GROWING UP AMONG THE LOOMS:

THE GROWTH AND NUTRITION OF CHILDREN

LIVING IN A PERI-URBAN ENVIRONMENT IN KATHMANDU, NEPAL

By

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ABSTRACT

This study examines the nutritional and health status of children under five years of age whose mothers are working as weavers and spinners in the carpet-making industry in Kathmandu, Nepal. The research design samples both carpet-making factories and households where the predominant mode of income generation for women is spinning wool at home for carpet manufacturers. A biocultural approach that combines quantitative and qualitative research methods - anthropometry, questionnaires and semi-structured interviews - is used to investigate the social and biological contexts of children's health and nutritional status.

Although low weight-for-height, or acute wasting, is not evident among the 283 children in this study, they are found to be moderately to severely growth stunted with poor upper arm musculature, relative to international growth standards. Similar to other children in Nepal, there is some weight loss evident in the hot and monsoon seasons compared to the cold season. Despite the fact that mothers are engaged in wage labour, both factory and home workers in this sample breastfeed for the first two to three years postpartum almost universally and therefore maternal lactation practices are not implicated in growth retardation. A synergistic interaction between low quality and quantity of weaning foods and an extremely high load of infectious disease - particularly diarrheal illnesses and gastrointestinal parasites - are implicated in growth retardation.

Some of the more traditional foci of child health studies such as maternal care and socio-economic status of the household are found to have little explanatory power in this research. An investigation of the peri-urban environment - the newly settled and marginal district that borders the city - points to the operation of macro environmental factors in debilitating the health of the children in this study. It is argued that an environmental health perspective constitutes the most appropriate framework for interpreting growth faltering among these children and that the lack of infrastructure in this peri-urban environment leads to poor sanitary conditions and high rates of chronic childhood infections. The research calls for increased anthropological attention to the environmental conditions that facilitate high pathogen loads among children, an area of inquiry that is often under-investigated relative to nutritional issues per se.

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CHAPTER ONE

Introduction: Perspectives on Child Health and Nutrition

> Of 1,000 children born in Nepal, seven will die on their first day of life; an additional 16 by the end of the first week; another 30 by the end of the first month; and another 54 by the end of the first year. Around 70,000 deaths occur each year, 192 a day, predominantly of causes that are either preventable or mainly manageable. Another 58 children will die between the ages of 1 and 5 each day, leading to a total of 165 deaths for every 1,000 children in the country (UNICEF 1992: xi).

There is no debate that the issue of child health in a country like Nepal is a compelling topic, worthy of study because of the clear goals that unify all in their endeavours: the prevention of child death and the promotion of child well-being. The biological imperative to focus on children is also straightforward - they are more vulnerable to morbidity and mortality than any other group in the human life cycle with the exception of the elderly (Caldwell 1996) and their rapid growth and development course can be detrimentally affected by environmental insults (Haas 1990; Schell 1986). Moreover, current social and political consciousness of children, perhaps more than at any other time in history (Scheper-Hughes 1987: 2), recognizes them as valuable members of our society who can and should not only survive through this difficult life stage, but develop to their optimal adult state.

From this deceptively straightforward agenda, however, emanates a much more complex field of study in terms of how we choose to research and represent child health as well as the solutions we propose to problems. Part of this complexity arises from the variety of disciplines of study which inform this issue - biological and medical anthropology, nutrition studies, biomedical sciences, development studies and health education to name just a few - as well as the fact that child health cannot be studied in isolation from other parts of human society, which range from the actions of members of the household to the global community.

As one of the major theoretical frameworks in biological and medical anthropology, the biocultural paradigm (Johnston and Low 1984; McElroy 1990; Armelagos et al. 1992; Wiley 1992) figures prominently in the theoretical approach of this study. Although there are diverse definitions of the biocultural framework (see Wiley 1992), I employ it in its most rudimentary form to approach the topic of human health by incorporating both biological and socio-cultural variables and perspectives. This approach has been shown to be critical to studies of infant nutrition for both past and contemporary human populations (Dettwyler 1987; Pelto 1987; Stuart-Macadam 1995; Herring et al. 1998), in part because breastfeeding and weaning, though both based in mammalian biology, are shaped by uniquely human forces. As well, the perspective on childhood illness taken in this thesis is also biocultural in that infectious disease, although clinically classified in terms of pathogens and bodily symptoms, is both distributed and interpreted in a community in socioculturally mediated ways (Inhorn and Brown 1990).

Another framework employed in this study is human adaptation, also known as human ecology (Little 1982). This field, rooted in human biology and anthropology, examines the way populations cope with and adapt to their environments, in particular to rapidly changing environments (Thomas et al. 1989; Baker and Hanna 1986). It is with this interest that human biology has turned its attention to populations living in the urban environment, both historical (Sawchuk 1993; Swedlund 1990) and contemporary (Schell 1997); the latter concentrating prominently on the health of newly urbanizing populations of developing economies (Schell et al. 1993; Johnston and Low 1995; Panter-Brick et al. 1996). Similarly, this study is situated in urban Nepal, and more specifically in one of the peri-urban parts of Kathmandu, the interface between rural and urban habitats where many migrants live. Although I did not set out to compare rural and urban differences in child health, I assert throughout this thesis that child health in this community is heavily influenced by the peri-urban nature of the environment.

As a physical anthropologist, part of my study of child health is rooted in the investigation of the human growth trajectory and its population variability. Part of a larger interest in exploring the relationship between human evolution and a changing environment, human adaptability studies originated by investigating the impact of the physical environment (abiotic and biotic aspects) on growth. One particularly important research focus was the effect of hypoxia at high altitudes on growth and development. Although there is some effect from hypoxic environments on growth, research done in the Andes (Leonard 1989; Leonard et al. 1990; Leonard et al. 1995) indicates that its effects are negligible after the prenatal and first postnatal months compared to the contribution of hypocaloric intake. This latter interest in nutrition, both in terms of bioavailability and social access to resources, has led to a dovetailing of interests of biological anthropologists and other child health and nutrition researchers (Martorell 1995; Huss-Ashmore and Johnston 1985). In the study of child health presented in this dissertation, the measurement of child growth under five years of age is employed as a tool to assess their health and nutritional status.

In part, prompted by criticism levelled by Critical Medical Anthropologists (CMAs) that medical ecology is apolitical and ahistorical (Baer et al. 1986; Singer 1989, 1990), and also by a growing awareness of the broader aspects of the environment to include social and cultural constructions, proponents of human adaptation have included political-economy into their models, and in particular, the biology of poverty (Leatherman and Goodman 1997). Likewise, my study is located among families who work as wage labourers in the carpet-making industry and who live in Nepal, a country grappling with major issues of poverty and economic development. Thus, in my study I consider poverty of material conditions and of human development opportunity to be one of the major constraining factors of child health.

The focus on the biology of poverty overlaps with those of biomedical researchers in international health studies. Indeed, these studies significantly inform the anthropological investigations of child health by borrowing standardized procedures of measurement in the field and by assuming a development stance in working towards interventionist strategies (Huss-Ashmore and Johnston 1985). Some scholars have critiqued, or perhaps more accurately, have augmented biomedical approaches. Nichter (1989), for example, challenges the public health education paradigm by emphasizing an anthropological perspective to consider people's understandings of their health and public health messages. Mosley and Chen (1984), likewise, advocate a synthesis of medical and social sciences in child survival research that downplays disease as the cause of death and emphasizes "proximate" causes of death, which are conceived of as behaviourally mediated biological mechanisms. In a similar vein, Millard (1994) proposes an integrated model for investigating child mortality which considers three tiers of interacting variables: 1) proximate or biomedical causes; 2) intermediate or household factors; and 3) ultimate or broad economic, cultural and ecological factors.

