



Research Paper No. 2007/84

Women's Status and Children's Food Security in Nepal

Milla Nyyssölä*

December 2007

Abstract

This paper focuses on gender aspects upon children's food security. Using data from the 1995/1996 Nepal Living Standards Survey, this study attempts to find evidence to whether children are heavier for their age, taller for their age or heavier for their height in families where mother's intra-family status is relatively better. The relationship between mother's intra-family status and children's food security was analyzed with a linear model, where on the left hand side are children's anthropometric z-scores and on the right hand side women's status indicators and other factors affecting children's food security. The test received significant positive evidence for the mother's knowledge upon birth controlling, mother's age at childbirth and the inter-spousal education difference. The boy preference shows in the results.

Keywords: women's status, gender, food security, children, Nepal, Asia

JEL classification: J16, Q18, D63, I31

Copyright © UNU-WIDER 2007

*Helsinki School of Economics, Finland. E-mail: milla.nyyssola@student.hse.fi

This study has been prepared within the UNU-WIDER project on Gender and Food Security, directed by Basudeb Guha-Khasnobis.

UNU-WIDER gratefully acknowledges, in particular, the project support provided by the Finnish Ministry for Foreign Affairs, and the financial contributions to the overall research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency – Sida) and the United Kingdom (Department for International Development). Special thanks go to the CSSSC – Centre for Studies in Social Sciences, Calcutta, India, and UNU-Institute for Natural Resources in Africa, Accra, Ghana, for providing logistical support to the project meetings.

ISSN 1810-2611 ISBN 978-92-9230-037-1

Acknowledgements

I would like to thank the Economics Department of Helsinki School of Economics and especially Professors Pertti Haaparanta and Pekka Ilmakunnas for valuable advice. I am grateful to Basudeb Guha-Khasnobis for making this work part of the 'Gender and Food Security' project at UNU-WIDER and Rafael de Hoyos for his recommendations.

The World Institute for Development Economics Research (WIDER) was established by the United Nations University (UNU) as its first research and training centre and started work in Helsinki, Finland in 1985. The Institute undertakes applied research and policy analysis on structural changes affecting the developing and transitional economies, provides a forum for the advocacy of policies leading to robust, equitable and environmentally sustainable growth, and promotes capacity strengthening and training in the field of economic and social policy making. Work is carried out by staff researchers and visiting scholars in Helsinki and through networks of collaborating scholars and institutions around the world.

www.wider.unu.edu

publications@wider.unu.edu

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Janis Vehmaan-Kreula at UNU-WIDER

The views expressed in this publication are those of the author(s). Publication does not imply endorsement by the Institute or the United Nations University, nor by the programme/project sponsors, of any of the views expressed.

1 Introduction

This paper examines the impact of women's intra-household status upon children's food security in Nepal. Food security, defined as the access at all times to safe, adequate and nutritious food for a healthy and active life, is greatly contributing to children's normal growth, being the most distinctive feature of children's wellbeing. Globally more than 300 million children are malnourished (UNICEF 2007). This means a higher risk to catch fatal infections, get permanent damages to intellectual development and growth (Onis et al. 2004). In Nepal children's malnutrition is a severe problem. The prevalence of stunting among under five-year-olds is the fifth worst in the world (51 per cent, UNICEF/Nepal 2007). Child malnutrition is a sign of poor food security, disease and improper care during illness (Sah 2005) and it is associated with children's mortality, which in Nepal is alarmingly high (UNICEF/Nepal 2007). In Nepal malnutrition is not due to the lack of food production, but it is caused by the social problems and more precisely by the low social status of women (Sah 2005).

Thus, this study attempts to find evidence from Nepalese household data to whether woman's intra-family status has an effect on children's growth (Quisumbing and Maluccio 2003; Guha-Khasnobis and Hazarika 2006). The main approach is to test whether the collective model of household holds against the traditionally used unitary model (Becker 1981). According to the collective models, the distribution of assets in a household is an outcome of Nash Bargaining between its members and the final shares depend on the member specific bargaining powers. Women, who usually have a relatively lower status in developing countries, are considered to invest relatively more on children's wellbeing (Thomas et al. 2004), whereas men tend to invest relatively more in so called adult goods (Duflo 2000). Most likely according to the traditional role models, where the mother is the primary contact and caretaker of children, play a role here. High relative investments in adult goods can be considered a sign of male dominance.

Previous studies have discussed various, sometimes controversial measures from household data to describe a woman's relative status, such as mobility, age related variables, differences in human and physical capital and working. What comes to female labour supply, many Nepalese women tend to abstain from labour force if families are well-off enough (NLSS 1). Furthermore, the U-hypothesis of female labour market participation suggests, that on low stages of economic development female labour supply tends to decrease with extra income. Only after reaching a certain stage of economic development, labour supply in the society increases. Then working and labour income can be considered a sign of a bargaining power (e.g. Goldin 1995). Thus, if the mother has to work, she may be even considered to have less bargaining power. Mothers empowered with education are more likely to perceive their children's illnesses and seek healthcare (Pokhrel and Sauerborn 2004). What's more, an increase in a woman's marriage age may lead to a more than proportional change in her education attainment (Field and Ambrus 2005). Thus, the indicators may be connected in a non-linear fashion. On a comfortable wealth level, improvements in e.g. female income have no longer visible effects on children's nutritional status. Earlier studies have noted that some endogeneity has to be tolerated in household models (e.g. in Quisumbing and Maluccio 2003). For instance the budget shares on adult goods are often considered to provide useful information about women's decisive power, but the shares themselves may be subject to preliminary bargaining. Yet, in NLSS 1 the correlation between the key status variables and adult good expenditure shares was moderate. The dependent

variable, food security, is measured with nutritional z-scores for weight and height relative to age and sex, since they convey information of the accumulation of nutrition over time.

The evidence from NLSS 1 supports the collective model as a description of household behaviour, especially upon the implications of the education difference between spouses, mother's knowledge concerning birth controlling methods and mother's age at child birth. The analysis finds evidence that mother's marriage age influences the education difference between spouses. Previous studies from NLSS 1 have shown that in Nepal mothers start controlling their fertility only after delivering a boy (Pokhrel and Sauerborn 2004). Mothers indeed seem to make decisions in favour of males, since male height and weight is affected positively upon birth controlling knowledge. However mother's age related bargaining power measures seem to improve female children's food security.

In Nepal the socio-economic conditions may have a smaller impact on the status indicators than the group norms, since according to Thapa (1989) the ethnic factor in Nepal has a significant effect on e.g. the timing of the family formation and labour supply. In NLSS 1 a small or positive age difference in favour of the wife does not necessarily imply a higher bargaining power, as it may be a mere norm. For instance among the Tharu, wives are practically always older than their husbands, because an older wife is seen as a more efficient contributor to the household chores.

The rest of this paper is divided into six further sections. The following section 2 goes through conceptual linkages between women's status and children's food security. The third section discusses the Nepalese context. The fourth describes the data, variables and methods. The fifth analyses the results. The sixth discusses the further research and the final section concludes the paper.

2 Conceptual linkages between women's status and children's nutritional status

According to Smith et al. (2003) mother's status affects child nutrition through three main pathways: food security, caring practices and household health environment. Mother's status has an impact on her own personal wellbeing and her capabilities to care for others. In Nepal the woman has the major role in taking care of the family nourishment, hygiene and security. An excess burden of physical labour and maternal malnutrition affect foetal growth, breast milk quality and adequacy as well as mother's capacity to protect and care for children (Mahajan et al. 2005). Mother's ill physical and mental health (e.g. depression) is transmitted to children through increased infection risk and foetal growth retardation, which is again associated with significant retardation on child's physical and mental development (Carter et al. 2001), perinatal and childhood morbidity (Mahajan et al. 2005). Women are seen as more empathetic and altruistic, possibly due to their traditional role models and close contact with children. Moreover, it is well known that mothers use more of their own income to buy food and medicines for their children's needs than men (Smith 2002). Moreover Nepalese women's income-earning abilities and productivity are inferior to those of men. Too early childbearing, due to family pressures, often causes pregnancy and birth complications (Smith 2002). Younger mothers will most likely have relatively lower cognitive abilities to care for children, as the early childbearing often is a reason for not enrolling to school. Research from several countries (e.g. Sandiford et al. 1995), states that literate mothers have

better nourished children and lower risks of mortality than illiterate mothers, irrespective of wealth. Nutrition knowledge, caring practices, hygiene and health knowledge, as well as the susceptibility to seek health care for children affect growth. Women with a higher status are more likely to use modern facilities and take the initiative in seeking care for themselves and their children (Caldwell 1996).

3 Background

Nepal is a landlocked country situated in Southern Asia between India and China (Tibet). It comprises of three main ecological regions: hills, terai¹ and mountains. The regions differ significantly in terms of population (Table A1), land, access to food and food grain production, the extent of malnourishment and undernourishment. Nepal is one of the poorest and least urbanized countries in the world (UNICEF 1992). Half of the population is illiterate and the country ranks the second lowest in South Central Asia in the human development index (144/174, UNDP 2006). Per capita income is the lowest in South Asia. Most of the inhabitants live on agriculture on the hills and on the terai (Chhetry 2001). At the national level Nepal has been food secure except for the drought years at the end of 1970s. The access to remote areas is highly limited due to the underdeveloped infrastructure and ecological variation. Consequently the hunger remains prevalent in endemic pockets, as food is not evenly distributed² (Pyakuryal et al. 2005). The rapid decline of forests, which often is an independent source of subsistence against shortages for women and children, the environmental aspects like heavy monsoon rains and the civil war have taken their toll on the livelihoods of the poor. The civil war has claimed 20,000 lives and has brought about destruction to infrastructure and medical facilities (Singh 2004). The ten year insurgency ended in November 2006 and the Maoist party is now involved in the interim government, which pursues a permanent peace and democracy to the still very disordered country (Embassy of Finland 2007).

Agriculture is becoming increasingly feminized as more men enter the non-farming sectors (ADB 1999). In addition, the sources of income for farmers have changed. The household- and the farming incomes have decreased five per cent, since agricultural productivity has stagnated from the mid-1980s onwards. On the other hand contribution to non-farm sources has come up from 11 per cent to 14.5 per cent (ADB 1999). This most likely implies that women's income relative to men is declining. Female productivity is lower at least since female literacy is less than 35 per cent and girls drop out of school earlier than boys.

Population groups, castes and languages are numerous³ (Table A1), which results in great variability in gender equality. The different ethnic groups have their specific beliefs, institutions and languages. For instance some groups have a positive age difference like the Tharu and some have a very negative difference like the Muslims.

1 Plains, a grain producing belt stretching from east to west in the South near the border of India. In literature terai is also called tarai.

2 Recent estimates of IPFRI of the per capita food deficit are 47 kg in the mountains and 32 kg in the hills, even though per capita surplus is 45 kg countrywide.

3 Depending on the classification method there are records of 40-120 different ethnic groups.

Many groups value monogamy, but some may consider polygamy as normal like Sherpas (Thapa 1989). Yet, some aspects are quite similar countrywide, such as the importance of maternal schooling to children's health. The caste system is unofficial, but it is strongly controlling the society, which sets special characteristics into women's life (e.g. within some groups widows are considered impure (Galvin 2005). The gender development index rating for Nepal is poor (138/177, UNDP 2006). Women carry heavy general workloads, high risks of pregnancy and child birth, worse general health, poor nutrition and education, all of which are causing exalted female mortality rates (Kelomaa-Sulonen 1991). Traditionally husbands and older family members hold the authority over decisions in financial, social and family-planning issues. Even if a woman develops a substantial intra-family status, the community factors still limit her autonomy (Niraula and Morgan 1996). Vice versa the individual level factors have a greater influence in a less patriarchal context (Niraula and Morgan 1995).

