Family influences on long-term and short-term child growth in Ossu area, Timor-Leste

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When family resources are limited, as in much of Timor-Leste (Mendoca 2002), the allocation of food between adults and children and among children can be crucial to child growth (Crooks et al 2007, Haaga and Mason 1987). We examine variation in household characteristics including resources available (e.g. wage labour, house materials, education etc), place of residency (town or hamlet) and family composition, and relate these variables to child growth in the Ossu area of Viqueque District. Because resources are acquired through labour and are consumed by family members, the age and perhaps sex composition of families may influence both resource accumulation and consumption (Pelto et al 1991).

From 1975 to 1999, the people of Timor-Leste suffered food shortages, foreign occupation, warfare, civil disturbances and political upheaval on a background of general poverty. Today, a sizeable proportion of the population (41%) survive on less than 88 cents per day (AUSAID 2011). Rural Timorese live a predominantly subsistence lifestyle. The rural diet relies on crops such as rice, potatoes, maize, papaya, banana, cassava and water spinach (Seeds of Life 2007). Most crops are seasonal resulting in a period of food shortage from November to April (United Nation Food Programme 2005) during the long wet season. Children suffer from malnutrition and are generally in poor health (Bucens and Macleman 2006). High levels of infectious diseases such as malaria exacerbate nutrition problems. Infant mortality is 45 deaths per 1000 live births (National Statistics Directorate Ministry of Finance DRTL 2010) ranking 66 highest of 222 countries in the world for infant deaths (CIA 2011). While under-5 year child mortality has declined in recent years, 58% of children under 5 years are stunted6 and 19% are wasted7 and these proportions have increased since 2006 (National Statistics Directorate Ministry of Finance DRTL 2010). Children are embedded in families and so understanding the conditions faced by families and their responses is important for improving child health. Child growth is one indicator of the well-being of families in subsistence economies like that of Timor-Leste (Crooks et al 2007).

Characteristics of the family influence how resources are acquired and distributed. Parental education (Taguri et al 2008), subsistence mode, and the number and productivity of other producers (Sellen 2003) impact on resource acquisition. Parental education influences the amount and type of resources coming into the household and a mother’s education is associated with health promoting childcare behaviours (Semba et al 2008); but results are mixed (Desai and Alva 1998). Education may also increase household income through better employment (Semba et al 2008; Taguri et al 2008). An unemployed adult increases the risk to the family of insufficient funds to provide food or other basic resources, while continuing to consume resources (Rickard et al 2007); however, higher income is not always related to better child health (Boyle et al 2006).

Investment in the care of children by adults other than the parents often is linked with lower rates of childhood mortality and positive growth measures (Sear, Mace and McGregor 2000). Other adults present in the household may increase family resources through income or labour and contribute to the care of

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1 School of Anatomy & Human Biology, The University of Western Australia
2 Ibid.
3 Ibid.
4 Ministry of Health, Dili, Timor-Leste
5 School of Anatomy & Human Biology, The University of Western Australia
6 Stunted: height-for-age is more than 2 standard deviations below the WHO child growth standard median (WHO 2008).
7 Wasted: weight-for-height is more than 2 standard deviations below the WHO child growth standard median (WHO 2008)
children, but they are also consumers of household resources. Therefore, the adult composition of the household may impact child health in various ways.

After resource acquisition, allocations among household members can affect individual child growth. Distributions may not be equal and can vary according to family size (Aerts et al. 2004; Downey 1995) and in some cases parental biases (Basu et al 1986; Chen et al 1981). Increased numbers of children in the household can negatively impact child growth as allocations per child generally decrease (Downey 1995) especially while children are young and do not contribute to household productivity (Stinson 1980). The amount of food in the household and food distribution among siblings is directly related to child growth (Taguri et al. 2008; Adekunle 2005).

Cross-culturally, motivations for adoption or fostering of children include manipulation of family size for the benefit of the adoptive family or the natal family (Rawson and Berggren 1973; Daly and Wilson 1980), to gain extra labour (Silk 1987), to modify the family sex ratio (Hooper 1970; Daly and Wilson 1980) and to remedy childlessness (Schroeder-Butterfill and Kreager 2005; Daly and Wilson 1980; Hooper 1970) and to compensate for parental death. These various motivations could result in differential treatment of fostered children and consequently different growth outcomes. Thus, household decisions impacting on resource allocations may be influenced by child age, sex, and natural or adoptive status.

Child growth is influenced by nutritional status. Anthropometric measures can assess both present and past nutritional status of children. Height-for-age indicates a child’s prior long-term nutrition whereas weight-for-height as measured by Body Mass index (BMI) is one of the best indicators of a child’s current nutritional state (Waterlow et al. 1977; de Onis 2001, p 75). Weight-for-age is a good indicator of general malnutrition and is useful for assessing young children in cross sectional studies (Waterlow et al. 1977). Mid upper arm circumference (MUAC) provides a good field indicator of protein energy malnutrition for children under 5 years of age (Jelliffe and Jelliffe 1969; van den Broeck et al. 1996).