The issue of maternal-child health and the role that mothers play in influencing child health and well-being assumes a high priority in international health research (See for example, Behrman 1995; Engle 1995; Harkness and Super 1994; Huffman and Lamphere 1984; Ware 1984; Popkin 1980, among others). While some, such as Coreil (1991), Leslie (1989) and Balasubrahmaniyam (1987), have raised the concern that too much burden is being placed on the parents (particularly the mothers) as the sole arbitrators of child health and well-being, much of this research continues to focus too narrowly on micro-level issues at the expense of wider environmental and political-economy contingencies. Thus, while in this study I consider the productive and reproductive roles of mothers, as both carpet workers and childcare givers, I maintain that the household environment is only one part of the total environment.

There is currently a movement afoot to shift the gaze of public health from a parochial study of lifestyle determinants - i.e., health based on individual responsibility - to wider concerns of the global ecosystem and human ecology (See, for example, Last 1998). This is a reflection of heightened interest and awareness in recent decades of the impact of global environmental destruction on human health. But it also has an historical precedent in public health concerns during the nineteenth-century sanitary revolution in Europe and North America which sought to improve the health of communities by cleaning up water, sewage and household sanitation (Last 1998: 10). Similarly, there is a move away from child survival interventions that rely only on primary health care technology - such as immunization, promotion of breastfeeding, and dietary supplements - to strategies which address the environmental determinants of child health and emphasize primary prevention (Murphy et al. 1996: 5). The anthropological perspective is suitable for this endeavour as it stresses a holistic appraisal of the environment as created and determined by humans, and considers, moreover, both its macro and micro features. Thus, those using this framework are poised to actively participate in this multidisciplinary environmental health approach.

It is for this reason that I ultimately adopt an anthropological environmental health perspective in this dissertation. This perspective is an intersection between aspects of biological and medical anthropology and public health concerns regarding child health. An environmental health perspective such as this considers both the health of human populations and of their environments and the interaction between the two entities. Going beyond previous concerns with child survival, it shifts the conceptual framework to prevention of ill health as well as placing emphasis on wider communities (village, nation and globe) and on changing the environment. In contrast to the "biology of poverty" approach, the environmental health perspective does not give priority to the political-economy, but rather situates it in a number of complex webs of causation which include the physical and social environment.

Following Kettel (1996: 1367), the environment is envisioned as the "biophysical life space": an amalgamation of abiotic and biotic aspects of the environment inhabited by people who are both being shaped by and shaping the environment. As Kettel points out, the use of this definition functions "to avoid arbitrary distinctions between natural and built environments..." (Kettel 1996: 1367).

Nowhere is the inseparability of natural and built life spaces more obvious than in the urban environment. For the most part, the work of human biologists and physical anthropologists has centred on rural communities, perhaps in part because so much of the former focus of adaptation studies was on the so-called more "natural" aspects of the environment. When urban environments have been considered, moreover, it is often, as Schell and colleagues (1993: 3-4) point out, in the context of a simplified urban-rural dichotomy, with little attention paid to the subtle variation and complexities of the urban ecosystem.

The impact of urbanization on child health is increasingly being recognized in low-income countries. Nevertheless, there is still a gap between that recognition and doing what needs to be done (WHO 1988: 2). This is particularly the case in Nepal, where urban health has never been viewed as a high priority. Given the recent rapid increase in urbanization, however, problems have already started to arise for Nepali children and will continue to grow (UNICEF 1992: 168). Peri-urban environments, in particular, are now a focus of urban research, due to their concentration of rural-to-urban migrants, poverty and rapid physical environmental change. They are, thus, considered to be prime target areas for environmental health intervention projects (Varley et al. 1996).

Finally, as stated above, the anthropological environmental health perspective includes the presumption that we as humans are not only affected by the environment but that we shape and create it as well. Thus, in going beyond traditional human adaptation and biocultural approaches, I endeavour in this dissertation to give some agency to the people who are the subjects of this study. While they are caught up in forces such as economic globalization, urbanization and environmental destruction, which are considered to be seemingly beyond their control, they are also making conscious and rational decisions about how they can best cope and in some cases prosper despite these contingencies. Many of the families discussed in this thesis have moved to the city in an attempt to improve their prospects and those of their children. Parents' perspectives and opinions of their children's health are not only good alternative lines of evidence to standard measures of health, but are also crucial in understanding what the researcher is unable to garner in a short fieldwork stint.

The dissertation

At its simplest this dissertation is about the health and nutrition of a group of children under five years of age whose mothers and some of their fathers work in the carpet-making industry in peri-urban Kathmandu, Nepal. The complexity of it lies in the multi-factorial nature of the chronic ill health that many of these children experience in a difficult environment.

The central questions of the dissertation are:

1) How do children grow in peri-urban Kathmandu?
2) What are the contributing factors to growth retardation, particularly stunting, in this environment?
3) What impact do maternal factors such as mothers' productive work and infant feeding practices have on children's health and nutritional status?
4) What role does infectious disease play in children's health and nutrition and is there a link between environmental contaminants and children's health?
5) Are there factors specific to the peri-urban environment affecting children's health?

The thesis is advanced by the following chapters. Chapter 2 describes the geography and recent political history of Nepal, the context of recent rapid urban growth and the development of the carpet-making industry, a major employer of rural-to-urban migrants. The location of the study, the community of Boudha, Kathmandu is introduced and the significance of the peri-urban environment is discussed, foreshadowing some of the biophysical and social features which influence the health of the study children.

Chapter 3 details the study design, which includes both carpet-factories and homes where mothers spin wool, and incorporates a number of different quantitative and qualitative data collection tools. As well, a socio-demographic profile of the families in the sample is presented to inform the reader of their situation at the time of study.

Chapter 4 introduces the issue of growth faltering generally and more specifically in Nepal and presents the anthropometric data gathered in this study. As in many low-income countries worldwide, the Nepali children in this sample, on average, begin the process of linear growth faltering early in their first year of life, a process which continues into their third year when they become classified as growth stunted. Some preliminary comparisons between this peri-urban sample and other growth studies in Nepal indicate that while these peri-urban children may have a slightly lower prevalence of growth stunting and slightly larger mean body mass than some rural Nepali children, they continue to suffer from chronic growth retardation. This is contrary to the expectation that the health and growth of children is improved across the board in urban areas and explains some of the ambiguous findings of world wide comparisons of rural and urban growth data (Schell et al. 1993: 4). Using some of the socio-demographic characteristics of the sample, including the mothers' workplace environments, some preliminary analysis of variation in growth status is conducted in this chapter. These micro-level influences have a minor impact on growth status and it is concluded that the immediate household and workplace environments are much less important to child health than the wider aspects of the social and physical environment. The following chapters, 5 and 6, investigate some of these macro-level biocultural factors which may underlie this pattern of chronic growth faltering.

Chapter 5 considers infant feeding practices among the mothers in this study, all of whom work as wage labourers either in their homes or in factories. It is argued that in this peri-urban community child feeding practices are not negatively influenced by productive work or urbanization as might be expected. Perhaps too much attention has been paid by international health researchers to worldwide trends in the replacement of breastfeeding by bottle feeding and not enough to women who are breastfeeding and how they are doing it. This chapter attempts to examine in some detail the duration of breastfeeding and the simultaneous introduction of non-breast milk food and how the weaning process influences children's growth.