According to the Hindu⁴ traditions marriage is a necessity for a woman. Nepalese laws support this as well (ADB 1999). Men's bargaining power increases with younger brides (Field and Ambrus 2005). It is not unusual for a Nepalese woman to marry before menarche or have no say in the selection of her future husband. About 40 per cent of 15 year-old girls are already married. Marriage age laws can often be ignored as these vital events are seldom officially registered (Thapa 1989). The kin pressures ensure that the first child is born by the age of 15 to 16. In Nepal women tend to start controlling their fertility only after giving birth to a boy, which is reflecting a gender bias⁵ (Leone et al. 2003). If there is no son who is entitled to a side of the bargain, male members can acceptably ignore conjugal sharing. Sons continue the family name, can perform funeral rituals and are expected to provide support in the old age (Leone et al. 2003). If the first wife does not deliver a son, the husband may take another wife for financial and religious motives (Leone et al. 2003). Thus for a woman a male progeny is nearly always her most manipulative link.

Boys are prepared for productive work and decision making, while girls are brought up to be housewives, mothers and service providers (Klawon and Tiefenthaler 2001). Girls have a lack of access to information, knowledge and resources, as they spend their life at home (Niraula and Morgan 1996). Open discussions between women about menstruation, sex and pregnancy are not common and sexuality is closely guarded by relatives (UNICEF 1992). Normally the female youth has no access to health or sex education or health services to deal with their problems, which as well contributes to infant mortality, being one of the highest in the Asian region (64.4/1000 births; UNICEF 2006). Currently over half of the under five year-olds are stunting (UNICEF/NEPAL 2007). And for the survey sample the figure for 0-3 year olds is 76 per cent. Malnutrition is more common on the mountains than on the terai plains. On the mountains the presence of ancient Tibetan gene pool and altitudinal variation may affect stunting (Pawson 1976).

⁴ Nepal is the only official Hindu state in the world.

⁵ Commonly used indicators are sex ratio at birth and sex specific immunization rate. According to Martorell et al. (1984) there is anthropometric evidence of no gender disparities in the Nepalese Terai in the growth retardation depending on the gender of the child. Secondly according to UNICEF report in 2006, there is no gender disparity in the rate of vaccination against measles, breast feeding or the extent of stunting due to malnutrition.

4 Data, variables and methodology

All empirical analyses were performed upon the Nepal Living Standards Survey 1 (NLSS 1). It was conducted by the World Bank and the Central Bureau of Statistics of Nepal (CBS) during 1995-1996 as a part of the living standards measurement survey series (LSMS) of the World Bank.⁶ The sample size considers 3,388 households in 73 districts of the country.⁷ The data is divided into four strata based on geographic and ecological regions of the country: mountains, urban hills, rural hills and terai-plains. The household questionnaire covers various levels; community, household and its members to gain a full picture of topics such as employment, housing, access to facilities, migration, food expenses, education, health, anthropometrics, marriage and maternity history, wage employment, farming and livestock, non-farm enterprises, credit and savings, remittances and transfers and adequacy of consumption. The sample size for 0-3 year old children is 1,600 observations. They are official family members and measured for height and weight. The number of families is 1,278, so in one family there can be more than one child.

4.1 Methods for z-scores

Children's anthropometric measurements provide useful information about health outcomes for populations. In addition, these indicators, percentiles and z-scores for weight/height conditional on sex and age, are widely used for measuring hunger, even though they have been subject to controversy (DeRose et al. 1998). This study uses z-scores for the linear regressions, because they are normally distributed. Weight conditional on sex and age, typically varies in the short run and is said to be a good indicator of current health status, whereas height given age and sex is said to be a stock variable of longer run well-being (e.g. DeRose et al. 1998). When either measure is very low, mortality risk rises dramatically (Chen et al. 1980). For neonate children very low (less than 2.5 kg) birth weight indicates problems in birth, diseases, poor maternal health or nutrition. If the child is stunting (abnormal smallness, retardation at growth), and lags severely behind normal growth curves still by the age of two, his/her adulthood height and development will be affected irreversibly. Z-scores are a means for answering how many standard deviations away the observation is from the mean. A positive (negative) z-score indicates that the observation is greater (less) than the mean (Table A2 summarizes the implications of z-score values).

The calculating method for z-scores follows the LMS model (Cole and Green 1992), used in the WHO Child Growth Standards reference data. This reference data on weight distributions was right-skewed, therefore it uses the LMS method, as it utilizes a Box-Cox normal distribution and includes adjustment for kurtosis. Means and standard deviations were computed from z-score values, because the z-score scale is supposed to be linear. The expected mean z-score for the reference population is zero, and the standard deviation value of the z-score is one. The Child Growth Standards reference values for Box-Cox power $L(t)$, median $M(t)$ and coefficient for variation $S(t)$

⁶ The original dataset was used since the newer NLSS 2 (2003/2004) is lacking the anthropometrics section.

⁷ Two districts were left out due to their scarce population.

are from the WHO Technical Report of Methods and Development 2006. The method used to calculate z-scores for an observation x of weight or height at age t from NLSS 1 (WHO 2006) is:

$$z_{ind} = \frac{[x/M(t)]^{L(t)} - x - M(t)}{S(t)L(t) \quad StDev(t)}$$

Z-scores – data problems and solutions

The anthropometrics section in NLSS 1 has some data problems. There are two different variables for child's age: age in months and a birth day in Nepalese calendar. A closer scrutiny showed that a few 'age in months' records were not in line with the ages calculated from the birth day information.⁸ The records calculated from the birth day information that were not matching age in months figures were replaced by age values in months. The naturally more plausible value was chosen when the monthly age was biologically impossible. Other impossible values were removed. Furthermore, getting reliable birth date information is a typical problem for data from developing countries (and only 30 per cent of small children had birth certificates in NLSS 1). A few observations on heights and weights have some clearly implausible value pairs as well. This was solved by removing the clearly incorrect, biologically implausible values (e.g. an eight month-old cannot be 110 centimetres tall). Height measuring position was supposed to be standing after two years of age, since normally they already walk and neonate infants may be complex to measure for height correctly as they are still bent.

4.2 Women's intra-family status indicators

The previous research has discussed many indicators for women's status; quantifiable and qualitative (social norms, laws and institutions, Agarwal 1997). Some status indicators are *sequentially interlinked* i.e. determinants of bargaining power, but also need to be bargained for (Agarwal 1997). In addition the outcomes from one bargaining process may affect positions in the next round as an iterative process. Parashar (2003) has divided indicators in three groups; giving evidence of empowerment, being sources to empowerment or being a setting for empowerment. The main indicators examined in this paper are indirect.⁹ Bargaining itself may be implicit and sometimes in Nepal the weaker side may end up in a more favourable outcome without open contestation. The variables are discussed next.

Marriage age affects a woman's life in many ways it predefines the start of the reproductive cycle,¹⁰ the use of contraceptives and education attainment rather well.

⁸ The ages were calculated by transforming the Nepalese birthdays and interview dates into Julian dates by subtracting 56 years, 8 months and 17 days. Then taking the date intervals in days and converted those to monthly figures. Dates lacking the dd information were added the expectation value for the dd of a month (the average number of days in a month divided by two: $30.33/2 = 15.67$).

⁹ In this study there are no direct indicators such as owning assets, permission to exit the house and prevalence domestic violence (Parashar 2003).

¹⁰ With the condition that preventives use is not common and the couple live under the same roof. In Nepal the average female marriage age is 16.9 years (NLSS 1), hence some females marry before menarche.

Delayed marriages are associated with more preventive health care (Field and Ambrus 2005). Often early marriage is a reason for not enrolling in secondary or tertiary school (Field and Ambrus 2005). Other options for child mothers are as well limited. Studies show, that adolescent brides have more domestic work and domination by their spouses. Even unschooled women who marry later face fewer restrictions by husbands and in-laws¹¹ with respect to consumption and mobility (Field and Ambrus 2005). Married adolescents have fewer social contacts and are less likely to discuss sexual issues with their friends, but simultaneously they have higher levels of sexual risks and activity. NLSS 1 shows that birth controlling knowledge is linked to later marriage through education; schooled women tend to have more knowledge about contraceptives. Younger bride maximizes husband's fertility and bargaining power, since they are more easily moulded into the roles desired by the husband and his family. This can be seen in rural Bangladesh in the increasing amounts of dowries with each additional year that the marriage is postponed (Field and Ambrus 2005). In Nepal marriages are often arranged by parents, therefore love is rarely the reason for the commitment (Thapa 1989).

Female autonomy tends to increase with the ability to control sexuality (Dyson and Moore 1983). The demand for children, boy preference, and contraceptives use goes hand in hand (Niraula and Morgan 1996). In rural societies children especially sons, are seen as economic assets in labour intensive farming practices (UNICEF 1992). Women who have many children, particularly males, are valued higher within the family in the Nepalese, strongly patriarchal society. A large number of siblings in a poor household has many implications to a child's food security and development. In Nepal adult literacy correlates strongly with the use of family planning methods (Kelomaa-Sulonen 1991). One could assume also that the older the mother the more knowledge. However in the sample of 0-3 year old children, older mothers do not seem to have a lot of knowledge of contraceptives and the use is not common.¹² However this may be explained with the fact that if they had had the knowledge they would possibly not all be in the sample. For this paper, the mother's awareness about birth controlling methods is used as a proxy for the ability to control her fertility.

The intra-household balance of power tends to improve with similar schooling attainments (Quisumbing and Hallman 2006). A small education difference ensures more equal capabilities in life and equal knowledge over various matters, which renders the initial bargaining positions more equal. In this paper the inter-spousal education ratio is expressed by mother's years relative father's years, where BA (or bachelor) stands for 15 years of completed studies, MA (or master) for 17 years and a PhD for 21 years of completed studies.

As noted earlier an early marriage is associated with a lower schooling attainment. This paper attempts to find whether marriage age has synergies with the education gap in Nepal. This is tested with a multiplicative variable:

$$\text{Multiplic} = 1/\text{mother's marriage age} * (\text{Educdif}), \text{ where} \quad (1)$$

$$\text{Educdif} = \text{father's education} - \text{mother's education}$$

¹¹ In Nepal the bride usually joins the groom's household (Niraula and Morgan 1996).

¹² 14 per cent of respondents or respondent's spouses use contraceptives. 38 per cent were not aware of birth controlling methods.

The larger the *Multiplic* is the less power a woman has. If the variable gets statistically significant values for z-scores, it suggests that by increasing marriage age the impact of the education gap will decrease. The ratio of education attainments is correlated with mother's absolute years of schooling. Therefore two separate tests were done; the first with all the variables and the second without mother's years of schooling.

Countries with a small per cent age difference are for most part characterized with a relatively high status of women, measured with indicators such as education and age differences (Casterline et al. 1986). The age gap between spouses influences many variables such as fertility, marital stability, marital satisfaction, family size preferences and contraceptives use (Casterline et al. 1986). A large age difference may cause an inferior bargaining position for the wife, as an older husband may easily mould the younger wife to a preferred role. Yet, in the Nepalese society the age difference does not seem striking (Casterline et al. 1986). In Nepal regional, religious as well as ethnicity related differences seem to play an important role, so the average differences do not tell the whole story. Large age difference is strongly related to the low caste groups such as Tharu (positive gap) and Muslims (negative gap) (NLSS 1). Tharu women's status is not clearly better than the status of Muslims even though the age gap is reversed for the Tharu. Consequently it most likely is not a reliable indicator of intra-family status.

