Title
Family Structure and Child Health in Cambodia, 2000-2010

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Publication Date
2013

Peer reviewed|Thesis/dissertation

Family Structure and Child Health in Cambodia, 2000-2010

by

Savet Hong

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy

in

Demography

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Kenneth Wachter, Chair
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Fall 2013

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Abstract

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In developing countries, where there are limited resources and social support, children rely primarily on their family for their well-being. Their lives are affected by the configuration of household members, by the type of family structure, and by household decision processes that determine the resources that are allocated for their well-being. This dissertation examines the influence of family structure on the outcomes of children's well-being, using the case of Cambodia, where between 2000 and 2010 the children composed more than a third of the population.

To assess the link between family structure and the well-being of children in Cambodia, this dissertation uses multilevel modeling. It examines three aspects of well-being. The first is the amount of time invested on children. The second examines the nutritional status of children. The third is the risk of infant mortality. In this investigation I focus on two forms of family structure: nuclear and multigenerational. For our purposes, a multi-generational household is one containing one or more grandparents.

To consider the investment of time, I take advantage of time-use data collected by the Cambodia Socio-Economic Survey and assess time spent on childcare individually and collectively by members of the household. My analysis reveals that children in multigenerational households receive more childcare time than those in nuclear households. Moreover, the additional care time these children receive is due to the presence of grandparents. Grandparents supplement maternal care time.

To assess the nutritional status of children in Cambodia, I use three waves of the Cambodia Demographic and Health Survey from 2000, 2005 and 2010. My findings reveal that children in multigenerational households have better nutritional outcomes than children in nuclear households. The gains of children in multigenerational households increased over the decade. This finding suggests that even though national economic development improves the overall health status of children, those coresiding with grandparents are the most advantaged.

To detect possible influences of family structure on infant and child mortality, I explore whether or not the health advantage of children in multigenerational households extends to a survival advantage. Findings reveal that even in the earliest stages of life, the presence of

grandparents safeguard infant survival more than the presence of a father in the household.

To my parents for their love and sacrifices, and without whom this work and my higher education would not have been possible. Also, to my sisters for helping set the stepping-stones.

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Acknowledgments

This dissertation would not have been possible without the support of so many people. First, I would like to thank members of my dissertation committee: Ken Wachter, Patrick Heuveline, John Wilmoth, and Khatharya Um. I am greatly indebted to Ken Wachter who has provided me with generous guidance and mentorship since I wrote my masters thesis in Public Health. The lessons he taught me on the research process, including the need for constant feedback, revisions, and deadlines, have been invaluable. To Patrick Heuveline, I am grateful for inspiring me to study Cambodian demography and exposing me to fieldwork. John Wilmoth, for his feedback and always driving me to do better. I thank Khatharya Um for encouraging me to learn about the works beyond my discipline.

In addition to my committee members, I am grateful to the other faculty members of Demography, Jennifer Johnson-Hanks and Ronald Lee. Jenna always readily allayed my anxieties and doubts through her encouragement and guidance. To Ron, I appreciate the support and kind smile during the early days of graduate school.

In addition to the faculty, I have found a tremendous amount of support from the Berkeley Demography community. The staff has shown much patience and kindness with all the administrative and technical issues that I among many other students have had. Thanks Carl Boe, Carl Mason, Monique Verrier, Liz Ozselchuk, and Ellen Langer for addressing our issues as they arise.

I would also like to thank my colleagues who have been such a strong foundation of support for me over the years. I am grateful to Nobuko Mizoguchi, Emilio Zagheni, and Miguel Sanchez-Romero for answering my first year questions, studying with me over the years, teaching me the need for balance, and most of all, continuously encouraging me to pursue my aspiration. I thank Romesh Silva, Sarah Tom, and Sarah Zureick for reviewing my work, providing feedback and guidance through the masters of public health. I would also like to especially thank Noli Brazil and Catherine Barry for the lively discussions, and for holding each other accountable and supporting each other through the dissertation phase.

In addition to the Demography community, I am thankful for the experience in D-Lab. This opportunity allowed me to work with graduate students from other disciplines across campus and showed me how much we know and are able to support each other. Moreover, working Cathryn Carson, Jon Stiles, Susan Grand, Christopher Church and many other graduate students and campus administrators to build D-Lab from a concept to a reality has been a thrilling journey that helped build my confidence.

I would like to thank my friends and family. I am grateful to my friends in Sacramento for their continual support through the highs and lows of graduate school. My friends in the Bay Area have kept me sane by helping me balance life. To my family, I am thankful for the strength and comfort they provide.

Chapter 1

Introduction

Death is the only guarantee that life promises—a promise that we hope would not be fulfilled or at least wait until old age. So when death claims the lives of the youngest members of society, it is a traumatic and heartbreaking experience. This pain is mostly felt by people in developing countries where 90% of the under-five mortality for the 10 million children dying each year occur (Black et al. 2003). Most of these deaths can be prevented through adequate nutrition and preventive health care. While macro infrastructures such as public health programs and sanitation projects create a healthier environment for society, it is the micro unit of the family that safeguards children's health and well-being on a daily basis. It is the juncture of family and children's well-being that is the focus of this dissertation.

The well-being of children can depend on the availability of family members, and this is indicated by the type of family or family structure in which they reside. Often family structure is synonymous with household structure, and these concepts will be used interchangeably within this dissertation. The type of family structure in which children reside is usually determined by their relationship to the adults in the household and their union status. For illustration, let us consider the family structure of children in developed countries before considering those in the developing world.

In a developed country like the United States, children may reside in a two-parent household where children are the biological offsprings of the married parents. Or they could reside in single-parent household, where one parent (usually the father) is absent. Cohabiting household is when the parent, usually the mother, and her partner reside in the household. And step-family household occurs when one of the biological parents is married to someone other than the second biological parent.

These family structures still play an important role in the well-being of children even though the risk of child mortality and undernutrition is low in developed countries. Among these family structures, children in the United Sates have better outcomes along the measures of educational performance, behavioral issues, frequency and the type of illness, and psychological health if they reside in two-parent households (Amato and Sobolewski 2001, Brown 2006, Dawson 1991, Fomby and Cherlin 2007). The disadvantage experienced by children in other households, especially for those residing in single-parent households, is gen-

erally argued as an association of being in a lower socio-economic status (SES) household. This implies that the resources a given household structure is able to provide to children is dependent on the number of parents in the household.

Yet, Thomson et al. (1994) find that the difference in income between two-parent and single-parent households only explains half the negative difference in the outcomes of children. The remaining 50% in the cause of the negative outcomes remain unclear. Potential explanations can be the social environment in which these children are residing and the care they are able to receive from the adults in the household. Through the investment of time by the adults, supervision of children can protect them from harm and nurture them as they develop.

Thus, for developing countries where the stakes on children's health are higher, household members can be crucial participants in the outcomes of children. The repercussion of the presence or absence of a family member can lead to early child mortality. While it is clear the primary actors in securing the survival of children are mothers, the role of other family members is less defined. In a comprehensive review of the literature on family members' influence on child survival in developing countries and historical Europe, Sear and Mace (2008) found that in some societies there is evidence to support the role of fathers, maternal grandmothers, or paternal grandmothers on child survival. Since there is no defining member aside from mothers who clearly affect a child's health, this review highlights the importance of context of the society and the potential interplay of family members, which is done at the household level.

Stepping away from the individual family members, the family structure itself determines which of these members are residing together, interacting with each other and with the children in the household. Through this socialization, decisions are then made regarding who provides child care and how much resources are invested in each child and each member. These factors then can affect the outcomes for children.

Therefore, in this dissertation, I focus on the relationship between family structure and children's outcome as measured by childcare and health outcomes in the form of nutritional status and mortality. In addition, I will be examining this relationship for the case of Cambodia, a developing country in Southeast Asia, that is in the middle of the demographic transition. Moreover, Cambodia is an interesting place in itself to study, which I will elaborate on later, but will also: i) shed light on how family structure in a rapidly growning economy in a developing country affect children, ii) the state of children's well-being in Southeast Asia, and iii) more broadly, enhance the general knowledge of family structure and children's well-being in developing countries.

With that said, I will briefly discuss the Cambodian context in the next section. This is followed by a discussion on the mechanism of how family structure can influence the well-being of children especially within the Cambodian family-structure context. I will end this introduction with an outline for the rest of the dissertation.

1.1 Cambodia: Population and Family

Population: Why Children?

At the turn of the 21^{st} century, Cambodia was a very young population. The natural growth rate in the country at the time was 2.49% with a total fertility rate (TFR) of four children per women, the highest level in Southeast Asia (DHS 2001, of Cambodia 2003). Combined with the high mortality during the socio-political conflicts of the 1970s and 1980s and the tragedy of the Khmer Rouge (Heuveline 1998, Heuveline and Poch 2007, Kiernan 2008, Zimmer et al. 2006), this led to a population distribution with more than 40% being under the age of 15. About a third of the population was either over the age of 60 or under 10 (Zimmer and Kim 2001). This meant that a substantial share of the Cambodian population were dependent and required support from the working age population, which was relatively small.

The high proportion of dependent children in the population is a concern for the development of the country. With a large proportion of children, this required investment in the infrastructure for education, public health, and economic resources. As the country was rebuilding after the socio-political conflicts, it already lacked the necessary infrastructure to support public health and education. The rapid population growth aggregated the situation and increased the poverty and poor health conditions for children. This prompted the government to institute its first population policy in 2003 to curb the population growth(of Cambodia 2003). Through promotion of contraceptive use and exclusive breastfeeding (Marriott et al. 2010, of Cambodia 2003), fertility rapidly declined to a TFR of about three children per woman by 2010 (DHS 2011). By this time, the proportion of children under the age of 15 years accounted for 35% of the entire population. This still meant that children remain a sizable proportion of the population.

Moreover, the health status of these children and the entire population at the turn of the century was poor. Generally, the health of the population is estimated by the life expectancy at birth. In 2000, this was estimated to be 54.4 years for Cambodia (DHS 2001). As the estimates of life expectancy is strongly affected by the survival of children through their first five years of life, the well-being of children of this age group is considered a good indication of the health status of the entire population. As healthy children survive through these years, they have better probability to survive through later life and become economically productive members of society.

The well-being of children under the age of five is generally indicated by their health status, which is measured by two indicators. The first is a measure of nutritional status. The ability to receive adequate nutrition and live in a safe and healthy environment would enable them to grow to their full potential; thereby, examining the nutritional status of children can indicate the level of malnourishment of a country. For Cambodia, about half the children under the age of five were considered stunted—a form of malnutrition that considers the child as too short for his or her age (DHS 2001). The improvement over the decade (2000-2010) reduced this prevalence to about 40% of children under the age of five

being stunted in 2010 (DHS 2011).

The second indicator normally used to measure the health status of children is a measure of the severity of health condition, that is their mortality. Undernutrition, exposure to infectious diseases, and unfavorable social conditions can lead to children's death. And Cambodia had a high mortality rate among children under the age of five. In 2000, the under-five mortality rate was 124 deaths per 1000 live births. By 2010, the under-five mortality declined to a rate of 54 per 1000, which is a substantial improvement in a very short period of time.

The improvements in health status of children over this decade depended in part on the economic development. With foreign investment and increased production within the country (Marriott et al. 2010, of Cambodia 2003), this led to rapid economic gains, which meant an increase in the economic resources available, and thereby, allowed people to consume more. Improvement in household resources can then be used to secure the health of children. The decision to use these resources for the benefit of children will then depend on who is in the household.

Residence: Where and with Whom?

The majority of children lived in rural areas of Cambodia where 85% of the population resides. These children resided primarily in households supported by subsistent farming, forestry, livestock, and fishing (Chandler 1972, DHS 2001, 2006). As such, 90% of the poverty is concentrated in rural areas despite some of the economic improvement. Attempting to alleviate poverty and encourage commercial rice production, which is the main economic activity in the country, the government promoted the system of rice intensification. This focuses on intense cultivation of dry-season rice which requires heavy use of fertilizer and pesticide, development of irrigation system, and machines. Farmers who participate in this process then become dependent on microcredit lending from season to season (Ovesen et al. 2012). Thereby, the economic yield is high, but improvement for farming families participating in the new process is only slightly above subsistence farming.

While both men and women participate in rice cultivation in Cambodia, parental responsibilities might not be evenly distributed based on gender roles. Laboring on the farm, men are expected to perform activities requiring physical strength like ploughing. Women, generally wives and mothers, conduct the transplantation of the rice. In addition to laboring on the farm, women are expected to manage their households, family finances, and care for the children. In order to earn extra cash income for their families, some women would sell meat or produce from their gardens in the village open air market. Others would sell prepared food such as noodles and bread (Frieson 2011). Thereby, Cambodian women have the responsibility of working on the family farm, managing the household and family finances, and caring for their children.

In addition to gender role expectations, the organization of villages shape the environment and households of children. Because Cambodians have a strong preference to have relatives as neighbors, sectors of villages can be comprised of related households Crochet (2011). On

large plots of land, there could be two to five independent households where members are related to each other by blood or marriage.

These independent households are predominantly nuclear households and accounted for about 66% of all households in 2000 (Demont and Heuveline 2008). It is the preferred form of household structure by Cambodians. As observed by demographers and anthropologists on the pattern of residence after marriage, grooms reside with the bride's family, a practice of uxorilocal residence (Demont and Heuveline 2008, Ledgerwood 1995). Once the young couples are financially stable, then they are expected to establish their own households, known as neolocal residence. As a consequence, most children in these villages reside in nuclear households with neighboring relatives.

Other children may reside in three-generational, or extended, households. As alluded to earlier, the practice of uxorilocal residence can expose children to coresiding grandparents prior to their parents establishing their own household. Children can also be exposed to these three-generational households, which I call multigenerational households, through Cambodian preference of residence in old age. That is, aging Cambodians prefer to coreside with their adult children, who may still have children of their own in the household. Among the elderly population, those over age 60, Zimmer et al. (2006) estimated that about 45% reside in three-generational households. Combined with the high fertility in Cambodia, this could mean a large share of the children are exposed to multigenerational households.

In sum, the large share of Cambodian children reside in rural parts of Cambodia where they are predominately in nuclear or multigenerational households. Given the subsistence living conditions for most households, the ability of children to be healthy and survive through the precarious stages of childhood will then depend on the adults in the household. Thus, the subsequent section will outline how the household structure, and members of these households, can affect the livelihood of children.

1.2 Mechanisms

What the literature in both developed and developing countries suggests is that the linkage between family and children's health is composed of two aspects: time and the provision of resources. Allocation of time from family members is essential for young children as they require supervision. Through adult supervision, children are prevented from engaging in harmful activities, nursed through periods of illnesses, and are given appropriate food. In the process, these activities then promote the health status of children. Whereas, the absent or neglect can lead to children having poorer health outcome.

$$\text{family} \longrightarrow \text{time} \longrightarrow \text{health outcome}$$

In addition to supervision, children require resources that safeguard and promote their development. The ability of family to provide a safe and sanitary environment reduces the risk of injury or exposure to infectious diseases that would impede their development. Also,

being properly treated during periods of illness requires family to have access to information and medical treatments. Above all, as children age, their diet changes from simple food to complex food similar to those of adults. This requires the family to provide children with appropriate and adequate sustenance rich in nutrients and calories.

$$\text{family} \longrightarrow \text{resources} \longrightarrow \text{health outcome}$$

The resources required for their development are then operationalized through household socio-economic status (SES), parental education, housing conditions, and medical care. Furthermore, children's ability to have access to these resources through their family represents one aspect of the relationship that affects their health. The other aspect depends on the decisions made by family to allocate these resources and how much are utilized towards the benefit of children. Subsequently, I will now talk about how family members affect the health outcomes of children.

Family Structure and Health Outcomes

In discussing how family members can influence the outcome of individual children, I principally focus on individuals from three generation. As this research largely compares the differences between nuclear and multigenerational household, I will discuss the influence of grandparents followed by parents, and then other children in the household.

Multigenerational household: Why Grandparents?

As previously discussed, Cambodian households tend to be nuclear except in households where elderly parents reside with their adult children and grandchildren. That is, nuclear and multigenerational households differ simply by the presence of grandparents. The formation of these multigenerational household can then affect the allocation of resources for children.

Macro-economic conditions can pressure the formation of multigenerational households. That is, the absence of assistance programs such as social security or medicare for the elderly in Cambodia increases the responsibility of family members to provide the necessary support. Aside from providing economic resources, they also require housing and care. Thereby, one of the surviving adult children will assume responsibility and house aging parents. This is supported by Zimmer and Kim (2001) finding of elderly parents residing with either married sons or daughters. Moreover, while there is no preference of coresidence with children of one sex or the other, residential pattern suggests that Cambodian elderly prefer to reside with the youngest daughter (Crochet 2011, Zimmer and Kim 2001). Therefore, adult children provide old age support for their parents, i.e. grandparents, as well as their own children. This can then alter how resources and parental time is allocated towards children in the household.

The well-being of children can then be affected by the presence of coresiding grandparents. As Cambodian women are expected to be nurturing mothers and responsible daughters

(Derks 2008), their ability to address these responsibilities among others may compete and divert her time from children towards parents. Mothers might spend more of their time providing care for coresiding grandparents which reduces their time for childcare. In addition, household resources that would have been devoted to children might be reallocated to meet grandparents' material and medical needs. This implies that as resources get redirected, children are deprived of resources that would help improve their health and well-being.

Alternatively, instead of hindering access to resources for children, grandparents might potentially increase the quantity of resources available to them. Coresiding grandparents may substitute maternal supervision, thereby enabling mothers to expand her participation in the labor market to supplement her husband's income. This would then increase household revenue and the total amount of resources available that can be directed towards children's development. What's more, instead of diverting maternal care time, coresiding grandparents can increase the total amount of childcare time with the additional supervision grandparents are able to provide.

The well-being of children can also be affected through other formation of multigenerational households. Single-parent in a multigenerational household can form through widowhood or marital disruption. Cambodian women have relative ease in accessing legal divorce and keep marital wealth (Heuveline and Poch 2006, Ledgerwood 1995). However, this is checked by social stigma associated with widowed and divorced women, particularly the latter. Because divorced women are perceived as falling short of her gender role in marriage, she is unlikely to remarry (Derks 2008, Heuveline and Poch 2006). This may disadvantage single-parent multigenerational households overall because of the resource lost through the absent parent. To compensate for the lack of financial support from their spouse, single mothers may need to go into the labor market to increase overall household resources, thus reducing the amount of care she provides to her children. However, the presence of the grandmother might substitute for the supervision that a mother can give. While the childcare time children receive may be compensated by the presence of grandparents, the economic loss might be more substantial and, thereby, adversely affect the health outcome of children.

In addition to the macro-economic and social factors leading to the formation of multigenerational households, micro-economic conditions can also lead to multigenerational household formation. The decision for coresidence can form as an economic strategy to pool shared resources. Families with low SES may coreside with grandparents to allow more adults in the household to participate in the labor market. This would increase household income and minimize cost through economy of scale. That is, the cost to maintain a household is less than having to maintain two separate households. Moreover, the responsibility of supervising children can then be shared among parents and grandparents in the household. This could maximize the amount of supervision and resources that the children in the household receive. However, a drawback might be that if all the adults in the household participate in the labor market, there may not be sufficient time for the supervision of children.

While families with low SES may choose to form multigenerational households to pool resources, wealthier households may form multigenerational households as an affordable expenditure. That is to say, wealthy households have the economic resources to offset the cost

of having more individuals in the households without requiring grandparents to participate in the labor market. Within these households, they gain additional childcare time while having adequate resources to safeguard children's health and support aging grandparents.

Nuclear Household: One, Two, Who?

As Cambodians prefer neolocal residence, young couples' ability to transition out of parental (usually the wife's family) household occurs when they are financially able to establish their own households. Upon establishing their own households, these nuclear households are largely independent in providing care and resources for children.

Two-parent households then have the potential to provide better outcomes for children than those residing in multigenerational households. With fewer adults in the households, there is a lower cost for maintaining the household and spreading the resources across all members. Through division of labor, where fathers are principally responsible for supplying economic resources and mothers are responsible for domestic duties including childcare (Demont and Heuveline 2008, Derks 2008), children in these households gain the maximum amount of resources and childcare that parents are able to provide. Thereby, children in these households are likely to have better outcomes than multigenerational or single-parent households, which would be on par with findings in other countries (Thomson et al. 1994).

With the absence of one parent in the household, children in single-parent household become the most disadvantaged of all children. The formation of nuclear households with a single parent is similar to those of single parents in multigenerational households. Through the death of a husband or divorce, these women maintain a household without the support of other relatives such as their parents. They may lack the support of extended family members either through the death of their own parents or siblings—from natural causes or a consequence of the violent history in Cambodia in the last half century—or through poverty. Relatives lacking a surplus of financial capital or residing in poverty cannot afford to supplement or provide extra support to single mothers and their children. Stripped of the economic support a spouse would provide, single mothers are then forced to heavily participate in the labor market. This would divert her time in providing childcare for her children. Thereby, children in single-parent households would have limited access to parental care and resources, which potentially hinders their development and exposes them to unsafe conditions that would lead to early mortality.

While a single-parent household is largely caused by widowhood, some are formed through divorce. As mentioned earlier, the prevalence of divorced single mothers is small because of the social stigma. As such, the chances for these children transitioning into step-family household is small. Yet, the chances of this transition is higher for children residing with divorced fathers. Since there is less of a social stigma attached to divorced men, divorced fathers have greater access to the opportunity of remarriage and creating step-families (Heuveline and Poch 2006). Children in step-families then usually live with their biological father and stepmother, who may treat them as her own. Children within these households are expected to do just as well as in two biological parent households. They would still receive access to eco-

nomic resources that fathers would provide and parental supervision through stepmothers. While the non-biological parent might not provide as much supervision or emotional support for the step-children, the combination of resources and supervision they receive will still be more than single-parent households. As such, these children are expected to do just as well as children in two-biological parent households as they will have similar characteristics.

Siblings: Helpers or Competitors?

Apart from the presence of parents and grandparents, households are driven by the composition of children. The number of children in the household, the sex of these children, and their birth order can shape the dynamics of a family in a manner that influences the well-being of all children. Because households are constrained by finite amounts of resources, whether it is parental time for care and supervision or goods that must be purchased by parents, the quantity and to whom resources are allocated will be affected by the composition of the children.

Size it Up

The number of children in a household can influence the outcome for each child. For instance, the more children in the household, the more childcare that will be required. The increase in childcare time might be slight with each addition child in the household, but the amount of direct parental time will be less for each child with increasing number of children. Aside from the pressure for greater parental supervision, larger households also increase the demand for economic resources. With more children in the household, the distribution of resources across all children will reduce the amount allocated for each child (Arnold et al. 1998). Households with fewer children will be less constrained and, therefore, should be able to provide more resources for each child.

Aside from affecting the share of resources, more children can mean poorer environmental health conditions in the household. With each child added to the household, the larger the total number of individuals living in the household become. As the amount of housing space is defined and does not expand with increased household membership, the proximity of members living in close quarter to each other can create an environment that facilitate the transmission of infectious diseases (Arnold et al. 1998, Reher and González-Quiñones 2003). If one member becomes ill, then through proximity of space, most if not all members will become sick. Bouts of illnesses can impede the development of children as their bodies use the nutritional resources to fight against infections instead of for linear growth. Furthermore, children with poor or undeveloped immune systems lack resistance to infection, which can lead to frequent infections and increased severity of illnesses (Arnold et al. 1998). Increasing severity and the type of infection can ultimately lead to early child mortality.

Sons or Daughters?

Increasing household size can be driven by parental desire for the gender or sex composition of their children. The observation of this sex preference in other countries suggest that consequences for the undesired gender can be severe. For instance, in India where there is a strong son preference, families would continue to have children until they have a son or the ideal number of sons and daughters, which leads to increasing household size. Moreover, preferences for sons influences parental decisions on allocating limited resources for the benefit of sons to the detriment of daughters (Arnold et al. 1998, Muhuri and Menken 1997). This illustrates how societal gender preferences can affect household size and their health outcome.

Unlike India, there is a lack of son preference in Cambodia, which might not translate into an absence of gender preference. Given the residential pattern in Cambodia, there may be potential favoring of daughters. As Cambodians prefer uxorilocal, followed by neolocal, residence during and after marriage and coresidence with daughters in old age (Demont and Heuveline 2008, Derks 2008, Ledgerwood 1995, Zimmer and Kim 2001), treatment of children may favor daughters. Mothers may devote more time and resources to their daughters than to their sons. This might manifest in more immediate responses to illness, or treatment, or providing daughters with more food for their development.

Due to this possible preference for daughters and expected gender norms, sex of sibling is expected to matter. Girls would be expected to contribute to domestic activities and boys in market labor. Therefore, having sisters who provide some of the supervision in place of mothers would improve the amount of childcare they receive, which can improve their health outcomes. At the same time, as boys are valued for their potential market earnings, sons may receive more care and resources to invest in their market capital such as schooling (Derks 2008). As children in Cambodia participate in the labor market at an early age, the presence of working-age boys might increase the overall household resources that may get redirected to other children. As the gender role and expectation value of sons and daughters, despite the favoring of daughters, the presence of siblings of either sex might not matter to the outcome of children's health.

Birth Order

With multiple siblings in the household, the order in which a child is born can then affect their outcome. Children of lower birth order, especially first-born children, may have better health status than younger siblings. During their birth and infancy, there are either no children or a few children present. This allows the oldest children to have more parental care and resources during the critical stages of early childhood. Later-born children, those of high-birth order, are born into household with existing children. The presence of older siblings reduces the amount of resources that parents can devote to them, lowering their potential development.

Moreover, birth order and the age group of sibling can either aggregate the risk of poor

health outcomes or mitigate some of the affect. The presence of siblings under the age of five can be disadvantageous for a child of the same age group. Children under the age of five are more vulnerable than older children, and are more dependent on parental care. Siblings of similar ages then compete for the same form of resources leading to increased competition for breastfeeding and care. As more children in this age group implies closer birth spacing, mothers may be physically strained from previous pregnancies limiting the amount of resources her body is able to provide for later-born children (Newcombe 1965, Saha and van Soest 2011, Scrimshaw 1978). Moreover, the presence of multiple young children can diminish her energy level and ability to provide the quantity and quality of care that each child needs. This implies a poorer health outcome for a child under five with siblings of similar age.

At the same time, the presence of older siblings might be able to mitigate the challenge of limited parental resources. For a child under the age of five, the presence of older siblings can be beneficial. While children who are six to ten years old continue to rely on parental support, they are not as vulnerable as younger children. These older siblings would be able to contribute to the household resources. They can perform household tasks that free up the mother's time on domestic duties to allow her to attend younger sibling. Children of this age can also contribute to household income through a family business or employment in the private sector.

For a young child to have siblings over the age of ten, the benefit may increase since these older siblings are able to contribute to or perform all the domestic labor. They may also provide supervision of younger siblings. This would increase the time the mother has to either spend with younger siblings or use her available time for market labor. In addition, children at this age are able to participate in the labor market and thereby contribute to household income. The additional resources would increase the share of household resources for all children including the youngest children.

1.3 Organization of the Dissertation

Thus far, in this chapter, I have presented the framework for thinking about the process of how family structure and family members can influence the well-being of children. In subsequent chapters I will closely examine and test these relationships. That is, I will consider the influence of family structure on childcare and their health outcomes in Cambodia.

In Chapter 2, I use the first and only time-use data ever collected in Cambodia to analyze childcare time. Within this chapter, I consider the total amount of childcare time children receive by household structure characteristics such as the presence of grandparents or being in a single parent household and presence of siblings. The second part of the analysis examines the underlying trend in childcare, that is, how much time parents and grandparents would have allocated to childcare when other socio-demographic characteristics are accounted for.

This is followed by an examination of the relationship between household structure characteristics on children's health. In Chapter 3, I consider the health outcome measure of

nutritional status for surviving children across three waves of data over a ten-year period. This analysis captures the social and health improvement over the decade while trying to isolate which of the three generations of family members have the most impact on children's nutritional status, whether it would be grandparents, number of parents, or the presence and number of siblings in the household.

While the influence of family structure can adversely affect children's health status prior to the time of the survey when nutritional status is measured, I then assess the impact on children's risk of mortality in Chapter 4. Unlike the other two analysis chapters, in this chapter the sample of children considered are infants. Children within the first year of life are more susceptible to the conditions of their environment including household characteristics that can place them at greater risk of mortality.

Finally, Chapter 5 summarizes the main findings of this dissertation. I also include final comments on the overall limitation of my research, its implication and a few concluding remarks.

Chapter 2

Can Grandparents Influence How You Care?: An Empirical Analysis of Time Use in Cambodia

2.1 Introduction

Anthropologists and demographers have noted a strong preference for nuclear households in Cambodia (Crochet 2011, Demont and Heuveline 2008, Frieson 2011, Ovesen et al. 1996, Zimmer et al. 2006). In 2004, about 35% of the population lived in non-nuclear households, most of which have at least one coresiding grandparent. In this rural agricultural setting, where time spent on agricultural labor is vital, grandparents can be influential in household function. Yet, the functional role of Cambodian grandparents has been under studied. Studies conducted in other countries may shed light on the importance of grandparents in Cambodia. These studies suggest that coresiding grandparents are active caregivers for grandchildren within the household. Whether or not Cambodian grandparents behave similarly can now be tested since Cambodia recently collected its first and only time-use data.

The economic and demographic conditions may be driving the amount of time allocated to childcare in households more strongly than the presence of grandparents. That is, economic systems shape how working adults, who are themselves parents, spend the vast majority of their waking hours. The ability to have a flexible working schedule can allow them time for other activities such as caregiving. The dominant economy in Cambodia is subsistence rice agriculture, and 85% of the Cambodian population resides in rural areas (DHS 2001, 2006). According to Zimmer and Kim (2001) about 60% of the elderly live in non-nuclear households, that is, someone other than the spouse or a child resides in the household. This includes households with children-in-law and grandchildren. Based on the 2004 Cambodia Socio-Economic Survey (CSES), about 37% of elderly, those aged 60 and above, reside in multigenerational households, which may include their spouse, a married child, and grandchildren. Even though the elderly population only accounts for 6% of the total population,

a significant share of children are exposed to multigenerational households because of the high fertility rate in the country.

About a quarter of the children under the age of five reside in a household with at least one grandparent. This includes multigenerational households, where the child's siblings, parents, and grandparent(s) are in the household, and extended-multigenerational households, similar to multigenerational households may include aunts, uncles, and cousins. Of the two forms of coresiding grandparent households, multigenerational households are second to nuclear households in Cambodia in terms of the most preferred living arrangement.

Furthermore, the Cambodian economy is based on subsistence agriculture where time-intensive labor is required in the field. Cambodian women are expected to care for their children, work on the family farm, and manage the household finances. Balancing these responsibilities constrains her ability to care for young children in the household. Therefore, the presence of grandparents may either increase the constraint by demanding additional care time or alleviate some constraints by providing childcare time.

This paper examines the relative influence of household structure. Specifically, it uses the first nationally collected time-use data to compare time spent on childcare between nuclear and multigenerational households, testing for potential differences based on the presence of grandparents in the households. Before presenting the research, the paper will review the literature on the role of grandparents and time use.

Grandparents as Caregivers

The focus of the literature on coresidence grandparents has been on American single mothers and black families, suggesting a potential role for Cambodian grandparents. However, due to differences in socio-cultural practice, Cambodian grandparents may behave differently.

For instance, in Western countries like the United States, coresiding grandparents are generally found in households with single teen mothers, whereas in Cambodia this is not the case. Because of Cambodia's near universal marriage and low level of sexual activity prior to marriage (DHS 2001), most children reside in two-parent households. As most elderly Cambodians coreside with other family members, many children are exposed to two-parents as well as at least one coresiding grandparent.

Furthermore, the literature on black families in the US suggests that grandmothers act as surrogate parents. In a community study in Chicago, Pearson et al. (1990) examine the presence of grandparents in households of first graders and the roles of grandparents. This study finds that black grandmothers tend to coreside in single-mother households where they are second to mothers in active caregiving. These black grandmothers actively perform parenting roles through disciplining children. In another study, Wilson et al. (1990) find that coresiding grandmothers provide more childcare in single-mother households than two-parent households. These studies find that when fathers are present in these multigenerational households, grandmothers are less involved in providing support in household work, childcare, and discipling children. The role of grandparents, especially grandmothers, is in the form of

a secondary parent in the absence of fathers.

As the majority of Cambodian households with young children are two-parents households, the function of grandparents, as surrogate parents in place of absent parents, may not be as relevant to Cambodia. Instead, given the high poverty and agrarian nature in Cambodia, the roles of grandparents there may be more similar to those in low-income families in other countries. In a qualitative study of rural, low-income families in the United States, Reschke et al. (2006) find that grandmothers act as caregivers in the event of an emergency and when mothers have to go to school or work. Coresidence grandmothers provide childcare in these families, which allows mothers to be employed. Therefore, Cambodian grandparents could be providing childcare for their grandchildren, thereby freeing mothers' time for agriculture or market labor.

