What Happens to Diet and Child Health when Migration Splits Households? Evidence from a Migration Lottery Program[#]

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Abstract

The impact of migration on food security and child health is likely to differ depending on whether children themselves migrate or whether they remain behind while other household members migrate. However, existing studies have not been able to examine how impacts differ in these two scenarios because parallel data are required for both the sending and receiving country. Moreover, self-selection into migration makes unbiased estimation of either impact difficult. We overcome these problems by using a unique survey of Tongan households that applied to migrate to New Zealand through a migrant quota which selects households through a random ballot. This survey covers both migrant children in New Zealand and non-migrant children in Tonga, with the migration policy rules providing a source of exogenous variation for identifying impacts. Our estimates of short-run impacts show that diets diverge upon migration: children who migrate experience improvements, while diets worsen for children who remain. There is also suggestive evidence of a divergence in health outcomes, with increases in weight-for-age and height-for-age found for migrant children, and decreases found for children who remain behind while other household members migrate.

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1. Introduction

Increases in migration and the rapid growth in remittances over the past decade have led to renewed attention as to the impact that the decision to move to a new country has on both migrants and their families. While revealed preferences suggest that migration should, on average, make migrant decision-makers better off in the long run, the same argument may not extend to other family members, such as children, who are not the ones making the decision to migrate. This may particularly be the case when migration causes the household to split, with some members migrating and others remaining in the source country. This is a common occurrence, with migration policies worldwide generally restricting which household members can accompany a migrant. It is thus of interest to determine whether the impact of migration differs for children who move and those who stay behind.

There is an extensive literature on immigrant assimilation which compares the diets and health of immigrant children to those of native-born children in the destination country (e.g. Bell and Parnell, 1996; Institute of Medicine, 1998; Akresh, 2007). There is also a more limited, but growing literature, which assesses the impact of migration on the health of children remaining in the source country (e.g. Kanaiaupuni and Donato 1999; Hildebrandt and McKenzie, 2005; Acosta et al. 2007). While results vary according to context, a stylized representation of these literatures is that child health starts off well compared to natives and gets worse over time in the destination country, while migration has a relatively positive impact on children left behind. However, in both these literatures there are concerns that migrant selection leads to potentially biased inferences, since children in migrant families are likely to differ in both observable and unobservable ways from natives and children from households in which no one migrates.

This literature has so far been unable to examine how the impacts of migration differ for migrant children versus the children who stay behind. A main reason for this is that survey data are typically available either for households in the sending country, or for households in the receiving country, but not both in parallel. This paper uses a survey designed by the authors, which measured diet and child health for Tongan households that applied to migrate to New Zealand through an annual quota called the Pacific Access Category (PAC), to directly examine how child health and diets change when households divide through migration, comparing the short-run impacts for children who migrate to those who stay behind. This paper is the first to examine these impacts in the same study and compare their magnitudes.

Many more households apply each year to the PAC than the quota allows, so a random ballot is used to select from amongst the registrations. Only the spouse and dependent children of a ballot winner can migrate with the principal applicant, while other household members must remain in Tonga. Thus, the lottery aspect of the quota provides an exogenous reason why some households migrate to New Zealand, and others do not, while the policy rule tells us why some household members migrate and others remain behind. We can then estimate the impact of migration on children who migrate by comparing outcomes for migrant children in New Zealand (whose parents were successful in the ballot) to those for similar children in Tonga who would have moved had their parents won the ballot. We can also estimate the impact of migration on children left behind. We do this by comparing outcomes for the children who remain in Tonga in migrant-sending households, because of the policy rules restricting who can co-migrate with the ballot winner, with outcomes for similar ineligible children in ballot loser households (i.e. children that would not be able to migrate if the adult household member who applied to the PAC had been selected in the ballot).

We begin by showing that in the absence of migration, child health in Tonga appears similar for children who are eligible to move and those that are not eligible within applicant households. We then demonstrate that migration leads to a divergence in household diet for the movers and stayers. Diets improve for children that migrate, with increased consumption of fats, meats and milk, while remaining household members consume less of these categories and increase their consumption of basic staples, such as rice and roots. We also find suggestive evidence that this change in diet has health consequences – height-for-age and weight-for-age increase for migrant children while falling for stayer children, although this divergence in outcomes is only significant at the 0.11 level for height-for-age. Moreover, since the average Tongan child is both shorter and heavier than the average child in a reference population, an increase in height and weight is a mixed blessing for health. Finally, we examine the channels through which these effects may be taking place, looking at the role of changes in household size and demographic composition, changes in income, and changes in preferences.

Although this study is unique in being able to use a migration lottery to address migrant selectivity, and in examining both changes in outcomes for migrant children and for children in migrant households who are left behind, there are several caveats that the reader should bear in mind when interpreting the results. The first is that the newness and small scale of the migration program being studied limits the sample size available for analysis, affecting precision, while restricting our results to impacts within the first year of migration. Secondly, the children who move are the children of the migrant, while those remaining are either nephews and nieces or siblings of the migrant. While the health of these two groups does not differ significantly before migration, we might expect migration of adults to have different effects if their own children were left behind as opposed to those in their extended family. Nevertheless, the household division induced by the PAC policy is quite common in practice, with immigration policies in many countries worldwide (e.g. Australia, Canada, France, Ireland, Italy, New Zealand, United Kingdom) allowing individuals moving on an employment visa to bring their spouse and dependent children, but not to immediately bring their parents or adult siblings. We therefore believe our findings are likely to generalize to other cases of permanent, legal, migration from countries with similar child health conditions to Tonga – that is, those where stunting and obesity are concerns, but where there are few underweight children. As childhood obesity is becoming more prevalent worldwide, these results are likely to become increasing relevant for policymakers (Wang and Lobstein, 2006).

