.191	0.219	0.225
Observations	4,468	4,468	4,468	4,468
Panel F - Overweight adults				
Left behind*Post	-2.491	-1.239	-1.189	-1.551
	(2.030)	(1.836)	(1.798)	(1.798)
Mean weight at baseline	75.339	75.339	75.339	75.339
R^2	0.039	0.266	0.311	0.317
Observations	888	888	888	888
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.5.2: Results from PSM-DID for children, migration between six and twelve months

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.175*	-0.197**	-0.191**	-0.182*
	(0.095)	(0.094)	(0.093)	(0.094)
Mean zbmi at baseline	-0.104	-0.104	-0.104	-0.104
R^2	0.001	0.055	0.068	0.070
Observations	4,736	4,736	4,736	4,736
Panel B - Males				
Left behind*Post	-0.053	-0.127	-0.100	-0.030
	(0.168)	(0.162)	(0.162)	(0.164)
Mean zbmi at baseline	-0.128	-0.128	-0.128	-0.128
R^2	0.005	0.118	0.126	0.137
Observations	1,662	1,662	1,662	1,662
Panel C - Females				
Left behind*Post	-0.191	-0.219	-0.218	-0.272**
	(0.141)	(0.141)	(0.136)	(0.137)
Mean zbmi at baseline	-0.074	-0.074	-0.074	-0.074
R^2	0.001	0.034	0.113	0.117
Observations	1,970	1,970	1,970	1,970
Panel D - Underweight children				
Left behind*Post	-0.267	-0.333	-0.325	-0.293
	(0.325)	(0.320)	(0.323)	(0.326)
Mean zbmi at baseline	-2.961	-2.961	-2.961	-2.961
R^2	0.433	0.573	0.597	0.600
Observations	246	246	246	246
Panel E - Healthy children				
Left behind*Post	-0.300***	-0.297***	-0.298***	-0.320***
	(0.109)	(0.108)	(0.107)	(0.109)
Mean zbmi at baseline	-0.416	-0.416	-0.416	-0.416
R^2	0.007	0.070	0.089	0.090
Observations	1,928	1,928	1,928	1,928
Panel F - Overweight children				
Left behind*Post	-0.223	-0.249	-0.249	-0.194
	(0.292)	(0.283)	(0.284)	(0.296)
Mean zbmi at baseline	2.276	2.276	2.276	2.276
R^2	0.408	0.498	0.506	0.507
Observations	316	316	316	316
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.5.3: Results from PSM-DID for adults, migration for more than twelve months

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-0.954*	-0.705	-0.713	-0.702
	(0.575)	(0.544)	(0.539)	(0.541)
Mean weight at baseline	62.831	62.831	62.831	62.831
R^2	0.001	0.125	0.142	0.142
Observations	8,422	8,422	8,422	8,422
Panel B - Males				
Left behind*Post	-2.042**	-1.868**	-1.787**	-1.745**
	(0.800)	(0.772)	(0.760)	(0.761)
Mean weight at baseline	63.660	63.660	63.660	63.660
R^2	0.004	0.099	0.130	0.130
Observations	3,798	3,798	3,798	3,798
Panel C - Females				
Left behind*Post	0.016	0.358	0.321	0.338
	(0.845)	(0.784)	(0.775)	(0.779)
Mean weight at baseline	62.127	62.127	62.127	62.127
R^2	0.003	0.163	0.184	0.185
Observations	4,266	4,266	4,266	4,266
Panel D - Underweight adults				
Left behind*Post	2.230	2.262*	2.263*	2.642**
	(1.367)	(1.271)	(1.269)	(1.282)
Mean weight at baseline	46.816	46.816	46.816	46.816
R^2	0.181	0.374	0.390	0.395
Observations	460	460	460	460
Panel E - Healthy adults				
Left behind*Post	-0.887*	-0.716	-0.734	-0.753
	(0.524)	(0.477)	(0.473)	(0.475)
Mean weight at baseline	59.043	59.043	59.043	59.043
R^2	0.009	0.198	0.212	0.213
Observations	4,368	4,368	4,368	4,368
Panel F - Overweight adults				
Left behind*Post	-0.710	-0.544	-0.568	-0.545
	(1.287)	(1.239)	(1.218)	(1.220)
Mean weight at baseline	75.257	75.257	75.257	75.257
R^2	0.030	0.133	0.167	0.168
Observations	2,386	2,386	2,386	2,386
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.5.4: Results from PSM-DID for children, migration for more than twelve months