Since the literature on grandparents largely takes place in developed countries where there are strong social supports for the elderly in terms of Social Security, pension, or welfare programs, the focus of the literature has been on grandparents providing for younger generations. However, Cambodia is similar to other Asian countries where social support for the elderly is absent or lacking. Very few Cambodian elderly receive a pension, savings, or health insurance. Therefore, they rely on their adult children for physical and financial assistance (Zimmer et al. 2006). Consequently, the presence of grandparents in the households may become an economic constraint, diverting resources from children. Because women are socialized to support their aging parents, mothers' time for childcare may decline as time is diverted towards caring for aging parents. Therefore, coresiding grandparents can actually be disadvantageous to mothers' time spent on childcare.

Because of the agricultural setting, lack of social support for the elderly, and pressure on mothers' time for labor and care, Cambodian grandparents can play an important role in the household. Moreover, an interesting question is whether or not their presence in households with young children improves the outcome, time spent on care, or serves as a disadvantage by diverting resources for their use—a question which we shall pursue in this research.

Time Use Filling in the Gap

In studies on the allocation of time for childcare, parent involvement is usually considered. Due to the financial, organizational, and other resources required to collect time-use data, time-use studies are mainly conducted in the United States or Europe (Chenu and Lesnard 2006). As these studies are principally based in developed countries where household structure are mainly nuclear, parental time for childcare becomes the usual level of analysis. Parents might not necessarily be the only childcare provider, as childcare time can be drawn from other members of the household, which includes older children in these nuclear households. Since household structure in Cambodia is not just nuclear but includes other structures such as multigenerational households, structural differences may shape childcare time differently. Households with other coresiding adults such as grandparents may influence the amount of childcare time parents provide.

Generally, the social expectation is that children are cared for by their parents, particu-

larly their mothers. This expectation is not limited to Cambodia but has been demonstrated to be practiced elsewhere. Time-use studies have shown that mothers spend more time providing childcare than fathers (Bianchi 2000, Chenu and Lesnard 2006, Craig 2006, King and Evenson 1983). While the trend in developed countries has shown a rise in fathers' participation in childcare, mothers still spend more time with children as a primary activity or a secondary activity while performing household work (Bianchi 2000, Craig 2006). Therefore, this study expects that Cambodian mothers will spend more time on childcare than fathers. However, for households to maintain or gain economic security, mothers' participation in the labor force is also necessary.

Cambodian women are actively involved in the economy. As Cambodia has only one major urban center, the capital city Phnom Penh, with a few smaller cities (Zimmer et al. 2006), there are limited modern occupations. Urban services and modern manufacturing in the garment industry provide the most paid employment opportunities and draw on female migration from rural areas. Whereas, in rural parts of Cambodia, agricultural farming, notably in rice crop, remains a vital part of village life. Both men and women participate in rice cultivation from ploughing to transplantation to winnowing. During the busy season, relatives and neighbors collaborate with each other by ploughing or cultivating each other's field in turn (Chandler 1972, Ovesen et al. 1996). However, most households are not able to produce enough rice for their own consumption (Crochet 2011, Ovesen et al. 1996). To earn extra cash income, women sell fresh produce, meat or prepared food at the village market (Frieson 2011). As women are actively participating in the labor market in Cambodia, the mothers' involvement in income-generating activities may compete with time for childcare. Some studies in the U.S. suggest maternal employment does not dramatically change the amount of time mothers spend on childcare. That is, they find that mothers' time on childcare has been stable, in part, because they reduce the amount of time spent on other activities such as sleep, housework ,or leisure time (Bianchi 2000). Since the economic conditions are different between these countries, Cambodian mothers may not have much flexibility in reducing time elsewhere and still maintain the operation and finance of their households. Consequently, employed mothers would either have to limit childcare time or may need other family members' aid. This would then require households to utilize other household members' time to provide childcare in addition to mothers' childcare time.

Potential caregivers, apart from parents, include other children and grandparents in the household. With a total fertility rate of approximately four children per woman (DHS 2001, Neupert and Prum 2005), the youngest child has on average three older siblings (assuming all survived) who could provide childcare. The role of older children providing some form of childcare has been revealed in other studies. For instance, children of high school age provide childcare through babysitting of younger siblings in the United States Gager et al. (1999). Apart from supervising younger children, older children are providing childcare through socializing activities including role play of adult roles and learning domestic activities (Crognier et al. 2002, Weisner 1987, Weisner et al. 1977, Whittemore and Beverly 1989). Older children participate in childcare and household production at young ages in non-Western countries because of the economic conditions placing pressure on maternal time for

economic production and need for older children contribute to childcare and the economic production of the household at young ages (Crognier et al. 2002, Hames and Draper 2004, Kramer 2002, Popkin 1980). Similarly, the pressure on children's time in Cambodia actually starts at an early age. Participation in the labor force in Cambodia is considered at aged 10 and older, and about 48% of those aged 10-14 are economically active. Therefore, Cambodian children at very young ages would already experience limited time to contribute to childcare for the youngest children in the household.

Unlike the children in these households, grandparents are at an age where they have completed their schooling and have limited involvement in the labor force. Most grandparents only have primary education, most likely because the armed conflicts in the 1970s interrupted schooling for some, and educated people were also targeted for murder during the Khmer Rouge period (1975-79) (de Walque 2004, 2005). In terms of economic productivity, grandparents in Cambodia, similar to elderly in other parts of Asia, are expected to be supported by their adult children (Knodel et al. 2005, Zimmer et al. 2007). Participation in the labor force begins to decline after age 50 with a 43% participation rate among those age 65 and over (CSES 2004). Therefore, grandparents have more flexibility with their time to provide additional childcare for children in the household. While time-use studies have not quantified the amount of childcare grandparents provide, one study suggests their potential role. Desai and Jain (1994) study the impact of maternal employment in rural India on childcare. They find that mothers of children under the age of five provide less than two hours of childcare per day. These children spend more time in the care of someone else. Whom these individuals are in providing alternate care was not the focus of their study, but they did note that some of the alternate caregivers were coresiding grandparents. As the economic constraint faced by rural Cambodians are similar to those in rural India, coresiding grandparents in Cambodia may provide childcare support for the youngest children in the household. As grandparents are in multigenerational household, the benefits of additional childcare time from grandparents would then benefit children in multigenerational households.

As Cambodian nuclear and multigenerational households are confronted by similar economic constraints, utilizing other household members' time for childcare in addition to parental time becomes important. Since the number of children within households does not substantially differ, both household structures potentially have similar amount of childcare time contributed by older children. As these children also contribute to the economic resources within the household, their time for childcare becomes limited. Therefore, whether or not grandparents act as an additional childcare providers can determine the difference in the quantity of care children received between these household structures.

Research Question

Bridging the gap in the literature between time use and coresiding grandparents, this research examines the time spent on care between different household structures, more specifically the difference between nuclear and multigenerational households. As the Cambodian setting is largely agricultural with a lack of social support for the elderly and has some vari-

ations in household structures despite the cultural preference for nuclear households, this research asks the questions:

1. Are there differences in time spent on childcare between multigenerational and nuclear household structures?

2. Does parental time spent on caregiving change with the presence of coresiding grandparents?

3. If grandparents contribute to time spent on care, does the number of grandparents in the household matter?

2.2 Data and Method

To address these questions, I analyzed the 2004 Cambodia Socio-Economic Survey (CSES) conducted by the National Institute of Statistics from November 2003 to January 2005. This is a nationally representative multistage sample survey designed to collect information at two levels: first, village information on the economy, infrastructure, and employment, and second, household information on demographics, employment, education, housing conditions, and health. With close to a 100% response rate, 14,978 households were interviewed composed of 74,719 members. Notably, at the household level, the 2004 wave of the CSES collected the first time-use data in the country. This was an extensive collection. Everyone in the household age five and above reported their activities, which yielded a total of 65,636 time-use records.

This study uses a subsample of the CSES time-use data. The analytic sample is restricted to nuclear and multigenerational households. Nuclear households consist of either one parent or two parents with children. Multigenerational households are three generational households that include children, their parents, and grandparent(s) in the households. To ensure that households are comparable except for the presence or absence of grandparents, the analysis is restricted to households with at least one parent. There were only a few households with only grandparents and grandchildren; these were excluded. Furthermore, prior studies suggest that very young children demand the most care time with older children requiring little or no care time (Gustafsson and Kjulin 1994, Ho 1979). Therefore, households without any children under the age of five are excluded. Reports of relationship to head of household are used to identify grandparents and potential parents. Individual reports of coresiding mother or father are used to identify parents of children. Within the nuclear and multigenerational households, 47 households with 51 children under the age of five did not report at least one coresiding parent and were excluded. Five multigenerational households had discrepancies between reports of relationship to head and reports of coresiding parents. For one of these households, the relationship between the head and children was ambiguous and was excluded from analysis. In the other four households, the relationship of the head of household to other children was used. This left 4,508 households with 23,193 members of whom 8,743

are parents and 798 are grandparents. Among parents and grandparents, 8,627 and 787, respectively, completed the time-use diary.

Dependent Variable: Caregiving Time

The questionnaire for the CSES provided by the National Institute of Statistics to researchers is in English. The term *to care* in English does not have a direct translation into Khmer, the national language in Cambodia, but there are multiple Khmer terms associated with caregiving in Cambodia. The closest translation of care into Khmer is *thae reaksaa*, to provide care. This concept can be used to refer to providing care for elderly or children. For clarification, terms designating older or younger generations would generally need to follow it. The term *thae toam* is commonly used and tends to be association with children. These terms come with expectation of ensuring the comfort of the recipient. For elderly, this entails providing physical assistance in their daily activities and financial support. Similarly, the physical needs of children are more demanding, requiring feeding and changing diapers as well as disciplining and playing with them. Something to note about these terms is that they are more conceptual terms instead of terms that defines a particular activity. A more action-specific terminology associated with care is *mael kon khmang*, literally meaning "watch young children," more in the context of supervision of young children.

A Khmer version of the questionnaire was not provided, which would have illuminated the terminology used during the survey. Unfortunately, the CSES also did not provide additional information on terminology used in association with the concept of care or activities associated with caregiving. Nor did it provide information on how enumerators were trained to ask for information on care, the terminology used, or how enumerators prompt respondents to report details of activities associated with care. Given that this paper is interested in time spent on care and not the caregiving activities, this should not be a problem. The data groups caregiving for elderly and for children as one activity. Since many of the elderly are actively participating in the labor market and reporting caregiving time, this analysis assumes that reported caregiving time is primarily childcare time and it is for children in the household.

Furthermore, the Cambodian time-use diaries record activities to a detail level of half-hour blocks during a 24-hour period. CSES coded reported activities into 22 primary categories, and included activities such as sleeping, attending school, working in agricultural or market labor, and providing care for children and elderly. The total amount of time spent on an activity within the 24 hours is calculated for the analysis.

Individual and Household Characteristics

This study analyzes time spent on childcare by household structure, the primary focus being on potential differences between nuclear and multigenerational households. Other household characteristics that have been noted in the literature to influence childcare includes

single- or two-parent households, household size, the number of young children, household income, and living in urban or rural areas.

Time spent on childcare can also be influenced by individual characteristics such as sex, age, education and employment status. In addition, prior studies have found parental time with children also fluctuates depending on days of the week, being that parents spend more time on childcare during the weekend.

The descriptive statistics of the analytic sample are presented in Tables 2.1-2.3. Household characteristics are shown in Table 2.1. Multigenerational households have on average one additional person in the household. A higher percentage of single parents reside in multigenerational households. However, nuclear households have slightly more children under the age of five. Table 2.2 shows parental characteristics. Over 90% of parents are employed with those in nuclear households spending more time in agricultural labor. Parents in multigenerational households report having more education than those in nuclear households. And Table 2.3 highlights the characteristics of grandparents in multigenerational households. Almost three-quarters of all grandparents are grandmothers and 2.41% have secondary education but not higher. In addition, in the analytic sample, more than half of grandparents are still actively working and 80% of those working are performing agricultural labor.

Table 2.1: Unweighted Household Characteristics of 2004 CSES Sample

	Total % or mean (standard deviation)	Nuclear Households % or mean (standard deviation)	Multigenerational % or mean (standard deviation)
household size	5.14 (1.75)	5.05 (1.76)	5.77 (1.54)
No. Children by Age			
< 5 year	1.27 (0.48)	1.28(0.49)	1.23 (0.43)
$5 - 9$	0.81 (0.81)	0.83 (0.82)	0.68 (0.81)
$10 - 17$	0.79 (1.07)	0.82 (1.08)	0.62 (0.94)
No. Parents			
Single	6.01	5.00	12.26
Two	93.99	95.00	87.74
Disability	3.16	2.721	5.58
Household Income (riels)	625,209.8 (2315032)	625,562.9 (2448978)	623,029.9 (1192961)
Employment Status			
Employed	76.58	77.69	71.35
Unemployed	0.33	0.16	1.16
Not in labor force	23.09	22.16	27.49
Employment Sector			
Agriculture	78.56	79.12	75.68
Non-Agriculture	21.44	20.88	24.32

Residence			
Urban	15.51	15.55	15.29
Rural	84.49	84.45	84.71
Weekend	20.04	19.77	21.51
Sample size	23,193	19,572	3,621
N Households	4,507	3,879	628

Table 2.2: Unweighted Characteristics of Parents of 2004 CSES sample

	Total % or mean (standard deviation)	Nuclear Households % or mean (standard deviation)	Multigenerational % or mean (standard deviation)
Gender			
Male	48.78	48.96	47.67
Female	51.22	51.04	52.33
Age (years)	32.48 (7.49)	32.75 (7.59)	30.75 (6.51)
Education			
None	0.55	0.26	0.00
Primary	85.11	85.84	80.79
Lower Secondary	9.42	9.33	9.93
Secondary Plus	5.25	4.57	9.28
No. Parents			
Single	6.01	5.00	12.26
Two	93.99	95.00	87.74
Disability	4.64	5.04	2.12
Employment Status			
Employed	91.87	91.75	92.62
Unemployed	0.11	0.07	0.42
Not in labor force	8.02	8.19	6.96
Employment Sector			
Agriculture	77.03	77.57	73.58
Non-Agriculture	22.97	22.43	26.42
Residence			
Urban	15.51	15.55	15.29
Rural	84.49	84.45	84.71
Weekend	26.63	26.67	26.38
Sample size	8,743	7,564	1,179
N Households	4,507	3,879	628

Table 2.3: Unweighted Characteristics of Cambodian Grandparents

	Total % or mean (standard deviation)
Gender	
Male	27.57
Female	72.43
Age (years)	64.11 (9.02)
Education	
None	1.37
Primary	85.91
Lower Secondary	10.31
Secondary Plus	2.41
N Grandparents	1.42 (0.49)
Disability	19.55
Employment Status	
Employed	54.48
Unemployed	2.40
Not in labor force	43.13
Employment Sector	
Agriculture	78.65
Non-Agriculture	21.35
Urban	15.41
Rural	84.59
Weekend	27.09
Sample size	798
N Households	628

Analysis Plan

I begin with a descriptive analysis of care time spent in nuclear and multigenerational household structures. This includes single and two-parent households as well as the number of coresidence grandparents. This form of descriptive analysis does not adjust for social demographic characteristics, which allows us to see existing patterns in time spent on care.

This is followed by two sets of regression analysis to understand if the observed patterns persist when social demographic conditions are the same. The first set of regression analysis examines parental time on care. That is, I examine the amount of time parents in nuclear

and multigenerational households spend on caregiving if their social demographic conditions are held constant. This procedure addresses the second research question.

To address the third research question, another set of regression analysis examines how much time grandparents spend on caregiving if they resided in single or two grandparent households. As grandparents in two-grandparent multigenerational households could be reporting care time for their grandchildren or their spouse, single grandparent multigenerational households provide additional information. The assumption is that the care time reported by grandparents in single grandparent multigenerational is time spent on childcare.

The regression analysis used for investigating time spent on care by parents and grandparents is a linear hierarchical structural (multilevel) model, which adjusts for clustering of observations in the data. Because of the multistage sampling design of households, individuals are not randomly selected, and, therefore, can be expected to cluster within households and villages. Since parents and grandparents are nested within households, they have similar household level characteristics. Structural modeling can adjust for this clustering. Thus, a two-level linear hierarchical structural model would be appropriate for this analysis. These levels are defined as:

1. i, for a given individual,

2. j, at the household level, where a household may have varying number of individuals.

In terms of the equations for parental time, the individual-specific, or level 1, variables are sex, age, education, and employment status. The household-specific, or level 2, variables are family structure, head of household is single, household size, number of children under the age of five in the household, household income, urban, and weekend.

Level 1: model with individual-specific covariates

$$\begin{aligned} y_{ij} &= \eta_{0j} + \beta_1 age_{ij} + \beta_2 female_{ij} + \beta_3 edu\_none_{ij} + \beta_4 edu\_lwsec_{ij} + \beta_5 edu\_secpl_{ij} \\ &\quad + \beta_6 employ_{ij} + \beta_7 NFL_{ij} + \epsilon_{ij}, \qquad \epsilon_{ij} \sim N(0, \theta) \end{aligned}$$

Parental time on care is a function of an individual-specific intercept (η_{0j}), age (with coefficient β_1), being female (with coefficient β_2), level of education (with coefficient β_3, β_4, or β_5), being employed in the labor market (β_6) or not in the labor force (β_7). ϵ_{ij} represents the individual and household-specific error term given by a normal distribution with mean 0 and variance θ.

The household specific intercept is modeled as:

Level 2: model with household-specific covariates

$$\begin{aligned} \eta_{0j} &= \gamma_{00} + \gamma_{02} multigen_j + \gamma_{01} single_j + \gamma_{03} hhsize_j + \gamma_{04} kids04_j + \gamma_{05} kids59_j + \gamma_{06} kids1017_j \\ &\quad + \gamma_{07} urban_j + \gamma_{08} urban_j + \gamma_{09} sat_j + \gamma_{0(10)} sun_j + \zeta_j, \qquad \zeta_j \sim N(0, \psi) \end{aligned}$$

Household-specific intercept is a function of the household-average intercept (γ_{00}), residing in multigenerational household structure (with coefficient γ_{01}), the parent is single (γ_{02}), the size of the household (γ_{03}), the number of children under age five (with coefficient γ_{04}), the number of children age five to nine (with coefficient γ_{05}), the number of children age ten to seventeen (with coefficient γ_{06}), household income (γ_{07}), being in an urban area (γ_{08}), time use collected on weekend (γ_{09} and $\gamma_{0(10)}$). Representing the household-specific error, ζ_j is given by a normal distribution with mean 0 and variance ψ.

As for analyzing time spent on care by grandparents, the regression equations are similar to those for parents. Individual characteristics that may impact time spent on care by parents are just as important for grandparents, so the level-one model for grandparents is the same as the one for parents. As for level two, since all the grandparents in this subsample reside in multigenerational households, this variable is omitted from the regression. However, as the presence of another grandparent in the household can influence their care time, this is included in the model. Thus, the model for level two is

$$\begin{aligned}\eta_{0j} &= \gamma_{00} + \gamma_{02} granpls_j + +\gamma_{01} single_j + \gamma_{03} hhsize_j + \gamma_{04} kids04_j + \gamma_{05} kids59_j + \gamma_{06} kids1017_j \\ &\quad + \gamma_{07} urban_j + \gamma_{08} urban_j + \gamma_{09} sat_j + \gamma_{0(10)} sun_j + \zeta_j, \qquad \zeta_j \sim N(0, \psi)\end{aligned}$$

For the regression analysis for time spent on care by parents and grandparents, four models are considered for each. Initially, the model will not contain any covariates to estimate the variance in care time that is between and within households. Next, the individual-level variables are added into the model. Subsequent models will include household level characteristics. Thus, Model 3 will contain the variables for household structure or the presence of multiple grandparents. The final model includes all level two characteristics such as income, urban and day of the week for time use.

2.3 Results

Descriptive Analysis

The overall characteristics of the households, parents, and grandparents were discussed in Section 2.2; now, we turn to childcare time. Table 2.4 shows the average household's total hours per day in primary childcare activities. The most striking feature of this table is that multigenerational households spend twice as much time on childcare.

Furthermore, the pattern of more childcare time generated by multigenerational households persists when considering the age of children in the household. Figure 2.1 shows households' total hours on childcare by the age of the youngest child in the household. In general, the amount of time spent on childcare tends to overlap between both forms of household structure. This is shown by the overlay of circles and x's, representing nuclear and multigenerational households respectively. Also, with increasing age of the youngest

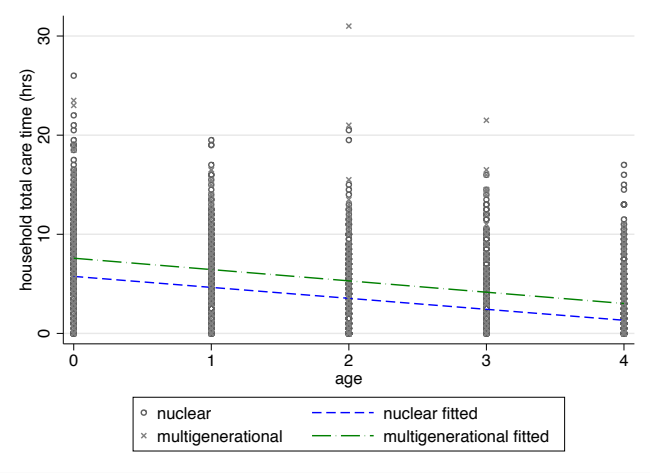
Table 2.4: Total Hours Per Day of Household Care Time by Family Structure, Cambodia, 2004

Family Structure	**mean**	**sd**
Nuclear	2.63	3.10
Multigenerational	4.92	4.37
Total	2.95	3.40

Source: Calculated by author.

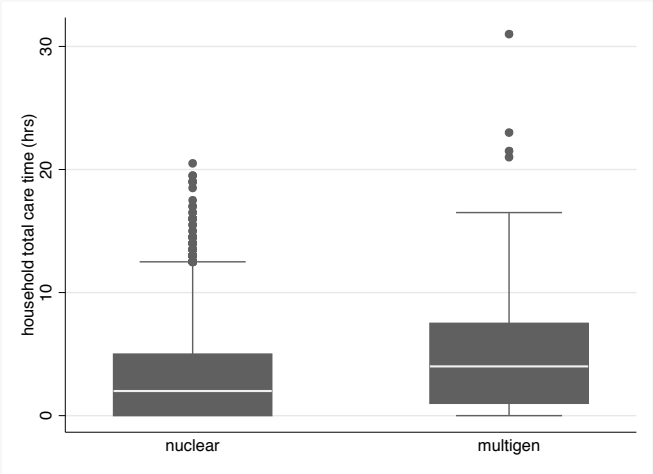
child, the spread of the graph narrows towards less amount of time. This suggests that both household structures invest less time on childcare with increasing age of the youngest child in the household. While they share many similar characteristics, the graph also shows that multigenerational households still invest more childcare time at every age.

Figure 2.1: Household Total Time on Childcare by Age of Youngest Child and Family Structure in Cambodia, 2004



Also, when taking into account the number of children under the age of five in these households, the same pattern emerges but with greater variation. Figure 2.2 shows the distribution of total hours per child under the age of five in the households. The box plot shows that there is more variability in childcare time among multigenerational households. The shaded region of the box plot represents the interquartile range of the distribution of childcare time. That is, the bottom and top of the box represent the 25^{th} and 75^{th} percentile of childcare time for each household structure. The white line through the middle of these boxes represent the 50^{th} percentile. That is among nuclear households, half spend less than two hours on childcare per child and half of the nuclear households spend more than this. Whereas, the median time on childcare for multigenerational household is four hours

Figure 2.2: Hours Per Child Spent on Care by Family Structure in Cambodia, 2004



per child, per day. As for the lines extending from these boxes, known as whiskers, they represent the lowest data point that is within 1.5 of the interquartile range from the lower quartile or highest data point within 1.5 of the interquartile from the upper quartile. Any data point beyond the whiskers are considered outliers. The box for nuclear households is very condense, showing that fifty percent of nuclear households spend less than four hours on childcare per child. It also has a very long tail in that several households are outliers by spending exceptionally more time on childcare. Whereas, there are only four multigenerational households that are outliers in the amount of time they spend on childcare. The majority of multigenerational households spend less than 7.5 hours per child on childcare. In general, this figure shows a greater spread on the amount of childcare time spent by multigenerational households, but the spread is at a higher number of hours than nuclear households.

Households that are able to provide more childcare have more household members but fewer children under the age of five. Since there are more people in the household who can provide childcare, this explains why some of the outliers in Figure 2.2 are able to report more than 24 hours of childcare time. Take the extreme outlier for multigenerational households for instance. This household has two parents, two grandparents and three children aged 13, 11, and 2. Each grandparent and the mother reported about 8-9 hours of childcare each and the eldest child contributed 5 hours, giving the household a total of 31 hours of childcare time. The most reported hours of childcare time per child under the age of five for nuclear household is 21.5 hours. Similar to the multigenerational household, this household has two parents and three children aged 9, 6, and under 1. Unlike the multigenerational household swhere most of the childcare time came from the adults in the household, in this nuclear household children reported more childcare time than their parents, 7-8.5 and 2-3 hours respectively. The pattern emerging from the outliers suggests that grandparents reduce the

demand for childcare time from children in the household, and they generate a substantial amount of childcare time.

The broad overview presented thus far suggests that multigenerational households collectively generate on average two hours more childcare time than nuclear households. The disparity between household structures is not as great when comparing parental time on childcare. Table 2.5 presents the total hours parents spend on childcare in a given day, and similarly, Table 2.6 shows the amount of time spent in a given day, per child under the age of five. Unlike the pattern for overall household structure, these tables show that parents in nuclear households are spending more time on childcare than parents in multigenerational households. Instead of hours, the difference is in matters of minutes, which is not enough to explain the substantial difference in the overall childcare time between these household structures.

Table 2.5: Parent Time on Care in a Day by Household Structure in Cambodia, 2004

Parents	Nuclear mean (sd)	Multigenerational mean (sd)
Single	1.23 (2.03)	1.16 (2.21)
Mother	1.29 (2.03)	1.32 (2.34)
Father	0.69 (1.92)	0.18 (0.60)
Two-Parents	1.35 (2.46)	1.34 (2.40)
Mother	2.48 (2.96)	2.40 (2.88)
Father	0.21 (0.84)	0.29 (1.02)

Source: Author's calculation from CSES 2004 data.

Table 2.6: Parent Time on Care Per Child in a Day by Household Structure in Cambodia, 2004

Parents	Nuclear mean (sd)	Multigenerational mean (sd)
Single	1.11 (1.93)	1.02 (2.01)
Mother	1.15 (1.93)	1.16 (2.13)
Father	0.69 (1.92)	0.18 (0.60)
Two-Parents	1.10 (2.11)	1.12 (2.09)
Mother	2.04 (2.58)	1.99 (2.55)
Father	0.17 (0.70)	0.24 (0.87)

Source: Author's calculation from CSES 2004 data.

These tables may not elucidate much information on parental time on childcare by household structure, but they provide additional information on other patterns of childcare. For instance, both Table 2.5 and 2.6 highlight the gender difference in caregiving. Cambodian mothers spend more time on childcare than their spouses irrespective of household structure. When focusing on the number of parents in the households, single parents spend less time on childcare in both nuclear and multigenerational households. The presence of an additional parent in these households enables mothers to spend about twice as much time on childcare. This suggests that while fathers are not spending time on childcare, their presence in the household frees up mothers' time from other activities that will enable them to spend more time providing childcare.

Similar to the pattern seen for parents, gender and the number of grandparents in the households influence their contribution to childcare. Table 2.7 shows the caregiving time reported by grandparents, and Table 2.8 shows the amount of childcare time grandparents provide by the number of coresiding parents. These tables indicate that the gender difference in providing childcare that exists among parents also persists among grandparents. Grandmothers provide more childcare time than grandfathers, although this pattern is not as strong in single grandparent households. In households with only one grandparent, grandfathers spend almost as much time on childcare as households with only a grandmother, 2.08 and 2.11 hours respectively.

Table 2.7: Grandparents' Time on Care Per Child in Cambodia, 2004

N Grandparent	**Multigenerational**	
	Grandmother	Grandfather
Single	2.11 (2.86)	2.08 (2.83)
Two	2.03 (2.77)	0.62 (1.76)
Total	2.08 (2.83)	0.70 (1.90)

Source: Author's calculation from CSES 2004 data.

Table 2.8: Grandparents' Time on Care Per Child by Number of Parents in Cambodia, 2004

N Parent	**Single Grandparent**		**Multiple (2) Grandparents**	
	Grandmother	Grandfather	Grandmother	Grandfather
Single	2.36 (3.09)	1.83 (3.56)	2.54 (3.13)	0.64 (2.16)
Two	2.08 (2.84)	0.80 (1.98)	1.94 (2.71)	0.62 (1.70)

Source: Author's calculation from CSES 2004 data.

The amount of childcare time grandparents provide is also related to the number of parents in the household. Grandparents are responsive to the number of parents residing in the

household. Whereas the presence of an additional parent increases the amount of childcare time of one parent; grandparents provide more childcare support when single parents are in the household. That is, single parents elicit more childcare time from grandparents in the household, especially grandmothers.

Table 2.9: Hours Spent on Activities by Parents and Household Structure in Cambodia, 2004

Activities	**Nuclear**			**Multigenerational**		
	Total Mean (sd)	Father Mean (sd)	Mother Mean (sd)	Total Mean (sd)	Father Mean (sd)	Mother Mean (sd)
Market Labor	3.00	4.11	1.94	2.96	3.81	2.18
	(3.81)	(4.11)	(3.14)	(3.76)	(4.01)	(3.34)
Agricultural Labor	1.92	2.66	1.22	2.07	2.84	1.36
	(3.00)	(3.51)	(2.19)	(3.11)	(3.54)	(2.45)
Domestic Labor	2.14	0.87	3.35	1.96	0.82	3.01
	(2.18)	(1.63)	(1.94)	(2.21)	(1.57)	(2.12)
Childcare	1.35	0.21	2.43	1.33	0.29	2.28
	(2.45)	(0.85)	(2.94)	(2.39)	(1.01)	(2.84)

Source: Author's calculation from CSES 2004 data.

Table 2.10: Total Hours Spent Per Day on Activities by Grandparents in Multigenerational Household Structure in Cambodia, 2004

Activities	**Total**	**Grandfather**	**Grandmother**
Market Labor	1.30 (2.76)	1.55 (2.97)	1.21 (2.68)
Agricultural Labor	1.36 (2.54)	2.19 (3.04)	1.05 (2.24)
Domestic Labor	1.45 (1.86)	0.53 (1.29)	1.80 (1.92)
Childcare	1.91 (2.85)	0.84 (2.16)	2.31 (2.97)

Source: Author's calculation from CSES 2004 data.

Alternatively, the gender differentiation among parents and grandparents in childcare may be a consequence of division of labor. Table 2.9 shows parental time on daily activities and Table 2.10 for grandparents. The first two activities in these tables are related to economy, that is, time spent on market and agricultural labor. The second set of activities are related to the home, reports of time spent on household work, domestic labor, and childcare.

In Table 2.9, the average time spent on each activity by parents in each family structure type is reported under total, and this is further disaggregated by gender. This table shows

that fathers in nuclear and multigenerational households almost exclusively spend their time in the labor force. They spend around seven hours, about twice as much time as mothers, on agricultural and market labor. Mothers participate in these economic activities, but the majority of their time, around five hours, are spent on household matters such as domestic labor and childcare. Mothers in nuclear households actually spend more time on these activities than those in multigenerational households. However, parents in multigenerational households have the benefits of having additional time from grandparents. As Table 2.9 shows, grandfathers, like fathers, spend more time on economic activities, and grandmothers spend more time on domestic activities. Grandmothers spend slightly more time on childcare than coresiding mothers. These tables indicate that the presence of fathers is essential for resource-generating activities, which complements mothers' domestic and caregiving roles. Furthermore, the presence of grandparents slightly reduces maternal childcare time and increases her market labor participation. However, grandmothers' childcare time does not substitute those of mothers', but rather complements her time on childcare.

This descriptive analysis indicates that under current conditions in Cambodia there exist differences in childcare time by family structure and the number of parents in the household. That is, multigenerational households provide more childcare time primarily through mothers and grandmothers, and dual parent households also are able to generate more childcare time. This addresses the first research question, and the next section will address the second question on whether or not parental time differs by household structure once socio-demographic characteristics are taken into account.

Parents' Time

The step-wise regression results for parental time on childcare is shown in Table 2.11. The rows are organized into three parts: the first set of variables are individual characteristics, the second are household level characteristics, and the third is information on the model. Unlike the descriptive results above, once individual and household characteristics are controlled for, parents in nuclear and multigenerational households do not significantly differ in the amount of time they spend on childcare. Some individual and household characteristics are better predictors of parents providing childcare time than others.