2. The Pacific Access Category, Survey Data, Context, and Methodology

2.1. The Pacific Access Category

Despite a long history of migration to New Zealand from Tonga, family reunification (mostly marriage) was the main channel of access in the 1990s following New Zealand's implementation of a points system which favors skilled migrants. In 2002, New Zealand introduced a new migration program, the Pacific Access Category (PAC), which allows for a quota of an additional 250 Tongans to permanently immigrate each year.[1] Any Tongan citizen aged 18 to 45 who meets certain English, health and character requirements can register to migrate to New Zealand. Many more applications are received than the quota, so a random ballot is used to select among applicants. Once a ballot is selected, the successful applicant must obtain a valid job offer in New Zealand (entry-level unskilled jobs suffice), and can then move.

The person who registers for the PAC is called the Principal Applicant. If they are successful, their immediate family (spouse and dependent children up to age 24) can also apply to migrate as Secondary Applicants. The quota of 250 applies to the total of Principal and Secondary Applicants, and averages about 80 migrant households in each year. Successful applicants cannot take other members of their household to New Zealand, so anyone living with parents, siblings, or other relatives will leave household members behind when they migrate. Thus, a child whose parent has a successful ballot is able to migrate, whereas one whose uncle, aunt, or elder sibling living in the same household has a successful ballot must remain in Tonga.

2.2. Survey Data

We use data from the Tongan component of the Pacific Islands-New Zealand Migration Survey (PINZMS), which measures multiple impacts of migration. The PINZMS survey was designed and implemented by the authors in 2005-06, surveying applicants in the first four years of the PAC.[2] The same survey team and questionnaire were used to survey households in both New Zealand and Tonga. In this paper, we use four groups of households, restricting our analysis to the subset of households with at least one child aged under 18 in the household.

The first group consists of Tongan immigrant households in New Zealand who had a member who was successful in the 2002-2005 ballots. There are 182 children under 18 living in 55 migrant households in the sample. Almost all dependents eligible to move with the principal migrant do so – at the time of our survey only 11 out of 283 total eligible dependents of principal applicants in New Zealand were in Tonga. They were typically very young children and their mothers, who moved subsequent to our survey

[1] See McKenzie et al. (2009) and Stillman et al. (2009) for greater detail on this policy.

[2] Full details of the sampling methodology are available in McKenzie et al. (2009) and at www.pacificmigration.ac.nz.

when the babies were able to travel. At most this could cause slight selectivity issues when considering impacts on infants, and our results are robust to excluding them. The second group consists of the remaining household members in Tonga in households where someone had moved to New Zealand under the PAC. There are 117 children in 43 such households in our sample, who were ineligible to move under the PAC relationship rules. The third group consists of households in Tonga where a member had a successful ballot, but no one had yet migrated to New Zealand. These are non-complier households which must be accounted for when estimating the impact of the PAC. Our sample contains 54 children in 17 such households.

The final group consists of households in Tonga where a member had applied for the PAC, but was not chosen in the ballot lottery. Our sample consists of 316 children in 91 such households. Some children in this group (278) would be eligible to move to New Zealand if the Principal Applicant in the household had won the ballot, while other children (38) would be ineligible in this counterfactual state of the world. Hence, some children in these household serve as the control group when estimating the impact of migration on migrant children, while others serve as the control group when estimating the impact of migration on the children left behind.

The survey includes detailed questions on household demographics, education, labor supply, income, remittances, asset ownership, and information on diet and health. Diet is measured at the household level by asking households whether any of thirty different foods were eaten by any member of the family during the day prior to the interview. For twenty-seven of these foods, we also asked at how many meals these foods were eaten. We ask about the same foods in New Zealand and Tonga, making a direct comparison of diet possible. To focus our analysis, we examine the cumulative number of meals in which seven foods are consumed, five of which are composites. These foods are: rice, roots, fruits and non-root vegetables, fish, fats, meats and milk.[3]

Height of children was measured in both Tonga and New Zealand to the nearest 0.1 centimeters using a portable stadiometer (Shorr Height Measuring Board, Olney,

[3] Roots include taro (swamp taro), taro taruas (Chinese taro), kumara (sweet potato), taamu/kape, yams, cassava/manioc, and potato. Fruits and non-root vegetables include other vegetables, coconut (fresh and dry), banana, mango, pawpaw, and other fruits. Fish includes tinned fish and fresh fish. Fats include corned beef, mutton, and coconut (fresh and dry). Meats include corned beef, mutton, fresh beef, chicken, pork, and other meat (e.g. sausage).

MD) and weight was measured to the nearest 0.1 kilograms on a digital scale (Model UC-321, A&D Medical, Milpitas, CA). The measurements were directly collected by trained interviewers. Based on these measurements and child age we compute three measures of child anthropometry: height-for-age, weight-for-age, and BMI-for-age.[4] These measures are each expressed as z-scores which show how many standard deviations each child is away from the age- and gender-specific median height, weight, or BMI in a reference population of well-nourished children. Child height (or stature) is generally known to be a sensitive indicator to the quality of economic and social environments (Steckel, 1995), while child weight and, more typically, BMI have been demonstrated to be good measures for identifying short-run effects on health (Strauss and Thomas, 1998).

