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Father absence but not fosterage predicts food insecurity, relative poverty, and poor child health in northern Tanzania

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Abstract

Objectives: The importance of fathers in ensuring child health in rural developing populations is questioned by anthropologists and population health scientists. Existing literature focuses on paternal death and child mortality. A relative lack of studies consider alternative forms of father absence and/or more subtle health outcomes. Here we determine the frequency and form of father absence in northern Tanzania, and its relationship to household food security, wealth, and child anthropometric status.

Methods: We conducted a cross-sectional survey of 3136 children under 5 years of age from 56 villages. Using multilevel regression we contrast children residing with both parents to those that (i) have experienced paternal death, (ii) reside with their mother but not their living father and (iii) are fostered apart from both living parents.

Results: Of the total, 3.5% of children had experienced paternal death. Thirteen percent resided with their mother but away from their living father. Supporting data indicate such cases primarily reflect parental divorce/separation, extra-marital birth, or polygynous fathers residing with an alternative cowife. Paternal death and residing apart from one's living father was associated with lower food security and/or relative poverty and there is suggestive evidence that children in such circumstances achieve lower height-for-age. Six percent of children were fostered, usually with grandparents, and were comparable to children residing with both parents in terms of household food security, wealth, and anthropometric status.

Conclusion: Our results highlight diversity in the form and consequences of father absence. We discuss limitations of the current study and wider literature on fatherhood and make suggestions for future research.

KEYWORDS
child health, fatherhood, family structure, fostering, parental investment

1 | INTRODUCTION

A large body of social science literature concerns the impact of father absence on child wellbeing in "modern" developed populations, particularly those in Europe and North America. This literature generally demonstrates that father absence due to extra-marital birth, paternal death, or divorce is predictive of poor child wellbeing, although most research is limited to educational attainment and achievement, and to a lesser extent mental wellbeing, rather than physical health outcomes (McLanahan, Tach, & Schneider, 2013). The role of fathers in providing both direct child care and financial support, along with the socioeconomic disadvantages of single-parent families, are typically concluded as key mediators driving the negative consequences of father absence. Related pathways such as the stress of parental relationship disruption and impact of new unrelated father figures on the rearing environment of children may also be influential (Daly & Wilson, 1985; Lawson & Mace, 2009). While debate remains regarding effect heterogeneity in interaction with socioeconomic status and related environmental factors (e.g., Bernardi & Boertien, 2016), negative relationships between father absence and indicators of child wellbeing are remarkably consistent, including in studies utilizing longitudinal analysis and related methods capable of isolating causality (McLanahan et al., 2013). The impact of father absence in rural developing populations is a much more contested issue, with recent scholarship challenging the traditionally held belief that father absence is necessarily detrimental to children. This shift is recognizable within both anthropology and the wider population health science and policy literature.

Historically, evolutionary anthropology painted a picture of the nuclear family, with paternal investment critical to offspring provisioning—an observation thought to account for the emergence of biparental care in humans compared to our primate relatives (Lovejoy, 1981). This model has gradually given way to an understanding that humans typically rely on larger cooperative networks of extended kin to raise children, and that the importance of fathers and other kin varies both across and within populations. For example, Sear & Mace (2008) conducted an influential review of large number ($n = 45$) of anthropological and demographic studies considering whether or not the presence/absence of alternative categories of kin (usually measured as currently alive or dead) predicts child survival in contexts of high child mortality and high fertility (primarily farming and patrilocal populations). In only one out of three studies providing appropriate data ($n = 22$) was the absence of a father associated with reduced child survival. Sear & Mace (2008) concluded that investment from fathers is frequently, although not always, replaceable by care from other individuals, so that, at least in terms of early life mortality, children growing up without fathers are often indistinguishable from those that grow up with fathers. This "replaceability" of fathers may in part explain why levels of paternal care vary cross-culturally—if fathers' care can be substituted then alternative investments of their time and energy may be incentivized. Alternatively cultures may vary in the extent to which fathers' contributions are indeed essential for rearing children, which will depend on factors such as gender division of labor and control of resources.

The population health science literature on father absence in rural developing populations has witnessed parallel shifts. Policy makers traditionally assumed that children only live apart from their parents in exceptional and undesirable circumstances, such as parental death, and that loss of fathers is pivotal for child wellbeing. Beegle, Weerdt & Dercon (2010, pp. 177), for example, critique the practice of orphan assistance programs that enroll only those children who have lost their fathers, despite evidence that maternal bereavement is critical. Today there is wider recognition that, particularly in Latin America and sub-Saharan Africa where kin fostering is common, children routinely spend substantial proportions of their childhood years apart from one or both parents, even when parents remain alive, and that such circumstances need not be detrimental (Lloyd & Desai, 1992). Nevertheless, concern about what living circumstances are most likely to lead to positive wellbeing outcomes for children remains, particularly where adult mortality has been elevated due to infectious diseases such as HIV (Beegle et al., 2010). These issues are acutely relevant in sub-Saharan Africa, where it has been estimated that one in ten children under the age of 15 have suffered the death of at least one parent, while one in six households care for a child with a dead mother or father (Monash & Boerma, 2004). Some scholars have argued that traditional kin-based systems of orphan care have been stretched to the breaking point by the impact of HIV, while others suggest the extended family, particularly if supported by appropriate interventions, can still support a large number of orphans (Abebe & Aase, 2007; Beegle et al., 2010; Mathambo & Gibbs, 2009).

An anthropological perspective emphasizes that to understand the impacts of paternal absence cross-culturally, we cannot extrapolate findings from the large literature on family structure and child outcomes in developed nations, where the frequency, form, and consequences of parental absence are distinct (Lawson & Uggla, 2014; Penn, 2012). Instead we must conduct and compile empirical studies capable of forging conclusions specific to their cultural and ecological context. The current study seeks to improve our understanding of father absence and its health consequences for children in rural northern Tanzania. Previous studies indicate that spending a substantial portion of childhood in the absence of

a biological father is a common experience for many rural Tanzanians. For example, a recent, particularly thorough, longitudinal study of the Rufiji Health and Demographic Surveillance System (Rufigi is a District of the Pwani Region in eastern Tanzania), reports that 40% of children experienced father absence in some form by 10 years of age between 2001 and 2011, with absence usually initiated by the age of 5 years (Gaydosh, 2015). Comparative estimates of father absence can be derived from national Demographic Health Survey (DHS) data. Using the 1999 Tanzanian DHS, Monash & Boerma (2004, pp. S58-9) estimate that 31% of Tanzania children under the age of 15 years did not presently live with their biological father and 6% had experienced paternal death. Thus, while adult mortality is certainly higher in Tanzania than many other countries, paternal death accounts for less than a quarter of the cases of father absence. For comparison, according to the same national estimates, currently living apart from mothers due to maternal death (3%) or other reasons (15%) was relatively uncommon, although clearly non-trivial in frequency.