For instance, individual characteristics such as gender, age, and employment status are important predictors of how much time parents will provide for childcare. This analysis finds that mothers spend 1.89 hours more than fathers when all other characteristics are the same except for their gender. Similar to the descriptive analysis, this finding is consistent with the Cambodian concept of gender role in providing primary care for children. This result is not unique to Cambodia, as time-use studies in other countries reported the gender division of labor where fathers spend more time in the market sector while mothers provide childcare for very young children (Bianchi 2000, Gustafsson and Kjulin 1994).

Table 2.11: HLM Regression of Parental Time for Care in Cambodia, 2004

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$
Intercept	1.343***	3.369***	3.387***	2.369***
	(0.03)	(0.15)	(0.15)	(0.19)
Gender				
Male		-	-	-
Female		1.812***	1.813***	1.888***
		(0.05)	(0.05)	(0.05)
Age		-0.035***	-0.036***	-0.024***
		(0.00)	(0.00)	(0.00)
Educational Level				
None		-	-	-
Primary		-0.024	-0.022	0.008
		(0.05)	(0.05)	(0.05)
Lower Secondary		-0.043	-0.039	0.006
		(0.10)	(0.10)	(0.10)
Upper Secondary +		-0.105	-0.092	-0.056
		(0.12)	(0.13)	(0.13)
Employment Status				
Not in labor force		-	-	-
Employed		-1.949***	-1.947***	-1.916***
		(0.09)	(0.09)	(0.09)
Unemployed		-0.484	-0.452	-0.366
		(0.67)	(0.67)	(0.66)
Household Structure				
Nuclear			-	-
Multigenerational			-0.086	-0.086
			(0.07)	(0.09)
No. Parents				
Two				-
Single				-0.734***
				(0.14)
Household Size				0.040
				(0.05)
No. Children by Age				
0-4				0.446***
				(0.06)
5-9				-0.112*

				(0.05)
10-17				-0.101
				(0.06)
Household Income				-0.000
				(0.00)
Residence				
Rural				-
Urban				-0.174**
				(0.06)
Survey Day				
Weekday				-
Saturday				-0.028
				(0.07)
Sunday				0.127
				(0.07)
Random effects				
Between group ψ	0.000***	0.365***	0.364***	0.256**
	(0.00)	(0.09)	(0.09)	(0.13)
Within group θ	2.438***	2.070***	2.070***	2.066***
	(0.02)	(0.02)	(0.02)	(0.02)
N	8743	8743	8743	8739

This division of labor has implications for mothers who are in the labor force. Model 3 shows that the magnitude of effect for employment status on childcare time is greater than the effect of gender. A parent whose individual characteristics are the same as any other parent except for working in the labor force can expect to spend a difference of 1.95 hours on childcare. That is, employed parents spend almost two hours less on childcare than a parent who is not in the labor force. This is a substantial amount of time which children lose from employed parents. It also hints at a divergent trend from developed countries analysis since the trend of parental time on childcare in developed countries has been stable or increasing with rising maternal participation (Bianchi 2000). This difference is explained in part by the minimal differences found in developed countries between employed and unemployed parents as unemployed mothers did not spend more time on childcare (Bianchi 2000, Bianchi and Robinson 1997). Also, participation in childcare by fathers in developed countries have been rising with maternal employment (Bianchi 2000, Craig 2006). Given that most parents in Cambodia or other developing countries do not work in white-collar jobs where there are structured work schedules with sufficient income that allows them to have more time to allocate to other activities, Cambodian parents then need to maximize their time in the labor force. Consequently, this implies that employment status of both mothers and fathers in Cambodia diverts parental time from childcare.

On a substantially smaller scale than gender and employment status is the effect of age

on parents' time on childcare. Although, since age is a continuously increasing variable, the effect can become larger. For instance, a young twenty-year-old parent is expected to spend 0.72 hours less on childcare whereas a forty-year-old parent would spend 1.62 hours less time on childcare. Given that other studies have found the incremental gain in childcare time for each additional child is marginal (Gustafsson and Kjulin 1994, Ho 1979) and given that Cambodia has a high fertility rate, it can be expected that as Cambodian parents ages they will have additional children. Moreover, these older children are able to contribute to household labor and childcare, thereby diminishing the need for aging parents to provide intensive amount of time on childcare for the youngest children.

In addition to individual characteristics that influence parental time on childcare, some household characteristics are associated with parental time for childcare. For instance, while most studies suggest that household size increases parental time (Bianchi and Robinson 1997, Quittner and Opipari 1994), this analysis finds that the number and age of children in the household are stronger indicators of parental time for childcare. Each additional child under the age of five in the household increases parental time for childcare by 0.45 hours. However, having children aged five and over reduces childcare time of parents. Since children as young as 10 years old start participating in the labor market in Cambodia to help their families earn additional income, older children can be expected to spend more time in the employment sector and have less time available for domestic labor. Younger children who have not entered the labor market would then have less time constraint and be able to spend more time on household chores and watch over younger siblings. Therefore, it is not surprising that each additional child age 5 to 9 significantly reduces parental time on childcare more than the number of children age 10 to 17. Children from age 5 to 9 provide more childcare time than older children (results not shown), thereby freeing up parental time from childcare. Therefore, this analysis suggests that it is not the household size itself that influences childcare time of parents but rather the age and number of children in the household.

In addition, geographical location of households also impacts parental time for childcare. Model 4 suggests that parents whose households are in urban areas spend 0.17 hours less on childcare than parents in rural areas. Since the living expenses of urban areas cost more than rural areas, this requires parents to earn higher income to sustain basic living conditions. Therefore, it becomes vital for parents in these geographical regions to maximize their time in the paid labor force. By investing more time in economic activities, parents in urban areas have less time to invest in childcare as their primary activity.

The emphasis on being economically active combined with limited white collar job opportunities also manifest itself in the absence of a pattern in childcare by days of the week. Since parental time for childcare does not significantly differ by day of the week, this suggests that parents spend almost as much time on weekends as they do on weekdays on market and agricultural labor. As local markets and shops are open daily, operation of the facility is maintained by vendors or their unpaid family members throughout the week. In addition, because of the poverty level, people are employed in multiple jobs. For instance, teachers can offer tutoring on weekends to earn additional money to supplement their government

earnings. Therefore, there is less of a distinction between weekdays and weekends in Cambodia. This may explain why parental time for childcare does not statistically differ by day of the week.

Among these household characteristics, the number of parents in the household is the most important indicator of parental time for childcare. Unlike the indicator for multigenerational households, where household structure does not appear to influence parents' time on childcare once individual characteristics are controlled for, the effect of being in a single parent household seen in the descriptive analysis remains strong in the regression analysis. Model 4 indicates, once individual and household characteristics are controlled for, that individuals who are the sole parent in the household spend about three-quarters an hour less on childcare than parents who have a spouse in the household. That is, single parents spend substantially less time on childcare than a parent who is in a dual parent household. The presence of a second parent enables greater division of labor that allows one person to invest more time in childcare; therefore, single parents cannot invest in childcare time as much as they would otherwise.

Overall, the regression analysis does not support the second research question; household structure does not influence how much time parents provide for childcare. Although, the analysis suggests that household level characteristics such as single parent status and the number of children under the age of five influence the amount of childcare time spent by parents. Furthermore, parental time for childcare is more driven by individual characteristics such as gender, age, and employment status.

Grandparents' Time

Now turning to the third research question about grandparents' caregiving time, this section presents the results from the regression analysis in Table 2.12. This table is organized in the same manner as the one for parents, with information on individual, household, and the model by rows with results from different regression models by columns. As indicated by the descriptive analysis, grandparents do provide childcare time; the amount of time they provide for childcare is not influenced by the number of grandparents in the household once socio-demographic characteristics are controlled for.

Table 2.12: HLM Regression of Grandparents' Time for Care in Cambodia, 2004

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$
Intercept	1.927^{***}	2.646^{**}	2.744^{**}	3.184^{*}
	(0.10)	(0.92)	(0.95)	(1.28)
Gender				
Male		-	-	-
Female		1.200^{***}	1.164^{***}	1.184^{***}

	(0.23)	(0.24)	(0.24)
Age	-0.013	-0.014	-0.007
	(0.01)	(0.01)	(0.01)
Educational Level			
None	-	-	-
Primary	-0.154	-0.150	-0.205
	(0.23)	(0.23)	(0.23)
Lower Secondary	0.065	0.058	-0.090
	(0.52)	(0.52)	(0.52)
Upper Secondary +	1.038	1.041	0.928
	(1.03)	(1.03)	(1.03)
Employment Status			
Not in labor force	-	-	-
Employed	-1.286***	-1.281***	-1.352***
	(0.22)	(0.22)	(0.22)
Unemployed	-0.640	-0.643	-0.767
	(0.65)	(0.65)	(0.64)
No. Grandparents			
Single		-	-
Multiple		-0.091	0.077
		(0.22)	(0.36)
No. Parents			
Two			-
Single			0.230
			(0.39)
Household Size			-0.190
			(0.28)
No. Children by Age			
0-4			0.127
			(0.36)
5-9			-0.026
			(0.31)
10-17			0.053
			(0.33)
Household Income			0.000*
			(0.00)
Residence			
Rural			-
Urban			-0.263
			(0.28)
Survey Day			

Weekday				-
Saturday				-0.362
				(0.29)
Sunday				-0.077
				(0.30)
Random effects				
Between group ψ	0.971	1.144	1.142	1.080
	(0.38)	(0.31)	(0.31)	(0.32)
Within group θ	2.676***	2.448***	2.449***	2.449***
	(0.15)	(0.15)	(0.15)	(0.15)
N	798	798	798	798

Instead, individual characteristics such as gender and employment status are stronger predictors of the amount of childcare time grandparents provide. Parallel to the results for parents, grandmothers provide more childcare time than grandfathers. Once individual and household characteristics are adjusted for (Model 4), grandmothers are expected to spend 1.18 hours more on childcare time than grandfathers. This gender difference, while substantial, is about half the amount expected for parents. Grandfathers actually spend more time on childcare so that the gender difference in time spent on care is smaller between grandparents than it is between parents. This smaller gender difference in childcare can be attributed in part to grandparents participating in the labor force at lower levels. Since the majority of grandparents reside in rural areas, their ability to participate in the labor force becomes limited as they age because of the physical demand in the dominant occupations of agriculture, forestry, and farming. Moreover, given that the social expectation is for children to support their elderly parents (Zimmer and Kim 2001), grandparents are more likely to withdraw from the labor force when their adult children are able to provide them with support. This is reflected in the fact that grandparents report the most leisure time. As they have more available time, they are able to invest more childcare time for their coresiding grandchildren.

Consequently, employed grandparents, like parents who are employed, will then have less time to invest in childcare. Based on Model 4, employed grandparents are estimated to spend 1.35 hours less time on childcare than grandparents who are not in the labor force. Time spent on the labor force is time which grandparents lose on spending with their grandchildren. Therefore, their employment status influences their involvement in the lives of their coresiding grandchildren.

Interestingly, the amount of time grandparents spend on childcare is not influenced by any household characteristics except income, and the effect is extremely small. Unlike studies in the U.S. where grandparents provide childcare in low-income households, this analysis finds that Cambodian grandparents are more likely to provide childcare in wealthier households. Since wealthier households are able to provide financial support for coresiding grandparents, this eliminates the demand for grandparents to be employed to help pool household resources.

Thereby, grandparents in these households are less likely to be employed, which then increases their available time and allows them to use their time for childcare.

Other household characteristics do not appear to influence grandparents' time on childcare. For example, this analysis suggests that the presence of single parents in the household does not significantly influence the amount of time grandparents spend on childcare. The implication is that there is an underlying pattern that grandparents do not differentiate how much childcare time they provide by the number of parents that are in the household. Instead, individual characteristics are the main drivers of grandparents' involvement in childcare. Grandparents residing in single parent households are prominently grandmothers, who invest more time in childcare. Therefore, the descriptive result in Table 2.8 may actually be detecting more of the gender effect than the presence of single parent. Also, the age and the number of children in the household are not associated with childcare time provided by grandparents. This may potentially be due to the strong expectation that childcare is the domain of mothers, and the care grandparents provide is rather supportive in nature.

Consequently, this analysis suggest that the supports grandparents provide in childcare is principally driven by their individual characteristics rather than those of the household.

2.4 Discussion

The results presented in this study are designed to elucidate the influence of family structure on the amount of care time children receive. Investigating this relationship is done by examining three different aspects of family structure on childcare time. First, an overview of family structure pattern in childcare time is examined, followed by an analysis of parental time for childcare. The third aspect considered is how the presence of multiple grandparents in the household influences the amount of childcare time grandparents provide.

The most notable finding is that the total care time children receive strongly differs by household structure: multigenerational households generate more care time for children than nuclear households. This difference is largely driven by grandparents who provide additional care time. Since parents' time on childcare did not differ between multigenerational and nuclear households, the childcare time generated by grandparents represent the additional time. That is, grandparents are not substituting parental time for childcare but supplementing it. Therefore, children in multigenerational household benefit from the presence of coresiding grandparents.

Moreover, children are benefiting more from the presence of grandmothers than grandfathers. While both grandparents contribute to agricultural or market labor, grandmothers spend half as much time as grandfathers in market labor. Grandmothers trade off their market time to spend more time on domestic labor and childcare. Since Cambodian women are trained to be responsible for domestic matters, it is reasonable to expect women to continue to perform some of these duties as they age and become grandmothers. Thus, grandmothers provide mothers with secondary support for childcare.

In multigenerational households, grandparents, especially grandmothers, may also be

spending their time in tandem with mothers. Grandmothers providing household labor and childcare can be doing these activities at the same time as mothers. If all the childcare time reported in multigenerational households were performed jointly then this may overestimate the amount of time children actually receive. That is to say, the additional childcare time gained by grandmothers would be marginal and overestimates the actual care time children receive. However, in larger households current childcare allows mothers and grandmothers to spread their time between children. This would allow each child to receive more focused attention from an adult in the household. Moreover, joint childcare data for which the CSES did not collect, may indicate the quality of the time. Concurrent childcare in multigenerational households may stimulate children socially and cognitively.

On a different note, mothers and grandmothers may still be providing childcare even though primary childcare time declines with increasing age of children. Because the CSES collects only primary activities, the results of this analysis reflect the direct childcare time children are given by parents and grandparents. What is not reflected is the time children may actually be receiving as a secondary activity. Studies that collect concurrent activities suggest that mothers also perform childcare as a secondary activity while performing housework (Craig 2006). Therefore, mothers and grandmothers in Cambodia may also be watching children while performing market or domestic labor. Secondary childcare may be more important for older children. Once children are able to walk and talk, parents and grandparents can supervise them from a distance while performing other activities, thereby, reducing the demand for direct primary childcare, and increasing the demand for secondary childcare as children age.

Also, findings in this study suggest, distressingly but not unexpectedly, that children living in single-parent households have a disadvantage. Two-parent households allow responsibility to be shared between parents, but single-parent households will have the same responsibility but less opportunity for sharing responsibilities. Since time is limited, single parents are not able to equally invest their time. The data suggests that single parents spend twice as much time as dual parents on market labor, trading off their domestic responsibilities. Since 90% of all single parents in Cambodia are women, single mothers substantially spend less time on childcare. This is a large difference compared to single mothers in the United States whose time on childcare did not differ much from mothers in two-parent households (Bianchi 2000, Bianchi and Robinson 1997). For children residing in multigenerational households, the care they receive from grandmothers help buffer the loss of caregiving time from the single parent. However, children in single parent nuclear households do not have coresiding grandparents to help buffer the loss time. They experience reduced care time from their single parent and lack care time from the absent parent and grandparents.

As Cambodia continues to modernize, the proportion of children experiencing a disadvantage in childcare time may continue to rise. While the divorce rate is at low levels, it has been increasing (Heuveline and Poch 2006). Combined with concerns of women being abandoned by their husbands (Öjendal and Sedara 2006), this would lead to a rise of single-parent households, which would disadvantage a greater number of children in receiving adequate childcare.

Study Limitations

Unlike previous studies on time spent on childcare, this study examines the input of care time grandparents provide and the characteristics of coresiding grandparents that provide additional childcare time. The complex analysis adjusted for potential confounding and clustering that could mask the underlying pattern that exists. Also, the results from the hierarchical models did not differ from the ordinary least square models performed on the nationally representative sample (see Appendix). Even so, there are limitations to this study.

Along the same line, as the CSES only has records of who provided care time, it does not collect information on who was the actual recipient of the care. By not collecting this, we cannot identify whether the recipient of care is a younger or older child. If a preferential pattern of care exists, then the design of the survey does not allow it to be discerned. Also, this analysis assumes that all care time is childcare time since the CSES classified care for children and elderly as a single category. If parents and grandparents are performing mainly elderly care, then the analysis overestimates the amount of care time children receive and potentially be diverting resources. However, since most Cambodian elderly are actively participating in the labor market well into their 70s and a very small proportion reported any disability, then grandparents may not require much care time. Instead, they are generating childcare time.

Lastly, all reported care is assumed to be generated for members of the household. Since rural villages tend to be collections of related households (Crochet 2011), if adults in one household are watching children from a different but related household, then this will bias the estimated amount of time children in the household receive. Or if children in a household are being cared for by relatives in a neighboring household, then this would underestimate the total care time children are receiving. Since this study restricted the analysis to households with children under the age of five and childcare is considered an important responsibility for women, we expect that parents in this study are actually reporting the time they spend on their children. Furthermore, while Cambodians prefer to live in close proximity to relatives, the functioning of each household is considered independent (Ovesen et al. 1996), so that caring for children in the household is most often performed by members of that household.

2.5 Conclusion

The findings of this study support the hypothesis that household structure does impact the amount of care children receive. The presence of grandparents, especially grandmothers, and two parents increases the amount of direct care a child receives. Since time is a limited commodity, the time allocated to childcare by families becomes an investment in the well-being of children. The amount of childcare time children receive may then influence the gradient of their health outcome. Thereby, family structures able to provide more childcare time may have healthier children. This research forms the basis for studying the relationship between time spent on care and child health outcomes.

2.6 Appendix

Ordinary Least Squares Regression Tables

Table 2.13: OLS Regression of Parental Time for Care in Cambodia, 2004

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$
Intercept	1.380***	3.297***	3.313***	2.206***
	(0.04)	(0.21)	(0.21)	(0.24)
Gender				
Male		-	-	-
Female		1.919***	1.920***	2.000***
		(0.07)	(0.07)	(0.07)
Age		-0.038***	-0.038***	-0.027***
		(0.00)	(0.00)	(0.00)
Educational Level				
None		-	-	-
Primary		-0.025	-0.022	0.011
		(0.07)	(0.07)	(0.07)
Lower Secondary		-0.017	-0.013	0.033
		(0.11)	(0.11)	(0.11)
Upper Secondary +		-0.052	-0.038	0.019
		(0.12)	(0.12)	(0.13)
Employment Status				
Not in labor force		-	-	-
Employed		-1.806***	-1.804***	-1.760***
		(0.18)	(0.18)	(0.18)
Unemployed		-0.741	-0.712	-0.646
		(0.88)	(0.87)	(0.89)
Household Structure				
Nuclear			-	-
Multigenerational			-0.082	-0.130
			(0.08)	(0.10)
No. Parents				
Two				-
Single				-0.765***
				(0.16)
Household Size				0.080
				(0.05)

No. Children by Age				
0-4				0.406***
				(0.08)
5-9				-0.156**
				(0.06)
10-17				-0.135*
				(0.06)
Household Income				-0.000*
				(0.00)
Residence				
Rural				-
Urban				-0.180*
				(0.09)
Survey Day				
Weekday				-
Saturday				0.001
				(0.07)
Sunday				0.104
				(0.08)
N	8743	8743	8743	8741

Table 2.14: OLS Regression of Grandparents' Time for Care in Cambodia, 2004

	Model 1	Model 2	Model 3	Model 4
	$\beta(se)$	$\beta(se)$	$\beta(se)$	$\beta(se)$
Intercept	1.892***	2.141*	2.198*	2.626
	(0.12)	(0.94)	(1.00)	(1.35)
Gender				
Male		-	-	-
Female		1.282***	1.255***	1.278***
		(0.22)	(0.26)	(0.26)
Age		-0.006	-0.006	0.001
		(0.01)	(0.01)	(0.01)
Educational Level				
None		-	-	-
Primary		-0.233	-0.230	-0.304
		(0.23)	(0.23)	(0.23)
Lower Secondary		-0.230	-0.234	-0.372
		(0.45)	(0.46)	(0.47)

Upper Secondary +		2.238	2.237	2.052
		(1.34)	(1.34)	(1.26)
Employment Status				
Not in labor force		-	-	-
Employed		-1.252***	-1.246***	-1.291***
		(0.26)	(0.26)	(0.26)
Unemployed		-1.640***	-1.645***	-1.818***
		(0.49)	(0.49)	(0.50)
No. Grandparents				
Single				-
Multiple			-0.059	0.120
			(0.25)	(0.39)
No. Parents				
Two				-
Single				0.014
				(0.39)
Household Size				-0.212
				(0.27)
0-4				0.189
				(0.34)
5-9				-0.054
				(0.31)
10-17				0.116
				(0.30)
Household Income				0.000**
				(0.00)
Residence				
Rural				-
Urban				-0.187
				(0.34)
Survey Day				
Weekday				-
Saturday				-0.217
				(0.28)
Sunday				-0.102
				(0.34)
N	798	798	798	798

Chapter 3

Family Structure and Membership: Who affects the Nutritional Status of Children in Cambodia?

3.1 Introduction

In 2012, UNICEF estimated 162 million or 25% of all children under the age of five worldwide are stunted—a form of malnutrition that is considered as being too short for the child's age. Most of the malnourished children resided in less developed countries (UNICEF 2013). As a developing country, Cambodia has made great stride in improving the health conditions for the population and children. Life expectancy at birth rose from 54.4 years in 2000 to 64.3 in 2010 (DHS 2001, 2011). The nutrition status of children also improved. Nationally, the proportion of children who are stunted declined from 49.8 to 39.9 over this time period (DHS 2011). While this is a substantial improvement, it also suggests that about half of the children are still suffering from malnutrition.

Extensive research has been conducted exploring the causes of malnutrition and interventions that can be performed to improve the nutritional status of children (Aubel et al. 2004, Lee et al. 1997). Studies have shown that improving access to water and sanitation for households can improve the environmental conditions for children and reduces the exposure to transmission of infectious diseases, which lead to mortality (Black et al. 2003, Caldwell 1986). Other studies have demonstrated that breastfeeding can improve the nutritional status and survival of very young children (DaVanzo 1988, Griffiths et al. 2001, Marriott et al. 2010, Ukwuani and Suchindran 2003). In addition, contributions made by other scholars have shown that maternal education and economic wealth can also affect children's health. While there have been numerous works exploring the factors that influence nutritional status of children, there still remains little consensus (Babu and Sanyal 2009). Moreover, there has been little progress in identifying an intervention with sustained improvement in child nutrition despite the investment in education on nutrition in developing countries (Aubel

et al. 2004).

Instead of examining nutritional status from a macro perspective, which may potentially entail massive resources for a public health intervention, this study examines the influence of children's nutritional status from a micro perspective. As the immediate environment of children is their family and the household in which they are raised, the context of this environment can potentially shape their health status. Thus, this research will be exploring the nexus of family structure and children's nutritional status.

3.2 Background and Research Question

Nutrition: What's the Metric?

Nutritional status is traditionally measured by anthropometric measurements. While the growth of children can be influenced by genetic and individual variation, it is also affected by environmental conditions (Babu and Sanyal 2009, Desai 1992, 1995, Sahn and Alderman 1997). Moreover, for young children, those under the age of seven, over 90 percent of the growth is attributed to environmental conditions (Kostermans 1994). After which, puberty and genetic factors play a greater role in the development of children's growth (Kostermans 1994). Therefore, examining the anthropometric status of children under the age of five will reflect the influence of environmental conditions.

Children's growth development can be influenced by environmental conditions such as the availability of food and the absence of chronic gastrointestinal diseases (Babu and Sanyal 2009, Desai 1992, 1995, Sahn and Alderman 1997). Availability of food rich in micronutrients allows children to have sufficient caloric intake to develop to their full potential. This potential can be achieved in the absence of diseases since chronic gastrointestinal diseases prevent the nutrients to be fully absorbed and forces the body to use substantial amount of energy to fight against the infection instead of for development. These environmental conditions are factors which children cannot control, but rather is affected by their household ability to provide food, other resources and care (Babu and Sanyal 2009). As such, variation in household structure can differentially influence children's nutritional status indicated by anthropometric indicators.

Family Structure: Which member has a role?

Grandparents

Considering the important role of family members' influence on children's health outcome, scholars have posited the beneficial role of grandparents. The "grandmother hypothesis" suggests that the evolution of menopause enables grandmothers to provide support for their daughters and grandchildren (Sear and Mace 2008, Sear et al. 2000). They can help with household chores, domestic production, and provide care in the event of illness in the household (Aubel et al. 2004). Moreover, grandmothers can also help provide childcare as

discussed in the previous chapter. Because of their ability to provide additional care and ability to influence household decisions and resources, grandparents can impact the health status of children. For instance, in a study conducted in South Africa, Duflo (2000) found that children residing in households with grandparents receiving a pension had better nutrition, which is manifested in children being taller than those residing in households without an elderly person. Studies conducted in other African countries have found similar beneficial effect of grandparents. Sear et al. (2000) found that the height of children improves in the presence of grandparents, particularly, maternal grandmothers. Whereas Linnemayr et al. (2008) found the presence of NGOs on children of teenage mothers improve only for those residing in multigenerational households—households with grandparents.

While these studies largely have been conducted in Africa, which is a different social-cultural context, the importance of Cambodian grandparents is expected to be consistent with these findings. A notable difference in terms of context is that some of the study areas conducted in Africa are in patrilineal and patrilocal societies. While there is some debate on whether Cambodian kinship system is matrilineal or bilateral, it is clear that it is not patrilineal (Crochet 2011, Demont and Heuveline 2008, Ledgerwood 1995). In terms of practice, it has been observed that Cambodians practice uxorilocal residence—residing with the wife's family. While the place of residence for young couples and their children may differ in these societies, the roles of grandparents are not that different. In a qualitative study conduced in Senegal by Aubel et al. (2004), they found that grandparents, mainly grandmothers, have an important role in the households. They are a source of information for reproductive women in the household during pregnancy as well as providing domestic labor and childcare. Similarly, Cambodian elderlders are also highly respected in the household (Frieson 2011). As shown in Chapter 2, Cambodian grandparents provide supplementary childcare, domestic labor as well as market labor. They play an important role in the household. Therefore, their influence in the household would then be expected to impact the health of coresiding grandchildren. Thus, the nutritional status of children in households with coresiding grandparents, i.e. multigenerational households, would be expected to fare better than households without grandparents, that is, nuclear households.

Parents

Furthermore, in addition to the role of grandparents, parents are also vital in influencing the health of children. Much of the literature on single- and two-parent households have been conducted in developed countries like the United States. Within this context, children are well fed in terms of having sufficient caloric intake and less likely to be malnourished. Therefore, measuring differences in child well-being in a developed country context has largely been in terms of psychological, behavioral, and educational outcomes. One study attempting to examine health differences between the number of parents in the households is conducted by Dawson (1991). In this study, the health measured were injury, asthma, frequency of headaches, speech defect, and enuresis. The principle findings were children in single-parent or step-family households were at greater risk of injury, and children from

divorced single-mother households are more prone to asthma. The differential in health outcomes in these households is suggested to potentially be caused by stress from changes in household structure, reduced parental supervision, and change in quality of environment after marital disruption.

While the quality of life in developing countries is lower and, therefore, the health consequences for children are greater, the mechanism through which the number of parents in the households affecting children's health are similar. For instance, single-parent households are at an economic disadvantage as there is only a single income earner in the household compared to two-parent households. Furthermore, women generally earned less than men, so the income that single mother earn will still be low. In addition to providing fewer resources to children in the household, single parents will also have less time to devote to childcare. Therefore, it is no surprise that studies in Latin America found that children from single-parent households fare worse than those in two-parent households, that is, children were at greater risk of stunting—being too short for the child's age and sex (Bronte-Tinkew and DeJong 2004, Desai 1992). Similar to single-parent households, children from cohabiting households were also at greater risk of stunting (Bronte-Tinkew and DeJong 2004, Desai 1992). Cohabiting or consensual union households are less stable than two-married-parent households (Desai 1992), and the financial exchanges between parents are more precarious (Bronte-Tinkew and DeJong 2004). Thereby, coresiding fathers in these unions might invest less in children in these household, which translated into poorer nutritional status of children.

These studies suggest that children in two-married-parent households have an advantage over children in single or cohabiting households. Having two parents in a stable union seems advantageous, yet having too many parents might not generate any additional gain, but have the opposite effect. For instance, studies examining polygamous families in Africa finds that children's nutritional status fares worse than monogamous (two-parent) households (Aaby et al. 1983, Ukwuani and Suchindran 2003). While children from polygamous households are residing in wealthier households, most of this wealth comes from working wives (Aaby et al. 1983). The income generated by men in polygamous unions would then have to be shared across a number of wives and children, thereby each child receive lower level of resources and paternal care time than children in two-parent households (Desai 1992). This would then put children in polygamous households on par with children in single-parent households, and thereby, lead to lower investment that results in poorer nutritional status of children.

These developing-country studies generate potential inferences for the Cambodia context. Unlike the polygamous households in Africa, Cambodian households are typically monogamous. Most Cambodian children reside in two-parent households since there is a taboo against divorce and having children out of wedlock (Heuveline and Poch 2006, Ledgerwood 1995). This means that single-parent households tend to form through widowhood, divorce or labor migration. Similar to single-parent households in Latin America and the United States, children in single-parent households in Cambodia may experience a nutritional disadvantage relative to two-parent households. This would form through limited access to resources as single-parent households earn less than two-parent households. Moreover, as

shown in the previous chapter, children in single-parent households also receive less care time. Less care time can lead to late detection and response to illnesses and potentially less food, which can then lead to poorer nutritional status.

Siblings

While the adults, parents, and grandparents, have prominent roles and responsibilities in the households that can affect the nutritional status of children, other members of the households can also be vital characters. That is, children's nutritional status can be influenced directly or indirectly by coresiding siblings. As household resources are limited, siblings could be competing with each other. The presence of multiple children can increase the spread of diseases (Arnold et al. 1998), and periods of illnesses can adversely affect nutritional status (Ukwuani and Suchindran 2003). Consequently, studies examining the impact of household size—driven by the number of children in the household—found some effect on the index child. For instance, children in Jamaica had increasing odds of being stunted for each additional coresiding sibling in the household (Bronte-Tinkew and DeJong 2004). This pattern of increasing risk of malnutrition with the numbers of coresiding siblings in the household was found in other developing countries in Latin America and Africa (Desai 1992, 1995, Linnemayr et al. 2008).

While the total affect of all siblings in the household can negatively affect young children's nutritional status, aggregating the siblings may mask the differential impact of siblings of different age group. As suggested in the previous chapter on time use, children of different age groups have different roles in the households. Siblings of the same age group who are under the age of five are still dependent on other household members for care, feeding, and other resources. Thereby, multiple young children would be competing with each other for the same economic resources and maternal time, so that each additional child under the age of five in the household can increase the risk of malnutrition for the index child.

Conversely, older siblings may potentially benefit younger children in the household. Children in developing countries participate in the labor market at a very early age (Desai 1995, Hsin 2007). Through their economic labor they are increasing total resources available in the household. This minimizes the amount of resources they need relative to what they earn, and this additional resource can be used to benefit younger children in the household. Also, these older children participate in home production which includes childcare for younger siblings (see Chapter 2). Therefore, the presence of older siblings may benefit younger children and help improve their nutritional status. Taking into account these differential roles of siblings, Desai (1995) examined the impact of siblings of different age groups on children aged 6-36 months in fifteen countries from Latin America, Africa, and Asia. This study found that the addition of a sibling aged less than five reduces the height status of the index child in most countries. Whereas the presence of siblings aged 12 and older increased the nutritional status, i.e. improved height status, for the index child in almost every country. Therefore, this study suggests that in most developing countries the differential role of siblings matter for young children nutritional status.

Similar to other developing countries, children in Cambodia also participate in the labor market at an early age. They also start contributing to home production at a young age. Therefore, the impact of coresiding siblings in the household is expected to differ by the age of the siblings in Cambodia. As young children under the age of five are vulnerable and largely dependent on the care of others, the number of children aged 0-5 would then be expected to adversely affect young children's nutritional status. Whereas the presence of older siblings would improve the nutritional status.

In sum, this chapter addresses the following questions with the following hypothesis based on the literature:

Research Questions and Hypothesis:

- Do children gain a nutritional advantage living in multigenerational household compared to nuclear households? That is, does the presence of grandparents improve children nutrition?

  Hypothesis: The presence of grandparents in the household, that is multigenerational households, is expected to improve the nutritional status of children.

- Do children residing in single-parent households experience a nutritional disadvantage?