This study assesses the characteristics of the family that impact child growth in the Ossu area of Timor-Leste. We evaluate associations of the above mentioned household characteristics in relation to achieved child size measures in three communities in Ossu sub-district of Viqueque. We then look at characteristics associated with patterns of short term change over the hungry season in the same communities.

Methods

Interviews and measurements were conducted from July to September 2009 (during harvest) and again in April to May 2010 (following the ‘hungry season’) at three localities in the sub-district of Ossu in the southern central region of Timor-Leste in the district of Viqueque. We sampled households with children in Ossu town (n = 47 households), and the rural hamlets of Liamida (3 km north of Ossu; n=20) and Kai-uai-hoo (7 km north of Ossu; n = 35). The first house selected in each locality was situated on the edge of the locality and the road towards the centre of the locality was followed, visiting all occupied houses that were visible on the way using the nearest neighbour pattern.

Household heads were approached and the study explained; fewer than five households overtly declined to participate. Informed consent was obtained from all participants. In the first sampling period, 157 boys and 145 girls in 95 of the households were fully measured and are the basis of the first set of analyses. The second sampling period included measures from 85 households; 3 families had moved out of the community, 2 families withdrew and the other 5 were temporarily absent. One hundred thirteen boys and 108 girls were remeasured and family histories updated; these children are the basis of analyses of short term change over the hungry season between September 2009 and April 2010.

For each household, we recorded the age, sex, education level and occupation of each adult member, as well as crops grown and numbers of livestock, availability of electricity, and housing construction materials. Because electricity was limited to some households in Ossu town it was confounded with locality and so excluded from further analyses. Information about the age, sex, birth order and status (biological, adopted/fostered) of each child was obtained. Interviews were conducted with the help of a male and a female language assistant and questions were repeated to minimize misunderstandings.
Households were visited several times during each season to complete interviews and measure children not present at the earliest visits.

Stature, weight and MUAC were measured following standard procedures (de Onis et al 2004) and BMI was calculated (kg/m$^2$). All measures were taken with the participants lightly clothed and without shoes. Recumbent length was measured for infants unable to stand erect. To adjust for the influence of sex and age, the four anthropometric measures were converted to Z-scores using the WHO anthropometric references (World Health Organization 2007). Z scores are available up to age 19 years for height and BMI, up to 10 years for weight, and up to 5 years for MUAC. These age and sex standardized variables were used in all statistical analyses.

Using the 2009 cross-sectional data, we fitted hierarchical linear models (HLM) regressing each of the four child growth measures against household and child characteristics modelled as independent fixed effects and household identity as a random effect. This approach is appropriate to the analysis of nested data (e.g. children within households) as it takes into account the correlation between individuals within the same household (Snijders and Bosker 1999). No interactions were significant and so were dropped from subsequent models. For each dependent variable we started with a full model and backwards eliminated non-significant independent variables until only significant predictors remained.

First we describe the characteristics of the 2009 sample. Then short-term changes in child growth between August 2009 and May 2010 are analysed via comparisons of paired measures. A change score was then calculated and regressed against household and personal characteristics using HLM, with particular focus on the adult composition of the household. SPSS 18.0 was used for data screening and analysis. A probability (p) value of < 0.05 was accepted as statistically significant.

**Results and Discussion**

**Characteristics of the sample.**
The number of residents per household ranged from 2 to 15 people (mean = 6.1). In Ossu town, households had significantly more occupants (7.0) on average than Liamida (4.6; $p < 0.001$) or Kai-uai-hoo (5.8; $p = 0.04$). Ossu town households averaged 4.4 children in contrast to 2.8 and 3.2 in Liamida ($p = 0.003$) and Kai-uai-hoo ($p = 0.008$), respectively. Households in Liamida averaged significantly fewer adults (1.8) than Ossu (2.6; $p = 0.02$) and Kai-uai-hoo (2.7; $p = 0.02$).

Fewer women from Liamida (22%) had received any schooling compared to Ossu and Kai-uai-hoo (63% and 56% respectively, $p = 0.01$). The proportion of men with any education was similar in each community (Ossu 60%, Liamida 71% and Kai-uai-hoo 55%). Household ownership of livestock and crops co-varied with the locality; a higher proportion of households in Ossu town did not have livestock (28%) and crops (58%) while Kai-uai-hoo had the largest proportion of households with livestock (91%) and two or more crops (66%).