These statistics direct us to consider the reasons why living fathers may not reside with their children. Divorce and separation are not uncommon in Tanzania, and are typically associated with the physical separation of fathers and children. In 2004, 23% of men and 24% of women of reproductive age had experienced at least one marital dissolution (de Walque & Kline, 2012, pp. 4). Fathers may also reside elsewhere when births occur outside of, or prior to, marriage. Age at first marriage has increased in Tanzania in recent decades, and is associated with a greater proportion of children being born outside of marriage, typically residing in mother-only households (Harwood-lejeune, 2000). Polygyny is also common among many ethnic groups, and fathers will be considered absent when resident with alternative wives and their associated children. In such cases fathers typically reside with their first wife. Fathers may also live separately from their children for extended periods if they are absent for labor opportunities that take them away from home. Father absence due to international labor migration may not be as relevant in Tanzania as in other African contexts, such as in South Africa (Gaydosh, 2015). In Tanzania, labor migration is more typically domestic and so less likely to lead to extended separation (Gaydosh, 2015). In all of these scenarios described, young children are anticipated to usually remain resident with their mother. A final special case of father absence is associated with the absence of both parents. As in many other sub-Saharan African countries, fostering, i.e., children temporarily or permanently living away from both parents, is very common in Tanzania. Indeed, Monash & Boerma (2004, pp. S58) estimate that nationally one in ten Tanzanian children under the age of 15 currently reside away from both living parents. In these situations children are most often resident with grandparents (Monash & Boerma, 2004).

Despite this variety of forms of father absence, most research and policy literature on rural developing populations to date has focused on paternal death, with relatively few studies contrasting the impact of father absence for alternative reasons (Gaydosh, 2015). The range of child wellbeing outcomes typically considered is also limited. In the evolutionary anthropological literature in particular, most studies of father absence have focused on the outcome of child mortality (Sear & Mace, 2008), in part following this outcome's close association with fitness (Jones, 2009). In the policy orientated literature the majority of studies have focused on educational attainment and progression (Beegle et al., 2010; Hampshire et al., 2014). Few studies have considered the relationship between father absence and anthropometric markers of child health (but see Beegle et al., 2010; Sear, Mace, & McGregor, 2000; Winking & Koster, 2015). Our study concerns paternal absence during early childhood, operationalized as not currently residing with one's father, and is based on data of children under the age of 5 years. We use height-for-age and weight-for-height as anthropometric measures of chronic and acute malnutrition respectively. We have two linked objectives: (i) describe the frequency and form of father absence, including fosterage, in a large and ethnically diverse sample of northern Tanzania villages; and (ii) using the same data, examine the relationship of alternative forms of father absence to current living circumstances, as measured by household food security and wealth, along with anthropometric measures of child nutritional status.

Different kinds of father absence may follow distinct patterns and may present different advantages or disadvantages in terms of child health. Fathers who are dead obviously will not be contributing to the financial and hands-on care of their children. Thus we predict that children who have experienced paternal death will live in relatively poor households, experience greater food insecurity and have relatively poor health. Children with a living but absent father also are likely to live in circumstances less conducive to good health if these absences mean that fathers' resources are being invested elsewhere (e.g., to another wife's family in the case of polygyny, as is likely in our study context) and spread more thinly. However, in the case of father absence due to labor migration, children may not experience costs to their health if fathers' earnings are returned home (Madhavan, Mee, & Collinson, 2008; Shenk, Starkweather, Kress, & Alam, 2013). Predictions with regard to the impact of fostering could go either way. On the one hand it is anticipated that children living in households that do not contain their biological parents will be less likely to see their interests prioritized. However, child fostering is a common practice in Tanzania, even for very young children, and like

elsewhere (e.g., Scelza & Silk, 2014) may occur for a combination of push and pull reasons, including marital dissolution, learning a trade or skill, assistance with household tasks, education, support during weaning, and desire for a child in the case of fertility problems (Beegle et al., 2010; Urassa et al., 1997). At least in some settings fostering is viewed as a beneficial practice and does not carry a social stigma in the same way that parental divorce or extramarital births might (Beegle et al., 2010). Provided children are fostered to households with sufficient wealth to ensure their wellbeing, we predict no health discrepancies between children living with both parents compared to fostered children.

In the sections below we describe the "Whole Village Project," the sample from which our data are drawn, the surveys conducted and measures of household structure, food security, wealth, and child anthropometric status utilized in our analysis. We then describe the forms of father absence observed in terms of vital status and co-residence, and use supporting data on household structure to inform our understanding of the living circumstances of children living without fathers. We then report associations between alternative forms of father absence and our outcome measures. We conclude by discussing how our results fit with the wider literature on father absence in Tanzania and in rural developing populations more generally, highlighting both limitations and implications of the current study and making suggestions for future research on fatherhood and child health.

2 | DATA AND METHODS

2.1 | The Whole Village Project

Data were collected between 2009 and 2011 as part of the Whole Village Project (WVP), coordinated by Savannas Forever Tanzania, the University of Minnesota (UM), and the Tanzanian National Institute of Medical Research (NIMR) (Borgerhoff Mulder et al., 2010). Between 60 and 75 households were randomly selected from 56 villages, leading to an initial sample of 3584 households. 2268 households provided data on children under the age of 5 years. Villages were sampled across the northern and central regions of Arusha (19 villages), Manyara (11 villages), Dodoma (7 villages), Singida (5 villages), Shinyanga (8 villages), Mwanza (3 villages), and Mara (3 villages). The sampling of villages was based in part on the priorities of development agency partners and the permission of government leaders. As such, data cannot be considered geographically representative, although effort was made to randomize village sampling where possible and to ensure a wide geographic spread. The WVP received ethical approval from the UM Institutional Review Board (code 0905S65241) and NIMR. Informed oral consent was obtained from participants and all individual data were anonymized before analysis. Consent was oral rather than written because this format is most appropriate in rural Tanzanian communities with limited literacy skills, and where many individuals harbor mistrust of written communication.

The study sample comprises a wide variety of ethnic groups, with over 50 distinct ethnic affiliations being listed by household heads (Lawson et al. 2014). Four ethnicities, the Maasai, Sukuma, Rangi, and Meru, make up 65% of households. The Maasai are traditionally seminomadic pastoralists but have recently diversified into cultivation. The Sukuma, Rangi, and Meru are all characterized as agropastoralists. Rangi and Meru primarily identify as Muslims and Protestants, respectively. Sukuma and Maasai identify with either Christian or indigenous religions. Previous analyses of these data (Lawson et al. 2014) revealed notable ethnic differences in child health, with comparisons of both nutritional status and self-reported incidence of childhood diseases demonstrating that Maasai pastoralists are disadvantaged compared to neighboring ethnic groups more reliant on farming. Meru children were relatively advantaged and Sukuma and Rangi children intermediate in most comparisons. These differences appear to be largely accounted for by variation in ecological vulnerability and service provision (Lawson et al. 2014, Lawson et al., 2015). Maasai pastoralist households are more commonly found in low rainfall villages and have particularly low levels of educational attainment. In contrast, the Meru, who generally had the best child health outcomes, occupy the relatively high rainfall, fertile slopes of mount Meru in close proximity to Arusha city, benefit from increased health care and education infrastructure, along with opportunities for beneficial forms of livelihood diversification. Maasai communities are relatively polygynous compared to other ethnic groups, especially the Meru where marriage is almost exclusively monogamous. However, there is no indication that polygynous marriage contributes to the comparatively poor child health outcomes of the Maasai; in both household and village-level comparisons polygyny is not predictive of poor child health once differences in rainfall and educational attainment have been accounted for (Lawson et al., 2015).