2.3 Context

Tonga's GDP per capita is approximately $2,200 in PPP terms and most households are able to grow some of their own food and/or gather fish from the sea. Remittances are equivalent to 32 percent of GDP, largely as a result of the migration stocks built up during earlier waves of emigration coupled with continued emigration through family reunification channels. The World Health Organization (WHO, 2005) reports that there is no chronic malnutrition in Tonga. However, earlier studies suggest that malnutrition may occur during infancy and early childhood due to delays in the introduction of supplementary food or lack of nutritionally valuable weaning foods and diets too low in protein for young children (Lambert, 1982, Bloom, 1986). In our data this is manifested in a larger proportion of Tongan children being stunted than in the reference population: 36% of 0-2 year olds, 12% of 3-5 year olds, 13% of 6-12 year olds, and 17% of 13-18 year olds have height-for-age in the bottom 5 percent of the reference population. Obesity is one of the main health problems facing adults in Tonga, and childhood obesity rates are also relatively high. In our data, children are heavier than the reference population, with 48% of 6-12 year olds and 64% of 13-18 year olds classified

[4] We use the 1990 reference standards for the United Kingdom, as derived in Cole et al. (1998), as they are available for children of all ages. Similar results are obtained using non-standardized measures of height, weight, and BMI, but standardizing makes it easier to pool together children of different ages, as well as allowing comparability with the existing literature. To ensure robustness to mismeasurement we trim the data to eliminate observations which are more than 4 standard deviations away from the reference population.

as obese and the median child under 18 weighs one standard deviation more than the reference population.

Our study focuses on Tongans who have entered for the PAC, who are the relevant group for which we are able to identify the impacts of migration. A natural question is then how the individuals entering the PAC ballot differ from the general Tongan population. In other work (McKenzie et al. 2009) we have shown that applicants to the PAC are positively selected in terms of education and prior earnings in Tonga, which is consistent with the positive self-selection of migrants on education worldwide (Grogger and Hanson, 2008). However, in Gibson et al. (2010) we show that there is no statistically significant self-selection in terms of either adult or child health. Therefore, the population we study is similar in child health to the overall Tongan population.

2.4. Estimation Methodology

We are interested in the impact of migration on two groups of children: those who migrate, and those who remain behind when other household members migrate. The PAC provides a mechanism for estimating both impacts. In both cases, we use the fact that the lottery randomly chooses a subset of households which become eligible to migrate to New Zealand from a larger pool of households that are all interested in migrating.[5] If all households that won the lottery migrated, we could simply compare mean outcomes for ballot winners and losers. However, approximately 15 percent of ballot winners do not ultimately move to New Zealand – in some cases because they changed their mind about moving, and in others because they could not meet the requirements of the policy, such as finding a job offer. We employ the standard technique of dealing with non-compliance to a treatment, which is to instrument migration with winning the PAC lottery, obtaining the average treatment effect on the treated.

To estimate the impact of migration on children who migrate, we use the PAC policy rules to restrict the analysis only to children who would move if the Principal Applicant was successful in the PAC ballot. In practice this means restricting analysis to children who are the child of the Principal Applicant and dropping all other children in

[5] For verification that randomization holds in practice see McKenzie et al. (2009) and Stillman et al. (2009).

the household. We refer to these children who migrate or who would migrate if their household's principal applicant did as "mover children". To estimate the impact of migration on children who remain behind, we instead restrict the analysis to children who would remain even if the Principal Applicant won the ballot lottery. These are all children in the household who are not the children of the Principal Applicant. In most cases they are nephews and nieces of the migrant, but in some cases they are younger siblings. We refer to these as "stayer children".

Note that the combination of a lottery which selects which households can migrate and a policy rule which determines within a household which members can migrate enables us to overcome the double-selection issue facing all existing studies of migration and child health. In a standard non-experimental setting, there is usually recognition that households self-select into migration, with authors then attempting to find an instrument for migration. In our case, the lottery outcome serves as the ideal instrument. However, there has been much less recognition in the literature of the second form of selection, which is selection into which household members migrate. In a traditional non-experimental setting there is no way of ascertaining among non-migrant households which children would remain behind if the household were to engage in migration and which would move with the migrant. The PAC policy rules enable us to do this, by dictating that only dependent children of the Principal Applicant can migrate.

3. Intra-household Differences in Child Health

In common with most household surveys which collect diet and food consumption data, our survey collected this information at the household level. This presents a challenge for interpreting our results on the impact of households splitting on diet, since we are unable to say whether, within a household, mover children and stayer children had the same diet before migration. While we are unable to look at this directly, we can examine this indirectly by asking whether the anthropometrics differ between these two groups of children. If the distribution of food within a potential migrant household was different for "mover" and "stayer" children, then this should be reflected in differences in weight and height.

We therefore run the following regression for child *i* in ballot loser household *h*, for households in which some members would stay if the Principal Applicant won the ballot:

$$Health_{i,h} = \alpha + \beta Stayer_{i,h} + \lambda_h + \varepsilon_{i,h} \quad (1)$$

We estimate equation (1) both with and without household fixed effects (λ_h) and report the results in Table 1. The R^2 when we do not include household fixed effects is always less than 0.02, and the coefficient on being a stayer is insignificant. This shows that whether or not a child is a stayer has little explanatory power for explaining differences in health among children. Furthermore, when we add household fixed effects, the stayer child coefficients remain insignificant. Thus, we cannot reject that food is shared equally enough within households that both mover and stayer children end up with similar weight, height, and BMI for age. If anything, the positive coefficients suggest that it is the stayer children who are getting more of the household food resources, not those children who would migrate. Such a finding seems reasonable in Tonga, where anthropological investigations have found that food and other resources are shared among extended family members (Pollock, 1992). However, it would of course not generalize to settings where households are much larger and children's access to food in the household varies with their relationship to the household head. With this is mind, we now examine how migration impacts diet for movers and stayers.