Chapter 6 is an investigation of morbidity among this sample of children and, more specifically, concentrates on the role of respiratory and gastrointestinal infections on child growth and health. It is concluded that frequent morbidity, caused by environmental conditions common in Nepal, but acute in the peri-urban community, is detrimental to children's growth and development. An investigation of the utilization of health care systems in the study area, both biomedical and traditional, illustrates some of their strengths and weaknesses in addressing the high level of child illness. Mothers' perceptions of diarrheal illnesses are explored with the view to future investigation of how they might be more compatible with an environmental model of health rather than a biomedical one.

Finally, the conclusion in Chapter 7 highlights the need to consider urbanization as an important environmental determinant of child health. The urban ecosystem, created and shaped by humans, presents both advantages and disadvantages to the children who inhabit it. Although growth stunting is a common feature of many poor children in low-income countries, this study illustrates that it is important to investigate the underlying contributing factors that vary from one environmental context to another. Although issues of breastfeeding, weaning and household determinants of health have received attention from anthropologists, I argue that high infectious disease load plays a very prominent detrimental role in children's health and growth status in this peri-urban context and deserves equal anthropological attention. In this study environmental contaminants, i.e., food and water-borne pathogens, are identified as having a significantly deleterious impact on child health. Thus, an environmental model of health which stresses prevention and shifts the focus from blaming maternal and household factors to identifying and ameliorating community-level determinants of health is deemed to be most appropriate for investigating health in this population of children.

CHAPTER TWO

The Study Setting: The Peri-Urban Community of Kathmandu, Nepal

This chapter locates the study geographically and in terms of international development and the domestic political-economy of Nepal. More specifically, it introduces the fieldwork setting, including the Tibeto-Nepali carpet-making industry and the broader community of Boudha, Kathmandu. Rural-to-urban migration and its contribution to current rapid urbanization in Nepal is considered as part of the development of the carpet-making industry and the recent growth of Boudha. Finally, the development of peri-urban Kathmandu and the concomitant environmental health issues for children are introduced.

Geographical setting

The Kingdom of Nepal is a small Himalayan nation nestled between Tibet (now part of the Peoples' Republic of China) and India. Its physical geography is extraordinarily diverse, although it can be partitioned into three parts: the Terai, the mid-hills and the mountains. Each section lies in roughly horizontal strips from south to north (Figure 2.1). Although Nepal is a small country in terms of area, it has a wide array of micro-climates because of its extreme variation in altitude. The Terai is the local term for

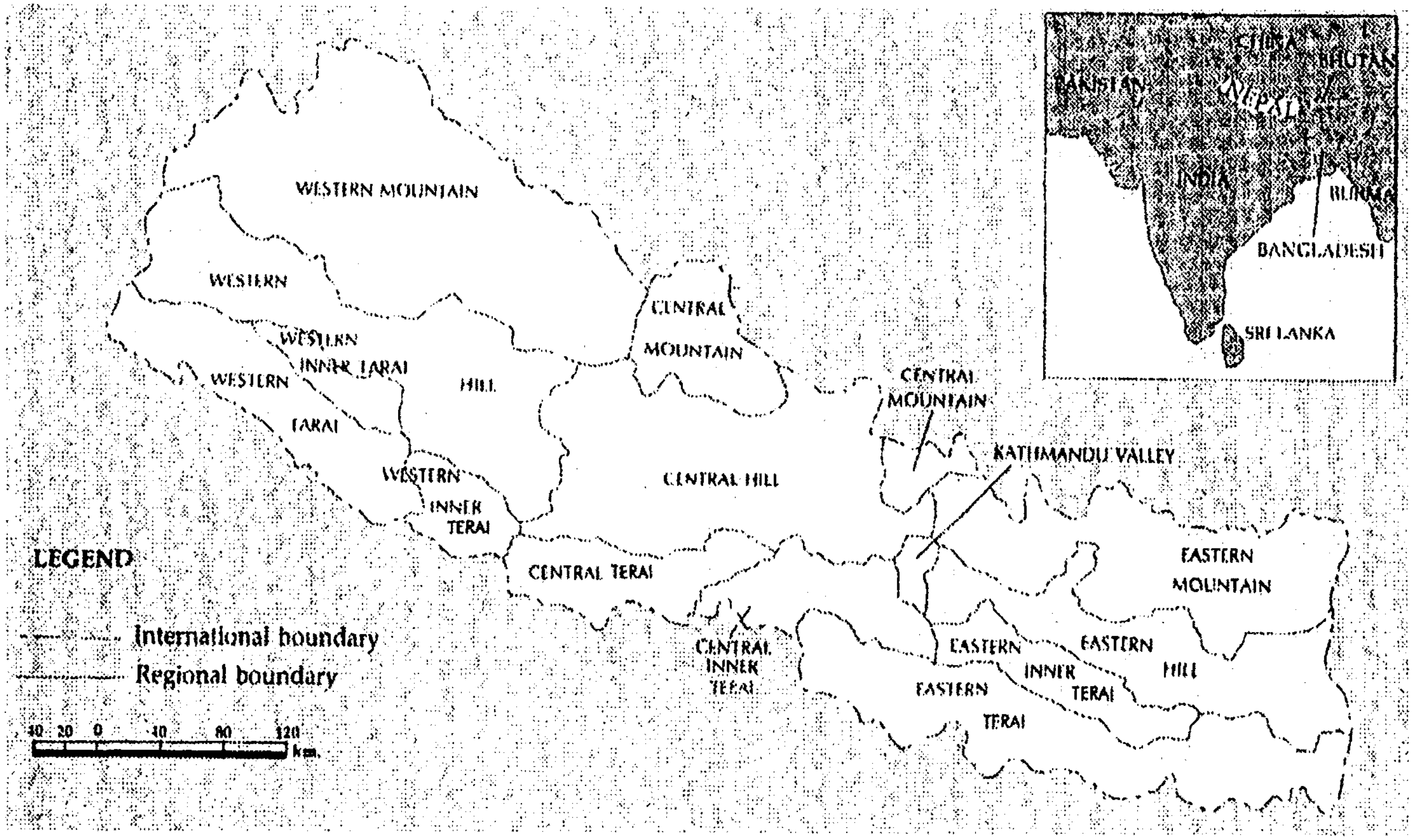

Figure 2.1 Map of Nepal showing regional divisions.

the flat plains bordering India. It is the warmest part of Nepal, having a semi-tropical climate. The mid-hills, which include the Kathmandu Valley at 1324 metres above sea level, have both hot and moderately cold seasons; the temperatures are usually just above freezing during the cold season and snow is very rare. Finally, the Himalayan mountain villages, due to their high altitude, have severe winters and snow is common above 2000 m (Sill and Kirkby 1991: 60).

Like the rest of South Asia, the monsoon is an important aspect of the climate of Nepal because most of the annual precipitation falls during this season. The monsoon air mass moves from east to west across the country, arriving in early to mid June and finishing in September. This season of precipitation is crucial for agriculture, but it also brings destruction: intense downpours can be detrimental to crops because of soil erosion and damage to terraced fields on the slopes of hills (Sill and Kirkby 1991: 60). Heavy rains are also capable of destroying physical infrastructure such as roads, walls and house roofs. The monsoon, moreover, is a time when gastrointestinal illnesses - particularly acute ones, such as cholera, dysentery and typhoid - are common and much feared.