2.2 | Data collected

For each surveyed household, children under the age of five were made the subject of a short "child survey." This survey included questions on the vital status and whereabouts of the child's biological mother and father, with valid responses provided for 3136 children. For each child, the "primary guardian" was also recorded. While responses to this question may have been relatively subjective compared to vital status and residence, this variable enables us to further distinguish between children recorded as under the care of their

parent(s), grandparent(s), or other relative(s). Additional data on the living circumstances of children were taken from a survey administered to the household head. This included a household roster providing data on marital status and sex of the household head. Data on the age and sex of other household members were also collected. The household survey also provides a measure of food security and several measures of household wealth. The Household Food Insecurity Access Scale assesses food insecurity during the last month on a 27-point scale (Coates, Swindale, & Bilinsky, 2007). We reverse scored this measure so a higher score means higher food security (mean: 16.9; standard deviation: 7.0). A household wealth index was calculated by principal component analysis applied to the ownership of 37 assets. Acres cultivated and livestock units were recorded separately. Some pastoralist households cultivated no land whatsoever, and some farmers did not keep livestock. Thus measures of acres cultivated and livestock units owned can only be meaningfully compared among those that farmed at least some land or kept at least some cattle. All wealth measures were transformed ($\log\ x + 1$) to approximate normal distributions.

Child weight was measured to the nearest 100 g using a Salter-type spring hanging scale for infants, and electronic scales for children able to stand. Child height was measured to the nearest millimeter using a measuring board for young children, and using a stadiometer for children of 2 years or older. All measurements were made once and immediately entered into a database. Children were measured by different field staff depending on the village sampled, but training of enumerators by UNICEF staff and oversight of anthropometric sessions by NIMR personnel ensured high levels of inter-rater reliability prior to data collection. Anthropometric indicators were derived using World Health Organization age and sex-specific growth standards (de Onis et al., 2012). Height-for-age *Z*-scores (HAZ) serves as an indicator of long-term effects of malnutrition. A child with a HAZ of <-2 standard deviations from the WHO reference is considered "stunted," i.e., chronically malnourished, which reflects failure to receive adequate nutrition over a long period of time and is influenced by recurrent and chronic illness. Weight-for-height *Z*-scores (WHZ) measure body mass in relation to body height/length and describes current nutritional status. A child with a WHZ, <-2 standard deviations is considered acutely malnourished (i.e., "wasted"), which represents the failure to achieve adequate nutrition in the period immediately preceding measurement and may result from recent inadequate food intake or illness. Following WHO guidelines extreme values were removed (for HAZ scores of <-6 or >6, and for WHZ scores of <-5 or >5), because they potentially resulted from measurement error, leading to 2971 valid HAZ scores and 2989 valid WHZ scores.

2.3 | Analytical strategy

First, we describe the form and frequency of father absence in our sample and, using χ^2 tests and ANOVAs, we then test whether alternative forms of parental absence are associated with key household demographic characteristics, ethnicity, and child age and sex. Second, we determine if alternative forms of paternal absence are associated with the level of household food security, wealth (wealth index, acres cultivated, and large livestock) and our anthropometric measures (HAZ and WHZ) of child health using multilevel linear regressions with a random intercept for village on complete cases. The average village provides data on 64 children from 40.5 households. We do not include an intermediate hierarchical level for household because the mean number of children surveyed per household was only 1.6 and Clarke (2008) has demonstrated that when clusters are unbalanced and sparsely populated both fixed and random effects may be overestimated. For the food security and wealth outcomes, a model was first run controlling for only ethnicity (Model Set A) and then with the addition of household demographic characteristics: number of youths in the household, number of adults in the household, and age of household head (Model Set B). For the anthropometric outcomes, models were first run controlling for ethnicity, child age, and sex of the child (Model Set A), and then with the addition of household demographic characteristics (Model Set B). Household demographic characteristics were included in full models because these factors could exert independent influences on the wealth of the household and the health of children. However, they may also be considered on the causal pathway – for example the effects of fostering on child heath may be mediated by the fact that a child has been sent to live in the household of a particular composition (e.g., more or less youths or adults). For this reason we present both model sets. Likelihood ratio tests were conducted to determine whether the inclusion of these variables improved upon the simpler models.

3 | RESULTS

3.1 | Frequency and form of father absence

In only a tiny percentage of cases (1%) did a child have a deceased mother (27/3136) or co-reside with their father but away from their living mother (12/3136). These cases are excluded from further analysis because we lack statistical power to meaningfully compare and contrast child health in such living circumstances to the wider sample. This brings our working sample to 3097 children. Table 1 summarizes descriptive information on four categories of child living circumstances that can be identified for this sample. The large majority of children ($n = 2386$, 77%) lived in an "intact

TABLE 1 Descriptive information on household and child-level variables by living circumstances ($N = 3097$)

	Full sample	Intact family[a]	Father dead[b]	Living father absent[c]	Foster child[d]	
N						
Mean (stand deviation)	**3097**	**2386**	**108**	**413**	**190**	P^e
Total <15 yr in household	4.0 (2.1)	3.9 (2.1)	4.2 (2.1)	4.3 (2.5)	3.8 (1.8)	.001
Total 15 yr to 64.999 in household	3.0 (1.8)	2.9 (1.7)	2.9 (1.8)	3.5 (2.2)	3.2 (1.9)	<.001
Total 65+ yr in household	0.2 (0.5)	0.1 (0.4)	0.2 (0.4)	0.4 (0.7)	0.5 (0.7)	<.001
Age of household head (yrs)	42.7 (14.3)	40.2 (12.5)	46.9 (14.4)	49.0 (17.6)	57.7 (13.8)	<.001
Age of the child (mo)	28.8 (17.1)	28.0 (17.1)	36.4(15.5)	27.0 (17.2)	39.7 (11.7)	<.001
Column percent						P^f
Household type						<.001
Male headed, monogamously married	65	73	25	35	48	
Male headed, polygynously married	11	11	4	12	21	
Female headed, monogamously married	4	5	3	4	2	
Female headed, polygynously married	5	5	2	10	4	
Female headed divorced, widowed, or separated	10	3	64	30	23	
Other	4	3	3	9	2	
Primary guardian						<.001
Parent(s)	89	98	77	81	1	
Grandparents(s)	9	1	15	17	88	
Other relative(s)	2	1	8	2	12	
Sex of child						.94
Male	51	51	48	50	51	
Female	49	49	52	50	49	

[a]Child lives with mother and father.
[b]Child's father is dead.
[c]Father is alive, but child lives only with mother.
[d]Child's parents are alive, but child lives with neither.
[e]ANOVA.
[f]χ^2 test.

family," i.e., both parents are alive and reside with the child. Most children from intact families lived in households headed by males and the majority of these male-headed households were monogamous rather than polygynous. In the overwhelming majority (98%) of cases the primary guardian of the child was listed as the parent(s).