4. The Impacts of Migration on Diet and Child Health

4.1. The Impact on Diet

Table 2 examines the impact of migration on the diet of households in which Tongan children live. Panel A examines the impact on diet in the households of children who stay in Tonga, while Panel B examines the impact on diet in the households of children who move to New Zealand. In each case, we first present the pure experimental results with no controls added. This gives the overall impact of migration on household diet. However, one of the most obvious channels through which migration can affect access to food is by changing the number of individuals in the household. The second row of each panel controls for the current demographic composition of the household (number of boys, number of girls, number of men, and number of women). It also controls for the income of the household in 2004, prior to migration occurring. Including these control variables improves the precision of the results, but generally does not affect the point estimates in any meaningful way, since the random nature of the lottery insures that income prior to migration is the same in migrant and non-migrant households. Finally, we also control for day of the week effects, since diet can vary over the week and migrant households were more likely to be interviewed on the weekend than non-migrant households.

Thus, in both Panel A and B, we estimate:

$$Outcome_i = \alpha + \beta * Migrant\ Household_i + \delta' X_i + \varepsilon_i \qquad (2)$$

where whether a child lives in a migrant household (either in New Zealand if they are a child of the Principal Applicant or in Tonga if they are a "stayer" child) is instrumented by whether or not the Principal Applicant who lives or lived prior to migration in the household was successful in the ballot lottery. Two specifications are estimated which differ in whether or not they include the control variables (X). We also present in Panel C the results from testing whether the impact of migration on the diet of household members left behind statistically differs from the impact of migration on migrant households in New Zealand.

The results in Table 2 show a statistically significant (Panel C) divergence in diets between children who move and those who stay. Migration leads migrant children to be living in households which consume more meats, fats, milk, and fruit and less fish and rice. Controlling for changes in household demographic composition reduces the size and removes the significance of the changes in rice, fruits, and fats, but still results in the children living in households with more fats, milk and meat. The impacts are sizeable as well as statistically significant – children go from living in a household that had milk only once every two days to having it 1.2 times a day, and from having meat 1.1 meal a day to having meat two meals a day. In contrast, the diet of children who remain behind seems to shift towards basic staples. Their households consume more rice and roots, and less fruits and vegetables. While such households may be able to preserve calorific intake by shifting to these staples of rice and roots, the vitamin and protein content of their diet is likely to have fallen.

4.2. Impact of Migration on Child Health

Next, we examine the impact of migration on the health of children. A number of studies have shown that the relationship between socioeconomic status and child health varies with the age of the child (Sahn and Alderman, 1997; Case, Lubotsky and Paxson, 2002), with health status being more strongly associated with income as children age. However, our sample sizes become small when we split the data. We therefore present results which pool all children aged under 18 (recall that the z-scores already standardize by age and gender). We then split the results into impacts on children aged 0 to 5, 6 to 12, and 13 to 18. The first row of each panel presents the pure experimental results without any controls, and the second row then shows the impacts after controlling for child and household characteristics that are not affected by migration. The two sets of estimates should be similar, with the second more precise if the random lottery has succeeded in balancing covariates across the two groups. To the extent that the parameter estimates differ greatly across the two specifications, this suggests there was some imbalance in covariates for this age group, and thus that one should be even more cautious in interpreting the impact.

Panel A shows the impact of a household member migrating on the health of children who remain behind in Tonga. If we first consider the results pooled over all child ages, which have the largest sample size, we see that migration lowers weight-for-age by 0.63 standard deviations when no controls are included, but has an insignificant impact on anthropometrics when we add controls. The results for 6-12 years show a large and significant fall in height-for-age and rise in BMI-for-age. However, this sub-analysis is based on less than 50 children, and in particular, there are only 7 children aged 6-12 in ballot loser households who are stayers. Given this small sample size we believe it is most reliable to consider only the pooled results for all children.

Panel B examines the impact of migration on the children who move. The point estimates suggest that migration raises height-for-age, weight-for-age and BMI, but none of the coefficients are statistically significant. Migration does have a statistically significant impact on weight-for-age for children aged 0 to 5, which is consistent with anthropometrics being more susceptible to changes in economic and social environments at early ages. In Stillman et al. (2010) we examine in more detail changes in health over the 0 to 5 range, finding that stunting of infants and toddlers (0 to 2 year olds) is reduced, but obesity increases among the 3 to 5 year olds.

Taken together these results suggest a mild divergence in health between children who migrate with their parents and those in the migrant's extended family who remain behind. Recall from Table 1 that, stayer and mover children had the same height-for-age and weight-for-age in households that contained both. Panel C pools the two sub-samples and tests whether the impacts of migration differ for migrants compared to stayers in migrant households. We see no significant impact for BMI for age, but significant evidence of a divergence in weight-for-age, and weak evidence of a divergence in height-for-age (p=0.11). This divergence in health is consistent with the pattern of divergence in diets seen in Table 2.

In Figure 1, we explore where in the distribution changes are arising between children who move with migrants and children who stay behind in migrant households. Figure 1a shows the distribution of BMI for age is quite similar for movers and stayers. Figure 1b shows reasonably similar distributions also for height-for-age, although the mover children have less mass at the lower tail and more mass above zero. This is consistent with the suggestive evidence in Table 3 that height for age is worsening in stayer children relative to mover children with migration. The largest distributional shifts are seen in Figure 1c, which shows the weight-for-age distribution for children who migrate lies to the right of the distribution of weight-for-age for children who remain behind in migrant-sending households.