  Hypothesis: Children with only one coresiding parent are expected to have poorer nutritional status than those in two-parent households.

- Does the presence of other siblings in the household provide a nutritional advantage or disadvantage?

  Hypothesis: The presence of siblings aged 0-5 are expected to reduce the nutritional status of the index child, while the presence of older siblings help improve their nutritional status.

With these questions on household structure's impact on child nutrition in mind, the subsequent section will discuss the data used to address these questions. This is followed by a description of the method, results, and further discussion on the findings.

3.3 Data

The data for this study comes from the Cambodia Demographic and Health Survey (CDHS). The CDHS is part of the worldwide Demographic and Health Survey (DHS) project, designed to capture information on fertility, family planing, and maternal and child health in developing countries. The CDHS is a nationally representative survey that is conducted about every five years. Thus far, Cambodia has had three survey rounds, 2000, 2005, and 2010. Through a complex multistage probability sampling design, information was collected at the household level from women aged 15-49 and from these women information about all

the children that she ever bore. Furthermore, in half of the household sample, the CDHS collected nutritional data for children under the age of five.

Dependent Variable

Children's nutritional status is traditionally measured by three anthropometric indicators. These indices are weight-for-age, weight-for-height, and height-for-age. Weight-for-age measures the child's body mass in relation to the child's age. This indicator is informative of current nutritional status. Repeated measures over time allows for monitoring of growth and nutritional status over time. Children who weigh very low for their age are consider *underweight*.

Another index of nutritional status is weight-for-height. This indicator measures body weight in relationship to the height of the child and serves as an indicator for recent acute nutritional status (Babu and Sanyal 2009, Kostermans 1994, Ukwuani and Suchindran 2003). This index is useful for measuring short-term fluctuation in nutritional status. Severe malnutrition along this scale is considered as *wasting*, when a child is too thin for his or her height (Babu and Sanyal 2009). This conditions occurs when a child experiences acute starvation during famines, crises, diseases or chronic malnutrition.

The third index is height-for-age. As height is a measure of linear growth over time, the indicator reflects long-term nutritional status. Past nutrition or chronic malnutrition can be revealed through children's height. A child who experiences periods of food shortage in early childhood can have impeded skeletal growth that might not be followed by periods of complete catch-up growth. Similarly, young children who have chronic illnesses may not grow to their full potential. The nutritional intake these children consume would be diverted by their bodies to combat illnesses, or the diseases inflicting them would not allow them to fully absorb all nutrients. Thereby, their ability to grow to their full height would be impeded by chronic illnesses. These periods of short growth can accumulate over time, so that with increasing age, children become shorter than expected (Bronte-Tinkew and DeJong 2004, Kostermans 1994). This can then lead to a condition called *stunting* where a child is too short for his or her age (Bronte-Tinkew and DeJong 2004, DHS 2001, 2006, 2011).

All three indices are usually expressed in z-scores, which compare the indicator for the child to a healthy reference population. The DHS reference population comes from the 2006 WHO Child Growth Standards, which is an international sample of children from Brazil, Ghana, India, Norway, Oman, and the United States. The mean z-score by age and sex for this reference population is the comparison by which Cambodian children in this study are compared to. Children whose z-score is less than -2 standard deviations from the reference population are considered *underweight, wasted, stunted* along the weight-for-age, weight-for-height, and height-for-age indicators, respectively.

Of the three indicators, height-for-age would appropriately capture the influence of family structure on children's nutrition. Weight-for-age and weight-for-height measure current nutritional status. As both acute and chronic health conditions can influence a child's weight, these measures can fluctuated with illnesses and good health. Combined with the

fact that the DHS is a survey, these indicators will not capture the long-term fluctuation. Since height-for-age measures long-term influence of nutritional status, this indicator will capture the influence of family structure on children's health for an extended period of time. Therefore, the height-for-age z-score (HAZ) will be used in this analysis.

Independent Variables

Family Structure

Household structure was determined based on two components of the survey. The CDHS collects information on every member in the household at the time of the survey. This includes whether or not the member is a usual resident in the household, the age of the household member, and his or her relationship status to the head of the household. The other component of the survey used to determine household structure is the report of coresiding mothers and fathers of children.

From the household rosters, only *de jure* or usual residents are considered in the analysis. As usual residents are more likely to influence the composition, as well as the social and economic dynamics of households, they would be stronger candidates of exerting any potential influence on infants in the household than visitors. Therefore, only usual residents are consider in the construction of household structure. As shown in Table 3.1, less than two percent of household members were not usual residents. Most of these nonresidents were not related to the head of household.

Reports of relationship status and of coresiding parents were used to construct household structure. Two forms of household structures are considered in this analysis. Nuclear households consist of either a single or two parents with children. Multigenerational households are three generational households that include children, their parents, and grandparent(s) in the households. Households are further restricted to having at least one parent. As information on children is reported by mothers, single-parent household in this analysis are single-mother households.

Besides grandparents and parents, other members of the households may potentially influence the health status of children. As suggested by the literature on child well-being, siblings can compete for household resources and parental care time (Desai et al. 1989, Gustafsson and Kjulin 1994, Hsin 2007). Alternatively, older siblings may provide additional household resources through their labor and freeing up parental time from domestic labor (Crognier et al. 2001, Gager et al. 1999). In terms of children's nutritional status, the study conducted by Desai (1995) in developing countries in Latin America, Africa and Asia suggests some sibling influence. This study found that the number of children under the age of five in the household can lower the nutritional status (HAZ) of the index child. Yet, the impact of older siblings on a child's nutritional status has not truly been explored within this literature. This study will include variables for the presence of young children who are aged five and under, as well as for children over the age of five coresiding in the households.

Table 3.1: Cambodia Demographic and Health Survey (CDHS) Sample Size

	2000	2005	2010
Total			
Household	12,236	14,243	15,667
Members	66,285	73,010	76,920
Usual resident	66,105	72,342	75,959
Children < 5	7,857	7,687	7,815
Subsample			
Household	2,095	2,031	2,018
Nuclear	1,805	1,673	1,626
Multigenerational	290	358	392
Children < 5			
Measured	2,817	2,643	2,511

Usual Resident normally resides in the household

Nuclear is parent and child household.

Multigenerational(s) includes grandparent, parent, and child.

Controlled Variables

Family-level Variables

Socio-economic status (SES) of households is considered an important indicator of nutritional status (Lee et al. 1997, Sahn and Alderman 1997, Ukwuani and Suchindran 2003). The CDHS created a wealth index, a quintile measure of household SES, based on a combination of household living conditions and possessions. Household SES is moderately correlated with maternal education. While SES has been found to be a strong indicator of nutritional status, the relationship with maternal education has been ambiguous (Babu and Sanyal 2009, Lee et al. 1997, Sahn and Alderman 1997, Ukwuani and Suchindran 2003). Both SES and maternal education will be controlled for in the analysis. The education for mothers is classified as follows: no education, primary education, and secondary or higher education.

Also, place of residence and level of sanitation are controlled for in the analysis. Place of residence is distinguished as urban versus rural. Sanitation is consider as whether the household has a toilet or latrine inside their home. Having a toilet minimizes the spread of diseases from fecal matter. And running water indicates more sanitary water for cleaning and drinking, which can also reduce the level and spread of disease throughout the community and households.

Child-level Variables

Child-variables are age, sex, and birth interval. Birth interval is the number of months between the birth of the index child and his or her immediate older sibling. Infants who had shorter birth intervals tend to be of lower birthweight and are at a higher risk of mortality (Arnold et al. 1998, Omariba and Boyle 2007, Saha and van Soest 2011). A birth interval of 15 months or less is considered as a short birth interval and is coded as 1.

3.4 Analysis Plan

The analysis is conducted in two parts. The first part of the analysis will be a set of descriptive statistics. This will provide a general overview of the sample characteristics as well as patterns of children's height by nuclear and multigenerational households, and by the number of parents and siblings in the households. These descriptive statistics will show existing patterns in children's height as they do not adjust for social and demographic characteristics.

The second part of the analysis consists of three sets of regression analyses designed to determine if an underlying pattern in children's height by household structure exists by adjusting for social and demographic characteristics. The first set of regression analyses examine the research questions among all children under the age of five in the analytic sample. This is meant to provide an overall assessment of children in the sample. Since the prevalence of stunting is generally greatest among children under the age of two and stabilizes afterwards (Kostermans 1994), this may introduce heterogeneity into the total sample population (Sahn and Alderman 1997). Therefore, two subsets would be considered. One subset will consist of children aged 0-24 months (0-2 years old), and the other will contain children between 25-59 months (or 2-4 years old). Thus, the second and third sets of regression will be for each subpopulation respectively. Subsequently, each set of regression analyses addresses all three aspects of the research questions, but they differ from each other in terms of the target population.

The regression analysis used to investigate children's height by family structure is a linear multilevel model. Multilevel modeling adjusts for clustering of observations in the data. Because of the multistage sampling design of households, individuals are not randomly selected, and therefore, can be expected to cluster within households. That is, children residing in the same household are likely to be similar across a wide range of characteristics. This would lead to a strong correlation between children nested within the same household. Therefore, a two-level linear multilevel model would address this concern. These levels are defined as:

1. i, at the individual or child level,
2. j, at the household level, where a household may have varying number of children.

As we are interested in estimating the effect of household structure characteristics, S_j, which are at the household level, j, characteristics on the individual (child) level, i, health outcome such as HAZ, y_{ij}, we then have

$$y_{ij} = \alpha + \beta_1 X_{ij} + \beta_2 H_j + \gamma S_j + \zeta_j + \epsilon_{ij} \tag{3.1}$$

This two-level OLS model includes both individual (child) and household levels components, which can be parsed and rewritten into two separate models. The first model being at the individual level has the form

Level 1: model with individual-specific covariates

$$y_{ij} = \beta_1 X_{ij} + \eta_{0j} + \epsilon_{ij}, \qquad \epsilon_{ij} \sim N(0, \theta) \tag{3.2}$$

The child's HAZ measurement, y_{ij}, is then effected by a set of individual level covariates, given by X_{ij}, and its corresponding parameter estimates, β_1, as well as household level intercept represented by η_{0j}. The individual and household level random error, ϵ_{ij}, is assumed to be normally distributed with a mean of 0 and variance of θ. Furthermore, η_{0j} represents the second model at the household level.

Level 2: model with household-specific covariates

$$\eta_{0j} = \alpha + \beta_2 H_j + \gamma S_j + \zeta_j, \qquad \zeta_j \sim N(0, \psi) \tag{3.3}$$

The household specific intercept is a function of household average intercept, and household level covariates, represented by H_j, which is a vector of household level covariates with the corresponding vector of parameter estimates, β_2. In addition, as we are interested in a set of household structure characteristics' influence on HAZ, represented by S_j with the corresponding estimate parameter, γ. The household level error term, ζ_j is also assumed to have a normal distribution with mean of 0 and variance of ψ.

Thus, the multilevel model adjust for clustering by decomposing the variance in the sample into two distinct components: one) the variance, θ, between individual (child) variation who are within the same household; and two) the variance, ψ, accounts for the variation between households. This would then allow a more precise estimate of household structure, S_j, an explanation of the variation in HAZ independent of the variation found between individuals.

3.5 Results

The previous sections discussed the rationale for using HAZ as a metric for child nutrition and the methodology applied to the data to assess the effect of family structure on the health status of children in Cambodia. Now, we turn to the results of the analysis. The overall

descriptive characteristics of the children and households in the analytic sample (Table 3.2-3.4) will be presented first. Then, the descriptive results addressing the research questions regarding family structures will be examined (Section 3.5-3.5). The analysis is considered in further details with the presentation of the regression results in Section 3.5.

Now, with regard to the descriptive statistics on the analytic sample, this is presented in Table 3.2-3.4. These tables are organized by the household structure, and the characteristics are divided into two sections, first for individuals' level characteristics followed by household level characteristics. Table 3.2 reports the characteristics for all children aged 0-5. Table 3.3-3.4 reports the characteristics for children aged 0-2 and 2-4, respectively.

In general, the sample contains some common characteristics across household structure and age groups. For instance, the analytic sample contains about an equal number of children of both gender. There is no substantial difference between household structure or by age group. Nor are there differences across household structure with regard to children's age, which is about 31 months for the entire sample, 29 months among children aged 0-2, and 49 months among children aged 2-4. While mother's age at birth was not substantially different across the different age groups among children, mothers in nuclear households are older than those in multigenerational households with the mean age at birth of 29 and 27, respectively.

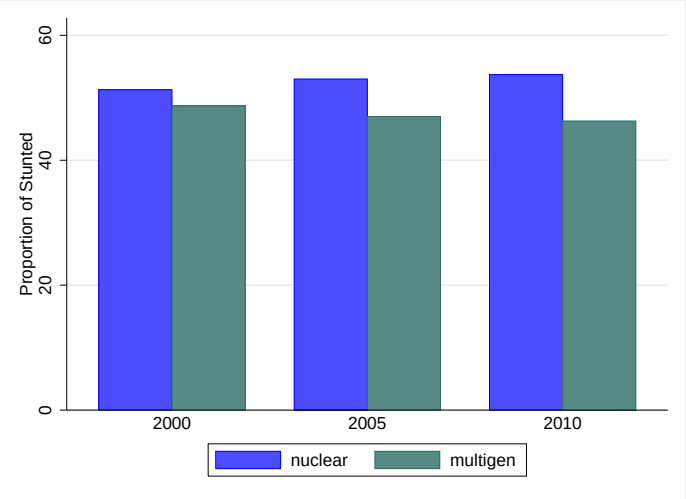
In addition, the main difference across the different age groups is the birth interval and the number of children in the household. There is a higher proportion of short birth intervals, defined as being borne less than 15 months of the previous child. Among older children, 4.25 percent of the children had short birth interval as shown in Table 3.4. Whereas, only 3.08 percent of younger children had a short birth interval (see Table 3.3). Moreover, there seems to be different patterns across household structure. A higher proportion of children in multigenerational households have short birth interval among children aged 0-2. Whereas, there are more children in nuclear households who have short birth interval among children aged 2-4.

Similar to birth interval, the number of children in the households differed by age group of children. In general, there is an average of two children in the household aged five and under, as well as two children over the age of five. However, children aged 0-2 reside in households with more children under aged five while children over the age of two are in households with more children over the age of five. Furthermore, similar to finding in the previous chapter, nuclear households have more children from both age groups (over and under the age of five) in the household than multigenerational households.

Other distinguishing characteristics at the household level include maternal education, household wealth, and sanitation. About a third of households in the sample have mothers without any education, and only about 15 percent of the mothers have more than a primary education. Mothers in multigenerational households have slightly more education than those in nuclear households with 21 and 14 percent, respectively (see Table 3.2). This parallels the wealth measurement in that there is a higher proportion of nuclear households in the bottom quintiles with very few households in the top quintiles. While multigenerational households are more evenly distributed across all five quintiles, this means a higher proportion in the fifth quintile than among nuclear households. In terms of sanitation, the majority of the

population, which live in rural areas, do not have a flushing toilet or latrine in the house. Yet, around a quarter of multigenerational households have a flushing toilet in the household compared to less than 15 percent of nuclear households.

Figure 3.1: Proportion of Children Under 5 Stunted by Household Structure, 2000-2010



In terms of the outcome variable HAZ, this varies by the age group of children and household structure. In general, the mean HAZ measure is -1.89, that is children in Cambodia height-for-age on average are 1.89 z-score below the reference population. Children aged 0-2 years old height-for-age on average are closer to the reference population than children aged 2-4 years old. These older children on average are below -2 standard deviation of the reference population, and, therefore, are considered malnourished, i.e., stunted. In fact, more than half the children aged 2-4 years old are consider stunted, see Table 3.4. The difference between household structure is shown in Figure 3.1. This graphs shows the proportion of children whose HAZ measurement are less than -2 z-core and therefore are considered stunted across the different survey year and by household structure. While there has been a decline over the decade, there still remains a substantial amount of children who are stunted. Moreover, a higher proportion of children residing in nuclear households are stunted compared to those in multigenerational households.

This section described the general characteristics of the sample of children by their age group and household structure. The following sections will explore children's HAZ measurement even further by household characteristics. This will include an examination of the presence of grandparents in the household, the number of parents present, and the number of children.

Table 3.2: Unweighted Characteristics of Children Under Age Five in Cambodia in 2000-2010.

	Total % or mean (standard deviation)	Nuclear % or mean (standard deviation)	Multigenerational % or mean (standard deviation)
Individual-level characteristics			
Nutritional Status			
HAZ	-1.89 (1.50)	-1.91 (1.50)	-1.78 (1.47)
Stunted	47.6	48.52	43.00
Gender			
Male	50.78	50.75	50.94
Female	49.22	49.25	49.06
Age (mos)	30.70 (17.05)	30.96 (17.00)	29.39 (17.28)
Maternal Age at birth (years)	28.88 (6.48)	29.20 (6.50)	27.33 (6.12)
Birth Interval			
Less than 15mos	3.80	3.84	3.60
Household-level characteristics			
Single Parent	5.37	4.27	10.77
No. Children by Age			
≤ 5 year	1.50 (0.64)	1.51 (0.64)	1.47 (0.64)
> 5 year	1.66 (1.65)	1.72 (1.68)	1.32 (1.46)
Socioeconomic Status			
1^{st} quintile	29.10	31.35	18.08
2^{nd} quintile	23.32	23.75	21.25
3^{rd} quintile	19.91	19.16	23.56
4^{th} quintile	15.98	14.66	22.50
5^{th} quintile	11.69	11.09	14.62
Maternal Education			
None	29.82	31.39	22.12
Primary	55.21	54.86	56.92
Secondary	14.97	13.75	20.97
Residence			
Urban	16.79	16.54	17.88
Rural	83.24	83.46	82.12
Sanitation (Toilet)			
FlushingToilet	15.98	13.85	26.44
Latrine	3.52	3.43	3.94
Other	80.50	82.72	69.62
Sample size	7,971	6,636	1,335
N Households	6,144	5,104	1,040

Table 3.3: Unweighted Characteristics of Children Aged 0-2 in Cambodia in 2000-2010.

	Total % or mean (standard deviation)	Nuclear % or mean (standard deviation)	Multigenerational % or mean (standard deviation)
Individual-level characteristics			
Nutritional Status			
HAZ	-1.39 (1.63)	-1.40 (1.65)	-1.34 (1.54)
Stunted	35.36	36.24	31.45
Gender			
Male	50.58	50.60	50.53
Female	49.42	49.40	49.47
Age (mos)	12.42 (7.02)	12.45 (7.01)	12.31 (7.03)
Maternal Age at birth (years)	29.18 (6.45)	29.57 (6.48)	27.48 (6.04)
Birth Interval			
Less than 15mos	3.08	2.94	3.71
Household-level characteristics			
Single Parent	4.49	3.38	9.47
No. Children by Age			
≤ 5 year	1.71 (0.69)	1.73 (0.69)	1.64 (0.70)
> 5 year	1.44 (1.61)	1.51 (1.64)	1.11 (1.40)
Socioeconomic Status			
1^{st} quintile	30.43	33.36	17.30
2^{nd} quintile	23.74	23.60	24.41
3^{rd} quintile	19.95	19.24	23.13
4^{th} quintile	15.66	14.28	21.86
5^{th} quintile	10.21	9.52	13.30
Maternal Education			
None	30.16	31.90	22.40
Primary	54.91	54.76	55.56
Secondary	14.93	13.34	22.04
Residence			
Urban	15.73	15.34	17.49
Rural	84.27	84.66	82.51
Sanitation (Toilet)			
FlushingToilet	14.13	11.64	25.32
Latrine	3.16	3.13	3.28
Other	82.71	85.23	71.40
Sample size	3,080	2,514	566
N Households	1,681	1,350	331

Table 3.4: Unweighted Characteristics of Children Aged 2-4 in Cambodia in 2000-2010.

	Total % or mean (standard deviation)	Nuclear % or mean (standard deviation)	Multigenerational % or mean (standard deviation)
Individual-level characteristics			
Nutritional Status			
HAZ	-2.20 (1.32)	-2.22 (1.32)	-2.11 (1.33)
Stunted	55.31	56.02	51.50
Gender			
Male	50.91	50.85	51.24
Female	49.09	49.15	48.76
Age (mos)	42.21 (10.01)	42.26 (9.92)	41.95 (10.46)
Maternal Age at birth (years)	28.69 (6.49)	28.97 (6.51)	27.22 (6.18)
Birth Interval			
Less than 15mos	4.25	4.39	3.51
Household-level characteristics			
Single Parent	6.22	5.10	12.22
No. Children by Age			
≤ 5 year	1.29 (0.50)	1.30 (0.50)	1.28 (0.50)
> 5 year	1.87 (1.66)	1.93 (1.68)	1.55 (1.50)
Socioeconomic Status			
1^{st} quintile	27.83	29.48	18.94
2^{nd} quintile	22.92	23.89	17.72
3^{rd} quintile	19.86	19.09	24.03
4^{th} quintile	16.29	15.00	23.22
5^{th} quintile	13.10	12.55	16.09
Maternal Education			
None	29.49	30.91	21.79
Primary	55.50	54.95	58.45
Secondary	15.01	14.13	19.75
Residence			
Urban	17.76	17.65	18.33
Rural	82.24	82.35	81.67
Sanitation (Toilet)			
FlushingToilet	17.76	15.91	27.70
Latrine	3.86	3.70	4.68
Other	78.39	80.39	67.62
Sample size	4,891	4,122	769
N Households	4,463	3,754	709

Descriptive

This section will now examine the nutritional status of children by household structure characteristic, that is, addressing the research questions through descriptive statistics. With regard to the first research question, children's height is examined by overall family structure—comparing nuclear and multigenerational households. Figure 3.2 shows the distribution of children height-for-age z-score (HAZ) by family structure. This box plot shows variability in HAZ among children under five in nuclear and multigenerational households are similar to each other. The shaded region of the graph represents the 25^{th} and 75^{th} percentile of HAZ among children of each household structure,which have about the same width in both household structures. Combined with the whiskers, representing data points within a 1.5 interquartile range of the lowest and highest quartile, being of similar length, shows very little difference in the overall distribution of children's height by family structure. The notable difference is that nuclear households have a longer tail in the distribution than multigenerational households.

Figure 3.2: Distribution of Height-for-Age Z-score (HAZ) Among Children Under 5 by Household Structure

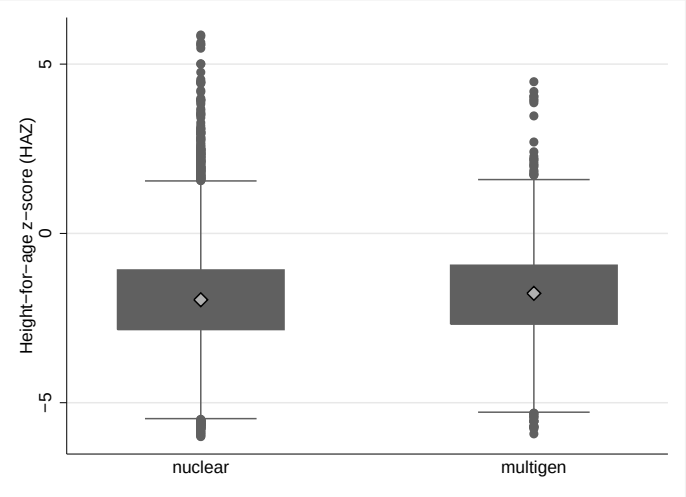


Figure 3.2 shows that the distributions between nuclear and multigenerational households are similar to each other, but it also highlights that children in both household structures are shorter than the mean height of children their age in the reference population. Moreover, this graph suggests a very high concentration of children who are malnourished in the Cambodia. This is illustrated even further in Table 3.5, which shows the prevalence of malnutrition among the sampled children by household structure. Almost half the children under the age of five experience chronic malnutrition as their HAZ is under -2 z-score of the reference population; the majority of whom are aged 2-4. Over 20 percent of the children are severely malnourished, and a quarter of the severely malnourished children are aged 2-4. Moreover,

this table shows a slightly higher proportion of children who are stunted and severely stunted residing in nuclear households. This difference does suggest that the presence of grandparents in multigenerational households have the potential to minimize malnutrition among young children.

Table 3.5: Prevalence of Malnutrition by Household Structure in Cambodia, 2000-2010

Malnutrition	Total	Nuclear	Multigenerational
Stunted			
Aged 0-5	47.60	48.52	43.00
Aged 0-2	35.36	36.24	31.45
Aged 2-4	55.31	56.02	51.50
Severely Stunted			
Aged 0-5	20.79	21.37	17.90
Aged 0-2	14.42	14.76	12.90
Aged 2-4	24.80	25.40	21.59

Stunted is being under -2 SD from the mean of the reference population
Severely stunted is being under -3 SD from the mean of the reference population

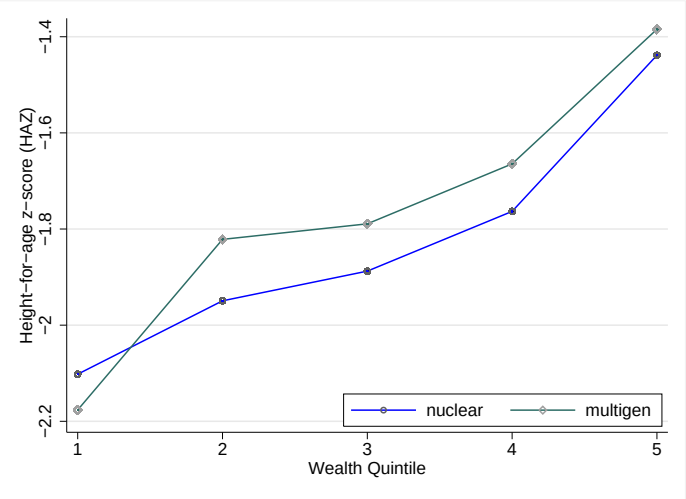
Considering the potential difference in HAZ across household structure even further, other household characteristics are then considered. When household wealth and maternal education is considered, differential in HAZ across family structure appears to persist. For instance, Figure 3.3 shows the mean HAZ across household wealth index and by family structure. As expected, the stature of children in Cambodia improved with increasing household wealth. This suggests that as household wealth rises, families have increased access to economic resources, which can then be used to improve the quality of life for children.They are able to invest in more sanitary housing conditions, provide more food, and more access to medical care, which enables them to grow taller than other children who are economically disadvantaged.

In addition, this graph suggests that children's height appears to also be related to household structure. Children residing in multigenerational households have, on average, higher HAZ score for each quintile except the first. For households in the lowest quintile, they are the most economically disadvantaged. They have limited resources for securing the welfare of all household members. Therefore, each additional person in the household becomes an economic strain whose presence would diminish the overall economic resources for all other members in the household. The economic strain is worse for multigenerational households in the lowest wealth quintile as the average household size is 6.22 persons compared to 5.54 in nuclear households.

While the number of individuals in the household by family structure does not really change across the wealth quintile, the increase in economic resources has a profound effect

on children's height. The increase in the mean HAZ for children from the first to the second quintiles is from below to above -2 SD. This increase means a difference between being stunted and not stunted. The improvement in growth is larger for children in multigenerational households as it is an increase of 0.36 SD—that is, for an average child of 51 months being 95.7 centimeters compared to 97.2. The gain in height for children across the 2^{nd} to the 5^{th} quintiles continues to be greater for children in multigenerational households than those residing in nuclear households. This implies that while improvement in availability of economic resources in the household improves the nutritional status of all children, the presence of grandparents in the household have an added benefit. After a certain economic threshold, Cambodian grandparents could be directing the extra resources, or a share of resources designated for them, for their coresiding grandchildren. This would allow children in multigenerational households to have slightly more resources. In addition, the increased care time children in multigenerational households receive (see Chaper 2) can imply that grandparents are feeding their coresiding grandchildren more under their supervision, as well as, they might be directing parents to feed the children more. This would then lead to children in multigenerational household to generally grow taller as they have better nutrition than children in nuclear households.

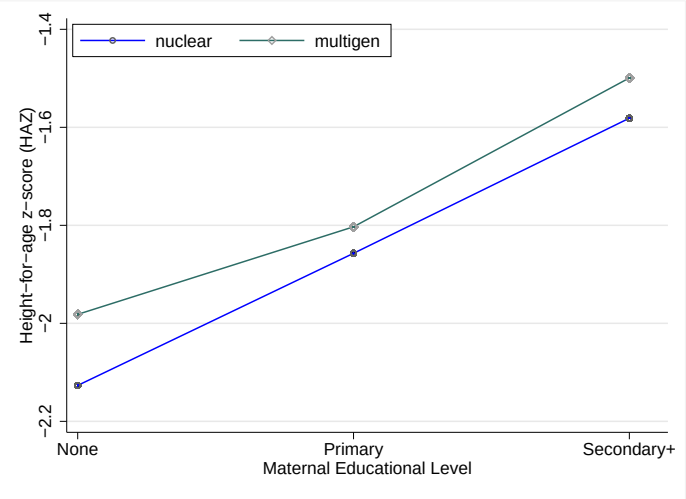
Figure 3.3: Mean Height-for-Age Z-score (HAZ) of Children Under 5 by Household Structure and Wealth Index



Similarly, when the relationship between HAZ and family structure is consider along maternal education, the pattern of a multigenerational household advantage persisted. This is shown in Figure 3.4. The height of children rises with increasing maternal education. The height status of Cambodian children gets closer to the mean of the reference population, closer to the expected height status of healthy children of similar age and sex. Moreover, children residing in multigenerational households have slightly better HAZ measurements across all levels of maternal education. Among children with mothers who have no education,

they are taller and less likely to be stunted if they reside in multigenerational households. There is a higher proportion of mothers without any education among nuclear households than multigenerational households. These mothers tend to be older than uneducated mothers in multigenerational households who are at the start at their reproductive years. Even so, children residing in multigenerational households still have a slight advantage over children in nuclear households at higher levels of maternal education.

Figure 3.4: Mean Height-for-Age Z-score (HAZ) of Children Under 5 by Maternal Education Level and Household Structure



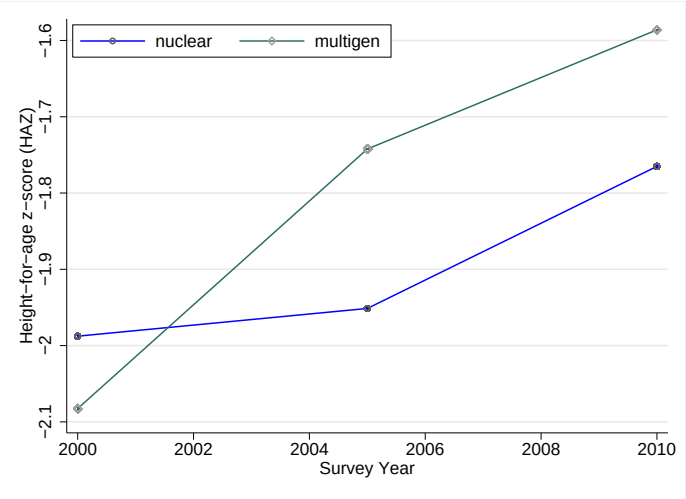
Furthermore, the pattern in family structure and height status of children continues to emerge in Figure 3.5, when the year of the survey is consider. There has been dramatic improvement in children's nutritional status over the course of the decade, with the mean HAZ of the children in Cambodia increasing with each survey round. However, the greatest gain in nutritional status over this period has been for children residing in multigenerational households.

Thus, this section highlights the importance of coresiding grandparents for children's growth, thereby supporting the first hypothesis on the importance of coresiding grandparents. There is a slight advantage of children residing in multigenerational households, and this advantage appears across a number of household characteristics including household wealth and maternal education. The next section will exam the importance on the number of coresiding parents in the household.

Parents: Single-Parent Disadvantage?

Turning towards the second research question, this section will examine the relationship between children's height by the number of coresiding parents in the household. Similar to the previous section, this section will continue to look at the descriptive statistics on this

Figure 3.5: Mean Height-for-Age Z-score (HAZ) of Children Under 5 by Survey Year and Household Structure

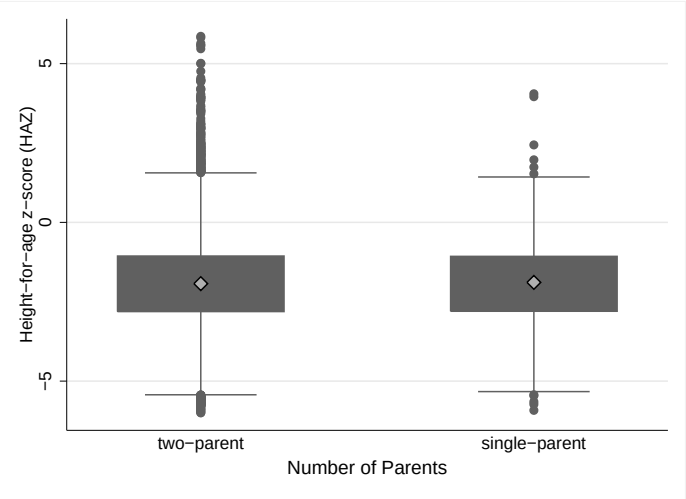


relationship. To start, Figure 3.6 shows the distribution of children's HAZ measurement by the number of parents present in the household. Similar to the distribution by household structure discussed above, the distribution of HAZ among children in single-parent households appears to be similar to children residing in two-parent households. The boxes and whiskers are about the same width, length and positioning for each category for the number of coresiding parents, which suggest that children in single-parent households fair just as well as children with two-parents.