Employment as a proxy for female autonomy is problematic, though the accruing income from working is found to be related to women's bargaining power in several studies (e.g. Haddad et al. 1997). Usually women's bargaining power affects labour allocation decisions within households, but working has different implications of women's power depending on the stage of economic development. Female labour force participation has a tendency to decline in the early stages of development and then increase. This is referred as the U-hypothesis of female labour market participation in the course of economic development (e.g. Goldin 1995). Nepal is allocated in the beginning of the U-curve (Goldin 1995). The female labour market participation rate was roughly 58 per cent in 1995 (ILO 2007) and women working outside the home are normally poorly educated and belong to the lowest castes (NLSS 1). Hence maternal working may even indicate a low intra-family position. Also according to Momsen (1991), employment in the agricultural or informal sector does not necessarily raise a woman's status. Moreover, working is not always an attractive option; in Nepal women's employment conditions have worsened and gender based discrimination has increased (Khan 1997).

Remittances are a form of unearned income, suggesting independence of labour supply decisions. According to Thomas (1990), unearned income in mother's hands has a bigger effect on the health of the family than under the control of the father and for child survival chances the effect is almost twenty times bigger. However, in NLSS 1 remittances to women are rare and nothing implies that the woman has the control over the money.

Variables such as the distance to the nearest health post and distance to a local shop were examined to see the effects of women's mobility. The further away the family lives from the village centre (measured by the distance to a shop), the lower the mobility and access to information and social contacts over the marketplace. The freedom of movement can though be limited by social norms as well.

4.3 Estimation strategy

Three regression equations were formed in order to measure how the status variables affect the three measures of malnutrition:¹³

$$waz \text{ (weight-for-height z-score)} = \alpha_1 \text{ Agebirth} + \alpha_2 \text{ Birthco} + \alpha_3 \text{ Agemar} + \alpha_4 \text{ Educdif} + \alpha_5 \text{ Distloc} + \alpha_6 \text{ Multiplc} + \alpha_7 \text{ Remitinc} + \beta_1 X' + e_1 \quad (2)$$

$$haz \text{ (height-for-age z-score)} = \gamma_1 \text{ Agebirth} + \gamma_2 \text{ Birthco} + \gamma_3 \text{ Agemar} + \gamma_4 \text{ Educdif} + \gamma_5 \text{ Distloc} + \gamma_6 \text{ Multiplc} + \gamma_7 \text{ Remitinc} + \beta_2 X' + e_2 \quad (3)$$

$$whz \text{ (weight-for-age z-score)} = \delta_1 \text{ Agebirth} + \delta_2 \text{ Birthco} + \delta_3 \text{ Agemar} + \delta_4 \text{ Educdif} + \delta_5 \text{ Distloc} + \delta_6 \text{ Multiplc} + \delta_7 \text{ Remitinc} + \beta_3 X' + e_3 \quad (4)$$

Agebirth is the mother's childbearing age. *Birthco* is a dummy variable of the mother's awareness of birth controlling methods (0 = no, 1 = yes). *Agemar* is the mother's age at marriage. *Educdif* is the mother's education divided by father's education. *Distloc* is the distance to the nearest shop in hours. *Multiplc* is the equation (1). *Remitinc* is the remittances received by the mother in 1,000 rupees. X' is a vector of other correlates of children's anthropometric nutritional status. The error terms are e_1 , e_2 and e_3 . The total and the male and the female samples were examined with these equations. The expected effects of the status variables and selected controls are presented in Table A3. The sign in the last column means the sign of the expected regression coefficient.

4.4 Other variables

Other essential variables affecting food security can be classified to following levels: mother, child, household, ethnicity and region. Mother's characteristics such as education attainment are usually linked to poor childcare knowledge (Block 2007). It as well correlates with fertility, health and hygiene education. Mother's absolute education may as well affect her bargaining power. The child level variables show e.g. if older children are less food secure. Past or chronic illnesses e.g. recently experienced diarrhoea normally affects weight considerably. The model has three breastfeeding variables classified by age: 0-6 months and not breastfed, 13-24 months and not breastfed, over 25 months and exclusively breastfed. Exclusive breastfeeding has a positive physiological effect on child health until the age of six months. Normally after two years normal growth requires solid foods. Household variables include wealth, amenities, hygiene, and family characteristics. Safe water and a toilet both remain very scarce in Nepal and these tend to have a positive impact on child health. Birth order may affect the way child the is treated in the household. However, it has a strong correlation with the family size, thus only the latter is used in the model. The social group tends to have different implications to child health and gender, which are examined with ethnic dummy variables. Health hazards and the way of living vary considerably according to the climatic zone (Kelomaa-Sulonen 1991). For example the monsoon increases considerably the incidence of children's infectious diseases (Kelomaa-Sulonen 1991).

¹³ The SAS Enterprise Guide 3.0 was used for all computations.

4.5 Expenditure shares

According to Duflo (2000) in male dominant families budget shares on adult goods tend to increase more when extra-income is in the hands of men. *Ceteris paribus* an increase in the expenditure shares on goods exclusively for adults, is supposed to decrease the relative expenditures on children's goods (Guha-Khasnobis and Hazarika 2006). Expenditure shares are subject to intra-household bargaining. Thus improvements in women's status suggest a decrease in male-preferred goods. Adult goods consumption in Nepal is far more common among males (Dhital et al. 2001). In addition an extensive use of adult goods is related to an increased intra-family violence and suppression of the weakest family members. Adult goods expenditure share as a determinant of woman's bargaining power is a complex measure. A low expenditure share on adult goods does not suggest that a woman has a higher status, since adult goods' purchasing decisions may be determined by the social group, since among Brahmins alcohol use has not traditionally been acceptable, but among Tamangs it may even be a necessity in some occasions. However adult goods were tested with correlation- and tobit analysis to see the possible effects of the model variables and especially the key status variables (to see the possible endogeneity). Adult goods include wine, gin, whiskey, beer, jandh (homemade beer), other alcoholic drinks, cigarettes, tobacco, jarda, khaini and betel nut.

The simplest way to explore mother's status implications on household investments on children's wellbeing, would naturally be analyzing the household expenditure shares upon small children's goods. However these goods, namely *baby milk and milk powder*, were purchased or received in-kind only in 28 cases, most of which were correlated with the Muslims.

5 Empirical findings

5.1 Descriptive statistics

Table A4 presents descriptive statistics for the sample. Z-scores are normally distributed.¹⁴ Means and standard deviations show that Nepalese children are malnourished; too short and too light for their age. The mean weight-for-age score -2.35 shows that the children are severely underweight, height-for-age z-score (haz) -2.04 shows severe stunting (a sign of chronic malnutrition), and weight-for-height (whz) -1.11 signifies moderate wasting. Body mass index is 15.6 for over 2 year-olds. 78 per cent are given just breast milk. 52 per cent are male. 76 per cent of the children were immunized, of which females represent slightly less. 35 per cent of the children had been ill in the past according to the mother. However boys were reported ill more often than girls (38 per cent are males and 32 per cent females). It would be unlikely that females fall sick less frequently. Pokhrel and Sauerborn (2004) state that gender biases in Nepal are in fact visible in the perception of illnesses and that household surveys do not capture childhood morbidity well, as clearly sick children are not reported ill. 1 per cent of the children suffer from chronic diseases. Birth order for the children in the sample is on average 6.44.

¹⁴ The z-scores for haz and whz were normally distributed according to Kolmogorov-Smirnov sigmas. See Graph A1.

5.1.1 Parents

Fathers are on average 32 years and mothers 27 years old. 60 per cent of fathers are literate and have completed on average almost four classes of school, whereas only 20 per cent of mothers are literate and their level of schooling is 1.3 years, hence on average the gap between parents is 2.6 years. Mothers' marrying age is on average 16.8 years and 99 per cent of them are married. 56 per cent of the mothers were aware of birth controlling methods. Mothers' mean childbearing age in the sample of 0-3 year-olds is 25.7 years, whereas for the first-borns it is 19.6 years. 26 per cent of mothers have been ill during the past month and 6 per cent suffer from chronic illnesses. The average amount of remittances received during the past 12 months, was 4,466 rupees of which 309.55 (7 per cent) accrued to mothers (amounts received in kind and in cash). Nine per cent works outside for a wage and 22 per cent of the mothers had received remittances. Every third remittance is coming from the husband, thus these remittances cannot be clearly considered to increase women's intra-family status relative to the man.

5.1.2 Household

Value of food consumed in a household (sum of total expenditures; produced and received in kind) is on average 3,363.90 rupees per month. The share of adult goods is on average 10 per cent of expenditures. The share of baby milk/-powder (consumed in 2 per cent of the households) of purchases represents 0.2 per cent. House sale value is on average around 124,103 rupees.¹⁵ The value of the livestock is on average 27,047 rupees and 82 per cent owns land. 11 per cent have water piped to the house, 84.5 per cent have no electricity, 87 per cent have no sanitation, 76 per cent have no toilet and 97 per cent have no garbage disposal. The distance to a health post is on average 1.35 hours, to a local shop 41 minutes and to a paved road it is over 11 hours. 11 per cent have migrated and 33 per cent of the households are multigenerational. 87 per cent of household heads are Hindus. Majority, 19 per cent are Chhetry. 41 per cent live on the Terai plains, 35 per cent on the rural hills, 14 on the mountains and 10 per cent on the urban hills.

5.2 OLS results

OLS estimates for the weight-age, height-age and weight-height models are presented in Tables A10, A11 and A12. The Tables include the total, male and female samples. T-values are next to the estimates and *, **, *** represent the p-values on 1 per cent, 5 per cent and 10 per cent significance levels. The statistically significant results are discussed next.

5.2.1 Status indicators

The multiplicative variable has significant positive signs for the weight-age and height-age z-scores. This suggests that a rise in the marriage age has an impact of decreasing the inter-spousal education gap. Moreover, later marriage age, which accordingly improves mother's status in terms of a smaller education gap, has as well positive significant sign for the female children's weight-age indicator. This suggests that an

¹⁵ In current Euro exchange rate this represents 1,477 euros.

increase in the marriage age has a positive impact on female children's food security. The mothers who had married after the age of 20 (Table A5), have children that on average are in a slightly better condition. Relatively these mothers tend to have fewer children currently, more female children, more education, smaller education difference and age difference. Marriage ages on the terai-plain are lower and some ethnic groups marry relatively later than others (i.e. Newar and Limbu). This is in line with Yabiku (2003), who states that community variables have an impact on the marriage ages in the Chitwan district on the terai-plain. Mother's childbearing age has very significant positive signs upon the weight-age indicators and in particular upon female weight-age and height-age z-scores, suggesting that a higher childbearing age has positive impacts on children's food security.

Mother's awareness of birth controlling methods and the consequently increased ability to control her fertility has a positive impact on children's food security; the weight-age and height-age indicators have positive signs. These are mostly coming from the estimates upon the male sample, suggesting the prevalence of a gender bias. As stated earlier, in Nepal women tend to control their fertility only after giving birth to a boy, as it brings a better bargaining position within the household. Therefore when already there is a boy, as is in the male sample, these mothers may start searching methods for controlling fertility and concentrating on the wellbeing of the male offspring. Pearson correlation coefficients for birth controlling knowledge and analysis variables (Table A6) show that the ethnic groups; Chhetrys, Muslims and Limbus are related to a scarce birth controlling knowledge, whereas Newars and Brahmins are related to better knowledge. Birth controlling knowledge is positively correlated with the urban hills, educated mothers and expenditures. Consequently the periphery areas such as the mountains and places far away from the local shop or health post are negatively correlated with the knowledge.

Education difference ratio (mother's/father's education) has positive signs as hypothesized, but neither of them is significant in model 1, because of correlations with other schooling related variables. Hence, in model 2, without mother's education level, the schooling difference shows significant positive signs for weight-age and weight-height z-scores. For male weight-height indicator the sign is positive, suggesting that the male offspring benefits more from a decreased education difference. Mother's schooling level has statistically significant estimates in line with the hypothesis, suggesting that maternal education improves child health. The male sample estimates show that mother's schooling affects male height age indicator positively. Females are not as much affected by mother's education.