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.253**	-0.347***	-0.319***	-0.349***
	(0.101)	(0.099)	(0.098)	(0.098)
Mean zbmi at baseline	-0.094	-0.094	-0.094	-0.094
R^2	0.003	0.062	0.091	0.093
Observations	4,662	4,662	4,662	4,662
Panel B - Males				
Left behind*Post	-0.209	-0.338**	-0.309**	-0.330**
	(0.140)	(0.137)	(0.135)	(0.135)
Mean zbmi at baseline	-0.117	-0.117	-0.117	-0.117
R^2	0.001	0.081	0.109	0.113
Observations	2,598	2,598	2,598	2,598
Panel C - Females				
Left behind*Post	-0.548***	-0.599***	-0.594***	-0.627***
	(0.200)	(0.201)	(0.198)	(0.201)
Mean zbmi at baseline	-0.065	-0.065	-0.065	-0.065
R^2	0.010	0.056	0.091	0.092
Observations	1,018	1,018	1,018	1,018
Panel D - Underweight children				
Left behind*Post	0.080	-0.270	-0.217	-0.178
	(0.294)	(0.273)	(0.270)	(0.270)
Mean zbmi at baseline	-2.951	-2.951	-2.951	-2.951
R^2	0.464	0.605	0.637	0.642
Observations	316	316	316	316
Panel E - Healthy children				
Left behind*Post	-0.050	-0.097	-0.078	-0.117
	(0.088)	(0.088)	(0.088)	(0.088)
Mean zbmi at baseline	-0.417	-0.417	-0.417	-0.417
R^2	0.005	0.031	0.048	0.054
Observations	2,920	2,920	2,920	2,920
Panel F - Overweight children				
Left behind*Post	-0.794***	-0.808***	-0.795***	-0.931***
	(0.182)	(0.177)	(0.172)	(0.174)
Mean zbmi at baseline	2.287	2.287	2.287	2.287
R^2	0.369	0.429	0.471	0.478
Observations	1,102	1,102	1,102	1,102
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.6 Heterogeneity by the number of migrants

In our sample of adults, 394 adults are in households with precisely one migrant for work for more than six months and 76 adults are in households with more than one migrant. In the children's sample, the corresponding figures are 251 children and 63 children. Since the number of individuals decreases for households with more than one migrant, I present the results without restricting to the common support to retain the maximum number of observations.

H.6.1 One migrant

Table H.6.1: Results from PSM-DID for adults, one migrant

	Weight			
	(1)	(2)	(3)	(4)
Left behind*Post	-1.135**	-1.305**	-1.333**	-1.402***
	(0.561)	(0.527)	(0.523)	(0.524)
Mean weight at baseline	62.801	62.801	62.801	62.801
R^2	0.001	0.133	0.149	0.149
Observations	9,006	9,006	9,006	9,006
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.6.2: Results from PSM-DID for children, one migrant

	Zbmi			
	(1)	(2)	(3)	(4)
Left behind*Post	-0.243***	-0.294***	-0.289***	-0.297***
	(0.092)	(0.090)	(0.090)	(0.090)
Mean zbmi at baseline	-0.096	-0.096	-0.096	-0.096
R^2	0.002	0.052	0.068	0.068
Observations	5,432	5,432	5,432	5,432
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.6.2 More than one migrant

Table H.6.3: Results from PSM-DID for adults, more than one migrant

	Weight			
	(1)	(2)	(3)	(4)
Left behind*Post	-1.425**	-0.512	-0.473	-0.261
	(0.614)	(0.587)	(0.583)	(0.591)
Mean weight at baseline	62.909	62.909	62.909	62.909
R^2	0.002	0.128	0.142	0.143
Observations	6,172	6,172	6,172	6,172
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.6.4: Results from PSM-DID for children, more than one migrant

	Zbmi			
	(1)	(2)	(3)	(4)
Left behind*Post	-0.254**	-0.365***	-0.330***	-0.502***
	(0.109)	(0.106)	(0.102)	(0.105)
Mean zbmi at baseline	-0.102	-0.102	-0.102	-0.102
R^2	0.002	0.099	0.169	0.182
Observations	3,748	3,748	3,748	3,748
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.7 Potential endogeneity concerns

Some variables used for matching and DID analysis may be considered endogenous. It is particularly applicable to variables related to household headship. Specifically, variables associated with the household headship, such as age, gender, and educational level, could be endogenous with respect to the treatment (Bertoli and Marchetta, 2014). Similarly, the variable accounting for household size may also be endogenous. The potential endogeneity may invalidate their inclusion (Lechner, 2008). As a result, it is imperative to ensure that these variables do not introduce bias to the results. To address this concern, I exclude these four variables (household head age, gender, and education level, as well as household size) from the matching and the DID analysis. The results are presented in Tables H.7.1 and H.7.2.