Table 4 provides more context by summarizing the rates of obesity, underweight, stunting and high weight-for-age for the movers and stayers in migrant households. These are based on the U.S. Center for Disease Control (CDC) recommendations, which define obesity as having standardized BMI above the 95^{th} percentile of the reference population, stunting as having standardized height below the 5^{th} percentile of the reference population, and underweight as having standardized BMI below the 5^{th} percentile

(Kuczmarski, Ogden and Grummer-Strawn, 2000).[6] We define high weight for age as weight for age above the 95th percentile of the reference population.

We see in Table 4 that among Tongan children there are very high rates of obesity, which are similar in both mover and stayer children, while few children are underweight. Stunting rates are higher for stayer children than for the mover children, while high weight for age is more prevalent for mover children than for children left behind.[7] These results are consistent with the findings in Stillman et al. (2010) that migration is reducing stunting but increasing obesity among children.[8] The results of treatment effect regressions using stunting, obesity, and high weight for age as alternative outcomes are qualitatively similar to those presented in Table 3 focusing on standardized z-scores.[9] Thus, our main findings are robust to concerns about whether migration has non-linear impacts depending on the initial level of health. This is unsurprising for this population, since there are so few underweight children that any movements in weight are moving children towards higher obesity rates.

5. What are the Channels through which this Impact is Occurring?

Of course, in addition to knowing *whether* migration causes a change in diet and health for children, researchers are also interested in *how* such changes occur. Given our sample sizes and the lack of exogenous variation needed to identify the relevant elasticities here, we can at most discuss some possible mechanisms, and describe what our data suggest about their relevance.

We begin by noting that our previous work has found that migration dramatically increased the incomes of the migrants themselves (McKenzie et al, 2009), but in the short

[6] There is considerable debate about the validity of using universal BMI cutoff points for comparing obesity prevalence across ethnic groups. In particular, Pacific Island children have been found to have lower body fat than New Zealand children of European origin for the same BMI (Rush, Plank and Davies, 2003). Nonetheless, since we are comparing rates for different groups of Tongan children, this concern is less relevant, since these cutoffs are merely a normalization.

[7] The largest differences in weight-for-age between movers and stayers are seen in 0-5 year olds, where the divergence is much greater than the divergence in obesity rates. This is because the mover children are both heavier and taller – with the reduction in stunting and increased height at this age offsetting some of the increase in weight when it comes to BMI and obesity measurement.

[8] Recall that the correct counterfactual for movers is not the children who stay, but the children in ballot loser households who would have moved if their household had won the lottery. This is what Table 3 is measuring. Nonetheless, Table 1 shows little difference between (would-be) movers and (would-be) stayers in ballot losing households, so the comparisons in Table 4 are still useful.

[9] Results not shown for brevity, but available upon request.

run appears to have led to reduced incomes and higher poverty for the remaining household members (McKenzie et al, 2007, Gibson et al, 2010). Although the remaining household members receive more remittances as a result of household members migrating, within the first year this is not enough to make up for the loss in household labor earnings and home production that the migrants previously contributed to the household. This direct income effect is likely to influence diet and other health inputs. Households typically respond to a fall in income by lowering consumption on income-elastic forms of food expenditure and substituting towards cheaper forms of calories. This response can be even greater than the standard Engel curve income-elasticity would predict if households perceive this fall in income as temporary (McKenzie, 2006).

In addition to the overall change in income, migration results in other changes to the household which may impact the diet of children. Table 5 presents the experimental impacts of migration on some of these key characteristics of the households left behind. The first four columns show that migration lowers the number of boys, girls, men and women in the household. This results in fewer mouths to feed, so the same amount of home production or food expenditure will translate into larger portions being allocated to the remaining children. Column 5 shows a 25 percent reduction in total household income per capita, which includes the value of own production. However, since own production of food from agriculture, fishing, and livestock is directly consumed, changes in it may have a different impact on diet than changes in other sources of income. We see that there is a modest and insignificant increase in log own production per capita – total own production falls, but is offset by the fall in household size. Column 6 shows an increase in remittances. There has been debate in the literature as to whether remittances are spent differently from other income, although the general evidence seems to be that the majority of remittances are consumed. Finally, the last column shows that the share of household labor income being earned by the principal applicant and his or her spouse falls when they move. It is zero by definition when they move; this point estimate shows how far it has to fall to get to zero. If the principal applicant had different dietary preferences than other household members, then changes in his or her bargaining power in the household may also lead to changes in diet.

Overall, given our priors on income elasticities, our finding that consumption of rice and roots increased while household size fell, and consumption of fruits, fats, milk, and meat declined suggests that lower incomes among households with left behind members is the main driver of dietary change in Tonga, rather than changes in household size or the composition of income. Table 1 suggests that differences in dietary preferences between migrant movers and stayers are unlikely to be that important in explaining child health changes for the stayers.

It is more difficult to be confident about the mechanisms underlying dietary change for migrant children since many more things change with migration. The change in diet for children who migrate reflects not only the change in income and household size and composition, but also changes in prices and in the marketing and availability of foods in New Zealand relative to Tonga. We do not have data on price variation in Tonga with which to estimate price elasticities of food demand. However, the estimated changes in diet are somewhat consistent with relative prices playing a role. Meats and milk are relatively cheaper in New Zealand than in Tonga compared with other foods, with roots and fish being relatively cheaper in Tonga. Over time, exposure to different foods and lifestyles is likely to cause further dietary change among migrant children, with the impact we measure just occurring within the first year of migration. This suggests there is likely to be a widening divergence over time in the diet of migrant children and the children who remained in Tonga.