In Nepal the mean age difference is not internationally striking (Casterline 1986), possibly due to the vastly differing social customs among the groups. The signs are in line with the hypothesis, but statistically insignificant. In Nepal the husband is on average four years older than his wife. However, the age gap has positive correlation coefficients with the Tharu-tribe, suggesting that they have the highest age gaps and even in favour of the wife (the wife is on average over 3 years older than the husband). The correlation Table A7 shows the important Pearson correlations for the age gap. Families with a considerable age gap tend to be large and multigenerational, as Tharu households indeed are (even up to 50 people living in so called long houses, Guneratne 1998).

OLS estimates show that if the mother works for wage, children are more malnourished. The signs are especially negative for the weight-age scores. The male weight-age and height-age indicators are affected more negatively when the mother is working. Working is thus more likely to indicate low intra-family status. Moreover, the families where mother works for wage are correlated with poverty (they have low levels of livestock only 6 per cent, no sanitation and no toilets), low caste (e.g. Sarki)¹⁶ and low maternal education. However, they are correlated with more birth control awareness and thus also their family size tends to be smaller (see correlations in Table A8). Muslims who are of low ranking in the caste strata are correlated with low levels of working, but still women's position among them measured with other indicators is low. Thus, the aforementioned assertion cannot be reversed to imply that not working for wage would reflect a better status for the mother. Estimate signs upon the remittances to mothers,¹⁷ income independent of labour decisions, are positive – in line with the hypothesis, but they are statistically insignificant.

Mother's physical health affects child health. Her recent illnesses have a negative impact on the weight- and height-age z-scores. Mother's chronic illnesses affect male weight-age and height-age indicators negatively.

Children's age categories show negative and significant estimates for weight- and height-age z-scores. Testing the model with child's age in months showed that the older the child the more malnourished he/she is. There may though be a slight bias, since children who are more recently born are easier to estimate for age. The age category of 13 to 24 months had the most significant negative signs for their estimates, suggesting that children between one to two years are most malnourished. Male children have a significant negative estimate upon their height for age, suggesting that they are more stunting than girls (Graph A2). Standard deviation of height-age z-scores for boys sample is as well larger than for girls and the mean is more negative.

Children who suffer from chronic illnesses tend to grow sluggishly, according to the negative signs upon weight- and height-age indicators. Moreover, the chronically ill females have negative signs for all food security indicators. Male food security does not seem to be affected as significantly. This suggests that chronic illnesses retard in particular female growth. Recent illnesses (e.g. diarrhoea) affect very negatively children's weight-height ratio. This is intuitive as recent illnesses cut down the short term weight, but their impact cannot yet be seen in the longer term malnutrition indicators. The higher incidence of recent illnesses is strongly correlated with having no toilet (Table A12), which is intuitive, since better hygiene protects from diseases. If the child is over two years old and still exclusively breastfed, all z-scores show very negative signs. This was expected, since normal growth after two years requires other foods as well. Breastfeeding variables show, that if a child of 0-6 months is given other milk daily as well, he/she is more food secure; estimates for weight for age have significant positive signs. This is evident as maternal feeding practices and nutrition

¹⁶ The Sarki are so called untouchables. Part of them belongs to the working bhul caste 'the shoemakers' who are inferior to many other castes (even inferior to other Dalits Kami and Damai) as they eat buffaloes and cows.

¹⁷ Only 41 mothers had received remittances in the sample, paid by husbands and other relatives. Remittances were related to young mothers, nuclear families and the ethnic group of Chhetry.

knowledge are found to be important to child micronutrient status in previous studies (e.g. Christaensen and Alderman 2004).

Natural logarithm of family size has statistically very significant negative signs for weight related z-scores, suggesting that a large family size has strong negative impacts on the short term food security. Female weight indicators are more negatively affected by a high number of siblings, which is implying gender bias. However if the family is extended estimates suggest that children are doing better, especially males are heavier for their height,¹⁸ which shows that having relatives benefits the males in particular. Having relatives under the same roof ensures support in childcare and better access to knowledge. According to Momsen (1991) in Nepal household tasks are normally shared between women in extended families. The contact to the natal kin provides access to social resources such as information, economic assistance as well as political support (Niraula and Morgan 1996). If the family is ranked poor (dummy variable), children are less food secure. Especially males have more negative signs for weight- and height-age indicators. Nonetheless the household value has a positive impact on the female weight for age. Children in families with more cattle are more food secure, as the natural logarithm of livestock has a positive significant estimate upon weight for age. Intuitively children in families that have water piped to the house are taller for their age, according to the height-age estimates. Having no toilet clearly affects children's susceptibility to catch infectious diseases, since weight-age and weight-height signs are significantly negative.

According to Kelomaa-Sulonen (1991) in Nepal the health sector has clear shortcomings. Thus a short distance to a health post does not necessarily improve child growth. The estimates are suggesting that the further away the health post is the heavier children are. A better indicator for this setting would most likely be the distance to a traditional healer. On the urban hills children's weight-age indicators have positive signs, whereas on the terai-plains children's weight for height has significantly negative signs. This is suggesting that on the southern areas children tend to be relatively underweight. If the family has migrated children are doing worse; signs are significantly negative upon weight for height. Ethnicity shows sex preference and clear differences for children's food security. Tamang, Magar (females) and Rai (females) are not as underweight (the signs upon weight for age are significant and positive). Surprisingly two of the higher castes, Brahmin and Chhetry have negative signs for estimates upon male weight for height, suggesting that males are more underweight than in the sample on average. Among Limbu the relative importance of a male progeny for a woman's status is fundamental (e.g. Leone et al. 2003; Acharya 2004). This shows in the statistically positive signs for boys' height for age estimates and significant negative signs for girls' height for age estimates among the Limbu. Yadav/Ahir children have negative significant estimates for the total population height-age indicator and female weight-age indicator, as among them the sex preference is very influential (Leone et al. 2003).

¹⁸ The model was tested for the effects of birth order; in the test family size was replaced with birth order variable. Results show that for the total sample birth order has no effects, because birth order affects male weight and height age indicators positively, but equivalent indicators for females negatively. The p-values are around 0.16 so statistically levels are not significant enough. This suggests gender bias, youngest females are neglected, but youngest males favoured.

5.2.2 *Adult goods expenditure shares*

The OLS results show that an increase in adult goods expenditures has a negative impact on male height for age (Table A10). This suggests that adult goods' use has a negative effect on stunting. On the contrary children's weight for height and weight for age indicators are correlated positively with adult goods. The weight for height indicator has a positive sign in the OLS analysis (Table A12), suggesting that even though children may be stunted (negative sign upon height for age) they are not underweight for their height in families where adult goods share of the budget is high. Table A9 presents correlation coefficients for variables that correlate the most with adult goods' expenditure shares. It shows that a high expenditure share of adult goods is correlated with a higher incidence of mothers' and children's recent illnesses. This may suggest that an excess investment in adult goods, probably at the expense of women's and children's essential goods, has a negative impact on these illnesses. Or it may be because in Nepal females often use alcohol as a medicine or a painkiller (Dhital et al. 2001). It shows that households on the hills tend to invest relatively more from their budget on adult goods. Especially Tamangs have considerably high correlations. According to Dhital et al. (2001) among Tamangs alcohol is an essential, often compulsory substance in many cultural and ritual ceremonies. Among them it is served to all; even to women during maternal period and children. Alcohol use among Nepalese women tends to rise with age (Dhital et al. 2001). The correlation analysis shows that mother's marriage age is positively correlated with adult goods, suggesting that in families where marriage takes place later, and more adult goods substances are used, since these women are relatively older. According to Dhital et al. (2001) alcohol use can be determined by three factors: availability, accessibility and the extent mobility. Hence poor families with low expenditures do not buy adult goods (Table A9). The tobit-model and correlation analysis did not result in any significant evidence concerning the key status variables, suggesting that endogeneity between adult goods' expenditure shares and status variables in the model is low.

6 Further interest

The Nepalese civil war started slightly after the collection of the NLSS 1 data. It has affected many people's lives, especially low caste women and children (Bishwakarma 2004). How has the civil war and the absence of males from the household changed women's autonomy and children's food security in Nepal? Which status indicators are affected the most by the war? The NLSS 2 panel data would enable a look at how the mothers and children from NLSS 1 have gotten through the civil war years.

7 Conclusion

Nepal is one of the poorest countries in the world with a remarkably rich ethnical identity, which results in a wide variability in women's status. The average status of a Nepalese woman is low in the society and she is traditionally considered inferior to her husband. This most likely affects children's growth and food security, as the mother and the child are tightly interlinked, especially when the child is very young. This study found evidence for the relation between women's status and children's food security. In Nepal a rise in mother's marriage age has an effect of decreasing the inter-spousal age difference. Mother's childbearing age, which is linked to her marriage age, has positive

significant estimates in the model, suggesting that an increase in the childbearing age leads to an increase in the intra-family status and children's food security. A decrease in the education difference has an impact of improving children's food security in terms of increased weight for age and weight for height. Estimates suggest as well that mother's knowledge about fertility controlling methods influences children's weight-age z-scores positively and male food security in particular. Decrease in the family size tends to affect positively child health as well as living in an extended family. Hygiene tends to affect child health positively. If the child is exclusively breastfed after the age of two, the children tend to be lighter and shorter for their age. This suggests that feeding practices and nutritional education affects child health in Nepal. Wealth improves children's food security. Low caste children are more likely to be underweight and stunting. On the terai-plains children seem to be relatively lighter for their height. In Nepal maternal working seems to be related to a low female status and children's low food security. Working is more common among the poor and the lowest caste ethnic groups. An increase in the adult goods expenditure shares has a negative impact on the male height for age. Age differences are related to a few ethnic groups; in the average the age gap in Nepal is not striking. Some ethnic groups face enormous discrimination and there women often suffer it double.

References

- Acharya, S. (2004). 'Democracy, Gender Equality, and Women's Literacy: Experience from Nepal'. UNESCO Kathmandu Series of Monographs and Working Papers, No. 1.
- ADB (1999). 'Country Briefing Paper Women in Nepal'. Programs Department West, Division 1. SODC.
- Agarwal, B. (1997). '*Bargaining' and Gender Relations: Within and Beyond the Household*. Routledge, Taylor and Francis Group, Volume 3, Number 1: 1 March, IAFFE.
- Becker, G. (1981). *A Treatise on the Family*. Cambridge MA: Harvard University Press.
- Bishwakarma, P. (2004). 'The Situation Analysis for Dalit Women of Nepal. FES/Nepal National Seminar 'Raising Dalit Participation in Governance'. Centre for Economic and Technical Studies.
- Block, S. (2007). 'Maternal Nutrition Knowledge Versus Schooling as Determinants of Child Micronutrient Status'. *Oxford Economic Papers* 59: 330–53.
- Caldwell, B. (1996). 'The Family and Demographic Change in Sri Lanka'. *Health Transition Review*, 6, Supplement: 45–60.
- Carter, A. S., F. E. Garrity-Rokous, R. Chazan-Cohen, C. Little, and M. J. Briggs-Gowan (2001). 'Maternal Depression and Comorbidity: Predicting Early Parenting, Attachment Security, and Toddler Social-Emotional Problems and Competencies'. *Journal of the American Academy of Child and Adolescent Psychiatry* 40(1): 18–26, January.
- Casterline, J. B., L. Williams, P. McDonald (1986). 'The Age Difference Between Spouses: Variations Among Developing Countries'. *Population Studies* 40: 353–74, JSTOR.
- Chen, L. C., A. Chowdhury, and S. L. Huffman (1980). 'Anthropometric Assessment of Energy-Protein Malnutrition and Subsequent Risk of Mortality Among Preschool Aged Children'. *American Journal of Clinical Nutrition* 33: 1836–45.
- Chhetry, D. (2001). 'Understanding Rural Poverty in Nepal'. ADB. Asia and Pacific Forum on Poverty.
- Christiaensen, L., and H. Alderman (2004). 'Child Malnutrition in Ethiopia: Can Maternal Knowledge Augment the Role of Income?'. *Economic Development and Cultural Change* 52: 287–312.
- Cole, T., and P. Green (1992). 'Smoothing Reference Centile Curves: The LMS Method and Penalized Likelihood'. *Statistics in Medicine* 11: 1305–319 - ncbi.nlm.nih.gov.
- DeRose, L., E. Messer, and S. Millman (1998). *Who's Hungry? And How do we Know? Food Shortage, Poverty, and Deprivation*. Chapter 2. United Nations University Press: Tokyo.
- Dhital, R., G. Subedi, Y. B. Gurung, and B. Hamal (2001). 'Alcohol and Drug Use in Nepal with Reference to Children'. CWIN Nepal.