For most of the individuals, the results remain consistent. However, the coefficients are no longer significant for the regressions related to the adult population, albeit they approach significance in columns (2) to (4). A second noteworthy difference is the newfound significance for the healthy children subsample, suggesting that migration has a negative effect on the z-score of left-behind healthy children. Nonetheless, the other results remain robust. The notion underlying the possibility of some variables related to household headship being endogenous is based on the idea that migration could entail a change in household headship. However, upon thorough data exploration, I observed that less than 4% of migrants were household heads in wave 2, i.e., prior to their migration. Furthermore, there is very little change in household heads, both among migrant and non-migrant households (less than 1% in both cases). Hence, even though we have examined the results without these variables, I believe that endogeneity related to household headship is not an issue in our case.

Table H.7.1: Results from PSM-DID for adults, without household headship variables and household size

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-0.938*	-0.853	-0.822	-0.836
	(0.552)	(0.529)	(0.525)	(0.527)
Mean weight at baseline	62.784	62.784	62.784	62.784
R^2	0.002	0.099	0.113	0.114
Observations	9,120	9,120	9,120	9,120
Panel B - Males				
Left behind*Post	-1.956***	-1.943***	-1.863**	-1.856**
	(0.745)	(0.732)	(0.724)	(0.725)
Mean weight at baseline	63.660	63.660	63.660	63.660
R^2	0.003	0.057	0.081	0.081
Observations	4,122	4,122	4,122	4,122
Panel C - Females				
Left behind*Post	-0.362	-0.155	-0.089	-0.054
	(0.799)	(0.753)	(0.742)	(0.747)
Mean weight at baseline	62.055	62.055	62.055	62.055
R^2	0.004	0.129	0.157	0.157
Observations	4,784	4,784	4,784	4,784
Panel D - Underweight adults				
Left behind*Post	0.850	0.800	0.780	1.017
	(1.094)	(1.027)	(1.028)	(1.052)
Mean weight at baseline	46.835	46.835	46.835	46.835
R^2	0.143	0.265	0.273	0.275
Observations	734	734	734	734
Panel E - Healthy adults				
Left behind*Post	-1.225**	-1.235***	-1.251***	-1.376***
	(0.480)	(0.443)	(0.441)	(0.443)
Mean weight at baseline	59.000	59.000	59.000	59.000
R^2	0.009	0.170	0.178	0.180
Observations	5,206	5,206	5,206	5,206
Panel F - Overweight adults				
Left behind*Post	-0.955	-0.621	-0.512	-0.535
	(1.213)	(1.190)	(1.175)	(1.176)
Mean weight at baseline	75.265	75.265	75.265	75.265
R^2	0.032	0.134	0.156	0.156
Observations	2,634	2,634	2,634	2,634
Individual variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age and gender. Household variables include number of working-age members, dependency ratio and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.7.2: Results from PSM-DID for children, without household headship variables and household size

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.200**	-0.245***	-0.237**	-0.266***
	(0.095)	(0.094)	(0.094)	(0.095)
Mean zbmi at baseline	-0.090	-0.090	-0.090	-0.090
R^2	0.002	0.041	0.059	0.059
Observations	5,014	5,014	5,014	5,014
Panel B - Males				
Left behind*Post	-0.129	-0.242*	-0.233*	-0.249*
	(0.137)	(0.135)	(0.135)	(0.135)
Mean zbmi at baseline	-0.118	-0.118	-0.118	-0.118
R^2	0.001	0.066	0.079	0.080
Observations	2,712	2,712	2,712	2,712
Panel C - Females				
Left behind*Post	-0.309**	-0.328**	-0.316**	-0.373***
	(0.137)	(0.136)	(0.135)	(0.137)
Mean zbmi at baseline	-0.055	-0.055	-0.055	-0.055
R^2	0.005	0.025	0.054	0.057
Observations	2,142	2,142	2,142	2,142
Panel D - Underweight children				
Left behind*Post	-0.004	-0.049	-0.009	0.008
	(0.242)	(0.240)	(0.237)	(0.237)
Mean zbmi at baseline	-2.962	-2.962	-2.962	-2.962
R^2	0.451	0.489	0.510	0.520
Observations	480	480	480	480
Panel E - Healthy children				
Left behind*Post	-0.150*	-0.189**	-0.182**	-0.208**
	(0.085)	(0.085)	(0.085)	(0.086)
Mean zbmi at baseline	-0.406	-0.406	-0.406	-0.406
R^2	0.006	0.029	0.039	0.042
Observations	3,098	3,098	3,098	3,098
Panel F - Overweight children				
Left behind*Post	-0.572***	-0.611***	-0.611***	-0.714***
	(0.168)	(0.166)	(0.163)	(0.164)
Mean zbmi at baseline	2.288	2.288	2.288	2.288
R^2	0.380	0.412	0.442	0.451
Observations	1,216	1,216	1,216	1,216
Individual variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age and gender. Household variables include number of working-age members, dependency ratio and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