Proportions of households with fostered children were the same across communities (Ossu 32%, Liamida 30% and Kai-uai-hoo 29%). Of 95 households with children fully measured, 28 (29.5%) had resident children (n = 41 children) who were not the biological children of either household head. Both the number of adults (2.7 and 2.4) and the total number of children (3.7 and 3.8) were similar in households with and without fostered children. Not surprisingly, households with fostered children had fewer biological children than non-fostering households (1.8 and 3.8, respectively; $p < 0.001$).

**Cross sectional analyses of child size for age during the harvest season of 2009**
Generally, children were small compared to the WHO international reference population as demonstrated by predominantly negative standardized anthropometric scores (Figure 1). Height-for-age was roughly two standard deviations below the international standard throughout childhood. Mean weight-for-age in the 0-5 age group was -1.44 (SD = 1.26), declining to -1.88 (SD = 0.93) in the 6-10 age group. Mean infant BMI approximated international standards (mean = 0.02; SD = 1.01) but declined through childhood to early adolescence and then stabilised (Figure 1). Mean MUAC, which is only available for infants up to 5 years of age, was -0.52 (SD = 1.18). Males and females did not differ on any standardized measure.
The results of the final models from the HLM analyses for each anthropometric trait in the cross sectional analysis of the 2009 data are summarised in Table 1. It is important to note that each significant association of a condition with a growth parameter is controlled for all other variables in the model.
Table 1: Final hierarchical linear model estimates for each standardized anthropometric measure in 2009.

<table>
<thead>
<tr>
<th>Input variable</th>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
<th>MUAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children</td>
<td>-0.18***</td>
<td>-</td>
<td>0.07*</td>
<td>-</td>
</tr>
<tr>
<td>Age group (0-5 yr)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 -12</td>
<td>-</td>
<td>-0.47 b***</td>
<td>-0.88***</td>
<td>-</td>
</tr>
<tr>
<td>13- 19</td>
<td>-</td>
<td>-</td>
<td>-0.91***</td>
<td>-</td>
</tr>
<tr>
<td>Community (Ossu town)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Liamida</td>
<td>-0.83**</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kai-uai-hoo</td>
<td>-0.33, ns</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Foster status of household (biological children only)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Biological child with co-resident foster children</td>
<td>0.79**</td>
<td>0.80**</td>
<td>-</td>
<td>0.82**</td>
</tr>
<tr>
<td>Fostered child</td>
<td>0.04, ns</td>
<td>-0.03, ns</td>
<td>-</td>
<td>-0.30 ns</td>
</tr>
</tbody>
</table>

a reference category in parenthesis.
b age group 6-10 years.
*p < 0.05, **p < 0.01, ***p < 0.001, ns = not significant.

Values are regression estimates. For number of children estimates represent change in z-score for every additional child. For age group, community and foster status, the estimates are the difference from the mean z-score of the reference category.

Input variables statistically excluded from the models were: house quality, paternal occupation, paternal education, maternal education, number of adults in the household, number of biological children in the household, child’s sex and child’s birth order.

Household characteristics influence the family’s ability to acquire resources. Unlike the findings of studies in some other developing nations (Mueller and Smith, 1999) but consistent with variation in findings across countries (Desai and Alva, 1998), we did not detect a statistically significant effect of parental education and paternal occupation on long-term indicators of child growth in Ossu. This may be a consequence of our modest sample size or low variability between households. Agho et al (2008) found no effect of maternal education on haemoglobin levels in East Timorese children. Children residing in Ossu town, where there is periodic electricity and easy access to health services, were significantly taller than those living in the rural hamlet of Liamida (Table 1). The rural hamlets were without electricity and more distant to health services, some schools and the main market.

Household characteristics may also influence how resources are distributed among family members and hence can impact child growth. Children co-residing with larger numbers of children had lower standardized height but higher standardized BMI (Table 1). Height-for-age is a long term cumulative index of child nutrition, whereas BMI is more labile to immediate food conditions. BMI may be artificially inflated by stunting as height squared is the denominator in calculating BMI.

More children in the family means that limited food must be shared between more people. Over an extended time period, limited nutrition will be reflected in reduced height (Waterlow et al 1977). However, in subsistence societies such as Timor-Leste, where children provide agricultural labour and assist with other energy demanding activities such as water collection, more children in the family could also reduce individual energy costs during times of high workload (e.g. harvest), positively impacting on body weight (and reflected in BMI). As children were measured during the harvest in 2009 this provides a plausible explanation for the different associations between number of children and height and BMI.
Children aged 0-5 years had higher BMI than older children. Similarly, weight was relatively higher in those aged 0-5 years than the 6-10 age group (Table 1). Younger children do not yet provide labour, perhaps again reflecting the costs of labour.