However, when considering the number of parents by household structure, the story is slightly different. Table 3.6 shows the mean HAZ value of children by the number of coresiding parents and household structure. In both nuclear and multigenerational households, children in Cambodia are shorter for their age when residing in single-parent households. These households are economically disadvantaged as there is one less adult in the household to participate in the labor market and provide resources for the children. As single-parent households in this analysis are headed by mothers, this means that these children do not have coresiding fathers, who generally are the most economically productive of the two parents. Thereby, they lost valuable potential resources. In addition, as demonstrated in the last chapter, children in single-parent households are also losing a substantial amount of maternal-care time as mothers attempt to minimize the economic disadvantage of the household by increasing her labor production. Consequently, children in single-parent households lose both economic resources and care time that is translated into their poorer nutritional status.

The disadvantage of children with single mothers is minimized for those residing in multigenerational households. Children with a single-parent in multigenerational households are even taller than children in two-parent nuclear households. The presence of grandparents in

Figure 3.6: Distribution of Height-for-Age Z-score (HAZ) of Children Under 5 by Number of Parents



single-parent households reduces the malnutrition of coresiding grandchildren. Since grandparents supplement maternal childcare time (see Chapter 2), grandparents are then ensuring the well-being of children during the maternal absence. This can prevent children from activities that would expose them to injuries and infections and ensure that they are fed. In addition, as grandparents in Cambodia are still marginally participating in the labor force (see Chapter 2), they are contributing to the economic resources available for coresiding grandchildren. Thus, children, especially those residing in single-parent households, benefit from the presence of coresiding grandparents enabling them to have better nutritional status.

Table 3.6: HAZ by Number of Parent and Household Structure in Cambodia, 2004

N Parents	Nuclear	Multigenerational
	Mean (sd)	Mean (sd)
Single	-1.96 (1.36)	-1.82 (1.55)
Two	-1.91 (1.51)	-1.78 (1.46)
Total	-1.91(1.50)	-1.78 (1.47)

Source: Author's calculation from DHS 2000, 2005, 2010 data.

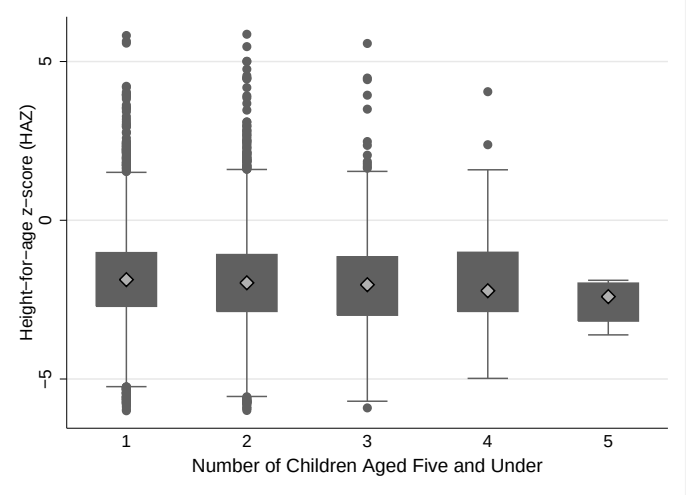
The descriptive results presented in this section do support the second hypothesis. Children do have a nutritional disadvantage based on the number of parents in the household. The disadvantage experienced by Cambodian children residing in single-parent households is minimized in presence of coresiding grandparents. Now that the roles of parents and grandparents have been explored, the subsequent section considers the influence of siblings.

Siblings Rivalry: Competition for Resources

This section will be descriptively exploring the third research question regarding the influence of siblings on young children's nutritional status. As stated in the hypothesis, siblings of different age group may have different impact on children and, therefore, this section will be considering them separately. The number of children in the household aged five and under will be examined first followed by children over the age of five.

Figure 3.7 shows the distribution of HAZ among children under the age of five by the number of children in the household aged five and under. This figure allows us to examine the pattern in children's height in the presence of siblings of proximate age. Based on the distribution of this graph, there is no distinguishing pattern in HAZ among children residing in households with fewer aged five and under. There appears to be a decline in HAZ among children with more children aged five and under. This is represented by the narrower box width and the diamond, a symbol for the mean, inside the box being closer towards the lower quartile. As the diamond in the box plots for households with 4-5 children aged five and under are lower than the diamonds for households with fewer children may suggest a potential decline in nutritional status of the index child in households with more children.

Figure 3.7: Distribution of Height-for-Age Z-score (HAZ) of Children Under 5 by Number of Children Age 5 and Under

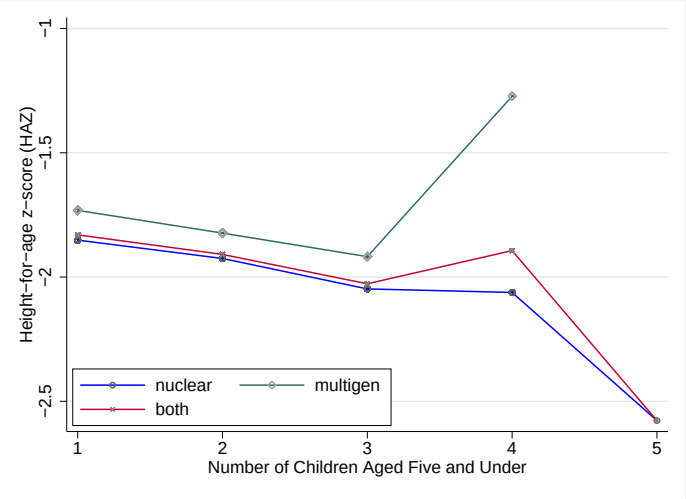


Furthermore, the nutritional status of children in households with more young children appears more clearly yet divergent when considering household structure. Figure 3.8 shows the mean HAZ of children by family structure and the number of children aged five and under in the household. In general, the graph shows a decline in the mean HAZ with an increasing number of children in the household for both nuclear and multigenerational households. This pattern then diverges after three children. For children in nuclear households, the mean HAZ rapidly declines, placing children in households with 4 or 5 children young children at

risk of stunting. Interestingly, in multigenerational households with more than three young children, the mean HAZ actually increases. The extreme divergence in larger households occurs because of the small sample size for multigenerational households with four children and nuclear households with five children. If the extreme variability were ignored and the trend is extrapolated from the other data points with large samples, then the figure suggests that children are shorter with increasing number of coresiding siblings in the household. With a larger share of young children in the household, the average height of these children is closer to -2 SD and, thereby, at greater risk of being stunted.

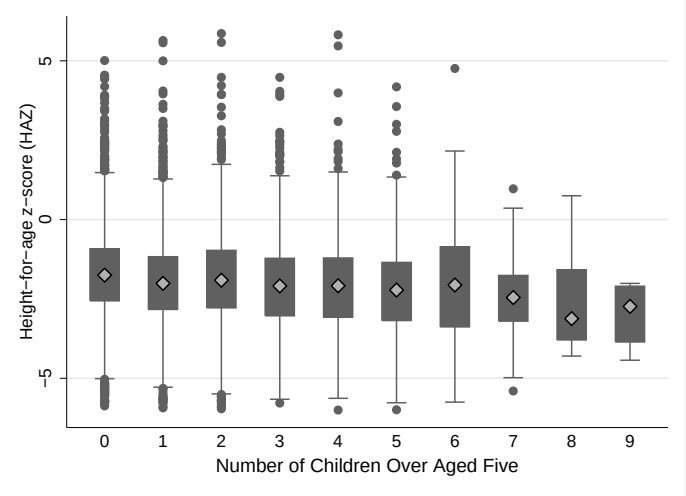
Moreover, this graph hints at possible differences between nuclear and multigenerational households. Children in multigenerational households are slightly taller than those in nuclear households across the number of young children in the household. This is similar to the pattern in Figure 2.1 (in the time use chapter) where multigenerational households spent slightly more time than nuclear households declines by the age of the child. This suggests that potentially additional investment in care time for young children in multigenerational households is translating into their better nutritional status as shown here in Figure 3.8.

Figure 3.8: Mean Height-for-Age Z-score (HAZ) of Children Under 5 by Household Structure and Number of Children Aged 5 and Under



The pattern observed among young children in the households becomes more defined when considering the presence of older siblings in the household. Children's HAZ pattern related to the presence of older siblings is shown in Figure 3.9. Each box plot represents the distribution of HAZ score of children under the age of five by the number of children in the household over the age of five, i.e. the number of older siblings in the household. There is a wide distribution of HAZ scores by the number of older siblings in the households, but this variability becomes narrower with increasing number of older siblings. Furthermore, this figure suggests that children aged 0-4 tend to have lower HAZ measurement with an increasing number of older siblings in the household.

Figure 3.9: Distribution of Height-for-Age Z-score (HAZ) of Children Under 5 by Number of Children Over Age 5



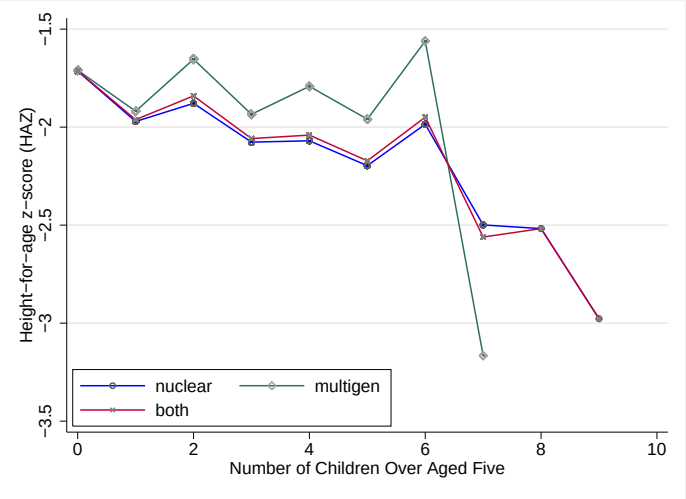
The pattern of declining HAZ measurement with the number of older siblings present is more noticeable when considering the mean HAZ of these children. This is highlighted in Figure 3.10, which shows the mean HAZ score of children aged 0-4 by the number of older siblings present in the household and family structure. The general trend is a decline in HAZ measurement with an increasing number of older children in the household. The more older siblings in the household, the more economic strain this could place on household resources with increasing household size. These older siblings may be contributing to the household resources as children in Cambodia start becoming active in the labor market at very young ages. Their economic contribution would be less than an adults in the household, and the pooled resources might not meet the nutritional demand of all members of the household, including the dependent young children. This would then lead to more malnourished children with the increasing number of children in the household despite the economic contributions of older siblings.

Also with increasing numbers of older siblings, the higher the parity of young children becomes. Children of high parity, or birth order, would then already be born nutritionally disadvantaged. As mothers with multiple children can experience nutritional depletion from previous births such that the youngest children are born with nutritional deficit (Newcombe 1965, Saha and van Soest 2011). Without adequate nutrition following their births, they would not be able to have a catch-up growth period. This would then mean worse nutritional status for younger children with multiple older siblings.

Children in multigenerational households potentially are experiencing some catch-up growth relative to children in nuclear households. As Figure 3.10 shows, children residing in multigenerational households have a slight advantage over nuclear households with increasing number of coresiding siblings. Children in nuclear households with more than

three siblings have poor HAZ scores as they are below -2 z-score, indicating that they are stunted and malnourished. With the exception of households with seven children over the age of five which has a small sample size accounting for the divergence, children in multi-generational households on average have HAZ scores above -2 z-score across the number of siblings. Despite the increasing competition for household resources and risk of being born malnourished for young children in large households, the presence of grandparents in these households are able to prevent the extreme deterioration in the health status of young children. The additional childcare time that grandparents provide in Cambodia (see Chapter 2) can mean additional feeding and other resources commanded by grandparents that get directed towards the youngest children in these households. This would then allow children born into larger households to have sufficient nutrition to have a growth spurt that enables them to catch up to other children instead of a continual decline in their health status. Thereby, the presence of grandparents in these households secure the nutritional status of children from becoming malnourished.

Figure 3.10: Mean Height-for-Age Z-score (HAZ) of Children Under 5 by Number of Children Over the Age of 5 in the Household



Overall, this section rejects the hypothesis that the presence of older siblings improves young children nutritional status. Children aged 0-4 have poorer nutritional status with increasing numbers of coresiding older siblings. The presence of grandparents helps alleviate some of the duress, preventing children from becoming malnourished. On the whole, the descriptive statistics presented thus far shows the nutritional status by the presence of other household members. These have either supported or rejected the research hypotheses. Whether these relationships hold once socio-demographic characteristics are adjusted for will be considered in the following section.

Regression Analysis

Controlling for individual and household characteristics is important for exploring the underlying relationships between the characteristics of household structure and nutritional status of children. Moreover, as children age their growth pattern can change. That is, there is a rapid growth period for children up to age two with some decline in the pace afterwards. During these stages, there can be a rapid rise in malnutrition for children aged 0-2 years old and a plateau of the effect for children aged 2-5 years (Kostermans 1994). Therefore, this section will report the analysis for all children collectively under the age of five, and by aged groups of 0-2 years (0-24 months) and 2-4 years (25-59 months). Furthermore, this section will be discussing the regression results for the controlled variables and for each of the household structure characteristics related to the research questions.

In terms of presentation of the regression results, these are shown in Tables 3.7-3.9. Table 3.7 reports the regression analysis results for all children under the age of five, and Tables 3.8-3.9 report the results for children aged 0-2 and 2-4, respectively. For each table, there are 8 models that consider the intraclass correlation, control variables, and six models regarding the three research questions. For each question, there are two sets of models that considers the main effect and interactions. In terms of the intraclass correlation presented in Model 1 for the entire sample, this is estimated to be 0.17, which can interpreted as the total variability in HAZ score explained by household characteristics.

In terms of the individual and household characteristics that have been adjusted for in the analysis, this is presented in Model 2. Individual characteristics such as sex and age determine the growth trajectory of children. As can be seen in Table 3.7, children in Cambodia are lagging behind in their development relative to the reference population for each month of life. The risk of malnutrition is substantial for children aged 0-2 years old. For each month of age, they are expected to fall 0.08 SD behind the median HAZ of children their age in the reference population. This means that by the end of their first year in life, Cambodian infants are about 1SD shorter than infants their age. This is equivalent to being about 72.2 cm long at 12 months. The impact of age on HAZ is less substantial for children over 24 months as shown in Table 3.9. After the first two years of life, children are less likely to experience a complete catch-up growth (Kostermans 1994). Thereby, the periods of malnutrition accumulate leading to a higher prevalence of stunting among older children such that there is less variation in height among children aged 2-4 years old.

As for sex, there does not appear to be gender preference that would lead one gender to be less malnourished than the other. The magnitude of effect is slight for all children under the age of five. However, girls under the age of two appear to have a slight advantage in Cambodia, but they not only lose this gain but are at risk of being shorter after age 2. As boys and girls can experience growth spurts at different ages of development, girls could be experiencing earlier development than boys.

Other characteristics of individual children that can affect their growth and have been controlled for are maternal age at birth and birth interval. Maternal age at birth has been suggested as an important indicator for child survival (Griffiths et al. 2001, Mosley and Chen

1984, Saha and van Soest 2011). As mothers age, they would have had multiple pregnancies leading to physical changes affecting the quality of later pregnancies, and with higher parity, the pregnancies become more precarious (Scrimshaw 1978). There is also the suggestion that because of increasing maternal age, she would have less micronutrients for children during pregnancies that lead to their low birthweight at birth. Yet, the implications of maternal age on children's nutritional status is absent for all children under aged five in Cambodia. As children can receive sufficient nutrients after birth, these children are then able to have catch-up growth (Kostermans 1994), which would offset the malnutrition they experienced at birth.

While children are able to recover from disadvantages of maternal age, they cannot recover from short birth spacing. Children at all ages born less than 15 months of the next oldest sibling are about 0.32 SD shorter than a child who had longer birth spacing. The closeness in births means that mothers did not have a chance to physically heal and recover from the previous births, such that during the pregnancy of the index child there is an in utero malnutrition (Newcombe 1965, Saha and van Soest 2011, Scrimshaw 1978). The lack of sufficient micronutrients are enough that even after birth, children are not fully able to recover. This can then be compounded by the competition with the next-born sibling for mother's feeding and care during the early stages of infancy when it is most vital for development and growth.

In addition to individual level characteristics that impact children's growth, there are household level characteristics that may cofound the effect of family structure on children's growth. These includes maternal education, household wealth, sanitation, and timing of the survey. For instance, the level of maternal education can affect the amount of time parents spend with their children and the quality of care children receive (Bianchi 2000, Bianchi and Robinson 1997). As Chapter 2 suggests, the level of maternal education does affect the amount of time parents provide care to their children in Cambodia given the economic conditions within the country. While the quantity of maternal time for childcare is not differentiated by level of education, the quality of care might influence children's health. That is, with an increased level of education, mothers have greater access to information on feeding practices, medicine, and nutrition. The implementation of this knowledge can then allow children to have better health status and thereby improved growth. This is supported by the analysis, that with increasing level of maternal education, the increase in magnitude of effect is substantial. Compared to children whose mothers have no education, children with mothers with just primary education have an increased height status of 0.22 SD and 0.16 SD for children aged 0-2 and 2-4 years, respectively. This rises to 0.24 SD for children in both age groups whose mothers had secondary or higher education.

Unlike education which had parallel effect on children of both age groups, household wealth is more important for older children. For each increase in the wealth quintile, there is an improvement in height status, which is statistically significant at every wealth quintile for children aged 2-4 years old and for children aged 0-2 years in the 5^{th} quintile of the wealth index. Since younger children are weaning, they are more dependent on maternal breastfeeding or formulas, which have a lower cost that does not differentiate across the

wealth index. Whereas older children are able to consume solid food and the ability of the household to provide nutritious food and enough caloric intake depends on the household resources. With increased wealth, households are able to provide more food and resources for children to grow; therefore, there is a stronger effect of wealth for older children.

In addition, sanitation can improve children's development by minimizing their exposure to bacterias and infectious diseases. An indicator of sanitary conditions is proxy through the type of toilet. As flushing toilet removes waste from the place of residence, exposure to fecal matter and diseases associated with it becomes less. This would minimize the spread of disease and illness throughout the household and improve the health conditions of all members. With less exposure to diseases, household members are less likely to spread it to young children in the household. This would prevent them from having frequent acute periods of malnutrition that eventually lead to stunting. Yet, having flushing toilets while an improvement, is not statistically different from using other forms of toilets such as open fields or bushes.

Instead, the regression models were able to detect a statistical significant difference in the height of children residing in household with access to laterines. The difference is a -0.19 HAZ score for all children, but largely driven by the effect on children aged 0-2 years. The negative impact of latrines may be related to the nature of the toilet facility. It is an an open source of accumulated waste that breads microorganisms. Individuals using the laterine are then exposed to potential diseases that get transmitted to household members. As very young children are still developing their immune system, they are susceptible to illness from these transmitted diseases. With frequent exposure, their health is compromised.

Table 3.7: Regression of Height-for-Age for Children Age 0-5 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Fixed Effects								
Intercept	-1.881***	-1.534***	-1.523***	-1.348***	-1.522***	-1.348***	-1.514***	-1.231***
	(0.02)	(0.10)	(0.11)	(0.14)	(0.11)	(0.14)	(0.13)	(0.17)
Gender								
male		-	-	-	-	-	-	-
female		0.038	0.038	0.038	0.038	0.038	0.038	0.038
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age (mos.)		-0.025***	-0.025***	-0.025***	-0.025***	-0.025***	-0.025***	-0.025***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.000	-0.000	-0.000	-0.000	-0.000	0.007	0.007
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval								
Less than 15mos		-0.315***	-0.315***	-0.316***	-0.315***	-0.316***	-0.290***	-0.288***
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Maternal Education								
None		-	-	-	-	-	-	-
Primary		0.168***	0.168***	0.168***	0.168***	0.168***	0.162***	0.162***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Secondary+		0.212***	0.212***	0.212***	0.212***	0.212***	0.193**	0.193**
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Residence								
Rural		-	-	-	-	-	-	-
Urban		-0.051	-0.051	-0.049	-0.051	-0.049	-0.049	-0.047
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)

Table 3.7 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Wealth Index								
1^{st} quintile		-	-	-	-	-	-	-
2^{nd} quintile		0.189***	0.190***	0.187***	0.190***	0.187***	0.184***	0.182***
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
3^{rd} quintile		0.227***	0.228***	0.227***	0.228***	0.227***	0.216***	0.214***
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
4^{th} quintile		0.327***	0.327***	0.330***	0.328***	0.330***	0.318***	0.319***
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
5^{th} quintile		0.595***	0.595***	0.598***	0.595***	0.599***	0.575***	0.577***
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Sanitation (Toilet)								
Other		-	-	-	-	-	-	-
Flushing Toilet		0.094	0.095	0.085	0.094	0.085	0.083	0.074
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Latrine		-0.191*	-0.191*	-0.200*	-0.191*	-0.200*	-0.194*	-0.203*
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Survey Year								
2000		-	-	-	-	-	-	-
2005		0.056	0.056	0.017	0.056	0.017	0.037	-0.004
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
2010		0.211***	0.211***	0.186***	0.211***	0.186***	0.179***	0.151**
		(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Household Structure								
Nuclear			-	-	-	-	-	-
Multigenerational			-0.009	-0.162*	-0.010	-0.163*	-0.008	-0.251*
			(0.04)	(0.08)	(0.05)	(0.08)	(0.05)	(0.11)
No. Parents								

Table 3.7 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Two				-	-	-	-	-
Single					0.017	0.010	-0.010	-0.020
					(0.08)	(0.09)	(0.08)	(0.09)
No. Children by Age								
≤ 5 year							-0.071**	-0.072**
							(0.02)	(0.02)
> 5 year							-0.044**	-0.044**
							(0.01)	(0.01)
Interactions								
Multigeneration x								
2005				0.261*		0.260*		0.269*
				(0.11)		(0.11)		(0.11)
2010				0.181		0.180		0.199
				(0.11)		(0.11)		(0.11)
Single						0.004		0.011
						(0.16)		(0.16)
≤ 5 year								0.003
								(0.00)
Random Effects								
Between Group $\sqrt{\psi}$	0.625***	0.625***	0.625***	0.624***	0.625***	0.624***	0.621***	0.619***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Within Group $\sqrt{\theta}$	1.363***	1.265***	1.265***	1.265***	1.265***	1.265***	1.265***	1.265***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
N	7971	7967	7967	7967	7967	7967	7967	7967

Table 3.8: Regression of Height-for-Age for Children Age 0-2 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Fixed Effects								
Intercept	-1.385***	-0.731***	-0.734***	-0.286	-0.724***	-0.285	-0.358	0.310
	(0.03)	(0.16)	(0.19)	(0.23)	(0.19)	(0.23)	(0.22)	(0.29)
Gender								
male		-	-	-	-	-	-	-
female		0.138*	0.138*	0.147**	0.138*	0.146**	0.135*	0.144**
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Age (mos.)		-0.075***	-0.075***	-0.075***	-0.075***	-0.075***	-0.078***	-0.080***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Birth Interval								
Less than 15mos		-0.323*	-0.323*	-0.325*	-0.327*	-0.330*	-0.262	-0.260
		(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Maternal Education								
None		-	-	-	-	-	-	-
Primary		0.220***	0.220***	0.223***	0.220***	0.222***	0.214***	0.218***
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Secondary		0.239*	0.239*	0.235*	0.242*	0.238*	0.230*	0.228*
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Residence								
Rural		-	-	-	-	-	-	-
Urban		-0.004	-0.004	0.003	-0.003	0.004	0.006	0.017
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)

Table 3.8 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Wealth Index								
1^{st} quintile		-	-	-	-	-	-	-
2^{nd} quintile		0.069	0.069	0.060	0.069	0.060	0.052	0.039
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
3^{rd} quintile		0.156	0.156	0.146	0.155	0.145	0.124	0.112
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
4^{th} quintile		0.166	0.166	0.174	0.167	0.174	0.142	0.146
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
5^{th} quintile		0.354*	0.354*	0.359*	0.356*	0.360*	0.325*	0.327*
		(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Sanitation (Toilet)								
Other		-	-	-	-	-	-	-
Flushing Toilet		-0.016	-0.017	-0.049	-0.019	-0.050	-0.033	-0.069
		(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Latrine		-0.402*	-0.402*	-0.424*	-0.407*	-0.428**	-0.393*	-0.421*
		(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)
Survey Year								
2000		-	-	-	-	-	-	-
2005		-0.025	-0.025	-0.113	-0.030	-0.117	-0.042	-0.128
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
2010		0.153*	0.153*	0.067	0.150*	0.066	0.129	0.041
		(0.07)	(0.07)	(0.08)	(0.07)	(0.08)	(0.07)	(0.08)
Household Structure								
Nuclear			-	-	-	-	-	-
Multigenerational			0.002	-0.392**	-0.007	-0.392**	-0.008	-0.577**
			(0.07)	(0.13)	(0.07)	(0.13)	(0.07)	(0.18)
No. Parents								

Table 3.8 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Two				-	-	-	-	-
Single					0.146	0.154	0.112	0.103
					(0.14)	(0.17)	(0.14)	(0.17)
No. Children by Age								
≤ 5 year							-0.183***	-0.191***
							(0.04)	(0.04)
> 5 year							0.006	0.005
							(0.03)	(0.02)
Interactions								
Multigeneration x								
2005				0.559**		0.559**		0.563**
				(0.18)		(0.18)		(0.18)
2010				0.554**		0.548**		0.570**
				(0.18)		(0.18)		(0.18)
Single						-0.076		-0.026
						(0.28)		(0.28)
≤ 5 year								0.014
								(0.01)
Random Effects								
Between Group $\sqrt{\psi}$	0.828	0.878	0.878	0.870	0.879	0.870	0.865	0.853
	(0.11)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Within Group $\sqrt{\theta}$	1.400***	1.245***	1.245***	1.247***	1.244***	1.247***	1.248***	1.251***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
N	3080	3077	3077	3077	3077	3077	3077	3077

Table 3.9: Regression of Height-for-Age for Children Age 2-4 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Fixed Effects								
Intercept	-2.197***	-2.670***	-2.669***	-2.668***	-2.673***	-2.674***	-2.799***	-2.584***
	(0.02)	(0.13)	(0.14)	(0.17)	(0.14)	(0.17)	(0.16)	(0.30)
Gender								
male		-	-	-	-	-	-	-
female		-0.032	-0.032	-0.032	-0.032	-0.032	-0.032	-0.031
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Age (mos.)		-0.001	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.001	0.001	0.001	0.001	0.001	0.012**	0.012**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval								
Less than 15mos		-0.311***	-0.311***	-0.312***	-0.313***	-0.313***	-0.296***	-0.295***
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Maternal Education								
None		-	-	-	-	-	-	-
Primary		0.162***	0.162***	0.162***	0.162***	0.161***	0.156***	0.156***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Secondary		0.239***	0.239***	0.240***	0.238***	0.239***	0.210**	0.213**
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Residence								
Rural		-	-	-	-	-	-	-
Urban		-0.083	-0.083	-0.081	-0.083	-0.081	-0.081	-0.080
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)

Table 3.9 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Wealth Index								
1^{st} quintile		-	-	-	-	-	-	-
2^{nd} quintile		0.252***	0.252***	0.251***	0.250***	0.250***	0.246***	0.244***
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
3^{rd} quintile		0.254***	0.254***	0.256***	0.253***	0.254***	0.244***	0.244***
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
4^{th} quintile		0.385***	0.385***	0.384***	0.383***	0.382***	0.376***	0.373***
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
5^{th} quintile		0.724***	0.724***	0.721***	0.721***	0.718***	0.700***	0.697***
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Sanitation (Toilet)								
Other		-	-	-	-	-	-	-
Flushing Toilet		0.131	0.132	0.134	0.133	0.134	0.119	0.121
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Latrine		-0.052	-0.052	-0.052	-0.052	-0.052	-0.063	-0.062
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Survey Year								
2000		-	-	-	-	-	-	-
2005		0.156***	0.156***	0.145**	0.158***	0.146**	0.128**	0.116*
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
2010		0.291***	0.291***	0.301***	0.291***	0.301***	0.247***	0.253***
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Household Structure								
Nuclear			-	-	-	-	-	-
Multigenerational			-0.001	-0.002	0.003	0.004	0.005	-0.179
			(0.05)	(0.09)	(0.05)	(0.09)	(0.05)	(0.22)
No. Parents								

Table 3.9 – continued from previous page

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3a $\beta(se)$	Model 3b $\beta(se)$	Model 4a $\beta(se)$	Model 4b $\beta(se)$	Model 5a $\beta(se)$	Model 5b $\beta(se)$
Two				-	-	-	-	-
Single					-0.066	-0.040	-0.102	-0.078
					(0.09)	(0.10)	(0.09)	(0.10)
No. Children by Age								
≤ 5 year							-0.043	-0.043
							(0.03)	(0.03)
> 5 year							-0.071***	-0.071***
							(0.02)	(0.02)
Interactions								
Multigeneration x								
2005				0.064		0.070		0.078
				(0.13)		(0.13)		(0.13)
2010				-0.056		-0.049		-0.028
				(0.13)		(0.13)		(0.13)
Single						-0.083		-0.079
						(0.19)		(0.19)
≤ 5 year								0.004
								(0.00)
Random Effects								
Between Group $\sqrt{\psi}$	0.750***	0.710***	0.710***	0.710***	0.710***	0.711***	0.702***	0.703***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Within Group $\sqrt{\theta}$	1.085**	1.063*	1.063*	1.063*	1.063*	1.062*	1.064*	1.064*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N	4891	4890	4890	4890	4890	4890	4890	4890

Grandparents

Once household structure is accounted for in the analysis, represented by Model 3a and 3b, the role of grandparents in the household have an interesting story. The underlying relationship of grandparents presence on children's health appears to have the greatest affect on the youngest children in the household. Moreover, this relationship and the role of grandparents have greater meaning over time.

First, I examine the direct relationship of household structure on the nutritional status of children as shown by Model 3a. In general, Table 3.7 suggests that the presence of grandparents slightly reduces children's growth for all children under the age of five. Yet, Tables 3.8-3.9 suggest that this pattern differed by the age of the child. As Chapter 2 found that the amount of time grandparents invest on childcare depended on the age of the children, with more time for newborn infants and declines with age of the child. This means that grandparents are investing more time on the youngest children in the household and are helping mothers in other activities that would allow them to spend more time caring and feeding the young. The investment in the youngest children manifests in a slightly positive magnitude in HAZ score for children residing in multigenerational households where they can benefit from coresiding grandparents.

Model 3a in Table 3.9 suggests that this pattern diverges for older toddlers. Instead of benefitting from the presence of grandparents, these children are disadvantaged by their presence. As grandparents invest less time on childcare for older children, these children are then receiving less supervision that would inhibit them from exploring contaminated matter that may expose them to infections. Moreover, by this age children are consuming solid food similar to the adults in the household. This could mean that the presence of grandparents as additional members of the household are competing with older children for limited household resources, so that children aged 2-4 receive a smaller share than they would otherwise. This matters most for the poorest households. Interaction effect between the presence of grandparents and household wealth were also tested but did not change the results of the model (see Appendix).

The interaction between household structure and the timing of the survey does matter for children nutritional status. As Figure 3.1 suggested, the proportion of children who are malnourished declined over the decade faster for multigenerational households than nuclear households. This interaction between the timing and household structure is supported in Model 3b. The magnitude of effect for being in a multigenerational household substantially change especially for children aged 0-2 years, which can reduce the HAZ of a child by 0.39 SD. However, the effect of being in a multigenerational household cannot be interpreted independently because the timing modifies it. Model 3b in Table 3.8 suggests that while residing in multigenerational households might decrease the nutritional status of children, being in a multigenerational household in 2005 or 2010 improves nutritional status such that there is a net increase in the height of these children.

Going beyond the numbers, the multifaceted roles of grandparents in the lives of children are implied. Model 3b suggests that the presence of grandparents disadvantage children.

They are competing with children for limited household resources and potentially for maternal time and care. However, as social and economic conditions improve for the entire population, grandparents can influence children health through other avenues that benefit them. As suggested by a study in Senegal by Aubel et al. (2004), grandmothers are highly respected members of the community whose advice during pregnancy, childcare and household management matters for coresiding parents. They are able to inform and direct the behaviors of mothers that improve the nutrition of grandchildren. Similar to grandparents in Senegal, Cambodian grandparents are respected members of the community and household. Their ability to influence household decisions and shape the behavior of household members will then differentiate multigenerational household from nuclear households. With the educational programs to encourage mothers to exclusively breastfeed among other health programs over this decade (Marriott et al. 2010), coresiding grandparents can encourage mothers to adopt these new practices. Through their social roles, grandparents are able to leverage it towards better health conditions for coresiding grandchildren, especially the youngest.