H.8 Migrants over 15 years old only

Table H.8.1: Results from PSM-DID for adults, migrants over 15 years old only

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.350**	-1.170**	-1.158**	-1.137**
	(0.591)	(0.558)	(0.554)	(0.557)
Mean weight at baseline	62.810	62.810	62.810	62.810
R^2	0.002	0.125	0.141	0.141
Observations	7,956	7,956	7,956	7,956
Panel B - Males				
Left behind*Post	-1.369*	-1.349*	-1.303*	-1.293*
	(0.805)	(0.770)	(0.757)	(0.760)
Mean weight at baseline	63.617	63.617	63.617	63.617
R^2	0.002	0.105	0.140	0.140
Observations	3,406	3,406	3,406	3,406
Panel C - Females				
Left behind*Post	-1.054	-0.654	-0.645	-0.574
	(0.883)	(0.824)	(0.814)	(0.821)
Mean weight at baseline	62.131	62.131	62.131	62.131
R^2	0.006	0.154	0.177	0.177
Observations	4,072	4,072	4,072	4,072
Panel D - Underweight adults				
Left behind*Post	0.136	0.309	0.295	0.994
	(1.466)	(1.285)	(1.266)	(1.324)
Mean weight at baseline	46.752	46.752	46.752	46.752
R^2	0.145	0.381	0.409	0.414
Observations	464	464	464	464
Panel E - Healthy adults				
Left behind*Post	-1.331***	-1.292***	-1.301***	-1.351***
	(0.501)	(0.455)	(0.452)	(0.454)
Mean weight at baseline	59.027	59.027	59.027	59.027
R^2	0.011	0.196	0.210	0.211
Observations	4,820	4,820	4,820	4,820
Panel F - Overweight adults				
Left behind*Post	-0.598	-0.198	-0.179	-0.194
	(1.289)	(1.239)	(1.223)	(1.228)
Mean weight at baseline	75.257	75.257	75.257	75.257
R^2	0.032	0.139	0.166	0.166
Observations	2,370	2,370	2,370	2,370
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table H.8.2: Results from PSM-DID for children, migrants over 15 years old only

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.322***	-0.366***	-0.351***	-0.364***
	(0.102)	(0.100)	(0.099)	(0.100)
Mean zbmi at baseline	-0.104	-0.104	-0.104	-0.104
R^2	0.003	0.060	0.078	0.078
Observations	4,346	4,346	4,346	4,346
Panel B - Males				
Left behind*Post	-0.383***	-0.485***	-0.458***	-0.446***
	(0.145)	(0.141)	(0.141)	(0.141)
Mean zbmi at baseline	-0.128	-0.128	-0.128	-0.128
R^2	0.003	0.093	0.106	0.107
Observations	2,348	2,348	2,348	2,348
Panel C - Females				
Left behind*Post	-0.464***	-0.494***	-0.500***	-0.589***
	(0.154)	(0.153)	(0.151)	(0.153)
Mean zbmi at baseline	-0.073	-0.073	-0.073	-0.073
R^2	0.006	0.043	0.080	0.086
Observations	1,652	1,652	1,652	1,652
Panel D - Underweight children				
Left behind*Post	-0.490	-0.834***	-0.769***	-0.572**
	(0.307)	(0.277)	(0.272)	(0.267)
Mean zbmi at baseline	-2.961	-2.961	-2.961	-2.961
R^2	0.436	0.585	0.613	0.638
Observations	376	376	376	376
Panel E - Healthy children				
Left behind*Post	-0.379***	-0.394***	-0.391***	-0.406***
	(0.084)	(0.084)	(0.084)	(0.084)
Mean zbmi at baseline	-0.411	-0.411	-0.411	-0.411
R^2	0.008	0.051	0.059	0.064
Observations	2,878	2,878	2,878	2,878
Panel F - Overweight children				
Left behind*Post	-0.607***	-0.548***	-0.556***	-0.612***
	(0.184)	(0.177)	(0.174)	(0.182)
Mean zbmi at baseline	2.284	2.284	2.284	2.284
R^2	0.324	0.406	0.436	0.437
Observations	1,026	1,026	1,026	1,026
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

I Alternative model including variables of labor market participation

As explained in the empirical strategy section, I explore the potential inclusion of labor market participation variables. This consideration stems from the understanding that labor market conditions might differ between left-behind and non-left-behind individuals, influencing migration decisions and, by extension, nutritional outcomes. Also, left-behind individuals might come from households with poorer labor market conditions, potentially affecting the estimated impact on their nutritional status. This consideration also applies to the labor market conditions of other household members, acknowledging the influence of collective income sharing on individual nutritional status.

Based on the employment screener section of the questionnaire,[29] I constructed variables reflecting both individual and household-level labor market participation. These are employed in the matching process and as controls in the DID. At the individual level, I categorized individuals as economically active, inactive, or looking for a job. At the household level, I constructed three variables representing the number of individuals per household in each of the above job categories. The results, incorporating these variables, are presented in Tables I.1 and I.2 below for adults and children respectively. Notably, for adults, while results are largely consistent, the introduction of these variables rendered the coefficient for overweight or obese individuals significant, suggesting a weight decline among left-behind adults post-migration. For children, the results varied slightly in coefficients but maintained similar significance and signs.