Standardized height, weight and MUAC were all influenced by the child’s status in the household as either biological or fostered. Biological children residing in households that included fostered children were taller, heavier, and had larger MUAC for age than biological children residing in non-fostering households and fostered children (Table 1). That fostered children and those from biological only households did not differ indicates that being fostered does not impose a growth cost. This might suggest that extended family and social networks allow children to move into households that are better able to provide for them.

**Short term change in standardized growth measures from 2009 to 2010**

Children were re-measured approximately 8 months later near the end of the hungry season. Standardized weight, BMI and MUAC declined significantly while, as expected over such a short interval, standardized height did not change (Figure 2).

**Figure 2** – Mean standardized growth measures of children in 2009 and 2010

Hierarchical linear modelling of the change in standardized size measures between 2009 and 2010 included the input variables: number of children, presence of mother, father, grandmother or grandfather, whether any children in the household were fostered, community (Ossu or rural hamlet), the Z for the outcome measure in 2009, child’s sex, and child’s age. Again, backward elimination regressions were performed.

For changes in standardized weight, both better anthropometric condition in 2009 (weight-for-age) and residence in Ossu predicted more weight loss over the hungry season; all other variables were not significant (Table 2). For BMI better condition in 2009 (BMI-for-age) and Ossu residence predicted greater loss. Greater body mass requires greater food energy intake to maintain energy balance. Thus, heavier individuals would be expected to lose more weight in times of reduced food availability. It is also possible that there may be some buffering of weight loss for those more disadvantaged prior to the hungry season, perhaps through differential allocations of food or work though this remains, as yet, untested.

The presence of a mother figure and living in a household that included fostered children, independently predicted better less decrement in BMI (Table 2). While 62% of fostering households had a grandmother present, only 22% of non-fostering households included a grandmother; thus grandmother
presence may help to explain the relative success of children residing in fostering households. It is not surprising that children from households without a resident ‘mother’ fared worse on markers of current nutritional status following the hungry season; Sear and Mace’s (2008) cross-cultural analysis documents the consistently positive effect of mothers on child well-being. While grandmothers may augment care of children, there is no evidence here that they are an equal substitute as reflected in child growth.

Table 2 – Final hierarchical linear models for change in standardized weight and BMI from 2009 to 2010

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std error</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z-weight in 2009</td>
<td>-0.16</td>
<td>0.05</td>
<td>0.001</td>
</tr>
<tr>
<td>Ossu town (rural hamlet)*</td>
<td>-0.35</td>
<td>0.10</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z-BMI in 2009</td>
<td>-0.25</td>
<td>0.04</td>
<td>0.001</td>
</tr>
<tr>
<td>Ossu town (rural hamlet)*</td>
<td>-0.19</td>
<td>0.09</td>
<td>0.039</td>
</tr>
<tr>
<td>Mother present (no)*</td>
<td>0.38</td>
<td>0.18</td>
<td>0.037</td>
</tr>
<tr>
<td>Foster household (no)*</td>
<td>0.23</td>
<td>0.11</td>
<td>0.041</td>
</tr>
</tbody>
</table>

* reference category in parenthesis.

Negative estimates indicate greater loss of weight or BMI from 2009 to 2010, whereas positive estimates indicate less loss of weight or BMI.

Input variables statistically excluded from the models were: number of children, presence of father, grandmother or grandfather, child’s sex and child’s age.

Conclusion

Some characteristics expected to associate positively with child growth (such as education and wage employment) were not significant in this sample. However, a number of aspects of family composition (number of children, age of child, fostering, mother present) were associated with child growth over the long and short term. Larger numbers of children in a family may decrease energy costs associated with subsistence agriculture during times of high workload and have short-term benefits, but negatively impact on growth in the long-term (height) through reduced allocations of food. There does not appear to be a growth cost to children who are fostered into households that also have biological children. Social networks may buffer the consequences of the hungry season on children’s weight and body mass and improve child growth over the long term by allowing children to move into resource richer households. The motivations and outcomes of child movement among households will be an important focus of future research.

Acknowledgements

The research was approved by the Human Research Ethics Committee of The University of Western Australia and carried out with the permission of His Excellency Dr Nelson Martins, Minister of Health and Sr Valente da Silva, Ministry of Health of Timor-Leste. We gratefully acknowledge the support of the Sub-district Administration of Ossu, the xefes de suco Ossu de Cima, Sr Tomas Gutierrez manager of the CHC Ossu, and our language assistants, Artins da Silva, Lucia Hornai and Sara Sexas. Sincere thanks to the families of Ossu, Liamida and Kai-uai-hoo for sharing their lives with us.
Bibliography

CIA 2011. World Factbook.
National Statistics Directorate Ministry of Finance DRTL 2010, Timor Leste: Demographic and Health Survey 2009-2010, ICF Macro, Calverton, Maryland, USA.


United Nation Food Programme 2005, *Food Insecurity and Vulnerability Analysis Timor Leste*. VAM UNIT.