- Duflo, E. (2000). 'Child Health and Household Resources in South Africa: Evidence from the Old Age Pension Program'. *American Economic Review* 90(2) May, 393–98.
- Dyson, T., and M. Moore (1983). 'On Kinship Structure, Female Autonomy, and Demographic Behaviour in India'. *Population and Development Review* 9: 35–60.
- Field, E., and A. Ambrus (2005). 'Early Marriage and Female Schooling in Bangladesh'. Harvard Papers.
- Galvin, K. L. (2005). 'Forbidden Red: Widowhood in Urban Nepal'. Washington State University.
- Goldin, C. (1995). 'The U-Shaped Female Labor Force Function in Economic Development and Economic History'. In T. Paul Schultz (ed.) *Investment in Women's Human Capital and Economic Development*. Chicago: University of Chicago Press, Chapter 3, 61–90.
- Guha-Khasnobis, B., and G. Hazarika (2006). 'Women's Status and Children's Food Security in Pakistan'. WIDER Discussion Paper 2006/03. UNU-WIDER: Helsinki.
- Guneratne, A. (1998). 'Modernization, the State, and the Construction of a Tharu Identity in Nepal'. *Journal of Asian Studies* 57(3): 749–73, August.
- Haddad, L., J. Hoddinott, and H. Alderman (1997). 'Intrahousehold Resource Allocation in Developing Countries: Methods, Models and Policy'. IFPRI: Washington DC.
- IFPRI. <http://www.ifpri.org/divs/fcnd/dp/papers/fcndp86.pdf> (1.4.2007)
- ILO (2007). <http://www.ilo.org/public/english/employment/gems/eeo/download/nepal.pdf> (13.8.2007)
- Kelomaa-Sulonen, K. (1991). Country Profiles 2, Health Sector in Nepal, A Review of available information and preliminary problem analysis. HEDEC - FINNIDA.
- Khan, A. R. (1997). 'Globalization and Sustainable Human Development: An Assesment of Challenges Facing Nepal'. Occasional Paper. UNCTAD/EDM Misc. 124.
- Klawon, E., and J. Tiefenthaler (2001). 'Bargaining over Family Size: The Determinants of Fertility in Brazil'. *Population Research and Policy Review* 20: 423–40, Kluwer Academic Publishers.
- Leone, T., Z. Matthews, and G. Dalla Zuanna (2003). 'Impact and Determinants of Sex Preference in Nepal'. *International Family Planning Perspectives* 29(2) June.
- Lethen, J. (1996). Statistical class notes. <http://www.stat.tamu.edu/stat30x/notes/node34.html> (1.4.2007)
- Mahajan, S. D., S. Singh, P. Shah, N. Gupta, and N. Kochupillai (2005). 'Effect of Maternal Malnutrition and Anemia on the Endocrine Regulation of Fetal Growth'. *Endocrine Research* 30(2): 189–203 January.
- Martorell, R., J. Leslie, and P. R. Moock (1984). 'Characteristics and Determinants of Child Nutritional Status in Nepal'. *American Journal of Clinical Nutrition* 39: 74–86.

- Momsen, J. H. (1991). *Women and Development in the Third World*. New York: Routledge.
- Niraula, B. B., and S. P. Morgan (1995). 'Gender Inequality and Fertility in two Nepali Villages'. *Population and Development Review* 21(3): 541–61.
- Niraula, B. B., and S. P. Morgan (1996). 'Marriage Formation, Post-marital Contact with Natal Kin and Autonomy of Women: Evidence from Two Nepali Settings'. *Population Studies* 50: 35–50.
- Onis, M., M. Blössner, E. Borghi, R. Morris, and E. A. Frongillo (2004). 'Methodology for Estimating Regional and Global Trends of Child Malnutrition'. *International Journal of Epidemiology* 33(6): 1260–70.
- Parashar, S. (2003). *A Multifaceted and Multi-dimensional Approach to Women's Empowerment and its Links to the Nutritional Status and Immunization of Children in India*. Princeton University.
- Pawson, I. G. (1976). 'Growth and Development in High Altitude Populations: A Review of Ethiopian, Peruvian, and Nepalese Studies. Proceedings of the Royal Society of London'. Series B, *Biological Sciences* 194(1114). A Discussion on Human Adaptability in Ethiopia (27 August): 83–98.
- Pokhrel, S., and R. Sauerborn (2004). 'Household Decision-making on Child Health Care in Developing Countries: The Case of Nepal'. *Health Policy Plan*. 19 July (4): 218–33.
- Pyakuryal, B., Y. B. Thapa, and D. Roy (2005). 'Trade Liberalisation and Food Security in Nepal'. IPFRI. MTID *Discussion Paper* No. 88.
- Quisumbing, A. R., and K. Hallman (2006). 'Marriage in Transition: Evidence on Age, Education, and Assets from Six Developing Countries, the Changing Transitions to Adulthood in Developing Countries'. Selected Studies, CPOP. National Academies of Press.
- Quisumbing A. R. and Maluccio J.A. (2003). 'Resources at Marriage and Intra-household Allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa'. *Oxford Bulletin of Economics and Statistics* 65(3): 0305–9049.
- Sah, N. (2005). 'Determinants of Child Malnutrition in Nepal: A Case Analysis from Dhanusha, Central Terai of Nepal'. Save the Children Japan-Nepal Office.
- Sandiford, P., J. Cassel, M. Montenegro, and G. Sanchez (1995). 'The Impact of Women's Literacy on Child Health and its Interaction with Access to Health Services'. *Population Studies* 49(1): 5–17, March.
- Singh, S. (2004). 'Impact of Long-term Political Conflict on Population Health in Nepal'. *Canadian Medical Association Journal* 171(12): 1499–1501.
- Smith, L. C., U. Ramakrishnan, A. Ndiaye, L. Haddad, and R. Martorell (2003). 'The Importance of Women's Status for Child Nutrition in Developing Countries'. South Asian Association for Regional Cooperation SAARC, IPRFI. Research report 131.
- Smith S. (2002). 'Too much Too Young? In Nepal More a Case of Too Little, Too Young'. *International Journal of Epidemiology* 31: 557–58.

- Stifel, D., and H. Alderman (2006). 'The "Glass of Milk" Subsidy Program and Malnutrition in Peru'. *World Bank Economic Review* 20(3): 421–48.
- Thapa, S. (1989). 'The Ethnic Factor in the Timing of Family Formation in Nepal'. *Asia-Pacific Population Journal* 4(1): 3–34.
- Thomas, D. (1990). 'Intra-Household Resource Allocation: An Inferential Approach'. *Journal of Human Resources* 25(4): 635–64 (Autumn).
- Thomas, D., L. Rubalcava, and G. Teruel (2004). 'Spending, Saving and Public Transfers Paid to Women'. (1 August). California Center for Population Research. On-Line Working Paper Series. Paper CCPR-024-04.
- Yabiku, S. T. (2003). 'Neighbors or Neighborhoods? Effects on Marriage Timing in Nepal'. Population Association of America, Minneapolis.
- UNDP (2006). Human Development Indicators/Country Fact Sheets/ Nepal (1.5.2007)
- UNICEF/NEPAL (2007). http://www.unicef.org/infobycountry/nepal_nepal_statistics.html (26.3.2007).
- UNICEF (2006). 'Situation of Women and Children in Nepal 2006'. Chapter 7, 9. <http://www.un.org.np/reports/UNICEF/2006/situation-analysis> (1.4.2007)
- UNICEF (2007). 'The State of the World's Children 2007'. http://www.unicef.org/sowc07/profiles/inequality_household.php. (1.4.2007)
- UNICEF, HMG (1992). 'Children and Women of Nepal: Situation Analysis of 1992'. Kathmandu.
- World Health Organization and CDC (2006). Technical Report of Methods and Development. http://www.who.int/childgrowth/standards/technical_report/en/index.html (1.6.2007)
- LMS model reference values (1.6.2007): http://www.phppo.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/module2/text/ad314_statistical.htm & <http://www.who.int/childgrowth/standards/en/index.html>

Appendix

Table A1: Ethnicity distribution of the sample

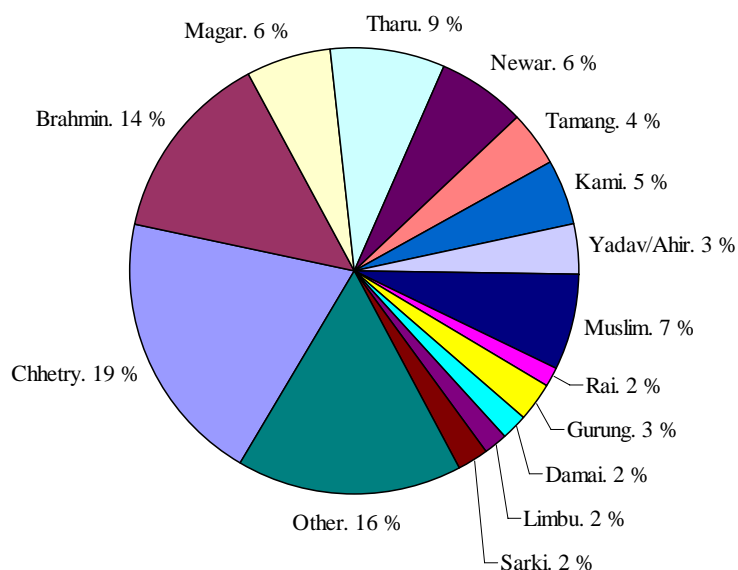


Table A2: Z-score values for mild, moderate and severe malnutrition (Lethen 1996)

Malnutrition indicator	Z < -1.0	Z < -2.0	Z < -3.0
Height-age z-score	Mild stunting	Moderate stunting	Severe stunting
Weight-age z-score	Mild underweight	Moderate underweight	Severe underweight
Weight-height-age z-score	Mild wasting	Moderate wasting	Severe wasting

Table A3: Expected effects of independent variables

Variable	Expected effects
Multiplicative variable	+
Mother's marriage age	+
Birth control knowledge	+
Mothers schooling years	+
Education difference	-
Mother's childbearing age	+
Share of adult goods in total budget	-
Family size	-
Remittances to the mother	+
Distance to nearest shop	-