However, these labor market variables were excluded from the main model. My reservations are threefold: 1) The imperfect representation of labor market conditions due to overlapping categories of activities in the survey data. Indeed, it is challenging to distinctly ascertain whether some individuals are economically active or not. For example, individuals may simultaneously report being full-time homemakers or students while owning an enterprise or contributing to a household farm. Additionally, another section of the questionnaire asking for the main paid occupation over the last seven days is only answered by a small subset of all the individuals currently working; 2) There is a temporal mismatch between the observed labor conditions and the actual migration decisions. Indeed, migra-

[29] In wave 2, this information appears in Section 1: Individual Information, Part D: Background Information, 1EA: Employment Screener, and in wave 3, in Section 1: Household Background, Part F: Employment, 0: Employment Screener.

tion occurs between waves 2 and 3, and there may be a disparity between the labor market conditions observed in wave 2 and those influencing migration decisions between waves 2 and 3[30]; 3) Additionally, the presence of missing data for these variables further complicated their use, significantly reducing the usable sample size. Despite these limitations, an alternative model incorporating these variables is presented, illustrating that the results are not markedly different from the main findings.

[30]Unfortunately, this issue cannot be mitigated by using wave 1 to demonstrate that labor market conditions are persistent over time, as the relevant questions from waves 2 and 3 were not included in wave 1

Table I.1: Results from PSM-DID for adults, with variables of labor market participation

	Weight			
	(1)	(2)	(3)	(4)
Panel A - All adults				
Left behind*Post	-1.248**	-1.063*	-1.112*	-1.076*
	(0.606)	(0.573)	(0.569)	(0.572)
Mean weight at baseline	62.440	62.440	62.440	62.440
R^2	0.001	0.124	0.140	0.140
Observations	7,204	7,204	7,204	7,204
Panel B - Males				
Left behind*Post	-2.043**	-2.222***	-2.144**	-2.172***
	(0.873)	(0.840)	(0.833)	(0.836)
Mean weight at baseline	63.193	63.193	63.193	63.193
R^2	0.004	0.107	0.127	0.127
Observations	2,926	2,926	2,926	2,926
Panel C - Females				
Left behind*Post	-0.380	0.199	0.081	0.235
	(0.915)	(0.849)	(0.838)	(0.843)
Mean weight at baseline	61.792	61.792	61.792	61.792
R^2	0.003	0.165	0.190	0.191
Observations	3,452	3,452	3,452	3,452
Panel D - Underweight adults				
Left behind*Post	1.699	1.399	1.364	1.657
	(1.395)	(1.285)	(1.276)	(1.331)
Mean weight at baseline	46.835	46.835	46.835	46.835
R^2	0.143	0.346	0.375	0.379
Observations	422	422	422	422
Panel E - Healthy adults				
Left behind*Post	-0.942*	-0.925*	-0.955*	-1.025**
	(0.566)	(0.517)	(0.516)	(0.518)
Mean weight at baseline	58.914	58.914	58.914	58.914
R^2	0.007	0.194	0.199	0.200
Observations	3,724	3,724	3,724	3,724
Panel F - Overweight adults				
Left behind*Post	-3.128**	-2.790**	-2.536**	-2.639**
	(1.326)	(1.280)	(1.262)	(1.269)
Mean weight at baseline	75.009	75.009	75.009	75.009
R^2	0.037	0.140	0.170	0.170
Observations	2,102	2,102	2,102	2,102
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, relationship to the head, and whether the individual is economically active, inactive, and looking for a job. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, wealth index quintiles, and the number of household members who are economically active, inactive, and looking for a job. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table I.2: Results from PSM-DID for children, with variables of labor market participation