In the remaining 23% of cases, children did not currently live with their father. We distinguish three alternative forms of father absence from these data. First, in a small fraction of cases ($n = 108$, 3.5%) a child's father was dead. In these cases the large majority of children live with the mother (93/108), while a small remainder lived away from both parents (15/108) despite the mother still being alive. Given the small number of cases, we group these instances into an overall living circumstance referred to as "father dead," acknowledging the most common scenario involved maternal co-

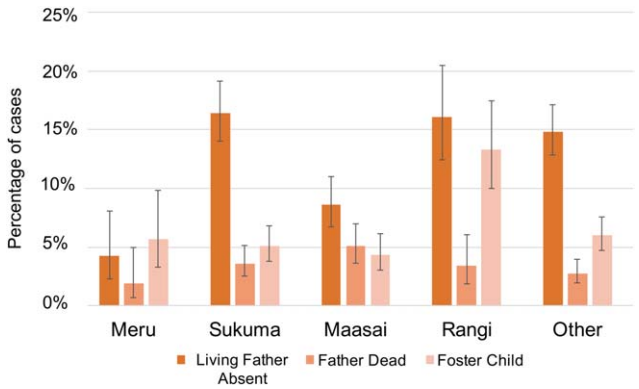

FIGURE 1 Frequency of father absence by category and ethnic group with 95% confidence intervals. There is significant ethnic variation in the frequency of father absence types (χ^2 (12, $N = 3097$) = 83.86, $P < .001$). Meru = 210 children, Sukuma = 809 children, Maasai = 671 children, Rangi = 323 children, Other = 1084 children

residence. Among children with a dead father, around two thirds of children lived in a female-headed household, with the female-head almost always recorded as "widowed, divorced or separated." These data are consistent with the interpretation that children with dead fathers often, but not always, lived in households headed by their widowed mother. For children with a deceased father, the primary guardian was listed as their parent (i.e., mother) in 77% of cases and as their grandparent(s) in 15% of cases.

Second, the most common ($n = 413$, 13%) form of father absence was for children to live with their mother, and have a living but nonresident father. These cases are referred to as "living father absent" cases. In this category, children were evenly divided between male and female-headed households. One third of children lived in households where the household head was female and listed as a "divorced, separated or widowed" female. A significant proportion also reported being unmarried (within the "other" category in Table 1) consistent with pre-marital or extra-marital birth where the mother remains resident in her natal home or lives alone. In one in ten cases living father absent children lived in households headed by women who were polygynously married—consistent with situations where the child's mother is a second or later wife, with the husband being resident with his primary wife and her children (see also Lawson et al., 2015). For living father absent cases, the primary guardian was listed as their parent(s) in most cases (81%), consistent with the mother being responsible for the child, although a notable proportion (17%) listed a grandparent as the primary guardian.

Third, a significant number of cases ($n = 190$, 6.1%) were categorized as "child fostered" with both parents being alive, but not resident with the child. Fostered children resembled children from intact families in that they were most commonly in male-headed households, although a larger proportion of households were polygynously headed than among children from intact families. Around a quarter of fostered children also lived in households headed by a divorced, separated or widowed female. The mean age of household heads was considerable older (57.7 years) for foster children compared to other groups, particularly intact families (40.2 years). For nine of 10 (88%) fostered children, the primary guardian is listed as their grandparent(s), with 12% fostered to others relatives.

Figure 1 shows that there are clear ethnic differences in the frequency and form of father absence. Overall, father absence was least common in the Meru (12%) and Maasai (18%), compared to the Sukuma (25%) and Rangi (33%). The frequency of having a living but absent father was higher in the Sukuma (16%) and Rangi (16%) compared to the Meru (4%) and Maasai (9%). Having a dead father was relatively rare in all ethnic groups, being most common in the Maasai (5%) and least common in the Meru (2%). The frequency of child fostering was around 5% for all ethnic group categories, with the notable exception of the Rangi where 13% of children under the age of five were currently fostered away from both living parents.

There is no association between the sex of children and the four categories of father absence/presence (Table 1). Children with dead fathers and fostered children are on average around a year older than children in intact or living father absent households. Comparison groups also differed in terms of the composition of youths and adults. On average children in intact families and foster children lived with fewer youths (3.8–3.9 children, respectively) than children with dead or absent living fathers (4.2–4.3 children, respectively). Children from intact families and with a dead father had fewer adults (2.9 adults on average in both cases) than children with absent fathers and who were fostered.

3.2 | Father absence, household food security, and wealth

In terms of bivariate associations between father absence/presence and wealth and health outcomes across villages, children with living but absent or dead fathers lived in households with lower mean food security and wealth, and fewer large livestock than children from intact and foster families (Table 2). Children in foster families lived in households with higher mean food security and wealth, and more large livestock than children from intact families (Table 2). Table 3 shows the results of multivariate multilevel models predicting differences in household food security and the three measures of household wealth. These models take into account village-level hierarchical clustering in the data which, when unaccounted for, has the potential to obscure underlying relationships between variables within villages