In theory migration can influence child health through a number of channels. Changes in household income and farm production can influence diet, which is the channel we think is most likely to affect child health in the short-run, particularly for children who remain in Tonga. Migration may also exert other influences on child health. For example, it may lead to changes in the activities undertaken by children. If children remaining in migrant households are now required to work harder in farms and other calorie burning activities, this could reduce weight and BMI. However, this appears not to be occurring in Tonga – there is no change in child schooling for those left behind, and few children work. Migrants may also send back information about health practices which could lead parents to use health inputs more efficiently, or send back new norms about diet and health behaviors which could lead parents to take actions to reduce obesity and increase nutrient intakes. While we cannot measure this channel, we have not come across stories of this happening to date in our fieldwork, and believe it is much more likely to occur in the long run if it occurs at all. Finally, children may suffer health problems, such as depression, which could influence body weight, if they are separated from their parents as a result of migration. However, in our context migrants move with their parents and the children who remain in Tonga do so with their parents.

We therefore believe that changes in diet are likely to be playing a prime role in the divergences in child health that appear to be occurring with migration. The increase in income and in milk and meat consumption for children who migrate should increase their height and weight for age, which is what we see, while the reductions in these quantities for children who remain in Tonga should reduce height and weight for age, which is again what we see.

6. Conclusions

In this paper, we show that the impact of migration on the diet and health of children differs depending on whether the child migrates with their parents or remains behind in their home country as part of the migrant's former household. We find that Tongan children migrating to New Zealand enjoy a diet richer in milk, meat, and fats, resulting in higher height-for-age and greater weight-for-age. In contrast, children who remain in Tonga while other household members migrate shift to a lower cost diet of basic staples, such as rice and roots, and appear to experience declines in height-for-age and weight-for-age. The results for child anthropometrics are only suggestive as small sample sizes reduce the precision of our estimates. Moreover, they reflect changes only within the first year of migration. Nevertheless, they are the first estimates that are able to simultaneously examine the impact on both migrant children and children left behind and to properly control for selection bias by taking advantage of a migration lottery program and policy rules to calculate experimental estimates.

Overall, we find that migration has a mixed impact on child health. Rates of stunting in Tonga are greater than in a standard reference population, so the improvements in height-for-age which come through migration to New Zealand are a definite health improvement. There is growing evidence of long-run impacts of height on income, possibly through improved cognitive ability (Case and Paxson, 2006), so these height improvements are likely to lead to longer-term health gains for migrant children, and to the extent that children who remain behind have lower height, to divergence in their lifetime economic prospects. The change in diet towards milk, meats, and fats for children who migrate has the advantage of increasing access to proteins and other key micronutrients while the shift to basic rice and root staples may have a detrimental impact on nutrient intake for children who remain in Tonga. However, given the already high levels of childhood obesity among the Tongan population, increases in weight-for-age present a concern for the health outcomes of migrant children. Given growing rates of childhood obesity globally (Wang and Lobstein, 2006), the case of children migrating from an already overweight population is likely to becoming increasingly common worldwide. The experience of Tongan migrants in this regard is likely to be of broader interest, and it will be important in future studies to examine whether the short-run impacts found here change as more time passes since migration.

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Figure 1: Distributional Comparisons between Migrating Children and Children Remaining in Migrant Households