	Zbmi			
	(1)	(2)	(3)	(4)
Panel A - All children				
Left behind*Post	-0.197*	-0.270***	-0.246**	-0.284***
	(0.104)	(0.103)	(0.102)	(0.103)
Mean zbmi at baseline	-0.099	-0.099	-0.099	-0.099
R^2	0.002	0.054	0.080	0.084
Observations	4,286	4,286	4,286	4,286
Panel B - Males				
Left behind*Post	-0.259*	-0.277*	-0.259*	-0.274*
	(0.148)	(0.143)	(0.142)	(0.143)
Mean zbmi at baseline	-0.105	-0.105	-0.105	-0.105
R^2	0.002	0.098	0.118	0.122
Observations	2,460	2,460	2,460	2,460
Panel C - Females				
Left behind*Post	-0.346**	-0.428***	-0.443***	-0.527***
	(0.156)	(0.155)	(0.151)	(0.153)
Mean zbmi at baseline	-0.091	-0.091	-0.091	-0.091
R^2	0.001	0.053	0.107	0.114
Observations	1,644	1,644	1,644	1,644
Panel D - Underweight children				
Left behind*Post	0.122	-0.008	-0.047	-0.093
	(0.330)	(0.294)	(0.298)	(0.293)
Mean zbmi at baseline	-2.958	-2.958	-2.958	-2.958
R^2	0.465	0.659	0.665	0.685
Observations	274	274	274	274
Panel E - Healthy children				
Left behind*Post	-0.042	-0.078	-0.070	-0.114
	(0.095)	(0.096)	(0.096)	(0.096)
Mean zbmi at baseline	-0.405	-0.405	-0.405	-0.405
R^2	0.005	0.036	0.046	0.053
Observations	2,632	2,632	2,632	2,632
Panel F - Overweight children				
Left behind*Post	-0.767***	-0.955***	-0.956***	-1.120***
	(0.230)	(0.225)	(0.221)	(0.222)
Mean zbmi at baseline	2.307	2.307	2.307	2.307
R^2	0.402	0.467	0.497	0.511
Observations	658	658	658	658
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, relationship to the head, and whether the individual is economically active, inactive, and looking for a job. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, wealth index quintiles, and the number of household members who are economically active, inactive, and looking for a job. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

J Profile of the migrants

Table J.1: Selected characteristics of the migrants, left behind and non-left behind

	Migrants	Left Behind	Non Left Behind	(1)-(2)	(1)-(3)
Less than 14 years old	0.155	0.386	0.361	-0.231***	-0.205***
	(0.020)	(0.015)	(0.005)	(0.029)	(0.027)
15-24 years old	0.646	0.125	0.120	0.521***	0.526***
	(0.027)	(0.010)	(0.003)	(0.024)	(0.019)
25-34 years old	0.158	0.060	0.128	0.099***	0.031
	(0.020)	(0.007)	(0.003)	(0.018)	(0.019)
35-44 years old	0.025	0.113	0.135	-0.088***	-0.110***
	(0.009)	(0.010)	(0.003)	(0.018)	(0.019)
45-64 years old	0.012	0.246	0.180	-0.234***	-0.168***
	(0.006)	(0.014)	(0.004)	(0.024)	(0.021)
Over 65 years old	0.003	0.071	0.076	-0.068***	-0.073***
	(0.003)	(0.008)	(0.003)	(0.014)	(0.015)
Male	0.599	0.473	0.486	0.127***	0.113***
	(0.027)	(0.016)	(0.005)	(0.032)	(0.028)
Head	0.040	0.247	0.348	-0.207***	-0.308***
	(0.011)	(0.014)	(0.005)	(0.025)	(0.027)
Spouse of the head	0.022	0.189	0.159	-0.168***	-0.137***
	(0.008)	(0.012)	(0.004)	(0.022)	(0.020)
Child of the head	0.780	0.462	0.422	0.318***	0.358***
	(0.023)	(0.016)	(0.005)	(0.031)	(0.028)
Grandchild of the head	0.084	0.065	0.040	0.019	0.043***
	(0.015)	(0.008)	(0.002)	(0.016)	(0.011)
Other relationship to the head	0.075	0.037	0.031	0.038***	0.044***
	(0.015)	(0.006)	(0.002)	(0.013)	(0.010)
None or preschool	0.181	0.522	0.435	-0.341***	-0.253***
	(0.022)	(0.016)	(0.005)	(0.030)	(0.028)
Primary education	0.241	0.249	0.247	-0.008	-0.006
	(0.024)	(0.014)	(0.004)	(0.028)	(0.024)
Post-primary education	0.350	0.172	0.220	0.178***	0.130***
	(0.027)	(0.012)	(0.004)	(0.026)	(0.024)
Secondary education	0.178	0.035	0.065	0.143***	0.113***
	(0.021)	(0.006)	(0.002)	(0.016)	(0.014)
Tertiary education	0.050	0.022	0.033	0.028***	0.017
	(0.012)	(0.005)	(0.002)	(0.011)	(0.010)
Married	0.053	0.360	0.341	-0.307***	-0.289***
	(0.012)	(0.015)	(0.005)	(0.028)	(0.027)
Rural	0.776	0.805	0.630	-0.028	0.147***
	(0.023)	(0.013)	(0.005)	(0.026)	(0.027)
Days of work per week[a]	3.480	4.647	4.491	-1.167***	-1.011***
	(0.196)	(0.096)	(0.029)	(0.200)	(0.180)
Paid employed[b]	0.076	0.051	0.100	0.025*	-0.023
	(0.015)	(0.008)	(0.003)	(0.015)	(0.017)
Owner of non-farm enterprise[b]	0.044	0.155	0.190	-0.110***	-0.146***
	(0.012)	(0.012)	(0.004)	(0.022)	(0.022)
Worker in non-farm enterprise[b]	0.083	0.144	0.181	-0.062***	-0.099***
	(0.016)	(0.012)	(0.004)	(0.022)	(0.022)
Owner of farm-plot[b]	0.054	0.281	0.268	-0.227***	-0.214***
	(0.013)	(0.015)	(0.005)	(0.027)	(0.025)
Worker in farm-plot[b]	0.397	0.519	0.396	-0.122***	0.001
	(0.028)	(0.017)	(0.005)	(0.033)	(0.028)
Full-time student[b]	0.514	0.332	0.298	0.182***	0.216***
	(0.028)	(0.016)	(0.005)	(0.032)	(0.026)
Retired or ill[b]	0.000	0.039	0.049	-0.039***	-0.049***
	(0.000)	(0.007)	(0.002)	(0.011)	(0.012)
Full-time homemaker[b]	0.051	0.156	0.150	-0.105***	-0.100***
	(0.012)	(0.012)	(0.004)	(0.022)	(0.020)
Looking for work[b]	0.171	0.078	0.098	0.093***	0.074***
	(0.021)	(0.009)	(0.003)	(0.020)	(0.017)
Moved to Accra region	0.358	0.000	0.000	0.358***	0.358***
	(0.027)	(0.000)	(0.000)	(0.015)	(0.005)
Moved to Ashanti region	0.218	0.000	0.000	0.218***	0.218***
	(0.024)	(0.000)	(0.000)	(0.013)	(0.004)
Observations	322	1,003	10,815	1,325	11,137