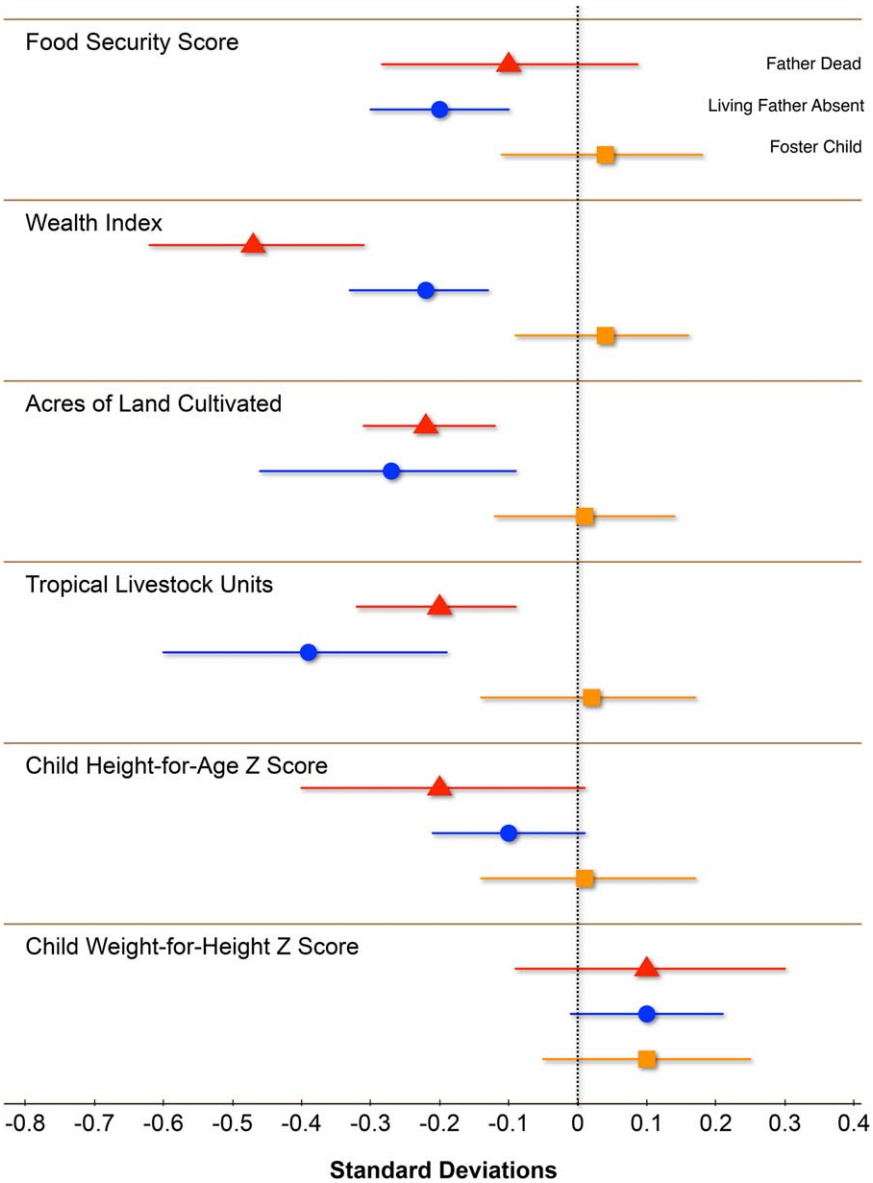

FIGURE 2 Food security, household wealth and child health by father absence category with 95% confidence intervals. The reference category (dashed line) represents intact families (i.e., child lives with both biological mother and father). Effect sizes are standard deviation units based on overall sample distributions. Models predicting food security and household wealth are adjusted for ethnicity, age of household head, number of youths in the household, number of adults in the household, and a village random effect (i.e., Model Set B, Table 3). Models predicting child anthropometry are adjusted for child age, child sex, ethnicity and a village random effect (Model Set A, Table 4)

(Lawson et al., 2015). Father absence/presence is a significant predictor of food security and all household wealth measures to the 0.05 level. The inclusion of household demographic characteristics into each of these models did not qualitatively change the correlations between living arrangements and household food security and wealth measures. The more complex models (Set B) were an improvement upon the simpler models (Set A) in all cases as indicted by the likelihood ratio tests and thus are interpreted here based on 95% confidence intervals. Children whose parents lived apart (father absent) resided in households with lower food security, lower wealth, fewer acres of cultivated land, and fewer large livestock than children living in intact families. Similarly, children whose fathers were dead lived in households with lower wealth, and fewer acres cultivated and large livestock than children from intact families, but they did not differ in levels of food security. Children in foster families did not differ from those living in intact families

TABLE 2 Bivariate associations between living circumstances and household and child outcome variables ($N = 3097$)

N Mean (standard deviation)	Full sample 3097	Intact family 2386	Father dead 108	Living father absent 413	Foster child 190	*P**
Food security continuous scale	16.38 (7.09)	16.33 (7.20)	15.03 (6.94)	15.46 (6.74)	17.17 (6.79)	.009
Log wealth index	1.30 (0.45)	1.31 (0.45)	1.05 (0.43)	1.26 (0.45)	1.39 (0.47)	<.001
Log acres cultivated	1.63 (0.74)	1.61 (0.72)	1.48 (0.78)	1.55 (0.74)	1.70 (0.74)	.079
Log tropical livestock units	1.52 (0.99)	1.50 (0.96)	1.16 (0.82)	1.43 (0.99)	1.64 (0.94)	.003
HAZ (length/height-for-age *z*-score)	−1.65 (1.56)	−1.63 (1.58)	−1.96 (1.50)	−1.74 (1.56)	−1.77 (1.53)	.109
WHZ (Weight-for-length /height *z*-score)	0.15 (1.34)	0.14 (1.37)	0.00 (1.41)	0.31 (1.33)	−0.03 (1.09)	.018

**P* value from ANOVA.

for any of the four household food security and wealth measures, once household demographic characteristics were accounted for. Figure 2 displays estimated effect sizes converted to standard deviation units for each outcome measure. In these terms having a dead or living but absent father is associated with household wealth levels substantially lower than intact families, while differences in food security are relatively modest.

Ethnicity also predicts household food security and wealth, with Maasai families being generally disadvantaged and Meru families being generally advantaged overall. The Maasai herders did, however, own more cattle that herders of other ethnic affiliations. Households with more adults have higher food security and wealth scores across all measures, while larger numbers of children in the household was only predictive of more acres of land cultivated and large livestock. The age of the household head had no meaningful correlation with any of the outcomes.

3.3 | Father absence and anthropometric status

Overall 41.4% of children were stunted (HAZ less than −2) and 4.1% of children were wasted (WHZ is less than −2). Bivariate analysis indicated that overall across villages children's health status as measured by HAZ did not vary between children's living circumstances, while WHZ was highest for children from intact families and those with absent living fathers (Table 2). Table 4 shows the results of multivariate multilevel models predicting children's anthropometric status. In both the model predicting HAZ and that predicting WHZ, the inclusion of household demographic controls (Model Set B) was not an improvement of the more simple models (Model Set A) and the simpler models are interpreted here. There is suggestive evidence ($P = .083$) that family circumstance correlated with children's HAZ scores: children with a dead father or who lived separately from their father had lower HAZ scores than children from intact families. Foster children did not differ from children from intact families in their HAZ score, as evidenced by the small regression coefficient and wide 95% confident interval. WHZ scores did not significantly differ by children's living circumstances. Figure 2 displays estimated effects sizes converted to standard deviation units, showing that in these terms the largest effect size for HAZ, at about 0.2 standard deviations, is the contrast between children having a dead father versus living with both biological parents.

As we have previously demonstrated (Lawson et al. 2014) there are substantial ethnic differences in child anthropometrics, with Maasai children's health being relatively poor compared to all other ethnic groups and Meru children appearing healthiest. Age of household head and number of youths in the household had no apparent relationship with child anthropometric status. Number of adults in the household was positively related to child WHZ.