In addition to the precipitation of the monsoon, temperature plays a large role in peoples' experience of the climate; at least, that is, in the Kathmandu Valley, where people tend to divide the year into two halves: the "hot" and "cold" seasons. Because Nepal is located in the northern hemisphere, the cold season lasts from October until March and the hot season from April to September. Many people prefer the cold season because it is considered to be fresher and healthier, as stored food lasts longer without turning bad and there is a lower incidence of the type of illnesses mentioned above. On the other hand, in Kathmandu, temperatures can be close to the freezing mark in the mornings and evenings during the cold season and without any indoor heating, not even a wood fire, it can be quite uncomfortable. Respiratory diseases, especially influenza and colds, are very common during this season and people correlate the changes in season with the changes in illness.

In 1995, the year of my field study, the coldest month was January when the minimum temperature measured at Tribhuvan Airport in Kathmandu averaged 1.1° C. During the winter afternoons, however, the sun was bright and the average maximum temperature for January was 17.9° C. The hottest months are April and May, just before the monsoon hits. In April and May of 1995, the average maximum monthly temperatures were 29.3 and 31.4° C respectively with extreme maximums of 34° C. Although the temperature stays warm throughout the monsoon, the heat is moderated somewhat by the cooling effect of the rains. The mean monthly temperature from June to September, 1995 was 28° C.

The main agricultural season begins in April with the tilling of the soil and the planting of the cereal crops including rice, maize, wheat, barley and millet. Rice paddies are planted at the beginning of the rains and are harvested in August. There are also winter crops in the warmer Terai. Above 2000 m rice cannot be grown so potatoes, barley and millet are the main crops (Sill and Kirkby 1991: 60).

The majority of the 18,491,097 Nepali citizens (CBS 1994: 2) are farmers who depend on agriculture as a principle source of subsistence. Unfortunately, most farms are very small, not only because land is parcelled within families, but also because there is production pressure on cultivated land which often leads to low yields and to soil depletion. With the high population pressure on agricultural land and the accompanying deforestation, soil erosion and land slides lead to the frequent destruction of agricultural plots. The distribution of land holdings, moreover, is very skewed: in 1981 land owners with large plots, over 3 ha of land, formed only 3 per cent of farm households, but occupied 48 per cent of the land (Sill and Kirkby 1991: 123). Thus, as a consequence of both environmental and political-economic factors, agriculture in Nepal, particularly in the hill and mountain districts, has been characterized as being in "a state of crisis" (Seddon 1987). At one time Nepal was a net exporter of food products, but by the end of the 1970s it had a trade deficit in crops which continues today (Sill and Kirkby 1991: 129). This results in a greater need for a cash economy; though always present in Nepal's history because of trade between Tibet and India, the cash economy is now a matter of survival for a growing portion of the population.[1]

The recent history of health and development

The history of health and health care in Nepal parallels the political events of the last two centuries and the nation's development and underdevelopment in terms of its social and economic institutions. The telling of Nepal's political and economic history, therefore, reveals why health and health care in Nepal are currently in a bad state vis-à-vis other nations in the world.

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[1] In his book *Himalayan Households: Tamang Demography and Domestic Processes*, Fricke (1993) uncovers the stimulus for a changing economy in a Himalayan village by examining population growth and household organization.

To a large degree Nepal's underdevelopment can be blamed on the Ranas, a despotic ruling family that maintained a feudalistic regime in Nepal for one hundred years (Whelpton 1986: 16). Nepal was unified as a nation in 1754 C.E. following the conquest of the Kathmandu Valley by King Prithvi Narayan Shah. After approximately a century of rule, a violent overthrow occurred by a rival faction led by Jang Bahadur Kunwar (Rana). This ushered in the Rana period, which lasted from 1846 to 1950. The Ranas specifically rejected economic development, namely industrialization, and followed an isolationist policy. They maintained an elite and self-serving lifestyle, paid for by the Nepali people through taxation. While the Ranas did keep Nepal free of colonial masters, they were supported by British India, which protected the Ranas against their enemies in Nepal and India and used them as allies in maintaining colonial control over India (Whelpton 1986: 4). Nepal was thus cut off from all political and social changes beyond its borders. Only the Rana family elites were educated and knew of the technological and cultural changes happening in the outside world.

Perhaps most damaging to the people of Nepal was the Ranas' reluctance to develop infrastructure, such as roads and social institutions like public education and hospitals. The exception to this negligence was Prime Minister Bir, the first leader to begin developing a health care system in Nepal. During his tenure the first hospital was built in Kathmandu in 1890. This was followed by a number of hospitals built at other administrative centres throughout the country (Dixit 1995: 21-22). At the beginning of the 20th century the Ranas did establish some Western style schools for middle and upper class elites, which eventually spawned some radical political movements in Nepal in the

1920s, influenced by the Indian Nationalist movement (Rose and Scholz 1980: 32). It was not until 1950, however, that the Ranas were finally deposed by the Nepali Congress Party in conjunction with Nehru's government in India. Nepal created a constitutional monarchy by restoring King Tribhuvan to the throne and attempted democratic rule for ten years until the King abolished parliamentary rule in 1960 and replaced it with the partyless *Panchayat* system and absolute rule by the monarchy (Hoftun 1994: 14-15).

It was during the second half the 20th century that Nepal opened its doors to the rest of the world. A series of five-year plans through the 1950s and 1960s attempted to establish health posts throughout the more remote regions of the country as well as various programs from the ministry of health. This era also ushered in development in the form of foreign aid. The U.S.A. was especially involved in aid projects, in part because of Nepal's strategic position next to China and the fear of the spread of communism, but also because it was, in general, an era of looking outwards from domestic affairs to global development. One of the most ambitious and successful aid projects of this time was the malaria eradication program started in 1953 in the Terai region (Justice 1986: 49). This project effectively eradicated malaria in the Terai and allowed many Nepalis to occupy lands which had previously been uninhabited.

Another such program was the family planning project established in the late 1960s. As Justice points, however, despite its huge scale and USAID's large budget, it was not as successful as the malaria project, because it was poorly designed and culturally inappropriate (Justice 1986: 50). To illustrate the insensitivity to the socio-cultural context of Nepal during the health and development projects of the 1970s, Justice describes a pilot project to introduce assistant nurse-midwives (ANMs) as part of the national maternal and child health program. The project flowed from and was justified by the Alma Alta declaration on primary health care and the use of women rather than men in planning women's health care needs (Justice 1986: 140). In Nepal, however, women's views on appropriate expectations about health care providers conflicted with the way the program was designed by development workers. The program offered two years of training for women at least 16 years old with at least eighth grade education. Although the ANMs were supposed to work in rural health posts, many preferred to work in urban hospitals and were often in the health posts on paper only. Part of the problem was that in many regions of Nepal it is considered socially unacceptable for girls and single women to travel and live alone. Rural women, moreover, rarely met the educational standards and thus most of the ANMs were urban- born and unused to the remote parts of the country. Many villagers were unwilling to call on strangers to help them with pregnancy care, but even local girls were not deemed knowledgeable enough to be midwives, as they were usually young and not married themselves. Finally, there really is no local custom of midwifery in Nepal, as women rely traditionally on family members, except in cases of complicated delivery when a woman will then seek professional help. Women were not in the habit of calling on midwives and consequently they did not use the government ANMs (Justice 1986: 145). This is but one example of some of the well-intentioned, but very misguided development projects that occurred during the era of intensive foreign aid to Nepal. Unfortunately, the country has come to depend on the income from such projects to support their infrastructural and social development and aid is one of the nation's largest sources of foreign revenue.