Notes: Migrants are those who have migrated for work for more than 6 months.

[a] Information only available for the household head, the first spouse, and one other household member over the age of 12, selected randomly.

[b] The categories related to an individual's activity are not mutually exclusive, meaning an individual can belong to multiple categories. For example, an individual can be a full-time student while also contributing to a household farm. Information only available for individuals from age 7 and above.

K Parental migration

In the surveys, I use information about co-residence with parents. I use the following questions: “Is [Name]’s father currently living in this household?” and “Is [Name]’s mother currently living in this household?”. The possible answers to these questions are: “Yes", “No, he/she is deceased”, and “No, he/she lives in another household”.

K.1 Parental migration for work

Based on the information regarding co-residence with the parents, I create a treatment group of children who were co-resident with at least one parent in wave 2 and are left behind by at least one parent who had migrated away for more than six months to find work between the two survey waves by using the previous treatment. The control group consists of children who were still co-residing with at least one parent in wave 3 but did not have at least one parent who had migrated away for more than six months to find work between the two survey waves. I drop children who had lost both parents (double orphans) between the two waves. The sample is composed of 2,478 children, of which 19 are left behind.

Table K.1: Results from PSM-DID for children, parental migration for work

	Zbmi			
	(1)	(2)	(3)	(4)
Parental migration*Post	0.111	-0.561***	-0.491***	-0.489***
	(0.197)	(0.199)	(0.188)	(0.187)
Mean zbmi at baseline	-0.061	-0.061	-0.061	-0.061
R^2	0.001	0.228	0.327	0.332
Observations	1,806	1,806	1,806	1,806
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

K.2 Parental migration based on non-co-residence

To obtain an alternative measure of parental migration, I also create two other groups, no longer relying on the treatment I previously completed based on migration for job-related reasons for more than six months. This time, it is solely based on co-residence. This treatment is, therefore, less restrictive, as it relies solely on co-residence to define parental migration, which is effectively a parental departure from the household. The treatment group consists of children who were co-residents with at least one of their parents in wave 2 but are no longer in wave 3. The control group, on the other hand, comprises children who remain co-residents with at least one of their parents, and no parent has left the household between the two waves, regardless of the reason. Similar to the approach in section K.1, I exclude double orphans. The sample is composed of 2,532 children, of which 145 are left behind.

Table K.2: Results from PSM-DID for children, parental migration related to non-co-residence

	Zbmi			
	(1)	(2)	(3)	(4)
Parental migration*Post	-0.205**	-0.178*	-0.193**	-0.163*
	(0.098)	(0.097)	(0.095)	(0.097)
Mean zbmi at baseline	-0.071	-0.071	-0.071	-0.071
R^2	0.003	0.070	0.112	0.113
Observations	4,888	4,888	4,888	4,888
Individual variables	No	Yes	Yes	Yes
Household head variables	No	Yes	Yes	Yes
Household variables	No	Yes	Yes	Yes
Rural dummy	No	No	Yes	Yes
Region dummies	No	No	Yes	Yes
Number of entries and exits	No	No	No	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Individual variables include age, gender, and relationship to the head. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

L Food consumption patterns

In the questionnaire, I use the questions in Section 11: Consumption module, Part A: Food items consumed. More specifically, I use the value reported by the most knowledgeable household member regarding the value of the quantity of food items (in Ghanaian cedis), whether the food items are sourced from purchases, self-production, or gifts.
Regarding the indices used in Table L.2, the Simpson index can be expressed as follows:

$$Simpson\ index = 1 - \sum_{i=1}^{n} w_i^2 \tag{5}$$

with w_i the consumption share (purchased, self-produced and received) of food group i (cereals, starches, pulses and nuts, fruits and vegetables, eggs, fish, meat, dairy products, cooking oils, sugary products, spices, beverages, wild food and out-of-home food). The Shannon index is defined as:

$$Shannon\ index = -\sum_{i=1}^{n} w_i log(w_i) \tag{6}$$

where w_i is defined as previously.