4 | DISCUSSION

4.1 | Father absence and child health in northern Tanzania

We set out to determine the (i) frequency and form of paternal absence in a large and ethnically diverse sample of northern Tanzanian villages and (ii) to determine its relationship with children's living circumstances, in terms of household food security and wealth, and child health, as measured by anthropometric indicators. Consistent with prior studies of Tanzania (Gaydosh, 2015), and Sub-Saharan Africa more generally (Beegle et al., 2010; Monash & Boerma, 2004), we

TABLE 3 Multilevel models predicting household food security and household wealth

	Food security ($N = 2743$)				Log wealth index ($N = 2686$)			
	A		B		A		B	
Model	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***
Fixed effects (β coefficient)								
Father absence/presence (ref: intact family)								
Father dead	−0.79 (−2.09 to 0.5)	.003	−0.74 (−2.04 to 0.57)	<.001	−0.2 (−0.28 to −0.13)	<.001	−0.21 (−0.28 to −0.14)	<.001
Living father absent	−1.37 (−2.08 to −0.66)		−1.41 (−2.14 to −0.69)		−0.07 (−0.11 to −0.03)		−0.10 (−0.15 to −0.06)	
Foster child	0.19 (−0.79 to 1.18)		0.25 (−0.79 to 1.28)		0.05 (−0.01 to 0.11)		0.02 (−0.04 to 0.07)	
Ethnicity (ref: Maasai)								
Meru	6.14 (4.44 to 7.84)	<.001	6.13 (4.43 to 7.83)	<.001	0.49 (0.38 to 0.6)	<.001	0.48 (0.38 to 0.59)	<.001
Sukuma	4.78 (3.48 to 6.08)		4.57 (3.27 to 5.88)		0.32 (0.23 to 0.4)		0.28 (0.19 to 0.36)	
Rangi	3.64 (2.21 to 5.07)		3.55 (2.13 to 4.98)		0.40 (0.3 to 0.49)		0.38 (0.29 to 0.47)	
Other	4.73 (3.69 to 5.78)		4.65 (3.6 to 5.69)		0.3 (0.23 to 0.37)		0.28 (0.22 to 0.35)	
Age of household head (yr)			−0.01 (−0.03 to 0.01)	.357			0.00 (0 to 0)	.172
No. youths in household			0.00 (−0.14 to 0.14)	.979			0.00 (0 to 0.01)	.251
No. adults in household			0.27 (0.1 to 0.43)	.001			0.05 (0.05 to 0.06)	<.001
Intercept	12.89 (11.89 to 13.89)	<.001	12.58 (11.33 to 13.84)	<.001	1.07 (1.300 to 1.14)	<.001	0.89 (0.8 to 0.97)	<.001
Random effects								
Village variance	3.90 (2.34 to 6.50)		3.87 (2.33 to 6.44)		0.03 (0.02 to 0.04)		0.03 (0.02 to 0.04)	
Child variance	38.90 (36.87 to 41.04)		38.73 (36.70 to 40.86)		0.13 (0.12 to 0.14)		0.12 (0.12 to 0.13)	
LR test A vs. B	0.007				<0.001			

TABLE 3 (continued)

	Log Acres Cultivated[a] ($N = 2410$)				Log Tropical Livestock[b] Units ($N = 1948$)			
	A		B		A		B	
Model	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***
Fixed effects (β coefficient)								
Father absence/presence (ref: intact family)								
Father absent	−0.05 (−0.12 to 0.03)	.002	−0.16 (−0.23 to −0.09)	<.001	−0.05 (−0.17 to 0.07)	<.001	−0.20 (−0.32 to −0.09)	<.001
Father dead	−0.14 (−0.29 to 0)		−0.20 (−0.34 to −0.07)		−0.3 (−0.52 to −0.09)		−0.39 (−0.59 to −0.19)	
Foster child	0.11 (0.01 to 0.22)		0.01 (−0.09 to 0.10)		0.2 (0.04 to 0.35)		0.02 (−0.14 to 0.17)	
Ethnicity (ref: Maasai)								
Meru	−0.09 (−0.3 to 0.12)	.003	−0.06 (−0.26 to 0.13)	.024	−0.37 (−0.65 to −0.09)	<.001	−0.38 (−0.64 to −0.11)	.012
Sukuma	0.19 (0.02 to 0.36)		0.12 (−0.03 to 0.27)		0.11 (−0.12 to 0.34)		−0.15 (−0.37 to 0.07)	
Rangi	0.09 (−0.08 to 0.27)		0.05 (−0.1 to 0.21)		−0.3 (−0.58 to −0.03)		−0.4 (−0.66 to −0.14)	
Other	−0.02 (−0.15 to 0.12)		−0.04 (−0.16 to 0.08)		−0.19 (−0.36 to −0.01)		−0.23 (−0.4 to −0.06)	
Age of household head (yr)			0.00 (0.00 to 0.00)	.002			0.01 (0.01 to 0.01)	<.001
No. youths in household			0.05 (0.03 to 0.06)	<.001			0.07 (0.04 to 0.09)	<.001
No. adults in household			0.12 (0.1 to 0.13)	<.001			0.10 (0.08 to 0.13)	<.001
Intercept	1.50 (1.35 to 1.65)	<.01	0.90 (0.75 to 1.05)	<.001	1.56 (1.38 to 1.73)		0.75 (0.55 to 0.96)	<.001
Random effects								
Village variance	0.13 (0.08 to 0.19)		0.11 (0.07 to 0.16)		0.13 (0.08 to 0.21)		0.12 (0.08 to 0.19)	
Child variance	0.36 (0.34 to 0.39)		0.29 (0.28 to 0.31)		0.73 (0.69 to 0.78)		0.65 (0.61 to 0.69)	
LR test A vs. B	<0.001				<0.001			

[a]Among land owners.
[b]Among livestock keepers.

TABLE 4 Multilevel models predicting children's anthropometric status

	HAZ (N = 2631)				WHZ (N = 2651)			
	A		B		A		B	
Model	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***	**Coef (95% CI)**	***P***
Fixed effects (β coefficient)								
Father absence/presence (ref: intact family)								
Father dead	−0.31 (−0.62 to 0.01)	.083	−0.32 (−0.63 to 0.00)	.072	0.14 (−0.12 to 0.4)	0.264	0.11 (−0.16 to 0.38)	.492
Living father absent	−0.16 (−0.33 to 0.01)		−0.17 (−0.34 to 0.01)		0.14 (−0.01 to 0.28)		0.10 (−0.05 to 0.25)	
Foster child	0.02 (−0.22 to 0.26)		0.01 (−0.24 to 0.26)		0.13 (−0.07 to 0.33)		0.07 (−0.15 to 0.28)	
Ethnicity (ref: Maasai)								
Meru	1.04 (0.7 to 1.39)	<.001	1.05 (0.71 to 1.4)	<.001	0.55 (0.28 to 0.82)	<0.001	0.46 (0.18 to 0.74)	.001
Sukuma	0.68 (0.42 to 0.93)		0.66 (0.4 to 0.92)		0.5 (0.31 to 0.7)		0.39 (0.18 to 0.59)	
Rangi	0.30 (0 to 0.59)		0.30 (0.00 to 0.59)		0.13 (−0.1 to 0.36)		0.04 (−0.2 to 0.28)	
Other	0.39 (0.17 to 0.6)		0.38 (0.17 to 0.6)		0.35 (0.18 to 0.53)		0.26 (0.09 to 0.44)	
Sex of child (ref: male)								
Female	0.1 (−0.01 to 0.21)	.047	0.1 (−0.01 to 0.21)	.087	0.07 (−0.02 to 0.17)	0.229	0.06 (−0.04 to 0.16)	.212
Age of child	−0.01 (−0.01 to 0)	<.001	−0.01 (−0.01 to 0)	<.001	−0.02 (−0.02 to −0.02)		−0.02 (−0.02 to −0.02)	<.001
Age of child squared	0.00 (0 to 0)	<.001	0.00 (0 to 0)	<.001	0.00 (0 to 0)		0.00 (0 to 0)	.287
Age of household head (yr)			0 (0.00 to 0.01)	.650			0.00 (0 to 0.01)	.438
No. youths in household			0.02 (−0.01 to 0.06)	.173			−0.01 (−0.04 to 0.02)	.452
No. adults in household			−0.02 (−0.05 to 0.02)	.446			0.03 (0 to 0.07)	.042
Intercept	−2.5 (−2.71 to −2.29)		−2.58 (−2.86 to −2.3)	<.001	−0.27 (−0.44 to −0.11)		−0.30 (−0.53 to −0.07)	.010
Random effects								
Village variance	0.08 (0.04 to 0.16)		0.08 (0.04 to 0.16)		0.04 (0.02 to 0.08)		0.04 (0.02 to 0.09)	
Child variance	2.15 (2.03 to 2.27)		2.15 (2.03 to 2.27)		1.50 (1.42 to 1.59)		1.58 (1.5 to 1.67)	
LR test A vs. B	0.538				0.097			