Table A4: Sample means

Variable	Mean	Std Dev	Min	Max	N
Weight for age	-2.35	1.60	-11.25	5.93	1599
Height for age	-2.04	1.64	-13.63	6.14	1592
Weight for height	-1.11	1.64	-16.32	4.07	1501
BMI for over 2 year-olds	15.62	1.79	10.92	32.25	665
Child is only breastfed (dummy = 1, if yes)	0.78	0.41	0.00	1.00	1600
Child has a birth certificate (1 yes 2 no)	1.68	0.47	1.00	2.00	1600
Child's age in months	20.79	11.99	0.07	48.49	1600
Child is male (dummy = 1, if yes)	0.52	0.50	0.00	1.00	1600
Child is immunized (dummy = 1, if yes)	0.76	0.43	0.00	1.00	1596
Child has a chronic illness (dummy = 1, if yes)	0.01	0.09	0.00	1.00	1600
Child was ill recently (dummy = 1, if yes)	0.35	0.48	0.00	1.00	1600
Child was/is breastfed (dummy = 1, if yes)	0.94	0.23	0.00	1.00	1600
Birth order of the child	6.44	2.87	2.00	22.00	1600
Height	74.48	10.60	32.00	100.90	1593
Weight	8.81	3.24	1.60	90.60	1599
Baby milk share of expenditures	0.00	0.02	0.00	0.40	1600
Share of adult goods of total foods	0.03	0.06	0.00	0.72	1599
Mother's age at marriage	16.87	3.60	0.00	33.00	1579
Mother knows birthcontrol (dummy = 1, if yes)	0.56	0.50	0.00	1.00	1592
Mother works for wage (dummy = 1, if yes)	0.09	0.28	0.00	1.00	1600
Education differential in years	-2.59	3.55	-15.00	10.00	1346
Distance to local shop	0.68	2.46	0.00	48.00	1581
Mother's age/father's age	0.87	0.11	0.37	1.33	1432
Remittances to mothers in 1,000 Rs	0.22	2.39	0.00	50.00	1600
Mother's age	27.40	6.46	15.00	51.00	1589
Mother's age at delivery	25.67	6.41	12.61	48.81	1589
Mother's age at delivery of first born child	19.59	3.76	6.00	56.00	1578
Mother was ill recently (dummy = 1, if yes)	0.26	0.44	0.00	1.00	1587
Mother has chronic illness (dummy = 1, if yes)	0.06	0.23	0.00	1.00	1587
Mother is literate (dummy = 1, if yes)	0.20	0.40	0.00	1.00	1430
Mother's highest level of schooling	1.31	3.07	0.00	15.00	1424
Mother is married (dummy = 1, if yes)	0.99	0.10	0.00	1.00	1589
Father's age	31.85	8.24	16.00	75.00	1432
Father literate (dummy = 1, if yes)	0.60	0.49	0.00	1.00	1380
Father's schooling level	3.87	4.38	0.00	21.00	1351
HH animals value in Rs	27047	33568	0.00	426000	1600
Natural logarithm of house value	9.63	3.02	0.00	15.83	1600
HH owns land (dummy = 1, if yes)	0.82	0.38	0.00	1.00	1600
HH is poor (dummy = 1, if yes)	0.47	0.50	0.00	1.00	1600
Log of food consumed total	7.90	0.69	5.70	10.65	1384
HH is multigenerational (dummy = 1, if yes)	0.33	0.47	0.00	1.00	1600
HH is Hindu (dummy = 1, if yes)	0.87	0.34	0.00	1.00	1546
Natural logarithm of electricity value	7.08	1.04	3.91	9.80	249
Water is piped to house (dummy = 1, if yes)	0.11	0.32	0.00	1.00	1600
No sanitation (dummy = 1, if yes)	0.87	0.34	0.00	1.00	1600
No garbage disposal (dummy = 1, if yes)	0.97	0.18	0.00	1.00	1600
No toilet (dummy = 1, if yes)	0.76	0.43	0.00	1.00	1600
Distance to health post	1.35	3.55	0.00	72.00	1596

Table A4 continued ...

Variable	Mean	Std Dev	Min	Max	N
Distance to a paved road	11.20	24.47	0.00	168.00	1590
Mountains (dummy = 1, if yes)	0.14	0.35	0.00	1.00	1600
Urban hills (dummy = 1, if yes)	0.10	0.30	0.00	1.00	1600
Rural hills (dummy = 1, if yes)	0.35	0.48	0.00	1.00	1600
Terai (dummy = 1, if yes)	0.41	0.49	0.00	1.00	1600
Family has migrated (dummy = 1, if yes)	0.11	0.32	0.00	1.00	1600
HH is Cchetry (dummy = 1, if yes)	0.19	0.39	0.00	1.00	1600
HH is Brahmin (dummy = 1, if yes)	0.14	0.34	0.00	1.00	1600
HH is Magar (dummy = 1, if yes)	0.06	0.23	0.00	1.00	1600
HH is Tharu (dummy = 1, if yes)	0.08	0.28	0.00	1.00	1600
HH is Newar (dummy = 1, if yes)	0.06	0.24	0.00	1.00	1600
HH is Tamang (dummy = 1, if yes)	0.04	0.19	0.00	1.00	1600
HH is Kami (dummy = 1, if yes)	0.05	0.21	0.00	1.00	1600
HH is Yadav/Ahir (dummy = 1, if yes)	0.03	0.18	0.00	1.00	1600
HH is Muslim (dummy = 1, if yes)	0.07	0.25	0.00	1.00	1600
HH is Rai (dummy = 1, if yes)	0.02	0.12	0.00	1.00	1600
HH is Gurung (dummy = 1, if yes)	0.03	0.16	0.00	1.00	1600
HH is Damai (dummy = 1, if yes)	0.02	0.13	0.00	1.00	1600
HH is Limbu (dummy = 1, if yes)	0.02	0.13	0.00	1.00	1600
HH is Sarki (dummy = 1, if yes)	0.02	0.14	0.00	1.00	1600
HH other ethnicity (dummy = 1, if yes)	0.16	0.36	0.00	1.00	1600

Table A5: Mean column: women married later than age of 20 years, n = 185. Mean all column: total sample means

Variable	Mean	Mean all	Variable	Mean	Mean all
WAZ	-2.10	-2.35	Natural logarithm of purchases	6.80	6.62
HAZ	-1.94	-2.04	Multigenerational	35%	33%
WHZ	-0.86	-1.11	Natural logarithm of family size	1.78	1.87
Age at marriage	23.41	16.87	Mountains	17%	14%
Mother aware of birth control	49%	56%	Urban Hills	18%	10%
Education differential in years	-2.0	-2.6	Rural Hills	41%	35%
Education ratio (mother/father)	0.71	0.63	Terai	23%	41%
Age differential ratio	0.91	0.87	Cchetry	19%	19%
Age differential in years	-4.0	-4.4	Newar	13%	6%
Mother's age at delivery	29	26	Tamang	4%	4%
Mother's age at first born	24	20	Rai	4%	2%
Mother is literate	27%	20%	Gurung	5%	3%
Mother's level of schooling	2.33	1.31	Limbu	4%	2%
Child is male	47%	52%	Sarki	2%	2%

Table A6: Pearson correlation coefficients in significance order upon birth controlling knowledge

Variable	Correlation coefficients	Variable	Correlation coefficients
Weight-age z-score	0.16	HH has no sanitation	-0.15
Height-age z-score	0.13	HH has no garbage disposal	-0.16
Multiplicative variable	0.16	HH has no toilet	-0.21
Mother's age at birth	-0.19	Distance to health post	-0.12
Education gap in years	-0.18	Mountains	-0.12
Mother's schooling	0.26	Urban hills	0.26
Mother's age	-0.19	Newar	0.12
Mother is literate	0.26	Muslim	-0.10
Child is immunized	0.18	Distance to shop	-0.09
Child was ill	0.10	Limbu	-0.09
Log of expenditures	0.18	Cchetry	-0.09
HH is of poorer half	-0.22	Brahmin	0.09
HH has piped water	0.20	Weight-height z-score	0.07

Table A7: Pearson correlation coefficients in significance order upon the age difference in years

Variable	Coefficient
HH is multigenerational	0.18
Multiplicative variable	0.16
Education gap in years	-0.16
Education difference ratio	-0.15
Mother's age at first child	0.11
Logarithm of family size	0.09
HH has migrated	-0.08
Tharu	0.08
Value of livestock	0.08

Table A8: Significant Pearson correlation coefficients in significance order upon mother working for wage

Variable	Coefficient
Other ethnic group	0.19
Region of Terai	0.16
Sarki	0.14
Education gap in years	0.11
Livestock value	-0.11
Cchetry	-0.11
Mother is literate	-0.10
Mother's education level	-0.10
Multiplicative variable	-0.10
HH has no sanitation	0.09
Region Rural Hills	-0.09
HH has no toilet	0.08
Weight-height z-score	-0.08
Child is only breastfed	0.08
Weight-age z-score	-0.07
Water is piped house	-0.07
HH is of poorer half	0.07

Table A9: Significant Pearson correlation coefficients for adult goods expenditure shares

Variable	Coefficient
Tamang	0.22
Ln of expenditures	0.18
HH is poor	-0.12
Terai	-0.12
Urban hills	0.11
Livestock	-0.11
Rural hills	0.10
Child was ill	0.10
Mother was ill	0.10
Other ethnic group	-0.08
Weight for height	0.08
Age at marriage	0.08
Sarki	0.08
Weight for age	0.08