Figure 1a: BMI for age

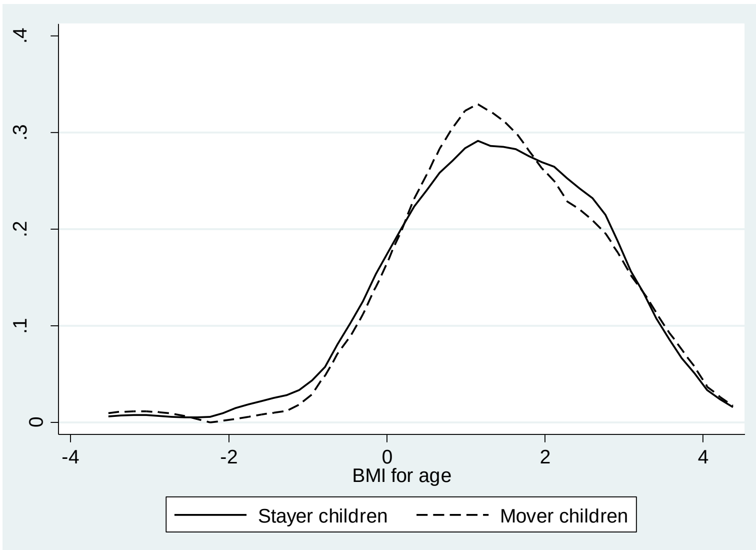

Figure 1b: Height for age

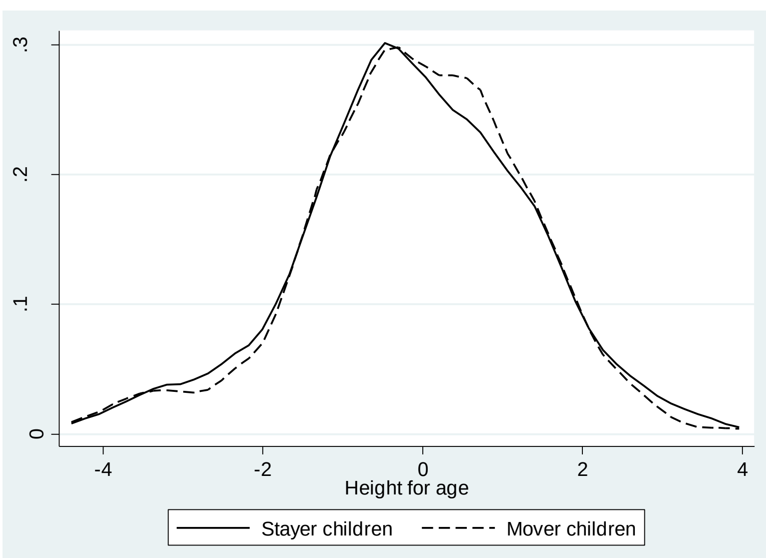

Figure 1c: Weight for age

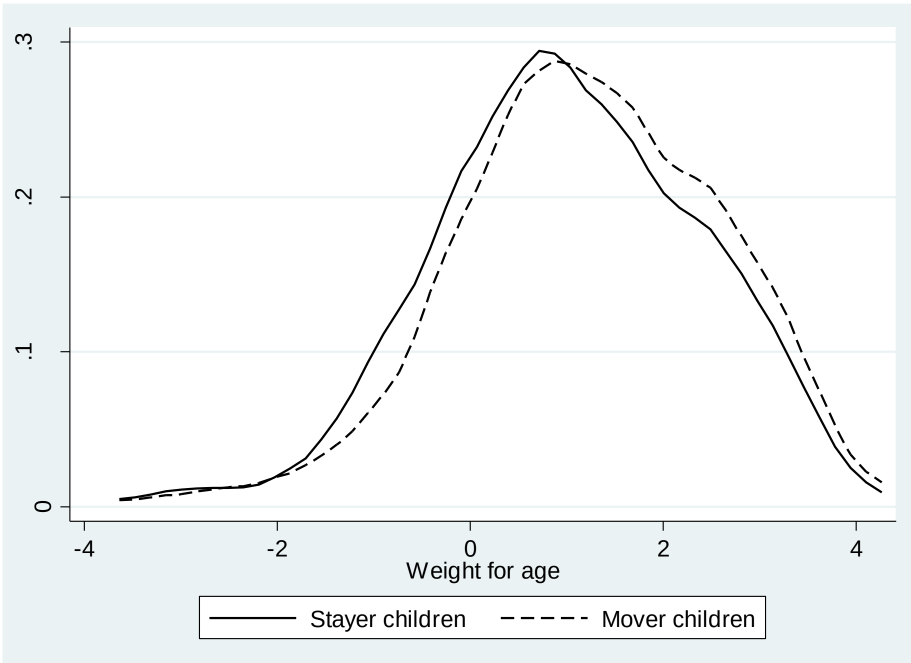

Table 1: Does child health vary between movers and stayer children in ballot loser households?
OLS regression results

	BMI for age		Height for Age		Weight for Age	
	(1)	(3)	(5)	(7)	(9)	(11)
Stayer child	0.006	0.482	0.396	0.821	0.251	0.542
	(0.397)	(0.633)	(0.484)	(0.697)	(0.276)	(0.536)
household fixed effects	no	yes	no	yes	no	yes
Observations	102	102	102	102	107	107
R-squared	0.000	0.593	0.013	0.497	0.007	0.534

Notes: Robust Standard Errors in Parentheses, clustered at the household level
Sample restricted to households where some members stay.

Table 2: Impact of Migration on Diet for Migrants and Household Members Left Behind.
Linear IV results instrumenting migration with success in the PAC ballot lottery.

Panel A: Impact of Migration on Diet of Household Members Left Behind.

	# of Meals Rice	# of Meals Roots	# of Meals Fruits / Vegs	# of Meals Fish	# of Meals Fats	# of Meals Meats	# of Meals Milk
Impact of Migration (no controls)	0.273***	0.388**	-1.605***	0.090	-0.134	-0.040	-0.086
	(0.077)	(0.174)	(0.504)	(0.133)	(0.178)	(0.155)	(0.116)
Impact of Migration (with controls)	0.238***	0.253	-0.963*	0.224	-0.085	-0.178	-0.032
	(0.090)	(0.239)	(0.563)	(0.160)	(0.213)	(0.173)	(0.131)
Mean for Unsuccessful Stayer Households	0.027	1.568	3.622	0.595	0.892	1.000	0.270
Sample Size	84	84	84	84	84	84	84

Panel B: Impact of Migration on Diet of Migrants

	# of Meals Rice	# of Meals Roots	# of Meals Fruits / Vegs	# of Meals Fish	# of Meals Fats	# of Meals Meats	# of Meals Milk
Impact of Migration (no controls)	-0.169*	0.025	0.995**	-0.247*	0.367*	0.850***	1.109***
	(0.090)	(0.185)	(0.470)	(0.129)	(0.204)	(0.180)	(0.152)
Impact of Migration (with controls)	-0.092	0.169	-0.332	-0.132	0.343*	0.908***	1.350***
	(0.090)	(0.213)	(0.504)	(0.136)	(0.205)	(0.207)	(0.153)
Mean for ballot loser households	0.236	1.764	2.436	0.582	0.818	1.127	0.491
Sample Size	112	112	112	112	112	112	112

Panel C: P-values for testing the impact is the same for Migrants and Household Members Left Behind