Parents

With regard to the second research questions, finding from the regression model is similar to the descriptive statistics. It does not support an underlying relationship between the number of parents and children's nutritional status. For instance, Model 4a only considers the main effect of the number of parents. Here, the result suggests that single-parent households are not statistically significant from two-parent households. This is interesting as the amount of time single-parents have to invest have been found to be substantially less than two-parent households in Cambodia (see Chapter 2). Moreover, the reduced childcare time children in single-parent households receive is mitigated by the presence of grandparents for those in multigenerational households.

Similarly, the descriptive results also suggest that children with single parents do better in multigenerational households. Accounting for the potential interaction between single parent in a multigenerational household, Model 4b tested this relationship. However, the nutritional status of children residing in single-parent households does not seem to be mitigated by the presence of grandparents. What these models suggest is that less care does not translated into a substantial nutritional disadvantage.

Furthermore, few studies on nutrition find a single-parent disadvantage. For instance, (Bronte-Tinkew and DeJong 2004) find that children in single-parent households are more likely to be stunted than those in two-parent households because children in single-parent households receive less investment from the absent parent and might not receive additional resources elsewhere. However, in Cambodia there is a strong family network, and single mothers might lean upon other relatives for financial support to secure the resources necessary to sustain the growth of their children. There is also the possibility that as single-parent households are not as common in Cambodia, there might not be enough variation to have statistical power to detect potential differences.

Children

Unlike the presence of parents, the number of children in the household has a strong effect on children's nutritional status in the household. That is, with regard to the third research question, the analysis provides support for the hypothesis that the presence of siblings aged 0-5 disadvantage young children. It also rejects the second hypothesis that older siblings in the household benefit young children in the household.

Model 5a in Table 3.7 shows that presence of children in the household affect the height status of all children under the age of five. The HAZ score of children decline by 0.07 SD for each additional child aged five and under in the household. That is, a child with three siblings under the age of five, on average, have a HAZ score that is 0.21 less than those without any siblings of proximate age. If young children have older siblings, then their growth can be even further inhibited. For each sibling over the age of five in the household, children under the age of five are 0.04 SD shorter than a child without any sibling. So, for the child with three siblings under the age of five and an additional two siblings over the age of five, this child now is estimated to be 0.29 SD shorter than a child without any siblings.

While the overall pattern suggests that all siblings have a negative effect on the nutritional status of children, the age group of siblings has differential impact on the children in the household. For instance, Table 3.8 suggests that the number of children aged five and under have a stronger impact on children aged 0-2 years. The magnitude of the effect for the presence of each child aged five and under in the household is now -0.18. The more children under the age of five in the household imply shorter birth spacing and higher birth order with each subsequent child. These are factors known to affect the health status of children (Arnold et al. 1998, Muhuri and Menken 1997). As birth order is strongly correlated with both the number of children in the household and birth spacing, it has been left out of the model.

In addition, with increasing numbers of children in the household, the potential for mothers to breastfeed children for a substantial length of time declines. About 96% of all children are breastfed by their mothers in Cambodia with an average duration of five months (DHS 2001, 2011, Marriott et al. 2010). With the breastfeeding campaign that took place over this decade, the prevalence of mothers who exclusively breastfeed rose from about 20% to 74% (DHS 2001, 2011). Because of the strong relationship between breastfeeding and the survey years, breastfeeding had been omitted from the analysis, and the survey year variable reflects some of the improvements in breastfeeding over the decade.

Whereas the number of children aged five and under has a greater impact on the malnutrition of children aged 0-2 years old, the number of older siblings has a stronger effect on children aged 2-4. Each sibling over the age of five impedes the growth of children aged 2-4 by 0.07 SD. Unlike younger children who require less and a different type of food for their nutritional growth, for children over the age two, consumption is more similar to that of adults and the amount of caloric intake they require also rises. Therefore, they place a greater demand on household resources, which increase competition among siblings.

As the demand for resources among children aged 2-4 increases, the amount available in

the household becomes important. This is noted by the magnitude and statistical significance on the wealth index. Unlike younger children where the economic resources were not as important as maternal education, older childrens reliance on availability of more household resource is essential. Access to economic resources improves the growth of children substantially from as much as 0.25 SD to 0.70 SD for the for the 2^{nd} and 5^{nd} quintile, respectively. The importance of socio-economic status (SES) among this age group of children has been noted elsewhere. In their study of children's nutritional status in Mozambique, Sahn and Alderman (1997) found that children's height-for-age among 3-6 years old respond to increases in household income by reducing the gap with the reference population by 3.3%. With increase in wealth, the less constrained households are meeting the nutritional needs of household members and can thus mitigate the impact of older childrens affect on children aged 2-4 years old.

Furthermore, Model 5b test if grandparents mitigate the influence of the presence number of young siblings. As noted in Chapter 2, grandparents invest more childcare time for the youngest children in the household. If younger children receive the most attention and care from grandparents, then the adversity of competition among young children might be mitigated by the additional care grandparents provide as hinted by Figure 3.8. However, the analysis suggests that grandparents do not modify the influence of the number of siblings on children's nutritional status. Rather, the competition among siblings for household resources is more important.

Consequently, children in Cambodian are strongly affected by the presence of coresiding siblings. As the demand for care and resources among children changes with age, children requiring similar resources act as competitors who then can restrict the amount of necessary resources. In addition, the presence of siblings close in age can increase the exposure to infectious diseases. Thereby, the presence of young children in the household affect the youngest in the household while children over the age of five affect those nearest them in age.

3.6 Discussion

This analysis was designed to elucidate children's household structure affect on their nutritional status. Investigating the relationship of this microenvironment, this analysis examined how household members relationship status can affect children height status. First, the overall pattern of children's height status is examined by household structure, the number of parents present in the household, and number of older and younger siblings in the household. This is followed a regression analysis of each members influence on all children under the age of five. Lastly, to disentangle potential difference in age among children under five, the same analysis is then considered separately for children aged 0-2 and 2-4.

The most notable finding is that the presence grandparents in multigenerational households influence the nutritional status of children substantially over time. Their presence in the household matters the most for the youngest children in the household. Young childrens

nutritional status improves as social conditions in the country improve. With the economic development, more households are able to afford basic resources and invest in better living conditions for household members. Moreover, with the rise in maternal education, mothers become aware of preventative health processes that would help ensure a better health condition for children. This includes gaining information about the importance of breastfeeding and the duration of breastfeeding to maximize the potential benefits for infants (Marriott et al. 2010). Furthermore, the presence of grandparents in the household can encourage the uptake of these new health practices that safeguards children's nutritional status.

In addition to the presence of grandparent, children's nutritional status is strongly affected by the number and age of coresiding siblings. Children aged 0-2 risk of malnutrition is largely driven by the presence of other children aged five and under. Since children aged 2-4 are more dependent on the economic resources available in the household, the competition with older siblings undermines their nutritional status. Thereby, young children residing in larger households are at greater risk of being malnourished early in life.

In terms of parents, the number of parents inside the households has no relationship with children's nutritional status. Given that children in single-parent households receive less childcare in Cambodia (see Chapter 2), it is fortunate that the reduction in care time does not translate into adverse nutritional status. The youngest children require more of their nutrients through their mother's breastfeeding and may be receiving adequate amount during maternal care time. As working mothers tend to work in the field or local market, they are able to feed their children while at work. As for older children, they might receive sufficient resources with fewer siblings to compete for resources as single-parent households have fewer children. Also, as Cambodians tend to live close to extended family members in the same village (Ovesen et al. 1996), these children might be supervised by other family members who feed them and ensure that they receive additional resources to those provide by single mothers.

The presence of adults in the households might have a strong impact on young children's nutritional status than what is otherwise presented. As the analysis is based on children surviving to the time of the survey, the most malnourished children may have already died from sever malnutrition or complications related to infectious diseases (Aaby et al. 1983, Scrimshaw 1978). Then the surviving children in both household structures are the ones who have better nutrition or whose malnutrition has not severely impacted them by the time of the survey. Knowing the nutritional status of children prior to their death can enhance the understanding of the relationship of grandparents and the number of parents in the household on children's nutritional status.

Furthermore, given the nature of the data, it is unclear that grandparents were present in the household throughout the child's life. If grandparents resided in the household shortly prior to the survey, then this would bias the analysis, as grandparents had not been around to impact the nutritional status of grandchildren. However, given that Cambodian grandparents tend to coreside with one of their children, usually their youngest daughter (Crochet 2011, Zimmer and Kim 2001), it is unlikely that grandparents migrated frequently enough to matter. Instead, much of the migration in Cambodia occurs for young, working-age adults,

who migrate into the capital city for labor (Nishigaya 2002).

3.7 Conclusion

Findings in this study do support the hypothesis of the presence of grandparents but only over time. The number of parents influence on children's nutritional status is not supported by this study. Moreover, it finds that siblings have strong influence on the development of the index child. The number of children aged under five reduces the nutritional status of kids aged 0-2 years, while children over the age of five reduce the nutritional status of children aged 2-4 years. Through competition of resources, larger households are unable to adequately meet the nutritional needs of all children, particularly the youngest children in the household. The consequence of not providing sufficient resources that meet the need of children can then lead to early mortality for children.

3.8 Appendix

Modeling Without Interactions

Table 3.10: Regression of Height-for-Age for Children Age 0-5 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$
Fixed Effects					
Intercept	-1.881***	-1.534***	-1.523***	-1.522***	-1.514***
	(0.02)	(0.10)	(0.11)	(0.11)	(0.13)
Gender					
male		-	-	-	-
female		0.038	0.038	0.038	0.038
		(0.03)	(0.03)	(0.03)	(0.03)
Age (mos.)		-0.025***	-0.025***	-0.025***	-0.025***
		(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.000	-0.000	-0.000	0.007
		(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval					
Less than 15mos		-0.315***	-0.315***	-0.315***	-0.290***
		(0.08)	(0.08)	(0.08)	(0.08)
Maternal Education					
None		-	-	-	-
Primary		0.168***	0.168***	0.168***	0.162***

	(0.04)	(0.04)	(0.04)	(0.04)
Secondary	0.212***	0.212***	0.212***	0.193**
	(0.06)	(0.06)	(0.06)	(0.06)
Residence				
Rural	-	-	-	-
Urban	-0.051	-0.051	-0.051	-0.049
	(0.05)	(0.05)	(0.05)	(0.05)
Wealth Index				
1^{st} quintile	-	-	-	-
2^{nd} quintile	0.189***	0.190***	0.190***	0.184***
	(0.05)	(0.05)	(0.05)	(0.05)
3^{rd} quintile	0.227***	0.228***	0.228***	0.216***
	(0.05)	(0.05)	(0.05)	(0.05)
4^{th} quintile	0.327***	0.327***	0.328***	0.318***
	(0.06)	(0.06)	(0.06)	(0.06)
5^{th} quintile	0.595***	0.595***	0.595***	0.575***
	(0.08)	(0.08)	(0.08)	(0.08)
Sanitation (Toilet)				
Other	-	-	-	-
Flushing Toilet	0.094	0.095	0.094	0.083
	(0.07)	(0.07)	(0.07)	(0.07)
Latrine	-0.191*	-0.191*	-0.191*	-0.194*
	(0.09)	(0.09)	(0.09)	(0.09)
Survey Year				
2000	-	-	-	-
2005	0.056	0.056	0.056	0.037
	(0.04)	(0.04)	(0.04)	(0.04)
2010	0.211***	0.211***	0.211***	0.179***
	(0.04)	(0.04)	(0.04)	(0.04)
Household Structure				
Nuclear		-	-	-
Multigenerational		-0.009	-0.010	-0.008
		(0.04)	(0.05)	(0.05)
No. Parents				
Two			-	-
Single			0.017	-0.010
			(0.08)	(0.08)
No. Children by Age				
≤ 5 year				-0.071**
				(0.02)
> 5 year				-0.044**

					(0.01)
Random Effects					
Between Group $\sqrt{\psi}$	0.625***	0.625***	0.625***	0.625***	0.621***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Within Group $\sqrt{\theta}$	1.363***	1.265***	1.265***	1.265***	1.265***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
N	7971	7967	7967	7967	7967

Table 3.11: Regression of Height-for-Age for Children Age 0-2 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$
Fixed Effects					
Intercept	-1.385***	-0.731***	-0.734***	-0.724***	-0.358
	(0.03)	(0.16)	(0.19)	(0.19)	(0.22)
Gender					
male		-	-	-	-
female		0.138*	0.138*	0.138*	0.135*
		(0.05)	(0.05)	(0.05)	(0.05)
Age (mos.)		-0.075***	-0.075***	-0.075***	-0.078***
		(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		-0.002	-0.002	-0.002	-0.002
		(0.00)	(0.00)	(0.00)	(0.01)
Birth Interval					
Less than 15mos		-0.323*	-0.323*	-0.327*	-0.262
		(0.16)	(0.16)	(0.16)	(0.16)
Maternal Education					
None		-	-	-	-
Primary		0.220***	0.220***	0.220***	0.214***
		(0.06)	(0.06)	(0.06)	(0.06)
Secondary		0.239*	0.239*	0.242*	0.230*
		(0.10)	(0.10)	(0.10)	(0.10)
Residence					
Rural		-	-	-	-
Urban		-0.004	-0.004	-0.003	0.006
		(0.08)	(0.08)	(0.08)	(0.08)
Wealth Index					
1^{st} quintile		-	-	-	-
2^{nd} quintile		0.069	0.069	0.069	0.052

		(0.08)	(0.08)	(0.08)	(0.08)
3^{rd} quintile		0.156	0.156	0.155	0.124
		(0.08)	(0.08)	(0.08)	(0.08)
4^{th} quintile		0.166	0.166	0.167	0.142
		(0.10)	(0.10)	(0.10)	(0.10)
5^{th} quintile		0.354*	0.354*	0.356*	0.325*
		(0.14)	(0.14)	(0.14)	(0.14)
Sanitation (Toilet)					
Other		-	-	-	-
Flushing Toilet		-0.016	-0.017	-0.019	-0.033
		(0.11)	(0.11)	(0.11)	(0.11)
Latrine		-0.402*	-0.402*	-0.407*	-0.393*
		(0.17)	(0.17)	(0.17)	(0.16)
Survey Year					
2000		-	-	-	-
2005		-0.025	-0.025	-0.030	-0.042
		(0.07)	(0.07)	(0.07)	(0.07)
2010		0.153*	0.153*	0.150*	0.129
		(0.07)	(0.07)	(0.07)	(0.07)
Household Structure					
Nuclear			-	-	-
Multigenerational			0.002	-0.007	-0.008
			(0.07)	(0.07)	(0.07)
No. Parents					
Two				-	-
Single				0.146	0.112
				(0.14)	(0.14)
No. Children by Age					
≤ 5 year					-0.183***
					(0.04)
> 5 year					0.006
					(0.03)
Random Effects					
Between Group $\sqrt{\psi}$	0.828	0.878	0.878	0.879	0.865
	(0.11)	(0.09)	(0.09)	(0.09)	(0.09)
Within Group $\sqrt{\theta}$	1.400***	1.245***	1.245***	1.244***	1.248***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
N	3080	3077	3077	3077	3077

Table 3.12: Regression of Height-for-Age for Children Age 2-4 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$
Fixed Effects					
Intercept	-2.197***	-2.670***	-2.669***	-2.673***	-2.799***
	(0.02)	(0.13)	(0.14)	(0.14)	(0.16)
Gender					
male		-	-	-	-
female		-0.032	-0.032	-0.032	-0.032
		(0.04)	(0.04)	(0.04)	(0.04)
Age (mos.)		-0.001	-0.001	-0.001	-0.000
		(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.001	0.001	0.001	0.012**
		(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval					
Less than 15mos		-0.311***	-0.311***	-0.313***	-0.296***
		(0.09)	(0.09)	(0.09)	(0.09)
Maternal Education					
None		-	-	-	-
Primary		0.162***	0.162***	0.162***	0.156***
		(0.04)	(0.04)	(0.04)	(0.04)
Secondary		0.239***	0.239***	0.238***	0.210**
		(0.07)	(0.07)	(0.07)	(0.07)
Residence					
Rural		-	-	-	-
Urban		-0.083	-0.083	-0.083	-0.081
		(0.06)	(0.06)	(0.06)	(0.06)
Wealth Index					
1^{st} quintile		-	-	-	-
2^{nd} quintile		0.252***	0.252***	0.250***	0.246***
		(0.05)	(0.05)	(0.05)	(0.05)
3^{rd} quintile		0.254***	0.254***	0.253***	0.244***
		(0.06)	(0.06)	(0.06)	(0.06)
4^{th} quintile		0.385***	0.385***	0.383***	0.376***
		(0.07)	(0.07)	(0.07)	(0.07)
5^{th} quintile		0.724***	0.724***	0.721***	0.700***
		(0.09)	(0.09)	(0.09)	(0.09)
Sanitation (Toilet)					
Other		-	-	-	-

Flushing Toilet		0.131	0.132	0.133	0.119
		(0.07)	(0.07)	(0.07)	(0.07)
Latrine		-0.052	-0.052	-0.052	-0.063
		(0.10)	(0.10)	(0.10)	(0.10)
Survey Year					
2000		-	-	-	-
2005		0.156***	0.156***	0.158***	0.128**
		(0.05)	(0.05)	(0.05)	(0.05)
2010		0.291***	0.291***	0.291***	0.247***
		(0.05)	(0.05)	(0.05)	(0.05)
Household Structure					
Nuclear			-	-	-
Multigenerational			-0.001	0.003	0.005
			(0.05)	(0.05)	(0.05)
No. Parents					
Two				-	-
Single				-0.066	-0.102
				(0.09)	(0.09)
No. Children by Age					
≤ 5 year					-0.043
					(0.03)
> 5 year					-0.071***
					(0.02)
Random Effects					
Between Group $\sqrt{\psi}$	0.750***	0.710***	0.710***	0.710***	0.702***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)
Within Group $\sqrt{\theta}$	1.085**	1.063*	1.063*	1.063*	1.064*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N	4891	4890	4890	4890	4890

Modeling With Interactions

Table 3.13: Regression of Height-for-Age for Children Age 0-5 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$	Model 6 $\beta(se)$	Model 7 $\beta(se)$
Fixed Effects							
Intercept	-1.881***	-1.404***	-1.394***	-1.392***	-1.376***	-1.071***	-0.865**
	(0.02)	(0.12)	(0.13)	(0.13)	(0.15)	(0.19)	(0.28)
Gender							
male		-	-	-	-	-	-
female		0.039	0.039	0.039	0.039	0.039	0.039
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Age (mos.)		-0.026***	-0.026***	-0.026***	-0.025***	-0.025***	-0.026***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.000	0.000	-0.000	0.007	0.007	0.007
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval							
Less than 15mos		-0.316***	-0.316***	-0.316***	-0.290***	-0.290***	0.089
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.22)
Feeding							
Other		-	-	-	-	-	-
breastfed		-0.110	-0.110	-0.110	-0.111	-0.111*	-0.143*
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Maternal Education							
None		-	-	-	-	-	-
Primary		0.167***	0.167***	0.167***	0.162***	0.162***	0.162***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Secondary		0.211***	0.211***	0.211***	0.192**	0.191**	0.194**
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Residence							
Rural		-	-	-	-	-	-

Urban	-0.054	-0.054	-0.054	-0.052	-0.048	-0.050
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Wealth Index						
1^{st} quintile	-	-	-	-	-	-
2^{nd} quintile	0.189***	0.190***	0.190***	0.184***	0.164***	0.180***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
3^{rd} quintile	0.227***	0.228***	0.228***	0.215***	0.201***	0.214***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
4^{th} quintile	0.327***	0.327***	0.328***	0.317***	0.295***	0.318***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
5^{th} quintile	0.591***	0.591***	0.592***	0.571***	0.570***	0.573***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)
Sanitation (Toilet)						
Other	-	-	-	-	-	-
Flushing Toilet	0.092	0.093	0.092	0.081	0.066	0.071
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Latrine	-0.195*	-0.195*	-0.195*	-0.197*	-0.209*	-0.206*
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Survey Year						
2000	-	-	-	-	-	-
2005	0.058	0.058	0.058	0.039	-0.002	0.001
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
2010	0.142*	0.142*	0.142*	0.110*	0.081	0.064
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Household Structure						
Nuclear		-	-	-	-	-
Multigenerational		-0.008	-0.009	-0.008	-0.274*	-0.462*
		(0.04)	(0.05)	(0.05)	(0.12)	(0.21)
No. Parents						
Two			-	-	-	-
Single			0.018	-0.009	-0.020	-0.017

	(0.08)	(0.08)	(0.09)	(0.08)
No. Children by Age				
$\leq$ 5 year		-0.072**	-0.074**	-0.065**
		(0.02)	(0.02)	(0.03)
$>$ 5 year		-0.043**	-0.043**	-0.040**
		(0.01)	(0.01)	(0.01)
Interactions				
Multigeneration x				
2005			0.261*	0.266*
			(0.11)	(0.11)
2010			0.194	0.314*
			(0.11)	(0.14)
Single			0.030	
			(0.16)	
$\leq$ 5 year				0.004
				(0.00)
2^{nd} quintile			0.144	
			(0.14)	
3^{rd} quintile			0.116	
			(0.14)	
4^{th} quintile			0.169	
			(0.14)	
5^{th} quintile			0.087	
			(0.16)	
Breastfed				0.182
				(0.15)
Birth Interval x				
$\leq$ 5 year				-0.134
				(0.10)
$>$ 5 year				-0.058
				(0.04)

Random Effects							
Between Group $\sqrt{\psi}$	0.625***	0.623***	0.623***	0.623***	0.619***	0.619***	0.621***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Within Group $\sqrt{\theta}$	1.363***	1.265***	1.265***	1.265***	1.265***	1.265***	1.263***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
N	7971	7967	7967	7967	7967	7967	7967

Table 3.14: Regression of Height-for-Age for Children Age 0-2 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$	Model 6 $\beta(se)$	Model 7 $\beta(se)$
Fixed Effects							
Intercept	-1.385***	-0.314	-0.318	-0.307	0.099	0.817*	0.711
	(0.03)	(0.20)	(0.22)	(0.22)	(0.25)	(0.32)	(0.49)
Gender							
male		-	-	-	-	-	-
female		0.138*	0.138*	0.138*	0.135*	0.144**	0.143**
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Age (mos.)		-0.079***	-0.079***	-0.079***	-0.082***	-0.082***	-0.084***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
		(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Birth Interval							
Less than 15mos		-0.321*	-0.321*	-0.326*	-0.259	-0.263	0.077
		(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.43)
Feeding							
Other		-	-	-	-	-	-
breastfed		-0.378***	-0.378***	-0.380***	-0.401***	-0.397***	-0.391**
		(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.13)
Maternal Education							
None		-	-	-	-	-	-
Primary		0.219***	0.219***	0.219***	0.213***	0.224***	0.217***
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Secondary+		0.233*	0.233*	0.237*	0.224*	0.221*	0.224*
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Residence							
Rural		-	-	-	-	-	-

Urban		-0.013	-0.013	-0.013	-0.003	0.010	0.006
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Wealth Index							
1^{st} quintile		-	-	-	-	-	-
2^{nd} quintile		0.071	0.071	0.071	0.053	0.052	0.042
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
3^{rd} quintile		0.154	0.153	0.153	0.120	0.068	0.111
		(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)
4^{th} quintile		0.163	0.163	0.164	0.139	0.058	0.143
		(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
5^{th} quintile		0.331*	0.331*	0.333*	0.300*	0.266	0.305*
		(0.14)	(0.14)	(0.14)	(0.14)	(0.15)	(0.14)
Sanitation (Toilet)							
Other		-	-	-	-	-	-
Flushing Toilet	-0.019	-0.020	-0.022	-0.037	-0.099	-0.071	
		(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Latrine		-0.411*	-0.412*	-0.417*	-0.403*	-0.424*	-0.431**
		(0.17)	(0.17)	(0.17)	(0.16)	(0.16)	(0.16)
Survey Year							
2000		-	-	-	-	-	-
2005		-0.016	-0.016	-0.021	-0.032	-0.123	-0.119
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
2010		0.082	0.082	0.079	0.054	-0.032	-0.030
		(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Household Structure							
Nuclear			-	-	-	-	-
Multigenerational			0.003	-0.006	-0.008	-0.640***	-0.550
			(0.07)	(0.07)	(0.07)	(0.19)	(0.36)
No. Parents							
Two				-	-	-	-
Single				0.152	0.117	0.114	0.095

	(0.14)	(0.14)	(0.17)	(0.14)
No. Children by Age				
$\leq$ 5 year		-0.189***	-0.195***	-0.189***
		(0.04)	(0.04)	(0.04)
$>$ 5 year		0.008	0.006	0.008
		(0.02)	(0.02)	(0.03)
Interactions				
Multigeneration x				
2005			0.565**	0.562**
			(0.18)	(0.18)
2010			0.539**	0.554**
			(0.18)	(0.19)
Single			0.002	
			(0.28)	
$\leq$ 5 year				0.012
				(0.01)
Breastfed				-0.003
				(0.28)
2^{nd} quintile			0.066	
			(0.22)	
3^{rd} quintile			0.319	
			(0.22)	
4^{th} quintile			0.517*	
			(0.23)	
5^{th} quintile			0.383	
			(0.26)	
Birth Interval x				
$\leq$ 5 year				-0.161
				(0.20)
$>$ 5 year				0.004
				(0.09)

Random Effects							
Between Group $\sqrt{\psi}$	0.828	0.878	0.879	0.879	0.864	0.851	0.864
	(0.11)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Within Group $\sqrt{\theta}$	1.400***	1.242***	1.241***	1.241***	1.244***	1.247***	1.240***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
N	3080	3077	3077	3077	3077	3077	3077

Table 3.15: Regression of Height-for-Age for Children Age 2-4 in Cambodia

	Model 1 $\beta(se)$	Model 2 $\beta(se)$	Model 3 $\beta(se)$	Model 4 $\beta(se)$	Model 5 $\beta(se)$	Model 6 $\beta(se)$	Model 7 $\beta(se)$
Fixed Effects							
Intercept	-2.197***	-2.437***	-2.435***	-2.438***	-2.551***	-2.499***	-2.464***
	(0.02)	(0.16)	(0.17)	(0.17)	(0.19)	(0.24)	(0.42)
Gender							
male		-	-	-	-	-	-
female		-0.033	-0.033	-0.032	-0.032	-0.033	-0.032
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Age (mos.)		-0.002	-0.002	-0.002	-0.001	-0.001	-0.002
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Maternal Age (years)		0.001	0.001	0.001	0.012**	0.012**	0.012**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Birth Interval							
Less than 15mos		-0.313***	-0.313***	-0.314***	-0.296***	-0.300***	0.176
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.25)
Feeding							
Other		-	-	-	-	-	-
breastfed		-0.222*	-0.222*	-0.222*	-0.223*	-0.225**	-0.210*
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)
Maternal Education							
None		-	-	-	-	-	-
Primary		0.160***	0.160***	0.160***	0.154***	0.151***	0.154***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Secondary+		0.237***	0.237***	0.235***	0.207**	0.209**	0.212**
		(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Residence							
Rural		-	-	-	-	-	-

Urban	-0.088	-0.088	-0.088	-0.086	-0.086	-0.088
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Wealth Index						
1^{st} quintile	-	-	-	-	-	-
2^{nd} quintile	0.251***	0.251***	0.250***	0.244***	0.206***	0.242***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)
3^{rd} quintile	0.256***	0.256***	0.254***	0.244***	0.250***	0.243***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
4^{th} quintile	0.386***	0.386***	0.384***	0.376***	0.388***	0.372***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
5^{th} quintile	0.720***	0.720***	0.716***	0.694***	0.707***	0.692***
	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)	(0.09)
Sanitation (Toilet)						
Other	-	-	-	-	-	-
Flushing Toilet	0.128	0.128	0.130	0.116	0.121	0.118
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Latrine	-0.062	-0.062	-0.062	-0.073	-0.080	-0.070
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Survey Year						
2000	-	-	-	-	-	-
2005	0.161***	0.161***	0.163***	0.133**	0.122*	0.124*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
2010	0.096	0.096	0.096	0.050	0.053	0.071
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)
Household Structure						
Nuclear		-	-	-	-	-
Multigenerational		-0.002	0.003	0.004	-0.039	-0.089
		(0.05)	(0.05)	(0.05)	(0.13)	(0.32)
No. Parents						
Two			-	-	-	-
Single			-0.068	-0.104	-0.079	-0.103

	(0.09)	(0.09)	(0.10)	(0.09)
No. Children by Age				
$\leq$ 5 year		-0.047	-0.048	-0.036
		(0.03)	(0.03)	(0.03)
$>$ 5 year		-0.070***	-0.070***	-0.065***
		(0.02)	(0.02)	(0.02)
Interactions				
Multigeneration x				
2005			0.061	0.074
			(0.13)	(0.13)
2010			-0.026	-0.108
			(0.13)	(0.24)
Single			-0.075	
			(0.19)	
$\leq$ 5 year				0.004
				(0.00)
2^{nd} quintile			0.281	
			(0.16)	
3^{rd} quintile			-0.010	
			(0.16)	
4^{th} quintile			-0.045	
			(0.16)	
5^{th} quintile			-0.068	
			(0.18)	
Breastfed				-0.085
				(0.23)
Birth Interval x				
$\leq$ 5 year				-0.166
				(0.10)
$>$ 5 year				-0.071
				(0.04)

Random Effects							
Between Group $\sqrt{\psi}$	0.750***	0.707***	0.707***	0.708***	0.701***	0.702***	0.707***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)
Within Group $\sqrt{\theta}$	1.085**	1.064*	1.064*	1.063*	1.064*	1.062*	1.059*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N	4891	4890	4890	4890	4890	4890	4890

Chapter 4

Family Structure and the Risk of Mortality in Cambodia, 2000-2010

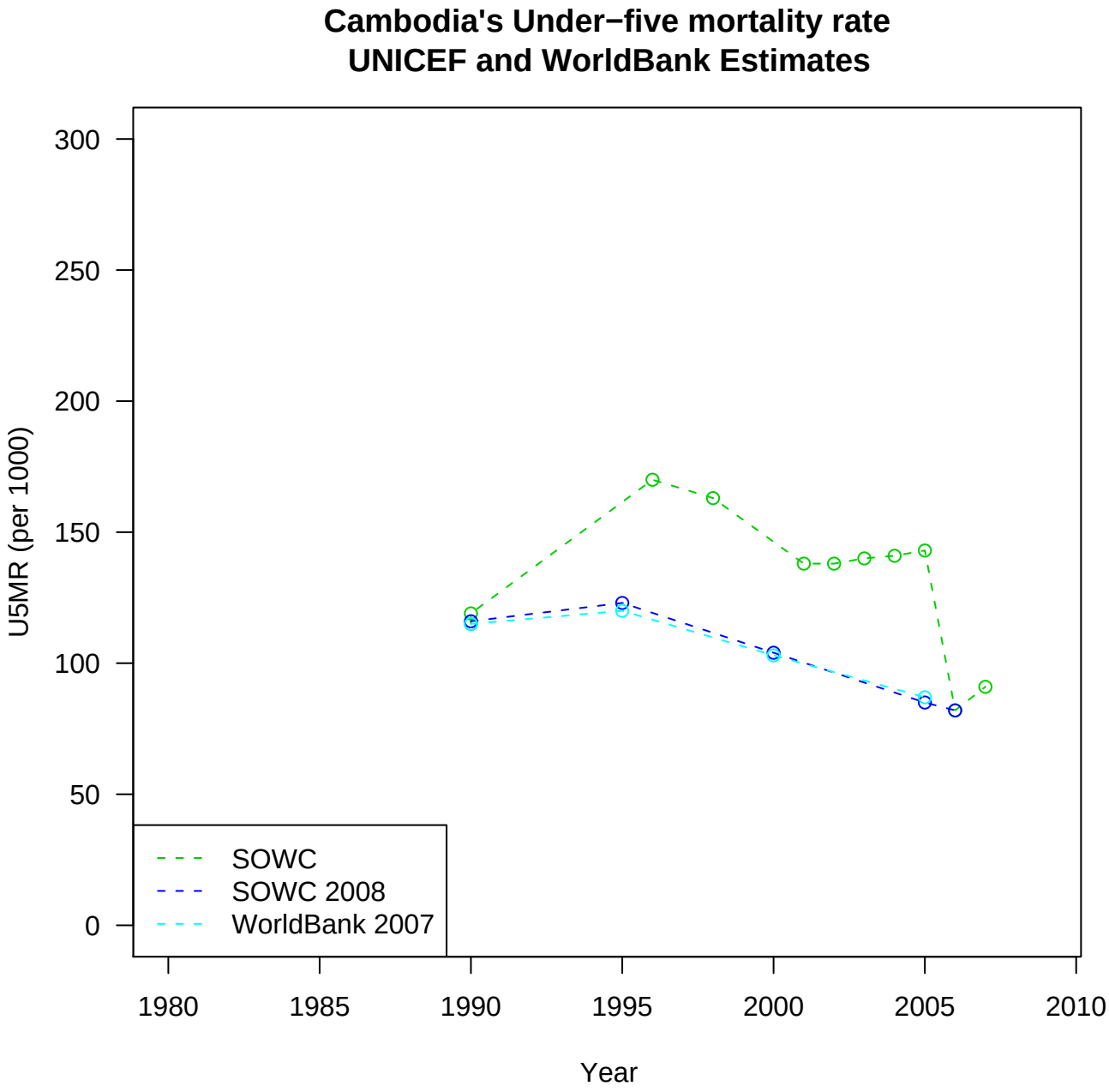
4.1 Introduction

In the previous two chapters, we have examined the relationship of family structure with childcare and nutritional outcome. Chapter 2 suggested that there is a differential pattern in the allocation of childcare time by household structure, with multigenerational households investing more time on childcare than nuclear households. Chapter 3 explored the differential effect of family structure on nutritional outcomes of children. Residing in multigenerational households improved the nutritional status of children over time. These relationships can mean they have little to extreme consequences on children's lives. Children in one family structure might receive slightly less care which might not have any substantial impact on the outcomes for children, but substantial differences in care time may imply neglect. Diminished attention and inadequate resources would then affect the health or survival outcomes of children. As the previous chapter explored differential nutritional outcomes of children in nuclear and multigenerational household structures, this chapter explores the more extreme health conditions, namely mortality.