found that father absence was common, even among children under the age of 5 years, and that father death accounted for a relatively small fraction of children living in the absence of their father. Instead, father absence was mostly accounted for by situations where children resided away from their living father, but not their mother—or where children were fostered away from both living parents. In the former case, supporting data on household structure are consistent with scenarios of parental divorce/separation, extramarital birth, and polygynous fathers being co-resident with an alternative wife. Survey restrictions mean we lack the precision and sample sizes to subcategorize and effectively analyze such living circumstances separately. We also lack data that could be used to assess the degree to which the absence of a living father may reflect labor migration. However, prior studies suggest paternal absence for this reason is relatively uncommon in Tanzania. For example, in a Sukuma area bordering our survey area, Urassa et al. (1997) found that in 37% of cases of father absence this was due to the child being born outside of marriage, 30% because of divorce and in 15% of cases because the child lived with another wife. Working away from the household was seldom a reason for father absence. Adult male migration may be more common in Maasai communities, although it often occurs prior to family formation (May, 2003). Overall our study highlights that, despite the emphasis on orphanhood in the research and policy communities, the reasons for father absence in developing populations such as rural Tanzania are diverse.

Children with deceased or living but absent fathers resided in households with lower food security and/or less wealth than children in "intact families." There is also suggestive evidence that paternal bereavement and the absence of a living father is costly for child health; child HAZ scores were lower for children with dead or absent living fathers compared to those children in "intact families," although confidence intervals overlap zero. As our study is cross-sectional, two lines of interpretation may account for this pattern of results. On the one hand, father absence could be at the causal root; leading to situations of low food security, relative poverty and poor child health because paternal investment has been withheld or withdrawn. This explanation offers consistency with literature on father absence in developed modern settings where father absence appears detrimental for children and where socioeconomic deficits associated with single-parenthood partially mediate such relationships (McLanahan et al., 2013). On the other hand, it is possible that low food security and/or relative poverty determine both father absence and poor child health.

With regard to paternal death, we suggest that both pathways are in effect since the death of a father is expected to have negative impacts on wealth available for human capital investment, and because adult mortality will likely be more common in initially poor households. Longitudinal data are required to tease these (potentially synergistic) pathways apart, but are rarely presented in the current literature on rural developing populations. Recently, Beegle et al. (2010) tracked the status of 718 children from the Kagera region of north-western Tanzania first interviewed between 1991 and 1994 and then reinterviewed them in 2004. Controlling for a wide range of household and child conditions before orphanhood, they report persistent and causal impacts of becoming a maternal orphan before age 15 on later height. Paternal orphanhood, while correlated with lower height, did not appear to have a causal link. Beegle et al. (2010) suggest that paternal bereavement may present a largely recoverable circumstance in the realm of physical health, at least to the extent to which stature is a suitable health indicator. This conclusion is shared by Sear et al. (2000) who report no association between paternal death and the anthropometric status and survival of children under five in a longitudinal study of rural Gambians. In contrast, the death of a mother or maternal grandmother had apparent negative child health consequences. Although we lack data on its occurrence in our specific setting, one factor buffering children from negative consequences of paternal death may be the practice of widow inheritance or leviratic marriage, whereby responsibility for caring for paternal orphans is inherited by the dead male's brother or close male kin (Palmore, 1987). However, as cautioned by Sear et al. (2000), we also note that available studies of paternal death and child outcomes, including our present investigation, lack statistical power because paternal death is a rare event, particularly in studies of early childhood. In the Gambian study, only 2.6% ($n = 52/1928$) of Gambian children had experienced paternal bereavement (Sear et al., 2000, pp. 1643). To better tackle these questions in the future, both longitudinal and large sample data may be required.

With regard to the absence of living fathers, causality could again go in both directions. However, unlike paternal death, it is not clear that extramarital birth or marital dissolution should necessarily be more common in disadvantaged households otherwise predisposed to low wealth and poor health outcomes. And in both cases there are clear reasons to anticipate a relative shortfall in paternal investment. Births that occur outside of marriage are less likely to elicit investment from fathers and patrilineal kin. The same goes for children separated from their father due to divorce or separation. Previous studies also suggest that paternal absence due to polygyny can lead to relatively negative food security and child health outcomes if male-controlled resources are preferentially diverted to alternative wives and their children (Gibson & Mace, 2007; Lawson et al., 2015). Although we emphasize that, in this population, polygyny itself cannot be seen as an overall risk factor for poor child health outcomes because male-headed polygynous households are typically

wealthier and have child health outcomes equivalent or better than children in monogamous households (Lawson et al., 2015).

Unlike other forms of father absence, fostering was associated with equal or relatively high household food security and wealth and clearly was not associated with either child health measure. Our results are thus consistent with the conclusion that children are most often strategically fostered to kin who are capable of ensuring their wellbeing in this context. Our conclusion here parallels work by Urassa et al. (1997) who found no evidence that fostered children were more at risk of poor well-being in northwestern Tanzania. In other contexts, however, fostering has been suggested to have negative health consequences. One study of fostering in rural Sierra Leone suggests a higher incidence of malnutrition in fostered children in early childhood, which may be due to expedited weaning (Bledsoe et al., 1988). Scelza & Silk (2014) have also reported relatively poor anthropometric status for fostered children among the Himba of Nambia. Recently Hampshire et al. (2014) reviewed the larger literature on fostering and child schooling outcomes, concluding that current findings are equivocal. In cases where children appear to be fostered to relatively wealthy households, null or positive effects have been suggested. For example, Zimmerman (2003), reported no association between fostering and school enrolment in a large South African dataset, but estimated an increase in school attendance for fostered children, accounted for by wealthier fostering households being more able to afford schooling. Seemingly contradictory patterns are to be expected—since fostering can occur under such a diverse set of conditions. Future studies of fostering and child health would benefit from collecting supporting data to determine the reasons for fostering and the degree to which it can be considered in response to push factors (in what Bledsoe et al. (1988) describe as the movement of children out of "crisis households") or pull factors (what Hampshire et al. (2014) describe as "purposive fostering"). In the context of developed countries, where fostering with non-kin is more common, distinguishing children fostered with kin vs. non-kin is also likely to be critical (see Sheppard et al., 2014).