Table A10: OLS estimates, dependent variable weight-for age z-scores

Variable	WAZ				MALES WAZ				FEMALES WAZ			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat
Mother's status												
Multiplicative	0,74	2.7 ***	0,73	2.65 **	0,78	2.32**	0,78	2.32 **	0,64	1,36	0,62	1,33
Mother's age at child birth	0,02	2.01 **	0,01	1.85 *	0,01	1,23	0,01	1,14	0,02	1.65 *	0,02	1,57
Mother's age at marriage	0,01	0,96	0,01	1,12	-0,02	-1,16	-0,02	-1,02	0,04	2.17 **	0,04	2.22 **
Birth control aware	0,19	2.1 **	0,21	2.34 **	0,37	2.97 ***	0,39	3.18 ***	0,01	0,08	0,03	0,19
Mother works for wage	-0,33	-2.15 **	-0,35	-2.31 **	-0,46	-2.3 **	-0,48	-2.44 **	-0,28	-1.16	-0,30	-1.24
Education difference ratio	0,12	1,45	0,15	1.99 *	0,09	0,95	0,12	1,41	0,12	0,76	0,15	1,00
Distance to a local shop	0,01	0,69	0,01	0,67	0,02	0,70	0,02	0,70	0,00	-0,06	0,00	-0,08
Adult goods	0,13	0,51	0,13	0,52	-0,13	-0,36	-0,12	-0,35	0,35	0,95	0,35	0,96
Age differential in years	-0,01	-0,67	-0,01	-0,60	0,00	-0,14	0,00	-0,20	0,00	-0,04	0,00	0,07
Remittances to mothers	0,11	0,71	0,10	0,68	0,03	0,11	0,02	0,09	0,16	0,80	0,15	0,77
Mother's characteristics												
Mother's schooling level	0,03	1,55			0,03	1,11			0,02	0,80		
Mother ill lately	-0,08	-0,78	-0,07	-0,70	-0,03	-0,25	-0,03	-0,23	-0,09	-0,63	-0,09	-0,59
Mother chronically ill	-0,30	-1.73 *	-0,30	-1.76 *	-0,72	-2.86 ***	-0,72	-2.88 ***	0,07	0,30	0,07	0,29
Child characteristics												
Age 7-12 months	-1,30	-8.76 ***	-1,30	-8.79 ***	-1,43	-7.19 ***	-1,43	-7.21 ***	-1,22	-5.49 ***	-1,23	-5.53 ***
13-24 months	-1,86	-14.7 ***	-1,86	-14.7 ***	-1,70	-10 ***	-1,70	-10.0***	-2,01	-10.6 ***	-2,02	-10.6 ***
25-45 months	-0,99	-7.1 ***	-0,99	-7.1 ***	-0,91	-4.82 ***	-0,91	-4.83 ***	-1,10	-5.28 ***	-1,10	-5.28 ***
Child is male	0,06	0,69	0,06	0,68								
Child is immunized	0,02	0,23	0,03	0,29	-0,02	-0,17	-0,02	-0,15	0,03	0,19	0,03	0,23
Child chronically ill	-1,69	-4.01 ***	-1,67	-3.98 ***	-0,18	-0,30	-0,16	-0,27	-3,29	-5.51 ***	-3,29	-5.51 ***
Child was recently ill	-0,11	-1,20	-0,11	-1,16	-0,03	-0,27	-0,03	-0,25	-0,12	-0,82	-0,11	-0,78
0-6 months not breastfed	1,95	1.95 *	1,92	1.92 *	2,08	1,46	2,06	1,45	1,42	0,95	1,38	0,92
13-24 months not breastfed	-0,46	-1,12	-0,49	-1,18	0,07	0,13	0,05	0,08	-0,60	-0,96	-0,62	-0,99
25-45 months only breastfed	-0,60	-4.49 ***	-0,61	-4.61 ***	-0,39	-2.23 **	-0,41	-2.3 **	-0,86	-4.19 ***	-0,87	-4.28 ***
Household characteristics												
Ln family size	-0,52	-2.82 ***	-0,53	-2.89 ***	-0,19	-0,78	-0,20	-0,83	-0,85	-2.97 ***	-0,86	-3.01 ***
Multi-generational	0,17	1,49	0,18	1,63	0,06	0,44	0,08	0,58	0,34	1.92 *	0,35	1.98 *
HH is poor	-0,25	-2.54 **	-0,26	-2.63 **	-0,45	-3.42 ***	-0,46	-3.53 ***	0,03	0,20	0,03	0,18
Value of livestock	0,00	1.88 *	0,00	1.85 *	0,00	1,09	0,00	1,04	0,00	1,02	0,00	1,00
Ln house value	0,02	1,55	0,03	1.81 *	-0,01	-0,46	0,00	-0,21	0,05	2.15 **	0,05	2.22 **
Ln of expenditures	-0,01	-0,22	0,00	-0,02	-0,02	-0,26	-0,01	-0,18	0,00	0,02	0,01	0,16
Water piped to house	0,23	1,28	0,29	1.68 *	0,34	1,51	0,40	1.8 *	0,12	0,42	0,17	0,60
No sanitation	-0,02	-0,15	-0,03	-0,19	0,10	0,49	0,09	0,44	-0,29	-1,12	-0,29	-1.12
No garbage disposal	-0,18	-0,67	-0,19	-0,70	-0,09	-0,28	-0,08	-0,26	-0,30	-0,67	-0,32	-0,72
No toilet	-0,29	-2.34 **	-0,33	-2.65 **	-0,28	-1,59	-0,31	-1.82 *	-0,33	-1.79 *	-0,36	-1.97 *
Health post distance hrs	0,02	1.71 *	0,02	1.75 *	0,01	0,44	0,01	0,45	0,01	1,09	0,01	-1.12
Regional characteristics												
Mountains	0,01	0,08	0,01	0,04	-0,02	-0,08	-0,02	-0,09	0,13	0,65	0,12	0,61
HH is on the urban hills	0,42	1.89 *	0,45	2.05 **	0,15	0,51	0,18	0,62	0,53	1,61	0,56	1.69 *
HH is on the Terai	-0,04	-0,32	0,00	-0,03	-0,27	-1,56	-0,24	-1,37	0,24	1,18	0,27	1,33
HH has migrated	-0,03	-0,19	-0,02	-0,15	-0,13	-0,71	-0,12	-0,66	-0,04	-0,17	-0,03	-0,15
Cchetry	0,03	0,17	0,06	0,35	-0,13	-0,63	-0,11	-0,53	0,21	0,83	0,24	0,97
Brahmin	-0,08	-0,48	-0,03	-0,17	-0,52	-2.24 **	-0,47	-2.08 **	0,37	1,45	0,42	1.69 *
Magar	0,39	1.89 *	0,41	2.03 **	-0,04	-0,14	-0,01	-0,05	0,88	2.77 **	0,91	2.85 ***
Tharu	0,20	1,16	0,19	1,10	-0,03	-0,12	-0,04	-0,18	0,44	1,61	0,43	1,60
Newar	0,33	1,56	0,35	1,63	0,66	2.4 **	0,68	2.47 **	0,24	0,74	0,25	0,77
Tamang	0,58	2.58 **	0,58	2.55 **	0,50	1.76 *	0,50	1.78 *	0,71	1.96 *	0,69	1.92 *
Kami	-0,10	-0,42	-0,08	-0,33	-0,29	-0,96	-0,26	-0,88	0,30	0,84	0,32	0,89
Yadav or Ahir	-0,43	-1.84 *	-0,46	-1.97 **	-0,29	-1,05	-0,32	-1,15	-0,94	-2.17 **	-0,96	-2.23 **
Muslim	-0,12	-0,68	-0,14	-0,77	-0,08	-0,30	-0,09	-0,37	-0,17	-0,66	-0,18	-0,70
Rai	0,73	2.25 **	0,75	2.31 **	0,27	0,65	0,27	0,65	1,28	2.56 **	1,31	2.63 **
Gurung	-0,04	-0,15	-0,02	-0,06	-0,15	-0,41	-0,14	-0,39	0,24	0,55	0,27	0,61
Damai	-0,22	-0,67	-0,21	-0,65	-0,34	-0,70	-0,36	-0,74	-0,23	-0,51	-0,22	-0,47
Limbu	-0,02	-0,08	-0,01	-0,02	0,38	0,91	0,41	0,97	-0,16	-0,38	-0,15	-0,36
Sarki	0,11	0,40	0,12	0,43	0,18	0,46	0,21	0,52	0,18	0,47	0,18	0,47
Intercept	-0,91	-1,43	-0,98	-1,55	-0,47	-0,57	-0,56	-0,68	-1,10	-1,12	-1,14	-1,16
N	1173		1173		601		601		572		572	

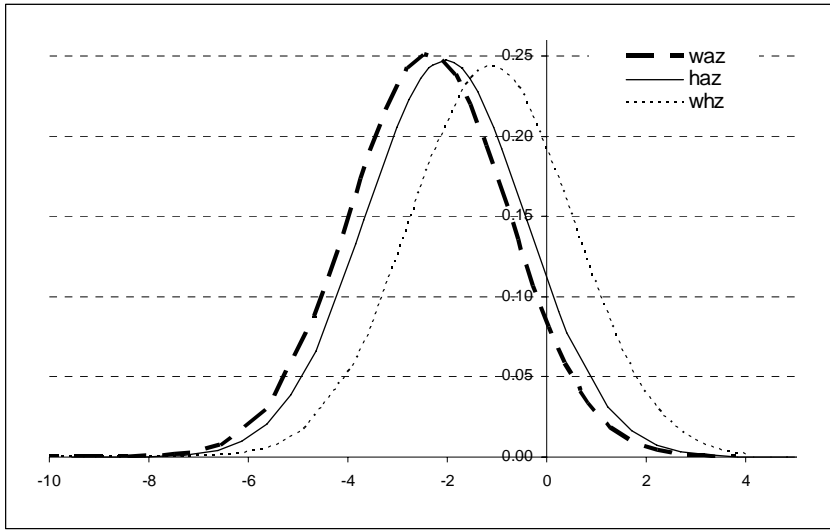
Table A11: OLS estimates, dependent variable height-for age z-scores

Variable	HAZ				Males HAZ				Females HAZ			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat
Mother's status												
Multiplicative	0.86	2.94 ***	0.85	2.9 ***	1.06	2.66 **	1.06	2.64 **	0.57	1.25	0.57	1.26
Mother's age at child birth	0.01	1.42	0.01	1.29	0.01	0.52	0.00	0.34	0.02	1.78 *	0.02	1.81 *
Mother's age at marriage	0.00	0.02	0.00	0.15	-0.03	-1.49	-0.03	-1.25	0.03	1.55	0.03	1.55
Birth control aware	0.13	1.30	0.14	1.49	0.35	2.37 **	0.39	2.67 **	-0.15	-1.14	-0.15	-1.17
Mother works for wage	-0.18	-1.09	-0.20	-1.23	-0.38	-1.58	-0.43	-1.82 *	0.03	0.12	0.03	0.13
Education difference ratio	0.05	0.56	0.08	0.97	0.00	-0.04	0.06	0.61	0.06	0.41	0.06	0.39
Distance to a local shop	0.01	0.34	0.01	0.32	0.01	0.41	0.01	0.41	-0.01	-0.28	-0.01	-0.28
Adult goods	-0.43	-1.60	-0.43	-1.60	-0.70	-1.7 *	-0.70	-1.69 *	-0.11	-0.31	-0.11	-0.31
Age differential in years	0.00	0.03	0.00	0.08	0.01	0.52	0.01	0.43	0.01	0.54	0.01	0.52
Remittances to mothers	0.06	0.36	0.05	0.34	-0.21	-0.70	-0.21	-0.71	0.15	0.77	0.15	0.78
Mother's characteristics												
Mother's schooling level	0.03	1.26			0.06	1.8 *			0.00	-0.19		
Mother ill lately	-0.21	-2.06 **	-0.21	-1.99 **	-0.13	-0.84	-0.13	-0.80	-0.23	-1.58	-0.23	-1.59
Mother chronically ill	-0.36	-1.94 *	-0.36	-1.97 **	-0.80	-2.72 **	-0.81	-2.75 **	-0.11	-0.45	-0.11	-0.45
Child characteristics												
Age 7-12 months	-1.04	-6.59 ***	-1.05	-6.61 ***	-1.19	-5.05 ***	-1.20	-5.08 ***	-0.89	-4.08 ***	-0.88	-4.08 ***
13-24 months	-1.44	-10.6 ***	-1.44	-10.6 ***	-1.52	-7.57 ***	-1.52	-7.58 ***	-1.33	-7.15 ***	-1.33	-7.16 ***
25-45 months	-1.58	-10.6 ***	-1.58	-10.6 ***	-1.63	-7.35 ***	-1.64	-7.36 ***	-1.51	-7.49 ***	-1.51	-7.5 ***
Child is male	-0.24	-2.7 **	-0.24	-2.71 **								
Child is immunized	0.05	0.47	0.06	0.52	0.22	1.31	0.22	1.35	0.00	-0.03	0.00	-0.03
Child chronically ill	-0.91	-2.03 **	-0.90	-2.01 **	-0.45	-0.65	-0.42	-0.60	-1.39	-2.4 **	-1.39	-2.4 **
Child was recently ill	0.31	3.1 ***	0.31	3.13 ***	0.45	3.18 ***	0.45	3.19 ***	0.18	1.29	0.18	1.29
0-6 months not breastfed	1.26	1.18	1.24	1.16	2.07	1.23	2.04	1.21	0.01	0.00	0.01	0.01
13-24 months not breastfed	-0.41	-0.94	-0.44	-1.00	0.15	0.23	0.10	0.15	-0.62	-1.03	-0.62	-1.02
25-45 months only breastfed	-0.30	-2.13 **	-0.32	-2.23 **	0.04	0.19	0.02	0.08	-0.74	-3.73 ***	-0.74	-3.74 ***
Household characteristics												
Ln family size	0.01	0.05	0.00	-0.01	0.16	0.57	0.14	0.50	-0.16	-0.58	-0.16	-0.58
Multi-generational	-0.08	-0.62	-0.06	-0.51	-0.22	-1.28	-0.18	-1.06	0.15	0.90	0.15	0.90
HH is poor	-0.31	-2.9 ***	-0.31	-2.98 ***	-0.34	-2.17 **	-0.37	-2.35 **	-0.24	-1.62	-0.24	-1.62
Value of livestock	0.00	0.95	0.00	0.93	0.00	1.03	0.00	0.94	0.00	-0.38	0.00	-0.37
Ln house value	0.00	0.10	0.00	0.29	-0.01	-0.60	0.00	-0.21	0.01	0.64	0.01	0.64
Ln of expenditures	-0.05	-0.91	-0.04	-0.75	-0.06	-0.72	-0.05	-0.60	-0.05	-0.69	-0.06	-0.73
Water piped to house	0.34	1.79 *	0.40	2.12 **	0.32	1.17	0.42	1.58	0.42	1.52	0.41	1.53
No sanitation	0.07	0.38	0.06	0.35	0.08	0.32	0.06	0.23	0.02	0.07	0.02	0.07
No garbage disposal	-0.27	-0.97	-0.28	-1.00	-0.35	-0.91	-0.34	-0.88	-0.29	-0.67	-0.28	-0.66
No toilet	-0.15	-1.09	-0.17	-1.32	-0.22	-1.08	-0.29	-1.43	-0.07	-0.40	-0.07	-0.38
Health post distance hrs	0.01	1.12	0.01	1.16	0.01	0.36	0.01	0.39	0.01	0.65	0.01	0.64
Regional characteristics												
Mountains	0.04	0.27	0.03	0.23	0.15	0.68	0.14	0.66	0.06	0.33	0.06	0.33
HH is on the urban hills	0.24	1.02	0.27	1.14	-0.03	-0.09	0.03	0.10	0.30	0.94	0.30	0.93
HH is on the Terai	0.21	1.45	0.24	1.72 *	0.10	0.47	0.17	0.81	0.29	1.45	0.29	1.45
HH has migrated	0.00	-0.02	0.00	0.00	0.00	0.01	0.01	0.06	-0.11	-0.52	-0.11	-0.52
Cchetry	0.19	1.11	0.22	1.27	0.18	0.71	0.21	0.86	0.22	0.90	0.21	0.89
Brahmin	-0.02	-0.09	0.03	0.16	-0.30	-1.10	-0.22	-0.83	0.33	1.33	0.32	1.34
Magar	0.16	0.75	0.19	0.85	-0.16	-0.50	-0.11	-0.35	0.52	1.66 *	0.51	1.66 *
Tharu	0.28	1.49	0.27	1.44	0.25	0.95	0.23	0.85	0.24	0.91	0.24	0.91
Newar	0.08	0.35	0.09	0.40	0.20	0.60	0.23	0.70	0.10	0.31	0.09	0.30
Tamang	0.56	2.33 **	0.56	2.31 **	0.68	2.02 **	0.69	2.04 **	0.43	1.22	0.43	1.23
Kami	0.03	0.13	0.05	0.20	0.06	0.17	0.11	0.30	0.20	0.57	0.19	0.56
Yadav or Ahir	-0.53	-2.1 **	-0.55	-2.21 **	-0.44	-1.36	-0.49	-1.51	-0.66	-1.57	-0.66	-1.57
Muslim	0.02	0.11	0.01	0.04	0.15	0.51	0.12	0.40	-0.05	-0.21	-0.05	-0.20
Rai	0.02	0.05	0.03	0.09	0.13	0.26	0.12	0.25	-0.18	-0.38	-0.19	-0.39
Gurung	-0.44	-1.44	-0.42	-1.37	-0.16	-0.36	-0.15	-0.33	-0.63	-1.47	-0.64	-1.48
Damai	0.22	0.62	0.22	0.63	0.03	0.05	0.00	-0.01	0.30	0.67	0.29	0.66
Limbu	0.01	0.03	0.02	0.07	1.00	2.01 **	1.05	2.11 **	-0.72	-1.73 *	-0.72	-1.73 *
Sarki	0.23	0.77	0.23	0.80	0.21	0.43	0.25	0.53	0.11	0.29	0.11	0.29
Intercept	-0.72	-1.06	-0.77	-1.14	-0.44	-0.45	-0.58	-0.60	-1.06	-1.11	-1.05	-1.10
N	1169		1169		599		599		570		570	