Children have the greatest risk of mortality when they are under five years of age, which includes children who are newborns and toddlers up to age four. Under-five mortality has been used by international organizations as a metric on the development and general health conditions of a country. Figure 4.1 shows the under-five mortality rate for Cambodia as measured by the World Bank and the United Nations Children's Fund (UNICEF). The State of the World's Children (SOWC), which is a report published by UNICEF, showed some fluctuation in under-five mortality over time, but this was in partly due to availability of data. In the revised report in 2008, UNICEF's report on under-five mortality is similar to the World Bank's. These organizations suggest that under-five mortality has been declining since 1998.

While under-five mortality has been declining over this period, it remains a very real

Figure 4.1:


Cambodia's Under−five mortality rate
UNICEF and WorldBank Estimates
U5MR (per 1000)
300
250
200
150
100
50
0
1980
1985
1990
1995
2000
2005
2010
Year
SOWC
SOWC 2008
WorldBank 2007

and important problem in Cambodia. Mortality in the first year of life accounts for more than 70% of all deaths under the age of five. While the infant mortality rate—the number of deaths for children between 0 and 12 months per 1000 live births—has been declining, it still remains high as shown in Table 4.1. As infant and under-five mortality reflects the well-being of a society in terms of its economic development and medical resources to prevent mortality, it also reflects the social conditions. The most important social condition for a child's well-being is the family. Individuals within the family are children's intermediaries to resources and providers of caregiving that would influence their ability to survive.

Table 4.1: Infant and Under-five Mortality Rate In Cambodia, 2000-2010

Year	Under-five mortality (per 1000)	Infant mortality (per 1000)
2000	124	95
2005	83	65
2010	54	45

During this period of mortality decline, there have also been changes in family structure. This includes a fertility declined from four children per woman in 2000 to three children per woman in 2010, but the average age at first birth remain relatively stable at age 21 years (DHS 2001, 2006, 2011). In spite of this mortality and fertility decline, household size remained stable at about 5-6 persons per household, in part due to extended-family households growing with the economic expansion (Demont and Heuveline 2008). This chapter then attempts to understand this relationship between family structure and infant mortality.

While family structure is a broad classification, this chapter focuses on nuclear and multi-generational households. Furthermore, as the individuals within these household structures and their relationship with the infants can determine the form of interactions, the composition of households impact on infants risk of mortality will also be explored. This includes an examination of the siblings', parents' and grandparents' effects on the risk of mortality for infants. Thus, this chapter will address the following questions:

Research Questions

- Does the presence of other siblings in the household affect the risk of infant mortality?
- Are there different risks for infants in single and two-parent households?
- Does the presence of grandparents in the household influence the risk of infant mortality?

- Does the presence of grandparents modify the risk for infants in single-parent households? And does the presence of grandparents create a differential effect for households with multiple children under the age of five?

With this relationship in mind, the subsequent section, Section 2, will discuss in further detail how different family members can influence the risk of mortality for infants. Section 4.3 describes the data used for the analysis followed by the methodology in Section 4.4. Section 4.5 reports the results with the final section discussing the results with final comments.

4.2 Background

Siblings in the Home

The composition of children in the household informs household decisions in the family-building process, but they can also influence survival conditions for subsequent children born into the household. While the literature on the impact of family members on child survival has been limited, the direction of effect of whether certain individuals increase or reduce the risk of mortality has been mixed.

The presence of multiple children in the household is often considered as biologically disadvantageous for subsequent children. In households with more than one child, children born later are of higher birth order. According to the demographic and health literature, children of a higher birth order are at greater risk of infant mortality because children of higher birth order are born to older women whose physical health may be compromised. Older mothers may be depleted of nutrients from previous pregnancies, and they undergo physiological changes that increases the risk of congenital disease for higher birth order children (Newcombe 1965, Saha and van Soest 2011, Scrimshaw 1978).

Also, closely spaced births can adversely influence the risk of mortality for all children, which can occur through two processes. One, pregnant mothers may choose to stop breastfeeding, or if she continues her body will produce less breast milk (Muhuri and Menken 1997). This would increase the risk of malnutrition by depriving infants of necessary nutrients that are in breast milk and thereby increasing their risk of mortality (Mosley and Chen 1984). Second, apart from the short breastfeeding period, older children may be subjected to less supervision and care from mothers (Muhuri and Menken 1997). As the results in Chapter 2 suggests, children in Cambodia do get less childcare time in households with multiple young children. This can adversely affect children in receiving appropriate nursing or obtaining medical treatment when sick (Muhuri and Menken 1997).

Not only older children in general, but children born a year before another infant are at risk from close birth spacing. Newborn infants face a similar risk of mortality. In terms of nutritional factor, unlike older infants whose nutritional intake is compromised by early weaning during their first year of life, newborns are at risk from maternal physiological conditions. A mother who becomes pregnant shortly after giving birth may not have time

for her body to fully recuperate from the previous birth. This potentially leads to a depletion of nutrients for the fetus, thereby increasing the risk of mortality for the child upon birth. Also, the physical demand can cause fatigue, which diminishes her ability to fully engage with her children and provide adequate care for all children. Thus, all her young children would not receive enough care time (see Chapter 2).

In addition to birth order and birth spacing, siblings can influence each other's risk of mortality through competition with each other. As there are limited amounts of resources, each young child may compete with his or her sibling for childcare time and household resources (Arnold et al. 1998, Muhuri and Menken 1997, Omran 1981). Decisions on the allocation for these resources are determined by parents or household members. These decisions can be influenced by other factors that may also drive the household formation process. For instance, parents may have an ideal number of children or a combination of sons and daughters in mind as part of their family-building process. And in places with strong son preference, parents are more likely to continue having children until they achieve a desired number sons and therefore have a shorter birth interval following the birth of a daughter (Muhuri and Menken 1997). However, gender preference would not be expected to influence the family building process in Cambodia. Since Cambodia has a bilateral kinship system that does not strongly prefer one sex over the other, an alternative explanation is the replacement theory. Following the death of a child, women would have their next birth sooner than they would otherwise. This leads to having closely spaced pregnancies, i.e., a short birth interval between children.

Increasing the number of children might increase competition among children, but they may also benefit each other. As discussed in Chapter 2 and Chapter 3, the presence of other children in the household in Cambodia can be both costly and beneficial. Increasing the number of children under the age of five in the household reduces the amount of care time and nutritional status for all children under the age of five. Whereas, the presence of children over the age of five increases the total amount of care time per child under the age of five. In addition, the presence of children over the age of ten in the household increases the amount of economic resources available in the household through their economic production. While the presence of other children in the household in Cambodia influences the quantity of household resources infants can expect, the degree to which this will affect their risk of mortality remains to be investigated in this chapter.

However, the existing literatures that examine this relationship suggest some potential benefits of siblings, for instance, in a study of Berber women in Southern Morocco, Crognier et al. (2001) found that the presence of other children in the household improves the survival of younger siblings. In particular, the presence of the four oldest children increases the survival of later-born children. These older children may increase the probability of surviving for later-born children by reducing parental investment. They provide childcare for later-born children and contribute to household activities. Similar to the children in this Berber community, children in Cambodia also participate in household and market production in addition to providing childcare. Therefore, infants' risk of mortality in Cambodia may be reduced through the presence of older siblings.

Overall, siblings can influence infant mortality in either direction. Multiple young children can increase the risk of mortality through close birth spacing, birth order, and competition for resources, while multiple older siblings can benefit infants through the provision of additional childcare time and resources for the household.

Parents: In Numbers

Since children can influence infant mortality within a household through competition or supplementation of resources, parents should have similar if not more substantial impact on their young children. The presence or absence of a parent can have differential impact on children; therefore, children residing in single or two-parent households can have different risks of mortality.

With the presence of both parents in the household, children can be expected to be at lower risk of mortality. Literature on child well-being suggests that children in two-parent households have better outcomes in cognition, education, behavior, and health status (Bronte-Tinkew and DeJong 2004, Brown 2004, Dawson 1991, McLanahan 1985, Thomson et al. 1994). In a study conducted in the United States that examined the influence of different forms of family structures on child well-being, McLanahan (1985) found that children in nuclear households with two biological parents have better outcomes than children residing in stepfamilies, mothers with coresiding partner, or single-parent households. They found that half the difference is attributed to two-parent households having greater resources than single-parent households. Economic resources enable two-parent households to afford better education and other goods that ensure better academic performance and behavior in school. The economic advantage in this scenario can also be applied to the Cambodian context. Households with more economic resources are able to afford more resources to keep children from becoming malnourished (see Chapter 3). Adequate nutrition will minimize illness and speed recovery (Cutler et al. 2006, Kostermans 1994). Furthermore, economic resources will enable parents to finance medical treatment and purchase medicine in the event children become ill.

Parents maximize their economic resources in Cambodia through a division of labor. There is a preference in Cambodia for one income earner and a stay-at-home spouse (Demont and Heuveline 2008). This preference of division of labor was shown in Chapter 2. In two-parent households, fathers spend about 7-8 hours per day in the labor force while mothers spend the majority of their time performing domestic labor. Whereas, single-parent households had limited time for both economic and domestic labor. This suggests that single-parent households are restricted in their ability to maximize their time for economic resources and childcare.

Single parents face the challenge of balancing household resources, but which parent is absent from the household can indicate which vital resource has been withdrawn from infants. As children are dependent on their mothers during the early stages of infancy for basic needs of breastfeeding, care, and protection, the death or absence of mothers during this stage would increase infants vulnerability. Thereby, this can increase infants' risk of

mortality. In a study on the influence of parental death on child health in historical Spain, Reher and González-Quiñones (2003) found that children who lost a mother in the first year of life had an increase of 3.22 times the risk of dying compared to children who had surviving mothers. Studies conducted in other countries in Europe, America, Africa, and Asia supports the important role of mothers on children survival during the first year of life (Sear and Mace 2008).

On the other hand, the influence of a father's presence on infant mortality is more varied. An infant's health is not as strongly dependent on a father as it is on a mother, then the absence of fathers from the household would be expected to have less of a substantial impact on children's risk of infant mortality. Reher and González-Quiñones (2003) found that children who experienced the death of a father had an increased risk of mortality of 11%, and this only mattered for children during their first six months of life. However, in a review of the literature across countries and time period, Sear and Mace (2008) found that the death of a father influences infant mortality in some communities and not others. Fathers might not have a strong influence on infant mortality in locations where paternal resources and care can be substituted by other family members. Also, fathers can influence infant mortality indirectly through the economic resources they are able to provide for households. The latter condition would be expected as the route for paternal influence on infant mortality. As Cambodian households expect parental divisions of labor, fathers would indirectly influence infant mortality through the economic resources brought into households. Moreover, employment of fathers would free maternal time for childcare.

While mothers and fathers can influence infant mortality differently, single-parent households can form in Cambodia through a death of one parent, divorce, abandonment, or migration. In terms of divorce, Cambodian women have relative ease in accessing legal divorce and keep marital wealth in the event of a divorce (Heuveline and Poch 2006, Ledgerwood 1995). However, this is checked by social stigma associated with widowed and divorced women, particularly for divorced women. Because divorced women are perceived as falling short of her gender role in marriage, they are unlikely to remarry (Derks 2008, Heuveline and Poch 2006). Therefore, children residing in a single-parent household (usually with their mother) can experience an economic reduction lost through their fathers and exposed to social stigma. Furtheremore, not only has the household lost one of its member who provided economic resources, mother's time would be divided between the direct care she is able to give her children and with the need for labor market participation.

Men do not have the same ease as women in access to legal divorce. Men could divorce their wives in cases where women were unfaithful; therefore, the alternative for men to leave a marriage is through abandoning his family (Heuveline and Poch 2006). Children in these households would then experience similar conditions as single-mother households formed through divorce.

Households that have one parent migrate into other areas—generally into cities to find employment and function similar to single-parent households. These households' daily operations function without one parent present in the household. However, unlike other forms of single-parent households, these households still have economic support from the absent par-

ent through remittance. Then adverse consequences for single-parent households mediated through economic resources should not be expected to influence infant mortality.

Consequently, the literature suggests that infants residing in two-parent households would benefit from economic and parental care. Whereas, children residing in single-parent households can have different risk factors depending on which parent is absent from the household. However, the effect of an absent father could be mitigated through support of grandparents in the household.

Grandparents

Through parental separation and the need for elderly support or pooling resources, various factors can determine the formation of multigenerational households in Cambodia. Through the formation of multigenerational households, grandparents become additional members of households. Their presence in the household can impact the lives of their coresiding grandchildren.

Similar to fathers, grandparents can indirectly influence the survival of coresiding grandchildren. In their review, Sear and Mace (2008) reported that most studies found grandparents had some influence on child survival. The direction of the effect varied depending on which grandparent. In some communities paternal grandmothers had an effect on child mortality while maternal grandmothers are more influential in others. Most studies did not find paternal or maternal grandfathers to influence survival status of children. The studies that did find an effect suggest that they either increase or reduce the risk of mortality depending on the society. Given the bilateral kinship system in Cambodia, grandparents from either the mother's or father's side would be expected to have the same value, and neither side would have a stronger influence than the other.

The influence Cambodian grandparents would be expected to have on grandchildren would be through their role in multigenerational households. As grandparents are additional members of households, they may be able to provide additional resources to households. On the other hand, resources may be diverted for their use.

Families may strategically reside in multigenerational households to increase household resources. Couples with low socio-economic status (SES) may want to coreside with grandparents to allow more adults in the household to participate in the labor market and be able to share responsibility for the supervision of children. Similarly, divorced or widowed mothers may move into their parents' household with their children. This may be disadvantagous to the household overall because grandparents now have to support the returned daughter as well as grandchildren. Mothers might decide to participate in the labor force to supplement household economic resources. In addition, additional adults in these households could maximize childcare with grandparents providing additional childcare time or substituting for the mother's time while she is in the labor market.

Alternatively, the presence of grandparents can place an economic hardship on multigenerational households. The absence of assistance programs such as social security or medicare for the elderly in Cambodia transfers the burden of elderly support to the family. While

Cambodian elderly may live with either sons or daughters, there is a preference to reside with the youngest daughter (Zimmer and Kim 2001). In these households, adult children provide support for the grandparent as well as their own children. This may divert the mother's time from children towards care of grandparents, but the grandmother may also substitute some of mother's time in supervision of children. This may allow mothers to participate in the labor market to supplement her husband's income and increase overall household resources.

Consequently, the role played by grandparents in the household dynamic can translate into survival outcomes for children. Studies in other countries have suggested the potential role of grandparents improving the probability of survival for young children (Griffiths et al. 2001, Kemkes-Grottenthaler 2005, Sear and Mace 2008). In a study conducted in India comparing three culturally different states, Griffiths et al. (2001) found that the presence of coresiding grandparents, particularly grandmothers, improves the chances of survival for infants and children. In a similar vein, in an empirical study conducted in South Africa, Duflo (2000) found that children benefited from coresiding grandparents. While this study did not examine the risk of mortality for children, they did find that children with grandparents who received a pension had better nutritional status than children in households without an elderly family member receiving pension benefits. As an improved nutritional status lowers the risk of illnesses and associated causes of death related to malnutrition, grandparents in these South African households in effect lower the risk of death for coresiding grandchildren. Moreover, the implication of these studies is that coresiding grandparents increase the resources available in the household, which then get allocated to children.

In Cambodia, children may potentially benefit from a higher allocation of resources in multigenerational households. Resources can be in the form of economic resources as well as available time. As the results in Chapter 2 showed, coresiding grandparents provide childcare time for coresiding grandchildren. They also contribute to economic production, which can increase the available economic resources in the household. While Cambodian grandparents may act as benefactors in providing additional resources for multigenerational households, the extent to which this would translate into survival outcomes for children still has yet to be explored for Cambodia. Thus, this paper will be exploring the role of grandparents in addition to other household members' influence on infant mortality will be investigated in the subsequent sections.

4.3 Data

The data for this study comes from the Cambodia Demographic and Health Survey (CDHS). The CDHS is part of the worldwide Demographic and Health Survey (DHS) project, designed to capture information on fertility, family planing, and maternal and child health in developing countries. The CDHS is a nationally representative survey that is conducted about every five years. Thus far, Cambodia has had three survey rounds, 2000, 2005, and 2010. Through a complex multistage probability sampling design of households, women of the age 15-49 who slept in the interviewed household the night before were selected for

interview. From these women, information on their reproductive history was collected.

This analysis is restricted to children born to interviewed women within a year period before each survey. This ensures that background characteristics of children closely correspond to the timing of their birth and/or death. As household structure is fluid and changes over time, restricting the analysis to the year prior to the survey minimizes the bias incurred from assuming stable household structure over an extended period. Furthermore, by restricting the analysis to recent births, this minimizes the overrepresentation of young children from older women so that the estimates will not be biased towards children of older women. The sample also excludes children born into households that are not nuclear or multigenerational. The final sample consists of 4,004 children from 3, 896 households. Description of this sample is presented in Table 4.2.

Table 4.2: Cambodia Demographic and Health Survey (CDHS) Sample Size

	2000	2005	2010
Total			
Household	12,236	14,243	15,667
Members	66,285	73,010	76,920
Usual Resident	66,105	72,342	75,959
Children < 1	2,709	2,315	2,093
Subsample			
Household	1,513	1,288	1,095
Nuclear	1,281	1,040	862
Multigenerational	232	248	233
Children < 1	1,567	1,315	1,122
Alive	1,363	1,188	1,031
Dead	204	127	91

Usual Resident normally resides in the household

Nuclear is parent and child household.

Multigenerational includes grandparent, parent, and child.

Dependent Variable

The survey collects a complete reproductive history of women. This includes information on all her biological children including the date of birth for each child, and if the child is alive, then his or her current age at the time of the survey. Otherwise the age at death for the child was recorded. This information was used to determine the survival status of children from birth to the age of one. Thus, a binary variable was generated for the analysis, indicating whether a child died by his or her first birthday.

Independent Variables

Family Structure

Household structure was determined based on two components of the survey. The CDHS collected information on every member in the household at the time of the survey. This included whether or not the member was a usual resident in the household, the age of the household member, and his or her relationship status to the head of the household. The other component of the survey used to determine household structure was the report of coresiding mothers and fathers of children.

From the household rosters, only *de jure* or usual residents were considered in the analysis. As usual residents are more likely to influence the composition as well as the social and economic dynamics of households, they would be stronger candidates of exerting any potential influence on infants in the household than visitors. Therefore, only usual residents were considered in the construction of household structure. As shown in Table 4.2, less than 2 percent of household members were not usual residents. Most of these nonresidents were not related to the head of household.

Reports of relationship status and of coresiding parents were used to construct household structure. Two forms of household structures were considered in this analysis. Nuclear households consist of either a single or two parents with children. Multigenerational households are three generational households that include children, their parents, and grandparent(s) in the households. Households are further restricted to having at least one parent. As information on children is reported by mothers, single-parent household in this analysis are single-mother households.

Family-level Variables

Besides grandparents and parents, other members of the households may potentially influence the survival status of children. For instance, the study by Muhuri and Menken (1997) suggests that the number of children under the age of five increases the risk of mortality of the index child. Whereas, the literature review conducted by Sear and Mace (2008) suggests that other children in the household can serve as helpers who reduce the risk of mortality. Therefore, two variables, one to indicate the number of children in the household aged five and under and another for the number of children over the age of five, are included in the model.

Socio-economic status (SES) of households is considered an important indicator of mortality. The CDHS created a wealth index, a quintile measure of household SES, based on a combination of household living conditions and possessions. This measure is missing for all observations in 2000. To avoid losing potential information from children in the 2000 survey, another measure is used as a proxy for household wealth. Household SES is moderately correlated with maternal education, which has also been found to be strongly related to infant mortality (Caldwell 1986, DaVanzo 1988, Omariba and Boyle 2007, Saha and van Soest 2011). Therefore, the level of maternal education is controlled for in this analysis. The ed-

ucation for mothers is classified as follows: no education, primary education, and secondary or higher education. Also, place of residence is distinguished as urban versus rural.

Child-Level Variables

Child-variables are sex, birth order, birth interval, and mother's age at birth. Birth interval is the number of months between the birth of the index child and his or her immediate older sibling. As shorter birth intervals are strongly associated with a higher risk of mortality (Arnold et al. 1998, Omariba and Boyle 2007, Saha and van Soest 2011), an indicator variable has been created to capture this short spacing. A birth interval of 15 months or less is coded as a 1. The mother's age at birth has a quadratic relationship with the outcome, and, therefore, a squared term is added into the model.

4.4 Methods

Since children are not randomly assigned into households at birth, children residing in the same household are likely to be similar across a wide range of characteristics, as they will have the same mothers and household characteristics . This would lead to a strong correlation between children nested within the same household. Therefore, to address this issue a multilevel model is used. Thus, the different levels are:

1. at the individual or child level, i
2. at the household level, j, where a household may have varying number of children

Furthermore, because the dependent variable is a binary outcome, a two-level logistic multilevel model is used for the analysis with the form

$$logit\{Pr(Y_{ij} = 1|x_{ij}, \zeta_j)\} = \beta X_{ij} + \zeta_j, \qquad \zeta_j \sim N(0, \psi)$$

with the assumption that, given $\pi_{ij} \equiv Pr(Y_{ij}|x_{ij}, \zeta_j)$, Y_{ij} are independently distributed as

$$Y_{ij}|\pi_{ij} \sim Bernoulli(\pi_{ij})$$

Y_{ij} is the probably of a child, i, in family, j, dying before the age of 1. X_{ij} is a vector of covariates corresponding to the child and household levels, and β is a vector of the parameter estimates. The term ζ_j is the household-specific error term, which is given by a normal distribution with mean 0 and variance ψ. Whereas the child-level residual is assumed to have a standard logistic distribution with mean 0 and variance $\pi^2/3$.

The models are estimated using Stata 12, which does not support survey weights in multilevel modeling. A forward step-wise procedure was applied in building the models.

Initially, the model will not contain any covariates to estimate the variance in death that is between and within households. Next, the individual-level variables are added into the model. Model 3 will contain the household structure covariates such as multigenerational households. This is followed by family structure and family level covariates.

4.5 Results

Descriptive Statistics

Table 4.3 presents the descriptive statistics of the analytic sample. This is presented either in means or proportions. The first column describes the experience of all infants from all three surveys. The subsequent two columns report the descriptive statistics for the sample of infants who died or were alive separately.

The total number of children from all three surveys is 4,004 infants from 3,896 households. About half of the sample is female (49%) with a mean age of six months. The mother's mean age at birth for all children is 30 years old. Children in the sample are of high birth order. In terms of household characteristics, the mean household size for these children is 5 people. Over 12% of these children have at least one coresiding grandparent, and less than 4% of children are residing in single-parent households. About 54% of infants were born to mothers with primary education and less than 14% have secondary or higher education. The majority, 85%, of these children reside in households in rural areas.

When considering individual and household characteristics of these children, there are interesting differences. In terms of individual characteristics, there are few differences among children who died relative to those who survived infancy. Children who died under the age of one tend to have older mothers, are of a higher birth order and have shorter birth intervals. A higher proportion of children who died were from nuclear households with a smaller household size than children who survived. Children who died had a higher proportion of mothers without any education. Children who survived had a higher proportion of mothers with more than primary education.

In terms of household structure, there are substantial differences. At the first generation or child level, the number of siblings that infants had differed by survival status. While all infants had on average 1.69 sibling who are aged five and under and 1.57 sibling over the age of five, children who died had about half as many young siblings compared to those who survived, 0.83 and 1.79 respectively. Although, children who died had about one more sibling over the age of five than those who survived.

As mentioned in Chapter 1, most children grow up in two-parent households. As reflected in this sample, less than 4% of infants reside in single-parent households. A larger proportion of surviving children reside in these forms of households than those who died. With development during this decade, Cambodia had also experienced improved living conditions that increases the rate of survivorship of children over time. In combination with the rising trend of divorce (Heuveline and Poch 2006) mentioned in Chapter 2, children from the later

Table 4.3: Unweighted Characteristics of Infants in Cambodia in 2000-2010.

	All % or mean (standard deviation)	Died % or mean (standard deviation)	Living % or mean (standard deviation)
Individual-level Characteristics			
Gender			
Male	51.35	53.55	51.09
Female	48.65	46.45	48.91
Age (mos.)	5.75 (3.77)	1.89 (2.69)	6.21 (3.61)
Maternal Age			
at birth (years)	29.55 (6.54)	31.02 (7.38)	29.38 (6.42)
Birth Order	3.72 (2.34)	4.45 (2.83)	3.64(2.26)
Birth Interval			
Previous birth (mos.)	45.73 (26.94)	42.05 (29.09)	46.18 (26.64)
Household-level Characteristics			
Household Structure			
Nuclear	81.70	90.30	80.84
Multigenerational	18.30	9.70	19.16
Single Parent	3.39	1.99	3.63
household size	5.35 (1.84)	4.71 (1.98)	5.42 (1.80)
No. Children by Age			
≤ 5 year	1.69 (0.81)	0.83 (0.77)	1.79 (0.74)
> 5 year	1.57 (1.71)	2.77 (2.02)	1.43 (1.62)
Maternal Education			
None	32.47	37.81	31.92
Primary	54.17	52.99	54.27
Secondary	12.94	9.20	13.33
Higher	0.42	-	0.48
Residence			
Urban	14.94	12.69	15.13
Rural	85.06	87.31	84.87
Sample size	4004	422	3582
No. households	3896	402	3549

Calculation based on the Cambodia DHS 2000, 2005 and 2010.

period are more likely to survive and reside in single-parent households.

The presence of grandparents differentiates between nuclear and multigenerational households. Infants residing in households with grandparents, constituting a three-generation household, experience a different mortality pattern. In this sample, approximately one in five infants reside in a multigenerational households, but experience a twofold difference in survival status. That is, among children who died, about 10% lived in multigenerational households, but twice as many children who survived were living in multigenerational households. These descriptive statistics suggest that the presence of grandparents in the household is advantageous for children. The potential survival benefits of residing in multigenerational households will be explored further in this chapter.

Overall, the descriptive statistics suggest that individual and household characteristics among Cambodian infants are consistent with the literature. That is, the relationship of characteristics such as birth order, birth interval, mother's age at birth, household size, and survivorship patterns are consistent with the literature. In addition, the descriptive statistics also showed that there are potential divergent trends when household composition is considered, in particular the presence of grandparents. Therefore, the subsequent sections will further analyze this relationship while adjusting for potential confounders.

Multilevel Regression

The results from the multilevel logistic regression analysis is presented in Table 4.4. The rows are separated by individual followed by household variables with information about the models last. There are five models presented in the table. The first is the null model, followed by Model 2, which controls for individual and household characteristics. The subsequent four models address the research questions laid out earlier in this chapter.

Table 4.4: Odds Ratios for Multilevel Logistic Regression of Infant Mortality in Cambodia, 2000-2010

	Model 1 OR (*se*)	Model 2 OR (*se*)	Model 3 OR (*se*)	Model 4 OR (*se*)	Model 5 OR (*se*)	Model 6 OR (*se*)
Fixed Effects						
Intercept	0.053	0.025	4.189	4.194	5.027	5.090
	(0.014)	(0.012)	(1.541)	(1.545)	(1.878)	(1.909)
Gender						
Male		-	-	-	-	-
Female		0.908	0.874	0.871	0.869	0.869
		(0.12)	(0.11)	(0.11)	(0.11)	(0.11)
Maternal Age (years)		1.040***	0.950***	0.951***	0.949***	0.949***
at Child's Birth		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Maternal Education						
None		-	-	-	-	-

Primary		0.855	0.934	0.936	0.961	0.962
		(0.12)	(0.13)	(0.13)	(0.13)	(0.13)
Secondary+		0.632*	0.726	0.719	0.785	0.788
		(0.15)	(0.16)	(0.16)	(0.17)	(0.17)
Residence						
Rural		-	-	-	-	-
Urban		0.886	1.046	1.032	1.013	1.011
		(0.17)	(0.19)	(0.19)	(0.18)	(0.18)
Survey Year						
2000		-	-	-	-	-
2005		0.727*	0.638**	0.649**	0.645**	0.644**
		(0.11)	(0.09)	(0.10)	(0.10)	(0.10)
2010		0.632**	0.585***	0.590**	0.580***	0.579***
		(0.11)	(0.09)	(0.10)	(0.09)	(0.09)
Birth Order			1.449***	1.452***	1.439***	1.440***
			(0.07)	(0.07)	(0.07)	(0.07)
Birth Interval						
Less than 15mos			7.415***	7.659***	7.680***	7.674***
			(2.05)	(2.13)	(2.14)	(2.14)
No. Children by Age						
≤ 5 year			0.085***	0.085***	0.085***	0.083***
			(0.01)	(0.01)	(0.01)	(0.01)
> 5 year			0.993	0.987	0.987	0.987
			(0.05)	(0.05)	(0.05)	(0.05)
No. Parents						
Two				-	-	-
Single				0.519	0.597	0.583
				(0.21)	(0.24)	(0.28)
Household Structure						
Nuclear					-	-
Multigenerational					0.488***	0.428*
					(0.09)	(0.16)
Interactions						
Grandparent x						
Parent						1.068
						(0.97)
≤ 5 year						1.149
						(0.38)
Random Effect						
Household Intercept	1.510	1.471	8.20e-08	7.17e-09	1.73e-08	3.89e-09

	(0.290)	(0.295)	(0.204)	(0.203)	(0.203)	(0.2040)
N	4004	4004	4004	4004	4004	4004

Exponentiated coefficients

Model 1, the null model, examines the relationship of infant mortality between households and individual children. This model shows that there is a significant variation between households ($\hat{\psi} = 2.28$). That is, the probability of infant mortality has a wide distribution across households, with infants in some households more at risk of dying than others. Moreover, this model also suggests that there is clustering of infant mortality within households. This is given by the intraclass correlation, considered as the proportion of the individual variance relative to the entire sample variance from the individual and household levels. The intraclass correlation for this sample is estimated to be 0.41. One interpretation of this value is that it is the correlation of two randomly selected children being from the same household. Alternatively, this can also be interpreted as 41% of the total variability in infant mortality explained by household characteristics. This provides strong evidence for the use of the multilevel modeling to adjust for household level clustering compared to regular logistic models, which assume randomization of infant mortality across the sample.

Once control variables are included in the model, the results suggest some interesting patterns in the population. For instance, the balance between male and female can be considered as an index for gender bias or, in other words, gender preference. In the absence of gender bias, infant mortality is expected to be at a higher rate for males than females (Arnold et al. 1998, Drevenstedt et al. 2008, Heligman 1983). In a study of 15 developed countries that included Western European countries, North American countries, and Japan, Drevenstedt et al. (2008) showed a higher male infant mortality than female over time. Furthermore, the sex ratio of infant mortality is considered as the ratio of the probability of dying within the first year of life for male to female (q_0^M/q_0^F). This ratio rises and falls over time. For these 15 developed countries, it was 1.15 in 1900. In other words, there were about 115 male infant deaths for every 100 female deaths. The sex ratio then rose to 1.24 in 2000. The increase in the sex ratio of infant mortality is attributed to a shift in the cause of mortality from infectious diseases to perinatal causes, which adversely affect males. This provides a range for an underlying sex ratio of infant mortality.