In the spring of 1990 Nepal experienced a democratic revolution in which a political party system with free and independent elections was established in the country, while the monarch remained a symbol of unity for the nation. Much hope was in the air for the expected economic and social development associated with western-style democracy. Unfortunately, the political changes have still not fulfilled these aspirations. Despite some impressive catch-up in the last fifty years, Nepal is still very poor. In 1992 it was one of 8 out of 145 nations that had a GNP per capita below 200 US$ (UNICEF 1995: 76).

Unlike larger countries in South Asia, Nepal's poverty has been distributed more evenly among the population and is less extreme because of its rural and subsistence agricultural base. As well, being smaller and less industrially developed, it has avoided the teeming mega cities of its bigger neighbours such as India, Pakistan and Bangladesh. Nevertheless, from 1980-93 Nepal's average annual growth rate of the urban population was 7.8%, the highest in Asia, and only exceeded by the nations of Botswana, Mozambique and Burkina Faso (UNICEF 1995: 74-75). Although one of the least urbanized countries in South Asia with only 9.2% of the population living in urban areas (CBS 1994: 2), Nepal currently has the highest rate of urban growth in the South Asian region.

Table 2.1 Average annual growth rate of urban population in South Asian countries from 1980- 93.

Country	Growth Rate (%)
India	3.0
Pakistan	4.5
Bhutan	5.4
Bangladesh	6.3
Nepal	7.8

From UNICEF (1995: 74).

Urbanization is just beginning in Nepal, but it is happening rapidly. Part of the impetus for this urbanization has been the push of people from the rural hill and mountain villages to partake in the urban cash economy because of the ecological conditions described earlier. As well, with development and modernization goals in the minds of many Nepali people, moving to the city is viewed as an opportunity to gain educational and economic advancement. With this rapid change in human habitat, however, poverty may become more visible in Nepal, as urban centres grow and the dependence on a market economy creates more inequities between haves and have-nots. It is hoped that with planning and forethought the difficulties of the megacities of other countries in the region can be avoided in Nepal.

Kathmandu, Nepal: field site

Kathmandu, the capital city of the Nepal, contains the largest urban population in the country. The population of Kathmandu in the 1991 census was estimated at 675,341. The other two neighbouring cities of Bhaktapur and Lalitpur have another 172,952 and 257,086 people respectively (CBS 1994: 6). The Kathmandu Valley historically has been the cultural and political centre of Nepal. In the Malla period, from the 11th to the 18th centuries, Kathmandu, Patan (Lalitpur) and Bhaktapur were capitals of independent principalities. During that period the Newars, the native inhabitants of the Valley, distinguished themselves as artisans, excelling in architecture, temple building, and woodworking, still gloriously present in these cities (Sharma 1989: 6-7). After the unification of Nepal in the 18th century, all governing leaders of the nation held their seat of power in Kathmandu and around them a large bureaucracy, modelled on the Indian system, was established. Although there has been some attempt in the last 20 years to move the central government to other urban settlements throughout Nepal, much of the power and political infrastructure is still centralized in Kathmandu.

Within the last thirty years, the villages that surround Kathmandu have slowly been swallowed up by the city, making them suburbs rather than separate villages. The built-up area as a percentage of Kathmandu's area was only 17.8% in 1954, but by 1981 it was 55.8% (Sharma 1989: 43). The communities where the current study took place - Boudha, Jorpati and Daksin Dokha, formerly separate villages lying approximately 5 to 10 km from downtown Kathmandu - are now connected by buses and other transportation vehicles to the downtown core and seem very much like part of the city (Figure 2.2).

Boudha is the location of the Boudhanath stupa, a great spiritual monument said to date to the third century B.C.E. when Buddhism was introduced to the Valley from India (Rose and Scholz 1980: 7). A community of mainly Buddhist peoples, engaged in agriculture and other pursuits, gradually settled around the stupa. Tourism has always figured prominently in Boudha, as it is a pilgrimage site for Buddhists from all over Asia

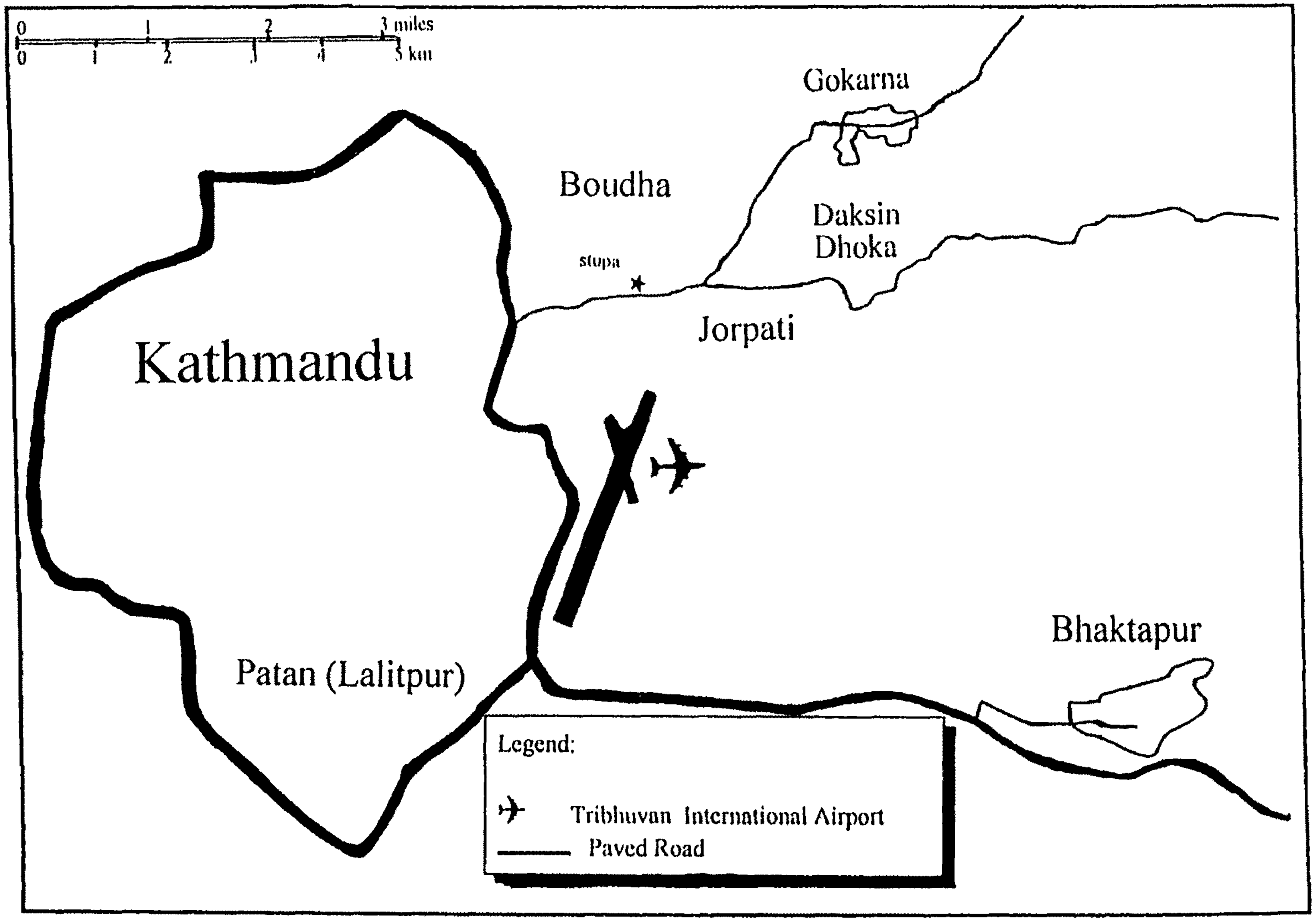

Figure 2.2 Map of Kathmandu with surrounding cities and peri-urban communities.