Table A12: OLS estimates, dependent variable weight-for-height z-scores

Variable	WHZ				Males WHZ				Females WHZ			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat	Coeff	t stat
Mother's status												
Multiplicative	0.34	1.07	0.32	1.02	0.15	0.36	0.15	0.36	0.45	0.88	0.42	0.82
Mother's age at child birth	0.00	0.44	0.00	0.31	0.01	1.00	0.01	0.99	-0.01	-0.64	-0.01	-0.77
Mother's age at marriage	0.02	1.38	0.02	1.52	0.01	0.43	0.01	0.46	0.03	1.57	0.03	1.63
Birth control aware	0.10	0.93	0.12	1.14	0.18	1.13	0.19	1.17	0.07	0.48	0.10	0.66
Mother works for wage	-0.27	-1.49	-0.30	-1.64	-0.37	-1.42	-0.38	-1.45	-0.29	-1.05	-0.33	-1.19
Education difference ratio	0.13	1.45	0.17	1.94 *	0.17	1.47	0.18	1.64 *	0.07	0.44	0.13	0.81
Distance to a local shop	0.01	0.56	0.01	0.55	0.01	0.29	0.01	0.29	0.01	0.42	0.01	0.38
Adult goods	0.58	1.93 *	0.58	1.93 *	0.45	0.93	0.45	0.93	0.58	1.48	0.58	1.47
Age differential in years	-0.01	-0.86	-0.01	-0.80	-0.01	-0.76	-0.01	-0.77	-0.01	-0.37	0.00	-0.19
Remittances to mothers	0.08	0.45	0.07	0.42	0.36	1.16	0.36	1.16	0.00	0.01	-0.01	-0.04
Mother's characteristics												
Mother's schooling level	0.03	1.39			0.01	0.21			0.04	1.32		
Mother ill lately	0.05	0.45	0.06	0.52	0.03	0.18	0.03	0.18	0.04	0.27	0.05	0.34
Mother chronically ill	-0.11	-0.54	-0.11	-0.56	-0.25	-0.79	-0.25	-0.80	0.14	0.52	0.13	0.49
Child characteristics												
Age 7-12 months	-0.22	-1.28	-0.22	-1.31	-0.40	-1.59	-0.40	-1.60	-0.18	-0.75	-0.19	-0.81
13-24 months	-0.54	-3.74 ***	-0.55	-3.77 ***	-0.52	-2.43 **	-0.52	-2.44 **	-0.58	-2.83 ***	-0.59	-2.89 ***
25-45 months	-0.04	-0.24	-0.04	-0.25	-0.02	-0.07	-0.02	-0.07	-0.11	-0.48	-0.11	-0.48
Child is male	-0.02	-0.17	-0.02	-0.18								
Child is immunized	-0.02	-0.15	-0.01	-0.09	-0.28	-1.58	-0.28	-1.57	0.08	0.51	0.10	0.59
Child chronically ill	-0.34	-0.61	-0.34	-0.60	0.92	1.12	0.93	1.13	-1.91	-2.44**	-1.94	-2.47 **
Child was recently ill	-0.38	-3.58 ***	-0.38	-3.55 ***	-0.40	-2.66 **	-0.40	-2.66 **	-0.30	-1.87 *	-0.29	-1.82 *
0-6 months not breastfed	1.24	1.10	1.21	1.07	0.50	0.28	0.50	0.28	1.78	1.13	1.70	1.07
13-24 months not breastfed	-0.30	-0.65	-0.33	-0.72	-0.05	-0.08	-0.06	-0.09	-0.45	-0.67	-0.48	-0.72
25-45 months only breastfed	-0.30	-1.86 *	-0.31	-1.97 **	-0.42	-1.82 *	-0.42	-1.84 *	-0.15	-0.62	-0.17	-0.75
Household characteristics												
Ln family size	-0.55	-2.6 **	-0.57	-2.69 ***	-0.51	-1.67	-0.51	-1.68 *	-0.61	-1.94 *	-0.64	-2.03 **
Multi-generational	0.23	1.71 *	0.24	1.85 *	0.37	2.00 **	0.38	2.04 **	0.07	0.38	0.09	0.49
HH is poor	-0.04	-0.39	-0.05	-0.46	-0.31	-1.86 *	-0.32	-1.89 *	0.27	1.62	0.27	1.61
Value of livestock	0.00	1.04	0.00	1.00	0.00	0.07	0.00	0.06	0.00	1.18	0.00	1.15
Ln house value	0.02	1.21	0.03	1.45	0.00	-0.19	0.00	-0.14	0.04	1.52	0.04	1.64
Ln of expenditures	0.04	0.68	0.05	0.87	0.02	0.22	0.02	0.24	0.07	0.74	0.09	1.01
Water piped to house	-0.11	-0.53	-0.04	-0.21	0.12	0.40	0.13	0.46	-0.36	-1.16	-0.27	-0.88
No sanitation	-0.17	-0.91	-0.17	-0.93	-0.05	-0.18	-0.05	-0.19	-0.41	-1.42	-0.41	-1.42
No garbage disposal	-0.09	-0.30	-0.10	-0.32	0.04	0.10	0.04	0.10	-0.13	-0.28	-0.17	-0.36
No toilet	-0.28	-1.9 *	-0.31	-2.15 **	-0.15	-0.67	-0.16	-0.71	-0.40	-1.94	-0.44	-2.18
Health post distance hrs	0.01	1.04	0.01	1.08	0.01	0.34	0.01	0.34	0.01	0.69	0.01	0.74
Regional characteristics												
Mountains	0.05	0.34	0.05	0.31	-0.09	-0.37	-0.09	-0.37	0.18	0.80	0.17	0.75
HH is on the urban hills	0.16	0.63	0.20	0.78	0.04	0.12	0.05	0.14	0.36	1.02	0.41	1.14
HH is on the Terai	-0.36	-2.31 **	-0.32	-2.09 **	-0.54	-2.41 **	-0.53	-2.41 **	-0.15	-0.64	-0.09	-0.41
HH has migrated	-0.28	-1.75 *	-0.28	-1.73 *	-0.50	-2.17 **	-0.49	-2.16 **	-0.03	-0.13	-0.03	-0.11
Cchetry	-0.21	-1.11	-0.17	-0.95	-0.48	-1.78 *	-0.47	-1.77 *	0.06	0.21	0.11	0.43
Brahmin	-0.38	-1.92 **	-0.32	-1.68 *	-0.79	-2.69 ***	-0.78	-2.69 ***	-0.01	-0.02	0.08	0.30
Magar	0.32	1.33	0.34	1.45	0.16	0.48	0.17	0.50	0.53	1.53	0.57	1.64
Tharu	0.09	0.44	0.08	0.40	-0.22	-0.76	-0.22	-0.77	0.44	1.46	0.43	1.43
Newar	0.33	1.35	0.35	1.42	0.46	1.31	0.46	1.33	0.31	0.86	0.33	0.91
Tamang	0.16	0.63	0.16	0.60	-0.11	-0.31	-0.11	-0.31	0.47	1.21	0.44	1.14
Kami	-0.20	-0.76	-0.18	-0.69	-0.54	-1.45	-0.54	-1.44	0.17	0.45	0.20	0.52
Yadav or Ahir	0.09	0.34	0.06	0.23	0.27	0.75	0.26	0.73	-0.52	-1.13	-0.56	-1.23
Muslim	-0.28	-1.30	-0.29	-1.37	-0.36	-1.12	-0.36	-1.14	-0.17	-0.58	-0.19	-0.64
Rai	1.02	2.71 **	1.04	2.77 ***	0.29	0.56	0.29	0.56	1.85	3.32***	1.92	3.45 ***
Gurung	0.18	0.49	0.20	0.56	-0.28	-0.59	-0.28	-0.59	0.79	1.34	0.86	1.46
Damai	-0.65	-1.53	-0.65	-1.52	-0.50	-0.73	-0.50	-0.73	-0.75	-1.36	-0.74	-1.34
Limbu	-0.04	-0.11	-0.02	-0.06	-0.77	-1.46	-0.76	-1.46	0.77	1.62	0.78	1.64
Sarki	-0.13	-0.38	-0.13	-0.39	0.05	0.09	0.05	0.09	0.07	0.16	0.06	0.15
Intercept	-0.36	-0.48	-0.44	-0.59	0.21	0.20	0.19	0.18	-0.70	-0.64	-0.77	-0.71
N	1100		1100		569		569		531		531	

Graph A1: Z-score distributions



Sample	Mean	Std Dev
Boys	-2.13	1.66
Girls	-1.92	1.55

Graph A2: Height-age z-scores distributions samples by gender