	# of Meals Rice	# of Meals Roots	# of Meals Fruits / Vegs	# of Meals Fish	# of Meals Fats	# of Meals Meats	# of Meals Milk
With no controls	0.000	0.174	0.000	0.043	0.032	0.000	0.000
With demographic and day of the week controls	0.009	0.788	0.298	0.058	0.095	0.000	0.000

Notes: Robust Standard errors in parentheses accounting for survey weights. *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.
Sample Restricted to Households containing Children in both panels.
In Panel A Controls are annual household income of stayers in 2004, current number of boys, girls, men and women in the household, whether on Tongatapu or not, and days of the week.
In Panel B controls are annual household income prior to migration or in 2004, current number of boys, girls, men, and women in the household, and days of the week dummies.
Roots include taro (swamp taro), taro taruas (chinese taro), kumara (sweet potato), taamu/kape, yams, cassava/manioc, and potato.
Fruits and vegetables include other vegetables, coconut (fresh and dry), banana, mango, pawpaw, and other fruits. Fish includes tinned fish and fresh fish.
Fats include corned beef, mutton, and coconut (fresh and dry). Meats include corned beef, mutton, fresh beef, chicken, pork, and other meat (eg. sausage).

Table 3: Impact of Migration on Child Health

Linear IV Results Instrumenting Migration with Success in the PAC Ballot Lottery

Panel A: Impact of Migration on the Health of Children Left Behind

	BMI for Age				Height for Age				Weight for Age			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age group:	<18	0-5	6-12	13-18	<18	0-5	6-12	13-18	<18	0-5	6-12	13-18
Impact of Migration (no controls)	0.177	0.194	0.902*	0.390	-0.670	0.061	-1.786***	-0.617	-0.634**	-0.815	-0.264	-0.020
	(0.359)	(0.667)	(0.473)	(0.357)	(0.451)	(1.205)	(0.532)	(0.527)	(0.262)	(0.549)	(0.473)	(0.337)
Impact of Migration (with controls)	0.208	-0.300	0.972**	0.293	-0.252	0.956**	-2.002***	0.462	-0.242	-0.306	-0.252	0.339
	(0.420)	(0.400)	(0.413)	(0.601)	(0.636)	(0.370)	(0.505)	(0.862)	(0.269)	(0.357)	(0.342)	(0.459)
Observations	119	45	44	37	115	44	41	37	128	53	45	37

Panel B: Impact of Migration on the Health of Migrant Children

	BMI for Age				Height for Age				Weight for Age			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age group:	<18	0-5	6-12	13-18	<18	0-5	6-12	13-18	<18	0-5	6-12	13-18
Impact of Migration (no controls)	0.145	0.390	-0.175	0.311	0.103	0.218	0.014	0.147	0.303	0.714*	-0.004	0.154
	(0.221)	(0.362)	(0.284)	(0.353)	(0.204)	(0.323)	(0.326)	(0.310)	(0.228)	(0.369)	(0.305)	(0.326)
Impact of Migration (with controls)	0.156	0.315	0.099	0.525	0.118	0.211	0.170	0.088	0.311	0.647	0.330	0.338
	(0.200)	(0.372)	(0.295)	(0.400)	(0.205)	(0.356)	(0.349)	(0.324)	(0.215)	(0.391)	(0.329)	(0.359)
Observations	420	133	192	108	433	142	197	107	442	142	201	111

Panel C: P-values for testing the impact is the same for Migrant Children and Children Left Behind

	BMI for Age				Height for Age				Weight for Age			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
With no controls	0.939	0.795	0.045	0.852	0.119	0.898	0.003	0.217	0.006	0.024	0.626	0.694
With gender, age and parity controls	0.281	0.710	0.090	0.858	0.113	0.857	0.006	0.355	0.053	0.018	0.451	0.641

Notes:

Robust standard errors in parentheses, clustered at the household level. *, **, and *** denote significance at the 10%, 5% and 1% levels respectively.

Panel A controls are gender, age and age squared, birth order, whether or not the household lives on Tongatapu, maximum education level in the household, and log household income .

Panel B controls are gender, age and age squared, birth order, mother and father's age and height.

Observations which lie outside 4 standard deviations of the standardized age distributions are trimmed.

Table 4: Obesity, Underweightedness, Stunting, and High Weight for Age among Children in Migrant Households

	Percent of Age Group			
	<18	0-5	6-12	13-18
Mover children				
Obese	42.9	38.1	35.6	67.5
Underweight	1.3	4.8	0.0	0.0
High weight for Age	39	31.9	35.5	55
Stunted	11.1	13.6	10.8	7.7
Sample Size	154	42	76	40
Stayer children				
Obese	44.8	34.1	44.8	68.4
Underweight	3.1	4.9	2.6	0
High weight for Age	23.8	6.5	34.2	42.1
Stunted	21.8	19.6	23.7	26.3
Sample Size	101	46	38	19

Note: High weight for age defined as in top 5 percent of reference distribution.

Table 5: Impact of Migration on Characteristics of Households Left Behind
Linear IV estimates

	# of boys in HH	# of girls in HH	# of men in HH	# of women in HH	Log per capita income	Log own production of food per capita	Net remittances (*100) per capita	Share of labor income from movers
Impact of Migration	-0.445	-0.412*	-0.728***	-0.721***	-0.252*	0.062	4.707***	-0.582***
	(0.292)	(0.233)	(0.215)	(0.245)	(0.150)	(0.189)	(1.585)	(0.073)
Observations	117	117	117	117	117	117	117	87

Notes:
Notes: Robust Standard errors in parentheses accounting for survey weights.
*, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.