(Figure 2.3). Jorpati is located to the east of Boudha. It has attracted manufacturing industries, including the carpet industry, and has become Boudha's less attractive neighbour (Figure 2.4). Dakshin Dhoka, the most rural of the peri-urban communities in this study, is located furthest to the east, at the end of the city public transportation line (Figure 2.2). "Dakshin Dhoka" is an unofficial name for the area, designating its proximity to the south gate (*dakshin* means south and *dokha* means gate) of the Gokarna Forest, the King's protected wildlife park.

The Tibeto-Nepali carpet-making industry

Part of the impetus for growth of urban Nepal in recent years, especially in Boudha and Jorpati, is the Tibeto-Nepali carpet-making industry. Although weaving cloth and carpets is a handicraft familiar to Nepali women, the export carpet industry in Nepal is based on a tradition of artisan craft production from Tibet, where carpets were made for monasteries and large households of upper class elites (O'Neill 1997: 61-68).

This industry was transplanted to Nepal after the exodus of approximately 100,000 Tibetans to Nepal and India because of the brutal Chinese takeover of Tibet by the Maoist government in 1959. An estimated 12,000 refugees settled in camps in the Kathmandu Valley (Gombo 1985). In 1961 the Swiss Aid and Technical Assistance organization helped to establish a cooperative Tibetan carpet-making industry in Kathmandu to manufacture carpets for European buyers and thereby enable Tibetan refugees to support themselves. This endeavour was very successful, so successful that some Tibetan entrepreneurs began to operate private carpet companies for the growing

Figure 2.3 The Boudha Stupa with rice field in the foreground.

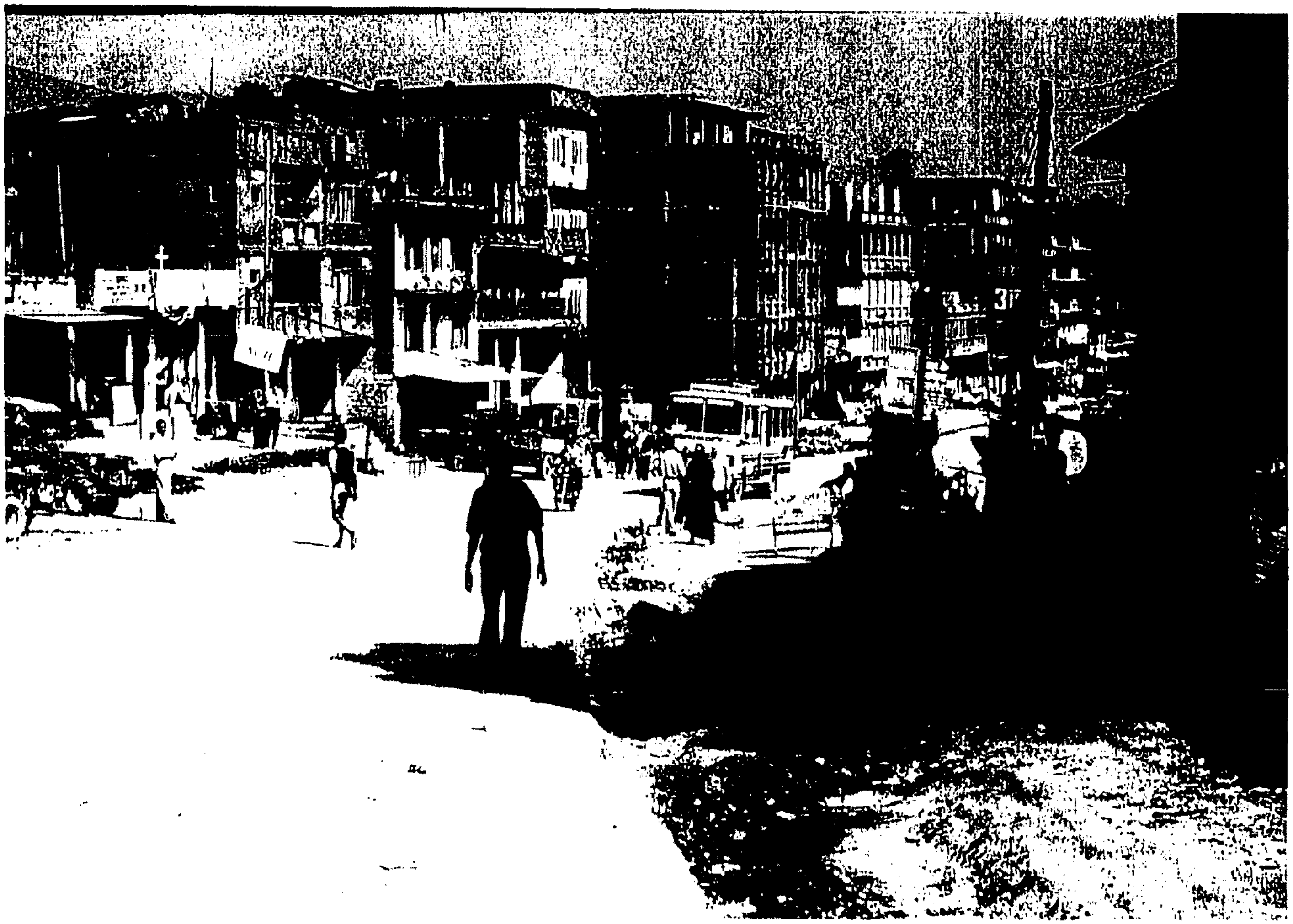

Figure 2.4 Main street of Jorpati showing its industrial character.

European market (Worcester 1992). At the end of the 1980s other non-Tibetan Nepalis joined the growing industry by opening both large and small weaving halls. It was at this point that there was a burgeoning demand for weavers and spinners to make the thousands of square metres of carpet for export (O'Neill 1997). Ironically, in 1995, most of the workers in the commercial carpet factories in the Boudha area were not Tibetans, as they had moved on to become the owners of carpet factories or to establish other businesses. This phenomenon is well-illustrated by the composition of my study sample of women, among whom only 3 out of 229 workers are Tibetan (See Chapter 3, Figure 3.5).

Many entrepreneurs began to commission labour from the rural villages in Nepal, mostly from the central and eastern hills and the Terai, as these regions are close to Kathmandu. These regions are also extremely overpopulated and there is a long tradition of out-migration to Kathmandu and other urban centres for employment. During that boom period children and young adolescents were brought into industry. As O'Neill (1997) explains, although the carpets were hand-knotted, they were being mass produced at a rapid rate and carpet weavers were in great demand. Many adolescents and young adults left their village to go to Kathmandu in search of carpet work.

Estimating the number of people in the Kathmandu Valley employed in the carpet industry is a tricky venture, in part, because the industry changes constantly. While there was a boom in the late 1980s and early 1990s, in 1995 there was a down turn in the industry mainly because of a world wide economic recession, forcing many factories to close and workers to be laid off. In 1992 an NGO, "Child Workers in Nepal" (CWIN), claimed that there were 300,000 people employed in the industry (CWIN 1992). USAID estimated that in 1992/93 the figure was closer to 102,000 although only full-time workers were included in their calculations. Based on this lower figure, however, the USAID report states that the carpet industry remains the largest employer in the Kathmandu Valley and the largest modern sector employer in the country (USAID 1994: 3). A survey of 300 factories in 1995 in the Boudha/Jorpati area alone, based on reported numbers by managers or owners, is 16,681. This figure does not include home spinners or carpet washing and dye manufacturing factories (O'Neill 1997: 228).