As for Cambodia, since it is a developing country that has a high infant mortality rate caused by infectious diseases, the expected sex ratio for infant mortality would be closer to the developed countries around 1900. The sex ratio for the probability of infant mortality in Cambodia is estimated to be 1.09, that is, 109 male infant deaths for every 100 female deaths. This is slightly lower than the ratio for the developed countries from 1900, so it may potentially reflect the recent improvement in Cambodia. Therefore, when individual and household characteristics are controlled for, the results from Model 2 support this hypothesis. With a female infant having a 0.91 odds of dying compared to males, the model does not suggest a gender preference. Rather, the finding is similar to what is expected in populations without strong gender preference. Given that the kinship system in Cambodia is bilateral

with no preference for either the male or female side of the family, then the absence of a gender preference in the population is not surprising.

Whereas gender was not expected to make a difference in the outcome of a child's risk of mortality, other individual characteristics such as maternal age at birth and the birth order are expected to increase the risk of dying for infants. Generally, children are at greatest risk of mortality when they are born to either very young or very old mothers (Hobcraft et al. 1985, Linnemayr et al. 2008). In Cambodia, the mean age at first birth for women is 21 with most births given by women in their early 20s. While it is not statically significant, Model 2 does suggest the effect of maternal age is in the expected direction. For a one year increase in maternal age at birth, the odds of dying for infants increases by 1.013. This means that for a ten year difference in maternal age, the odds of dying increases by 14 percent.

Maternal education has been an important predictor of children well-being. This ranges from the amount of childcare time they receive (see Chapter 2) to nutritional status (see Chapter 3) to mortality. Studies have suggested that increasing maternal education improves the survival status of children (Cutler et al. 2006, Omariba and Boyle 2007, Rosero-Bixby 1986, Saha and van Soest 2011). Caldwell (1986) argues that educated mothers are better informed about the health status of their children and provide educated treatment when their children are ill. The educational gradient in mortality outcomes can also be observed among children in Cambodia. With each level of educational obtainment, the magnitude of mortality decreases. However, the effect is not statistically significant. This may potentially be caused by the similarity in education among Cambodian mothers in this sample as shown in Table 4.3. Education among mothers is not that varied because less than 15% of the population has more than primary education. As most Cambodian are poor, families may differentially invest in their children's education—more schooling for boys than girls. As females are considered to be responsible for domestic matters, girls education might end earlier than boys, thereby leading to lower level of education for mothers.

Furthermore, maternal education might only reflect mothers' knowledge or access to information but not necessarily the ability to obtain necessary resources such as medical care, medicine, or appropriate food that would prolong survival. Rather, household wealth would proxy the ability to provide adequate provision or ability to obtain medical assistance. A separate analysis performed on each survey year (not shown here) suggests that household wealth is significant to reducing the risk of mortality only for children in the top quintile, that is the top 20% of the wealth index created by the CDHS, which includes about 10% of the households in the sample. This impacts about 10% of the children in the sample with more than 50% of children residing in households in the bottom two wealth quintiles. However, as mentioned earlier, household wealth is highly correlated with maternal education. And Model 2 is able to detect the direction of effect, but the lack of statistical significance may be related to the small variability in maternal education.

Children born into households in urban areas have a slight advantage in survival. The odds of dying for children in urban households is 0.95, but this is not statistically significant. One potential explanation for why this is the case includes low quality health care in the country in general and, therefore, little variation in quality of health care. The quality

of public health such as sanitation and plumbing in urban areas is better than rural areas. However, the concentration of the population in urban spaces means faster spread of diseases, which may lead to higher risk of illness or mortality.

The improvement in the general population over this period is distinct. As the model shows, children from later surveys have a better chance of survival than those born in 2000. The country did much to improve public health over this period, including a reduced fertility rate which in turn reduced the number of children born to younger mothers and increased birth intervals.

Overall, this section highlights the importance of individual and household characteristics. While the direction of effect for these variables is consistent with the literature, not all values are statistically significant. In the subsequent sections, the relationship of infant mortality with household structure will be explored even further, starting with the impact of other children in the household.

Coresiding Siblings

Now turning to the first research question regarding siblings, this section presents the results from the analysis on siblings' influence on infant mortality. Variables accounting for the potential influence of siblings is introduced in Model 3 of Table 4.4. Some of the characteristics of sibling influenced infant mortality in an expected manner while others differed in unexpected ways.

As the literature suggests, the risk of infant mortality differed by the age groups of siblings. The results with respect to siblings will be discussed in two parts. First, children under the age of five are the closest in age to infants and would, therefore, be expected to exert the greatest influence on infant risk of mortality. Second, children over the age of five are more distal from infants. Because their physiological needs and roles in the household would be different, they would be expected to have a different relationship to their infant siblings.

Children under the age of five in the households can affect their infant siblings' risk of dying through physiological and social factors. In terms of physiological factors, this includes birth order and birth interval, which indirectly influences infants' risk of mortality. For instance, birth order indicates the order in which a child was born. Infants of higher birth order are born to mothers who had experienced multiple births, and, therefore, their mother would be older by the time the child is born. Therefore, it is not surprising that when birth order is included into the regression model, it reduces the main effect of maternal age. This suggests that the negative influence of maternal age on infant mortality is mitigated through child-level characteristics such as birth order. Not only has the effect of maternal age been mitigated, but it suggests that the effect of maternal age is protective once the influence of siblings is controlled for. As the mother ages, she would have gained experience in providing care or addressing immediate crises that would improve the risk of survival for later-born infants.

Moreover, since infants of higher birth order have mothers who had multiple pregnancies,

this suggests that their mothers may have experienced physiologically changes and nutritional depletion from previous pregnancies (Newcombe 1965, Saha and van Soest 2011, Scrimshaw 1978). Nutritional deficit would then place infant at greater risk of mortality. This negative relationship between birth order and infant survival is detected in Model 3. For the average child in the sample whose birth order is four, they have a 3.04 odds of dying relative to a first-born child.

The nutritional deficit that later-born infants may experience would be exacerbated when infants are born shortly after the previous sibling. The model suggests that infants born less than 15 months after the previous sibling have an odd of 7.42 of dying compared to infants who were born more than 15 months after the previous birth. The short spacing between births implies inadequate amount of time for mothers' bodies to heal and replenish nutrients for the next pregnancies (Saha and van Soest 2011). This would then lead to nutritional depletion for the next child, thereby increasing the risk of infant mortality for infants born shortly after the previous pregnancy. Consequently, birth spacing like birth order are individual characteristics of children related to maternal health and physiological well-being that can impact children's chances of surviving through infancy.

While birth order and birth spacing are related to infant mortality through maternal well-being, siblings in the household could directly affect the survival of infants. Though birth order indicates the maximum number of siblings available in the households (one minus the child's birth order), this does not take into account the number of siblings who survived or reside in the household at the same time as the child. Instead, the household variable for the number of children in the household would capture this information. More children in the household can mean faster transmission of diseases from one child to the next as they live in close proximity of each other. As infants are immunologically vulnerable, they are more susceptible to diseases transmitted from older siblings, thereby increasing their risk of mortality. Also, the age of a sibling can suggest different stages of their physiological/immunological development as well as social roles. This can then translate to a differential influence of siblings in relationship to infants. Therefore, two variables were used to indicate the number of children in the household who were aged five and under and those over age five.

The result in Model 3 suggests that the number of children aged five and under has an unexpected relationship with infant mortality. As the amount of maternal attention, care, and other resources available in the household is limited, the presence of multiple young children would then constrain the amount of resources available for all children. This competition for resources has been shown in Chapter 2 with regard to childcare time, where the amount of care time each child receives diminishes with an increasing number of children under the age of five. The competition for household resources among young children would then lead to increasing risk of malnutrition or illnesses that would then increase the risk of mortality (Muhuri and Menken 1997).

Instead, the results from the regression model suggest that in Cambodia the presence of multiple young children in the household is beneficial for infants. That is, infants have an odds of dying of 0.09 for each additional child in the household aged five and under. Infants may be protected from competition among siblings as parents may divert more household

resources to infants who are the youngest and most vulnerable children in the household. Alternatively, infants could be benefitting from resources of other siblings. Since children aged five to nine were found to contribute to childcare time in Chapter 2, it is possible that they were trained to contribute to household resources at an earlier age. Siblings are trained to share goods and watch younger siblings at younger ages. Thereby, infants would benefit from the presence of multiple siblings. A third possible explanation is that households utilize wealth to support all children. In households that do not have the necessary resources to support a growing family, parents would then rely on credit to finance the necessary resources (Chandler 1972, Ovesen et al. 2012).

Unlike the effect of young siblings, the presence and number of older siblings in the household has no impact on survival status of infants. This is given by the odds ratio of 0.99 in Model 3. As the odd is about 1, this can be interpreted as the difference between one sibling over the age of five having the same effect on infant mortality as no sibling over the age of five. Also, having several siblings has the same effect as having one or no sibling over the age of five.

The presence of children over the age of five might not be associated with infant mortality because of their biological and social conditions. That is, children have a lower risk of mortality over the age of five. Their immune systems might be developed by this age, allowing them to be less prone to infection and thereby lowering the risk of them spreading diseases. Moreover, older siblings would be experiencing different social contexts since they are attending school, performing domestic duties, or participating in the labor force. These activities can take older siblings away from the home for part or most of the day, thereby lowering the amount of interactions they would have with infant siblings. Therefore, with increasing responsibilities older siblings would have fewer opportunities to directly engage with and affect infant siblings.

In sum, this section discusses the impact of younger siblings in the household on infant mortality, as well as the lack of support for older siblings influencing mortality. The presence of young children in the household modifies the effect of control variables such as mother's age at birth. The following section carries this further by analyzing the influence of single-parent households.

Single-Parent Households

Turning to the next research question about the presence of parents on infant mortality, this section discusses the results of their influence. Model 4 accounts for single-parent households. Similar to the results for other children in the household, the association of infant mortality and the number of parents in the household is contrary to expectation.

The multilevel regression model suggests that infants in single-parent households have a survival advantage over those in two-parent households. The odds of dying for infants in single-parent households is 0.52 relative to infants in two-parent households. The lack of statistical significance of this variable can be interpreted as no relationship between infant mortality and the number of parents in the household. However, it is possible that the small

sample size of single-parent households leads to high variance and low statistical power to detect a relationship. However, if the regression model does not have power to detect statistical significance but estimated the appropriate direction, this would suggest something unique about single parents in Cambodia.

The formation of single-parent households, as mentioned earlier, can be through various factors. In households where one parent migrate out of the household and village for labor elsewhere, children experience a loss of a parent in the household. They lose the additional care time a father would have contributed or their participation in the function of the household would enable mothers to spend more time providing childcare (see Chapter 2). The loss of this parent might be mitigated through the resources the absent parent provides. The migrated parent's earning might be higher than the local economy of the household. Sending home remittance increases the household income to a level that may be as high or higher than the income of local two-parent households. This would allow the single-parent household to purchase more necessary goods that ensure the physical health of the mother and infant. If so, then infants in these single parent households would benefit more than those in two-parent households.

Infants in single-parent households formed through divorce, widowhood, or abandonment of a parent might not fare as well. These households lost the parental support of one parent measured by time and social contact. Also, they lose the economic resources that the deceased or absent parent would have brought into the household. Combined with the social stigma associated with these forms of single-parent households (Derks 2008, Heuveline and Poch 2006), these households would then be of lower socio-economic status where household members would have limited access to resources. In turn, this would place individuals in the household at greater risk of illness or untreated health conditions that may transmit to infants in the household and, thereby, increase their risk of death. While this may be the expected consequences of these single parent households, other factors may intervene and alleviate the risk associated with being in single-parent households.

The disadvantage of these single-parent households could be mitigated by external sources. For instance, single-parent households could benefit from the presence of non-governmental organizations (NGOs) within the country. With numerous NGOs present in the country with missions to help improve conditions for women and children, organizations are providing resources and skills for these targeted populations. The benefits gained through these organizations for single-parent households can reduce the loss of resources that the absent parent would have provided. That is, through the infusion of resources from NGOs, the downward spiral in living conditions for single-parent households could be halted or improved. In effect, these programs potentially mitigate the risk of mortality for children in these single-parent households, particularly for infants.

Alternatively, single-parent households could be supported through extended families. Since Cambodians prefer to live near other family members (Crochet 2011), some of the childcare support lost through the absent parent could be provided by extended family members residing in nearby households. Furthermore, these extended family members could provide additional resources in terms of economic support. Extended relatives could offer

their labor to help with farming the household plot (Chandler 1972, Crochet 2011, Ovesen et al. 1996). Other contributions could be made in the form of gifts of food, materials, or cash (Knodel et al. 2005, Zimmer et al. 2006). Through the support of relatives especially immediately following the departure of one parent from the household, infants might not be affected immediately by the loss but could be protected through the additional resources in the household provided by relatives.

Furthermore, families may strategize to maximize resources by integrating other relatives into single-parent households. That is, single-parent households could move into other relatives' households or have relatives move into their households. This would maximize the number of individuals available in the household to provide childcare and participate in the labor force to increase household resources. Although, inclusion of extended relatives in the household, such as the infants' cousins, aunts or uncles, or other extended relatives, would not be captured in this analysis as these households do not fit inclusion criteria of the analysis. However, the inclusion of grandparents in single-parent households is within the domain of this analysis. Therefore, single-parent households who had grandparents move into the household or moved into the grandparents' household (without other relatives present) would be captured in this study as these households would be considered multigenerational households. This would enable single parents to gain the additional childcare time and resources that grandparents would be able to provide. The analysis on the presence of coresiding grandparents would be discussed in further details in the following section.

Overall, this section suggests that single-parent households are not associated with infant mortality in Cambodia. Other avenues of potential resources for single-parent households could be mitigating the influence of residing in a single-parent households for infants, which could reduce their risk of mortality. A potential factor could be the additional resources for infants including the presence of grandparents, which will be explored in the next section.

Multigenerational Households

While the previous section explores the influence of single-parent households on infant mortality, this section addresses the last two research questions regarding the presence of grandparents in the household. Model 5 and 6 report the results of the presence of grandparents in the households and the interactions of grandparents with other household factors. These results confirm the beneficial role of grandparents, but suggest an interesting relationship with other factors.

Model 5 suggests that infants residing in multigenerational households benefit from the presence of grandparents. The presence of coresiding grandparents in the household reduces the risk of infant mortality. This is expressed by the coefficient for the multigenerational household variable, where the odds of dying is 0.49 for infants in multigenerational households relative to infants in nuclear households. The roles grandparents play in these households could increase or redirect resources to protect infants. For instance, the results in Chapter 2 suggested that grandparents provide additional childcare time for children in the households. Infants in multigenerational households are then getting additional supervision from coresid-

ing grandparents. Besides care time, infants can receive additional resources from coresiding grandparents. A study by Duflo (2000) suggests that children in households where grandparents received a pension had better nutritional outcomes. While the elderly population in Cambodia do not receive a pension, coresiding grandparents can receive gifts or remittance from non-coresiding adult children (Zimmer et al. 2006). These resources might be used to invest in food or medicine for coresiding grandchildren. Thereby, grandparents use their resources to increase the total amount of resources available to infants in the household. More resources available directly through coresiding grandparents for infants can then lower the risk of infant mortality.

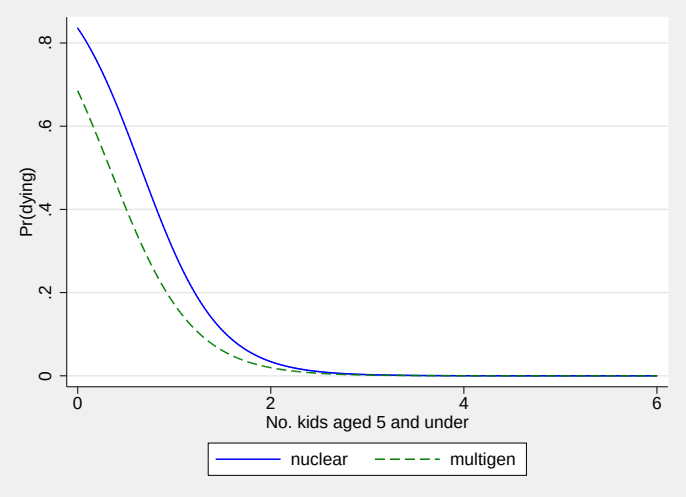
In addition, coresiding grandparents can indirectly influence infants' survival. Grandparents' utilization of their time aside from childcare can influence maternal time. Coresiding grandparents participate in household production as shown in Chapter 2. Their involvement in domestic labor can reduce the overall burden on mothers to perform these tasks. Lowering the demand for mothers to participate in household production would allow her to have more time. The time and energy saved from performing household labor could be used to provide childcare and engage with infants. This intensification of childcare can allow parents to notice the onset and respond quickly to illnesses. Thus, grandparents' participation in domestic production can indirectly reduce the risk of infant mortality through mothers.

The advantage of having coresiding grandparents in the household seems to favor infant survival, but this may potentially differ when considering the presence of grandparents with other household factors. Model 6 addresses this concern by including interactions. For instance, the effect of coresiding grandparents can vary by the number of parents in the household. The presence of grandparents in single-parent households might not reduce the risk of mortality for infants but rather have the opposite effect. This is given by the coefficient for the interaction of grandparents and single-parent households, which is 1.07. This suggests an elevated risk factor when infants are residing in single-parent households with coresiding grandparents, but the coefficient cannot be interpreted independently. Interaction terms need to be interpreted in conjuction with the main effects. For example, compared to single-parent households, infants in single-parent households with coresiding grandparents have the odds of 0.46 of dying. This is a lower risk of dying than just residing in a single-parent household (see Model 4). The presence of grandparents in single-parent households lower the risk of mortality for infants. The benefits of having coresiding grandparents to provide additional childcare or resources for infants can further protect them from the risk of mortality than simply being in a single-parent household. Conversely, infants in single-parent multigenerational households have higher risk of mortality than those in two-parent multigenerational households. Their risk of dying is 0.62. This implies that the combination of having a single-parent and coresiding grandparent slightly elevates the risk of mortality for infants. Coresiding grandparents can provide additional resources for the household, but the amount of resources they are able to provide would not be equivalent to a household with two parents, where the additional parent would be able to bring additional and more stable income than the grandparent. Also, single-parent households with a coresiding grandparent might lose potential support from extended family if relatives perceive the coresiding grand-

parent as a substitute parent in the household. This would then lead to lower resources for single-parent multigenerational households.

Furthermore, the advantage of grandparents in the household can be modified by the the number of young children in the household. Model 6 does suggest that the number of young children in the household modifies the advantage gained by the presence of grandparents, that is increasing the risk of mortality of infants in multigenerational households with more children. However, when taking into account the main effects in addition to the interaction between the presence of grandparents and number of children under the age of five, the advantage of grandparents in the households persist up to a certain number of children. This relationship is shown in Figure 4.2. The graph shows the probability of dying for infants by the number of children aged five and under in the household and by household structure. The risk of dying for infants declines for each additional child and remains stable after three children in the household. Infants in multigenerational households have a lower risk of mortality than nuclear households, but this protective effect disappears after two young children in the household. More importantly, the risk of dying for infants in multigenerational households does not exceed that of nuclear household. The leveling off of the risk of dying for infants in both nuclear and multigenerational households indicates a lack of difference in the risk of mortality by household structure after two children in the household, which could explain why the interaction is not statistically significant.

Figure 4.2: Probability of Dying by Household and Number of Children Aged 5 and Under



Even though the interaction is not statistically significant, the graph suggests when the presence of grandparents is important. That is, the presence of grandparents in the household is important when there are fewer than three children aged five and under. Children in households with one or two children aged five and under are correlated with the first- and second-born children. This means that mothers are new and inexperienced in their role. Coresiding grandmothers can advise mothers in the childcare process, recognize early signs

of illness, and respond accordingly. Their knowledge and experience would then benefit infants in the households. After the first and second child, mothers would gain experience in providing care to her young children, which would demand less intervention from coresiding grandmothers. Consequently, coresiding grandparents can lower the risk of infant mortality for young children who are the first or second child in the household until mothers gain experience with childcare.

Overall, this section addresses the third and fourth research questions regarding the presence of grandparents in the household. This analysis suggests that the presence of grandparents in the household protects infants from the risk of mortality. While infant mortality is principally driven by individual characteristics, household characteristics such as the presence of grandparents in multigenerational households also affects infant mortality. However, the presence of grandparents in combination with other household factors are not strong predictors of infant mortality.

4.6 Discussion

This chapter addresses the influence of family structure on the risk of infant mortality in Cambodia. This relationship is investigated through an examination of three aspects of family structure on the risk of infant mortality: the presence of coresiding siblings on infants' risk of mortality is examined; the number of parents; and the presence of coresiding grandparents in the household. The findings suggest that household structure reflected in these measures does influence the risk of mortality for infants.

The most notable finding of this analysis is that grandparents matter for infant mortality. If we isolate the main effect of grandparents, the presence of grandparents in the household provides a safety net that increases the chances of survival for infants. Grandparents can increase infants' chances of surviving through their first year of life by investing their potential resources on coresiding grandchildren. That is, grandparents can bring additional resources into the households that can be utilized directly to improve infant well-being or indirectly via a maternal well-being that is subsequently transferred to the infant. Grandparents can share the caregiving role with mothers in terms of their knowledge as well as the time spent providing care for children in the household.

Unlike the presence of grandparents, the number of parents in the household has no relationship with infant mortality in Cambodia. The finding in Cambodia might be considered as surprising when compared to findings from places like Spain or Africa. Infants and children under the age of five residing in single-parent households had a higher risk of mortality than those in two-parent households in historical Spain and contemporary Sub-Saharan Africa (Omariba and Boyle 2007, Reher and González-Quiñones 2003). In these patrilocal societies, fathers were the primary provider of resources, which meant single mothers had difficulty substituting the resources that father would have provided. Although, mothers' ability to supplement fathers' economic resources might be lower but sufficient enough to sustain the household in most societies. This would explain the absence of fathers in most

societies having little to no effect on infant mortality (Sear and Mace 2008). In which case, the results found for single-parent households in Cambodia would then be consistent with other empirical findings.

Unlike parents, findings on the effect of siblings is not consistent. The findings in Cambodia with regard to siblings are not consistent with the literature. Not all siblings affect infants' risk of mortality. While evolutionary biology suggests older siblings act as helpers in the nest and thereby increase the rate of survival of younger siblings (Crognier et al. 2001), the empirical analysis for Cambodia does not support this hypothesis. The data do support a role for the presence of younger siblings on infant mortality. However, unlike studies conducted in other developing countries like South Asia, where the presence of young siblings increases the risk of mortality (Arnold et al. 1998, Muhuri and Menken 1997), the presence of young siblings in Cambodia improves the survival of infants.

A potential factor that may explain the difference in results for Cambodia from other studies could be related to the data. As the CDHS is a survey collecting retrospective data, there is the possibility for underreporting infant death. Mothers may omit births that resulted in deaths during the first few months of life. If the death of the child occurs within the previous year of the survey, then the omission of the birth and death of a child in the household can bias the results downward. That is, the protective effect of having younger siblings in the households might actually be neutral or in the opposite direction.

As differences in the findings appear not to be an issue of data quality, then the potential difference may be related to contextual differences. That is, places with a negative association between infant mortality and the number of children in the household also experience higher fertility rates and gender preferences. With higher fertility there is a stronger pressure on household resources than households with fewer individuals. Moreover, Cambodia does not have a strong gender preference like India and Bangladesh where a negative association has been found. The absence of gender preference may lead to parents treating their sons and daughter more equally in the distribution of resources. This might then foster a more collaborative and communal environment that engages children in the well-being of all individuals in the household.

Another noteworthy finding is the mortality decline over the decade. Children born in later periods of the surveys have lower risk of mortality than infants captured in the 2000 survey. The decline in mortality captures the marked improvement in the country over this period. These improvements include the socio-political stabilization within the country and the economic growth (Marriott et al. 2010, of Cambodia 2003). With the economic development, new job opportunities opened in the textile and service industries in urban areas. These opportunities attracted migrants from rural areas into the capital. Cambodian households then responded to these changes. Larger household structure formed in urban areas with extended family members (Demont and Heuveline 2008). This means the presence of other relatives in the household may potentially influence infants in the household.

4.7 Conclusion

This study found evidence that family structure does influence infants' risk of mortality in Cambodia. Infants residing in multigenerational households benefit from the presence of coresiding grandparents. As life expectancy continues to rise and families are expected to support the elderly, more children can expect to live in households with coresiding grandparents for extended periods of time. While this study found an association between infant survival and household structure, additional research will be needed to examine the mechanism by which grandparents modify infant survival.

4.8 Appendix

Table 4.5: Multilevel Logistic Regression of Infant Mortality in Cambodia, 2000-2010

	Model 1 OR (*se*)	Model 2 OR (*se*)	Model 3 OR (*se*)	Model 4 OR (*se*)	Model 5 OR (*se*)	Model 6 OR (*se*)
Gender						
Male		-	-	-	-	-
Female		0.913	0.874	0.871	0.869	0.869
		(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
Maternal Age		1.013	0.950***	0.951***	0.949***	0.949***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Birth Order		1.090**	1.449***	1.452***	1.439***	1.440***
		(0.04)	(0.07)	(0.07)	(0.07)	(0.07)
Birth Interval						
Less than 15mos		3.971***	7.415***	7.659***	7.680***	7.674***
		(0.89)	(2.05)	(2.13)	(2.14)	(2.14)
Maternal Education						
None		-	-	-	-	-
Primary		0.912	0.934	0.936	0.961	0.962
		(0.11)	(0.13)	(0.13)	(0.13)	(0.13)
Secondary+		0.746	0.726	0.719	0.785	0.788
		(0.15)	(0.16)	(0.16)	(0.17)	(0.17)
Residence						
Rural		-	-	-	-	-
Urban		0.946	1.046	1.032	1.013	1.011
		(0.16)	(0.19)	(0.19)	(0.18)	(0.18)
Survey Year						
2000		-	-	-	-	-
2005		0.759*	0.638**	0.649**	0.645**	0.644**
		(0.10)	(0.09)	(0.10)	(0.10)	(0.10)
2010		0.699*	0.585***	0.590**	0.580***	0.579***
		(0.10)	(0.09)	(0.10)	(0.09)	(0.09)
No. Children by Age						
≤ 5 year			0.085***	0.085***	0.085***	0.083***
			(0.01)	(0.01)	(0.01)	(0.01)
> 5 year			0.993	0.987	0.987	0.987
			(0.05)	(0.05)	(0.05)	(0.05)
No. Parents						
Two				-	-	-

Single				0.519	0.597	0.583
				(0.21)	(0.24)	(0.28)
Household Structure						
Nuclear			-	-	-	-
Multigenerational					0.488***	0.428*
					(0.09)	(0.16)
Interactions						
Multigeneration x						
Single						1.068
						(0.97)
$\leq$ 5 year						1.149
						(0.38)
N	4004	4004	4004	4004	4004	4004

Exponentiated coefficients

Chapter 5

Conclusion

The purpose of this research is twofold. First, this dissertation attempts to provide an understanding of the current state of child well-being in Cambodia. Second is the role of family structure in protecting the well-being of these children. As the context of these conditions changes with development in Cambodia, I tried to untangle the important underlying need children have for grandparents to secure their well-being. In this chapter, I will summarize the findings of the different aspects of child well-being that have been assessed in this dissertation, discuss the implications of these results, and highlight the limitation of the research and directions for further study.

5.1 Summary

This study considered three aspects of child well-being, which are the quantity of childcare time children receive and their health outcomes measured in nutritional status and mortality. To quantitatively assess the impact that family structure has on child well-being in Cambodia, data from the Cambodia Socio-Economics Survey and the Cambodia Demographic and Health Survey were analyzed.

As the quantity of care can have implications on children's health, I first investigate the amount of care time children receive in different household structure in Chapter 2. Instead of finding the presence of grandparents substituting maternal care time, children in Cambodia benefited from the presence of grandparents who supplement maternal care time. The gain in care time for children in multigeneration households is largely through the presence of grandmothers in the household.

In terms of health consequence of family structure, I considered the nutritional status of children. In Chapter 3, I found that children are less likely to experience chronic malnutrition when residing in households with grandparents. As children receive additional care time from coresiding grandparents, they are able to have increased resources and experience less frequent bouts of illnesses that allows them to grow taller than their peers in nuclear households.

Moreover, grandparents provide children an even greater health advantage: their survival. As noted in Chapter 4, there is a lower risk of mortality for children residing in multigenerational households. This pattern builds on the previous findings that grandparents are helping mothers with childcare and household activities so that she can focus on nurturing her infants. Thereby, they allow children to maximize the amount of care and breastfeeding from mothers that would ensure their nutritional status. With better nutrition, they are then less prone to infections that could claim their lives.

5.2 Implication

In order to discuss the implication of this research, I want to begin with how we traditionally view studies on the elderly population in Asia. With the demographic transition, where the rates of fertility and mortality are declining, people are expected to live longer than they ever have before. With increasing life expectancy, there is a general concern about the dependency of the elderly population on working-age adults. Built into the concern is the assumption that this segment of the population are not active and contributing to the economy or households. Instead, let us ask the question: How is this population contributing to households and society at large?

As we have discussed in Chapter 3, grandparents, who are the oldest members of the household, are still economically active and contributing to the household resources. While the share of their contribution is not as substantial as working-age adults, their contributions are still important in an environment that is largely based on subsistent farming. Moreover, their contribution inside the household is equally important for society. Through grandparents' time, children are able to receive additional supervision that helps improve the health status of children.

Healthy children not only indicate how well a country is doing, but the potential of its future. As the life-course literature suggests, early childhood conditions can influence the health and mortality risk far later in life. As children with better nutrition and health status are then less prone to illnesses and for shorter duration, their health is less compromised over time allowing them to have more active days that can be directed towards economic production as they age. Moreover, healthy children are known to miss less schooling and have better performances. Since learning is an accumulative process, being health in early childhood can then help build the foundation for learning over the lifetime. With better health conditions and education, children can then grow into healthy, educated adults who are economically productive and have a higher socio-economic status.

Consequently, coresiding grandparents' ability to secure the health and survival of children early in life are also securing their future. They are then potentially ensuring the long-term health advantage of coresiding grandchildren. These children are then potentially able to grow into productive members of society.

5.3 Limitation

In this section, I will discuss the major drawback of my study with regards to the data and method of analysis.

In this study, I benefited from the data collected from two nationally representative surveys: Cambodia Socio-economic Survey and Cambodia Demographic and Health Survey. These surveys are rich in the detailed information and the large sample sizes but have their own limitation for this analysis. For instance, as they are surveys, they cannot capture the fluid change in household composition and the health conditions of children over time. How families allocate their time and organize their membership because of the rapid development in Cambodia during this time period might be missed. I would have liked to compare how family members allocated their time during the early part of this decade to a later time period to determine if changes in Cambodia affected how families restructure time. Moreover, it would have been nice to capture the shift in family structure and the onset of children's health conditions. While the rates and causation process is less clear with survey data, the sample size and prevalence of the health conditions and family structure in the country permitted the analysis to estimate the potential relationships.

Family structure in the analysis has been narrowed to consider nuclear and multigenerational households. This restriction permits the interpretation of having an additional family member, namely grandparent, in the household. However, household structure in Cambodia is not limited to nuclear and multigenerational households but includes households with other relatives and non-relatives. An extension on the definition of family structure to include these other forms of household structure would then enable a greater understanding of who else in the family network impacts children's health.

Furthermore, family structure has synonymously been associated with household structure. While Cambodian households tend to be organized as independent units, qualitative studies suggest the interdependence of households through clustering of related family members in the same village and the social mechanism that binds members together. These bonds could mean sharing of resources and childcare that would be missed through assessment of independent households. However, as the surveys only collected households' information, it is difficult to assess the implication of how shared resources across households affect children. Nonetheless, these household analyses provide an estimate of potential impact of independent households.

5.4 Further Study

The results with the data limitation presented in this dissertation encourages extended research on this topic. With regard to family structure, it will be useful to expand the classification to include extended households containing other relatives. While multigenerational households are distinct in that they allow a clear study of the relationship of grandparents' influence on the outcomes of children, discerning which member of the extended household

impact children's well-being will be more challenging. Nonetheless, consideration of extended households is also important as they account for more than 12% of household structure in Cambodia. The socio-economic context that drives the formation of these household can mean something different for the children.

In addition, while the quantity of care has been informative on the amount of supervision children receive, it is also important to understand the quality of care. How parents and grandparents spend their time with children informs how the differences in children's health outcome may arise. As studies in developed countries suggest, parents spend time with children translates into differential academic performances. Then understanding how adults in multigenerational households in Cambodia spend time with children might inform the mechanism through which children have better health outcomes.

Lastly, this dissertation has principally focused on Cambodia. It would be useful to analyze the influence of family structure on children's health in other countries in the region. Through this process, I believe it would help generalize the importance of children benefiting from the intergenerational interactions. This is especially important in a context where there is a lack of a pension system and a need for familial support.

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