4.2 | Limitations and methodological considerations

As we have outlined above, causality cannot be confidently established with cross-sectional data. This issue extends to the majority of the current literature on paternal absence in sub-Saharan African and beyond. Clearly we need more longitudinal studies, with sample sizes sufficient to address concerns of low statistical power for rare forms of paternal absence, along with the exploration of alternative methodologies like propensity score matching to control for endogeneity (Beegle et al., 2010; Kadiyala, Quisumbing, Rogers, & Webb, 2009). Longitudinal designs also have the relative strength of enabling the length of paternal absence to be considered and temporary from long-term absences to be distinguished.

A second methodological concern, once again applicable to the wider literature as much as our own study, is the ubiquitous use of residence as an indicator of paternal investment to assess the importance of fathers in ensuring child health. Fathers may often be still effectively present and involved in a child's life while not technically residing in the same household in some contexts. We need more sophisticated survey methods to deal with the complexity of African family structure—to map family relationships beyond residence (Madhavan, Mee, & Collinson, 2014). One reason for current restrictions is that a lot of datasets brought to bear on such questions (including the Whole Village Project and the DHS) were not originally designed to specifically consider family structure and childrearing, and so while they often produce seductively large samples, they lack the sophistication to accurately track the complex dynamics of human family structure and parental investment. Few studies have measured paternal investment directly and estimated its precise relationship with child outcomes. Addressing this evidence gap, Winking & Koster (2015) recently took a novel approach and used photo-based peer ranking of men's direct and indirect involvement in childcare in a small-scale study of a rural horticulturalist community in Nicaragua. Both measures showed weak positive associations with child weight, although not height. Male income variation, which could be considered a measure of investment, was positively related to child height and weight. While parental investment is difficult to measure, and isolate from potential confounds, future studies of this kind would be most informative.

The Whole Village Project cannot be used to make representative statements about northern Tanzania, given the non-random sampling of villages. However, we emphasize that this disadvantage is offset by advantages of this data in terms of our ability to take into account both spatial clustering and consider ethnic variation in the frequency and form of paternal absence. In Tanzania, ethnicity data is unavailable from the majority of DHS datasets, and most large surveys sample relatively few households per village, making it difficult to estimate random effects at this level (Lawson et al. 2014). Previously we have demonstrated that ignoring such patterning in the data can lead to spurious associations and misinterpretation (Lawson et al., 2015). Further exploration of ethnic variation in the impacts of father absence in this context would be most valuable.

While our overall sample size is large, ethnic diversity is high and father absence is a relatively rare event (at least when subcategorized by type of absence), meaning that a

stratified analysis by ethnicity would have limited statistical power to examine such variation in this study. The lack of observational data on father's activities also means we are not in a position to provide contemporary ethnographic insights into culturally varying norms regarding paternal care. However, differences in the frequency of father absence types between ethnic groups (Figure 1), along with noted variation in the incidence of polygynous marriage and the wider socioeconomic and ecological environment inhabited by each ethnic group (Lawson et al. 2014), suggest that the causes and consequences of father absence are unlikely to be uniform. More generally, the anthropological record indicates high cultural variation in the father-child relationship and child-rearing practices (Hewlett, 1992; Lancy, 2015), including the extent to which the practice of leviratic and widow marriage provide institutional support for widows and their dependents (Palmore, 1987). On the other hand, the socialist political movement, aimed at constructing a secular national identity, beginning with the emergence of an independent Tanzania has unquestionably eroded cultural divisions (Campbell, 1999; Weber, 2009).

A number of hypotheses could be explored in future research to better understand context-dependency in the importance of fathers for child development. Most obviously, father absence is logically likely to be less consequential in settings where fathers typically provide less support for a mother and their children and/or where variation in child wellbeing is significantly determined by factors outside of familial influence. This logic has been forwarded to explain effect heterogeneity by socioeconomic class in studies of father absence in western developed nations. For example, Bernardi & Boertien (2016) conclude that British children have "more to lose" from father absence if they originate from relatively high socioeconomic backgrounds, because the reduction in household income associated with parental separation is larger and entails more negative consequences for such children compared to those from lower socioeconomic backgrounds (see also Nettle, 2008).

5 | CONCLUSIONS

While historically both evolutionary anthropology and policy-orientated research often assumed that paternal involvement is a major determinant of child health and survival in rural developing populations, the existing empirical literature presents a challenge to this position. In response, both research and policy have refocused attention in recent years to the importance of the extended family and to a greater awareness of cultural diversity in childrearing arrangements. Further supporting this shift, we present findings that indicate the impact of father absence depends on its form. Children with dead or living but absent fathers live in relatively poor/food insecure households compared to children living with both of their biological parents. We also report suggestive evidence of health disadvantages to children with dead or living but absent fathers. However, that associations between father absence and child heath are statistically weak, suggests shortfalls in household wealth associated with father absence may be at least partially offset by investments from outside of the household. In contrast fostered children, living apart from both parents, are indistinguishable from children from "intact families" in terms of food security, household wealth and health outcomes. Since fostered children are mostly under the care of their grandparents this also provides supporting evidence of their significance, not only in providing assistance to parents, but as primary caregivers (see also Scelza & Silk, 2014).

Our study has a number of methodological strengths, including its relatively large sample size and our consideration of alternative forms of paternal absence across an ethnically and ecologically diverse setting. However, we are also limited by cross-sectional data and the use of co-residence as a crude proxy for paternal investment. These specific issues are so ubiquitous in the wider literature and important in their potential to introduce bias, that there is a very real possibility that our understanding of the importance of fathers remains at least partially obscured. In developed countries, sophisticated longitudinal data sets that simultaneously track changing family structure measures of parental involvement and child outcomes are increasingly available, enabling researchers to address issues of causal inference more effectively. (e.g., Lawson & Mace, 2009; McLanahan et al., 2013). To match this sophistication research funders must prioritize data collection of the same quality in rural developing settings. Including anthropological perspectives in such efforts will be crucial in ensuring that collected data is capable of accurately reflecting cultural diversity in family structure and its consequences.

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AUTHOR CONTRIBUTIONS

DWL, SJ, EN, BN, SGMM, and MBM designed research; DWL, SBS, and AH analyzed data; DWL, SBS, AH, and MBM wrote the paper; and SJ, EN, BN, and SGMM collected the data.

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