The problem with trying to quantify the labour force, however, centres on the transient nature of the businesses themselves, which open and close continuously depending on the fortunes of the owners. Many of the factories are not registered with the government and exist for several months only while they are sub-contracted by a larger company to fill an order. As well, because the work is piece-rate in nature, many workers come and go and some workers move from factory to factory negotiating better positions for themselves. (See O'Neill (1997) for an explanation of the nature of labour contracts.)

Most of the weavers learn to weave when they arrive in Kathmandu. Although weaving is commonly done by many Nepali women, who make household carpets on small, horizontal looms, the Tibetan technique is different. The Tibetan style of weaving is done on a vertical loom and the weaver follows a graph or map located above the weaving area (Figure 2.5). Weaving a carpet is technically difficult; however, some parts of the carpet are easier to weave than others, as they are a solid colour with no graphical

Figure 2.5 Three women weaving on a vertical loom in a carpet factory.

design[2]. As well, some carpets have more knots per square inch than others; the denser ones require finer skilled work.

Another huge part of the labour market is hand spinning wool. Wool work is something that all Nepalis (particularly those in the more temperate and colder climates) are very familiar with, as Nepali women have always done wool work, knitting sweaters, shawls, hats and mittens. The hand knitted clothing industry has been a thriving cottage industry for some time and the traditional hand-driven spinning wheel used in Nepal is also used in the carpet industry. Unlike weaving, only women spin wool, although I have seen some elderly men spinning wool in their homes and a few young boys in the factories. This may be because it is considered "women's work", but also because it requires less skill than weaving and is not well paid.

When the industry first began, many women set up looms in their homes and made carpets there for contractors. As the industry became more regulated in the 1990s, however, carpet manufacturers decided that they wanted the business centralized and told women that they had to bring their looms to the factories. One woman in my study said that at that point she gave up weaving because she didn't want to leave her home and six children to work in the factory. She switched to spinning wool at home, which is less lucrative but easier work. Although many factories have spinning rooms on site (Figure 2.6), many women in Boudha continue to spin wool at home (Figure 2.7). They pick up the wool at a depot and return it there when they have finished.

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[2] The open field in the middle of the carpet with patterns around the border is actually not a traditional Tibetan design, but rather a German innovation (O'Neill 1997: 77-78).

Figure 2.6 A spinning room in a carpet factory.

Figure 2.7 A woman working on her hand-powered spinning wheel at home.

It should be noted that carpet work is one of the few wage earning opportunities for uneducated women in Nepal. According to a survey of manufacturing done in 1990/91, of the 55,649 Nepali people working in the formal textiles and wearing apparel sector, 39.7% of them were women. That statistic does not include spinning wool at home, which is considered to be part of the informal economy. Of the 36,729 manufacturing jobs done by women in Nepal in 1990/91, 22,084 or 60.1% of them were in the textile and wearing apparel sector. Other sectors such as food, tobacco, wood, paper and printing, plastics, chemicals and pharmaceuticals among others did not have more than 18% of women relative to men (Acharya 1994: 69). In a survey of carpet industries in Boudha and Jorpati, managers were asked the approximate number of women employed in their factory. From a total of 300 factories, managers reported that approximately 45% of their employees were women (Personal communication, O'Neill 1995).

Thacker's (1993) report on the status of women in the carpet industry in Nepal notes that women face barriers in the carpet industry when it comes to salaried work such as making carpet designs and graphs, which requires some education and training. In the factories I surveyed, I did not meet any women who were "master weavers" (middle managers) or salaried workers such as accountants, or higher level business owners or partners. I did meet one woman employed as a graph maker, who worked with her husband, also a graph maker, in the same factory, but by and large salaried employees were usually men. Thacker (1993) argues that it is women's lack of formal education in Nepal, coupled with sexist views that women are biologically incapable of working with technology, that bars them from garnering any of these better jobs. One factory owner told me that women were not physically strong enough to assemble a loom and therefore were unable to be master weavers. Ironically, in this same man's factory, a woman was seen to assemble her own loom because the owner could not afford to hire a master (personal communication, O'Neill 1995). Although Thacker (1993: 40) points out that women are maintained as piece-rate weavers and spinners, in part, because they are considered to be a "docile work force", even women skilled at such work may be losing ground to the swelling ranks of young men in search of wage earning work and women may eventually be pushed out of the carpet industry altogether.

A city in transition: the peri-urban environment of Boudha, Kathmandu

The majority of the Tibeto-Nepali carpet industry is found in the Kathmandu Valley. This is because the Valley is linked to transportation routes and to the main exit point, the Tribhuvan International Airport, from which the carpets are flown to Western Europe and to North America. Carpet factories are located on the peripheries of the major urban centres in the Valley: Kathmandu, Bhaktapur and Lalitpur (Patan). The urban periphery offers less expensive land to build the big compounds needed for factories. Many carpet factories are surrounded by agricultural fields, and indeed are located in what used to be small villages on the outskirts of the bigger towns and cities (Figure 2.8).

Boudha, Jorpati and Dakshin Dhoka were originally considered separate villages from Kathmandu, but they are now linked to the city by roads. Yet their character is