In this section, I exclude from the sample households that likely have reporting issues. For instance, some households report consuming only a single type of food, such as exclusively cooking oils or only beverages. Considering the unlikely nature of that occurrence, these households are omitted, along with 0.10% of the outliers regarding the share of consumed food items. Also, consistent with the data treatment, I chose a complete case analysis, thus excluding observations with missing outcome values for at least one wave.

Table L.1: Results from PSM-DID, food consumed per capita from various sources

	Purchased food per capita (1)	Produced food per capita (2)	Received food per capita (3)	Total food consumed per capita (4)
Household left-behind*Post	-7.375**	3.868*	-0.992	-4.498
	(3.353)	(2.079)	(1.118)	(4.409)
Mean at baseline	86.512	27.120	9.730	123.389
R^2	0.350	0.090	0.070	0.270
Observations	5,642	5,642	5,642	5,642
Household head variables	Yes	Yes	Yes	Yes
Household variables	Yes	Yes	Yes	Yes
Rural dummy	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Number of entries and exits	Yes	Yes	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Household head variables include age, gender, and education level of the head. Household variables include number of working-age members, dependency ratio, and wealth index quintiles. Number of entries and exits are two separate variables. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table L.2: Results from PSM-DID, dietary diversity indices

	Simpson index (1)	Shannon index (2)
Household left-behind*Post	-0.008**	-0.017
	(0.004)	(0.013)
Mean at baseline	0.779	1.843
R^2	0.150	0.220
Observations	6,172	6,172
Household head variables	Yes	Yes
Household variables	Yes	Yes
Rural dummy	Yes	Yes
Region dummies	Yes	Yes
Number of entries and exits	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. Number of entries and exits are two separate variables. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table L.3: Results from PSM-DID, food consumed per capita and per food group

	Total food consumed (purchased, produced & received) per food group													
	Cereals	Starches	Pulses & Nuts	Fruits & Vegetables	Eggs	Fish	Meat	Dairy	Oil	Sugar	Spices	Beverages	Wild	Out-of -home
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Household left-behind*Post	-0.018	0.217	1.651	-2.301***	-0.268**	-0.367	-0.951	-0.108	-0.316	0.123	0.059	-0.600*	-0.216	-1.400
	(1.002)	(0.986)	(1.071)	(0.836)	(0.105)	(0.736)	(0.784)	(0.204)	(0.250)	(0.119)	(0.111)	(0.318)	(0.157)	(1.644)
Mean at baseline	13.395	14.017	18.689	17.676	1.455	13.712	9.068	2.440	4.047	1.584	1.365	3.191	1.197	21.552
R^2	0.100	0.180	0.090	0.280	0.200	0.240	0.090	0.170	0.190	0.080	0.150	0.210	0.050	0.070
Observations	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642	5,642
Household head variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rural dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of entries and exits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. Number of entries and exits are two separate variables. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table L.4: Results from PSM-DID, share of food group's consumption out of total household consumption

	Share of total food consumed (purchased, produced & received) per food group													
	Cereals	Starches	Pulses & Nuts	Vegetables & Fruits	Eggs	Fish	Meat	Dairy	Oil	Sugar	Spices	Beverages	Wild	Out-of -home
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Household left-behind*Post	0.005	0.005	-0.001	-0.010**	-0.001	-0.000	-0.003	-0.000	0.003	0.002**	0.001	-0.002	-0.001	0.002
	(0.006)	(0.005)	(0.005)	(0.002)	(0.001)	(0.004)	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.006)
Mean at baseline	0.131	0.133	0.160	0.157	0.012	0.114	0.074	0.017	0.038	0.014	0.013	0.021	0.011	0.105
R^2	0.440	0.029	0.100	0.070	0.090	0.170	0.090	0.140	0.050	0.007	0.140	0.180	0.110	0.100
Observations	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424
Household head variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rural dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of entries and exits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors are in parentheses. The variables listed at the bottom of the table are included in the DID, i.e., after matching. Household head variables include age, gender, and education level of the head. Household variables include household size, number of working-age members, dependency ratio, and wealth index quintiles. Number of entries and exits are two separate variables. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.