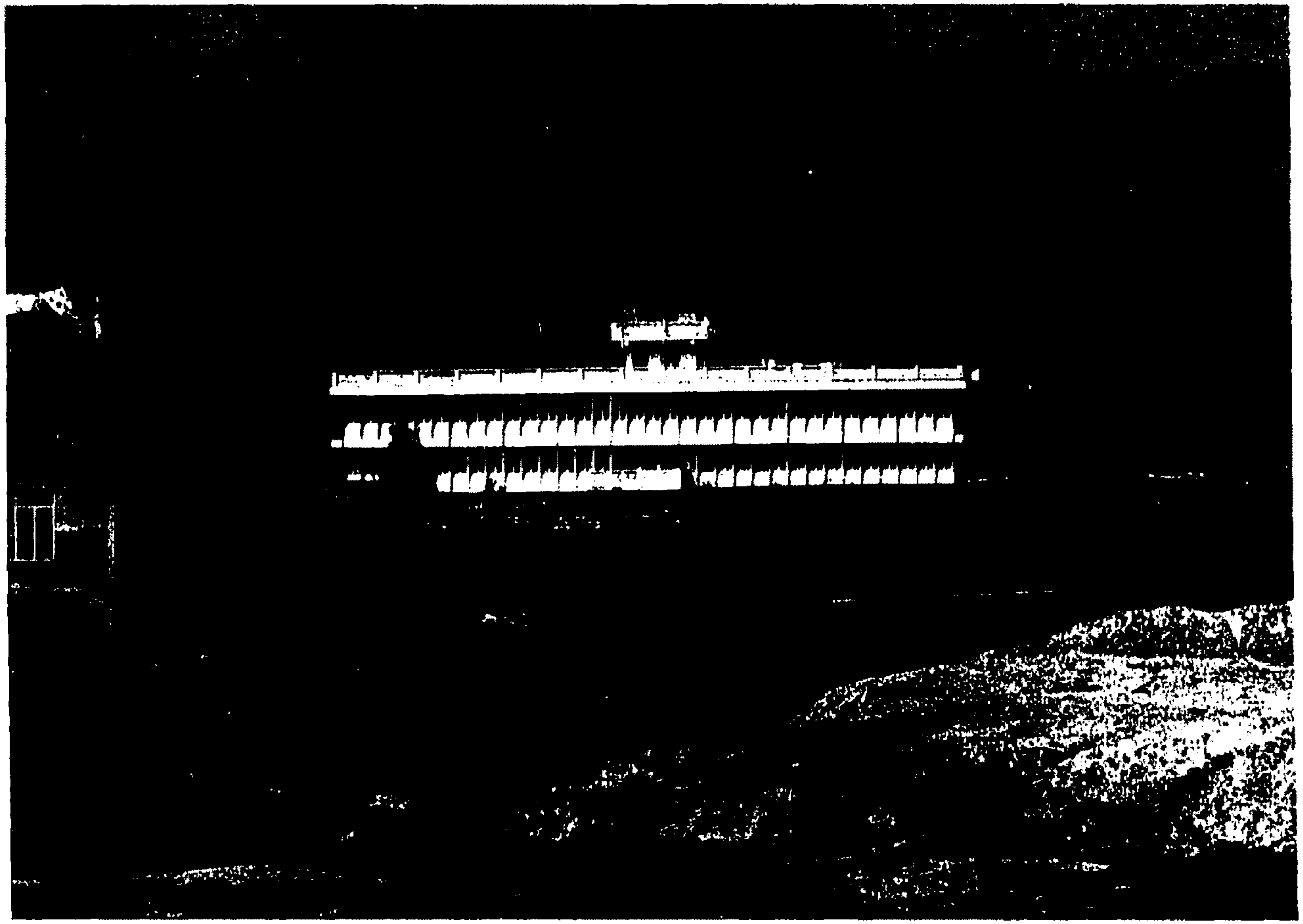

Figure 2.8 The rural setting of a large carpet factory.

unique in that Jorpati and Dakshin Dhoka are not officially part of Kathmandu, and none of them have the same level of services as does the city proper. They continue, moreover, to have an agricultural element to them, as shown in Figures 2.8 and 2.3. They are best categorized as peri-urban centres, part of an increasingly recognized environmental and social phenomenon found in low-income countries all over the world (Harpham et al. 1988; Varley et. al. 1996).

Cities in low-income countries generally have better health statistics than rural areas. Globally, rates of child mortality and morbidity are much lower in urban than rural areas (Williams 1990). In keeping with this trend, infant mortality rates in Nepal are lower in urban areas than rural ones (Gubhaju 1991). This difference is due mostly to the greater accumulation of wealth and education among the urban population as well as better access to health care services. It is now increasingly recognized, however, that the urban population is not homogeneous and that there are large pockets of urban poor who do not enjoy the same health advantages as the rest of the urban population (Brockerhoff 1995). The urban poor tend to live in the peri-urban centres or in what Harpham et al. (1988) describe as the "shadow of the city", meaning that they are marginalized spatially, socially and economically from the mainstream activities of the city.

The unofficial city has poorer services because it lacks public institutions and basic infrastructure. To some extent this is because these communities are caught between the rural and urban areas. For example, they are close enough to take advantage of urban hospitals and clinics, but far enough away that transportation to those places, especially for women with young children, can be problematic.

Two of the most important issues in terms of environmental infrastructure in peri-urban Kathmandu are water supply and waste disposal. Water supply is a difficult problem throughout the Kathmandu Valley, in part, because of the growing population, but mostly because the water system itself is inadequate. Kathmandu proper is served by a water supply system that comes from a reservoir on the edge of the Valley north of Kathmandu. Although the source is quite plentiful, the city's water system is faulty. The pipes were laid in Kathmandu in the 1930s and due to leaks between the sewage and water pipes, sewage seeps into the water supply, rendering it polluted. As well, around 60 per cent of the water distributed in Kathmandu is lost through leakage (KC et al. 1991: 203-204, cited in KC 1995: 69).

Most of Boudha and Jorpati and other peri-urban areas are out of range of this piped water system and are not connected to it; therefore, they must procure their own water supply. Many private householders and industries build their own tubewells, which tap into the ground water. Unfortunately, during the rainy season ground water is contaminated by run off and during the driest season (March to June), ground water can, and in the case of spring of 1995 did, dry up. At this time many people who could afford it had to buy water of questionable quality from vendors; others waited in long line-ups at public water taps.

Another problem for peri-urban Kathmandu is the lack of waste disposal for both solid waste and sewage. There is no formal solid waste collection in Boudha and Jorpati, although the municipal government in 1995 provided some dumpsters by the side of the main road into which people were able to throw their waste. The problem with this method is that it is a long walk for many residents to take their garbage, so many just throw it on the street beside their homes (Figure 2.9). As well, the dumpsters sit with huge amounts of rotting garbage, which do not move for many weeks at a time, and during the warmer months they become a stinking eyesore. In many ways it is better to let the roadside garbage be consumed and recycled by roving cows and dogs, although some people were concerned about the number of plastic bags being swallowed by cows, a sacred Hindu animal. In the spring of 1995 a local youth group in Boudha organized a garbage disposal system which seemed to run quite well over the following four months; however, without consistent funding from the city, it is not clear how sustainable that program will be, if in fact it is still in operation.

The sewage dilemma is even more dangerous to health, as lack of effective human sewage disposal is one of the major sources of gastro-intestinal infection. Most of the houses and apartments that accommodate the poor in Boudha and Jorpati do not have latrines. My survey of households in the government housing project of Ramhiti, a neighbourhood of Boudha, (see Chapter 3, p.58), indicated that 40% of households (14 of a total of 45 surveyed) had no latrine; their plots of land were so small that there really was no room to build a latrine for each household. There is very little in the way of standard regulations to control the quality of apartment blocks and private homes; it is up to the discretion of the builder to install a pit latrine or indoor plumbing. It should be noted that all the large carpet factories I surveyed provided public latrines for the workers, although many of them were so filthy that they themselves could be sources of infection; moreover, some of them were built in such a way that sewage from the toilets was simply

Figure 2.9 Garbage lying on a street in Boudha.

dumped down the back of a hill or into a nearby water source. During my year in Boudha, I saw many people squatting to defecate in nearby fields and bushes (Figure 2.10). Young children do not wear diapers and are able to squat anywhere along the roads. Thus, feces are openly exposed and children playing in the street regularly come in contact with human waste. Feces are also washed by the rain into well and ground water. There are a few public toilets in Boudha, but they are in such a filthy state that most people do not want to use them. The contrast between the peri-urban communities and downtown Kathmandu is quite pronounced. In Kathmandu, the streets are clean and there is not the same level of garbage or excrement seen on the streets in Boudha.

Housing is also inadequate in the peri-urban communities. The Ramhiti housing project, mentioned earlier, was established approximately 20 years ago by the government as part of their land distribution policy to allocate small parcels of land to "landless people". People were given a lease on the land where they were able to build their own private homes. The neighbourhood is a hodge-podge of different homes, a few restaurants and stores. The quality of housing varies, depending on how much people can afford or want to invest in their homes (Figure 2.11). Many families were grateful for this housing and this is an example of a good program, helping some people who would otherwise be destitute in the city. Yet, because there are no building standards or support to include latrines, water, electricity or sewerage infrastructure in the development of the housing project, these environmental problems persist.

The rooms provided to carpet factory workers constitute some relief to the peri-urban housing problem. This system is mutually beneficial to both employers and

Figure 2.10 Children defecating in a field.

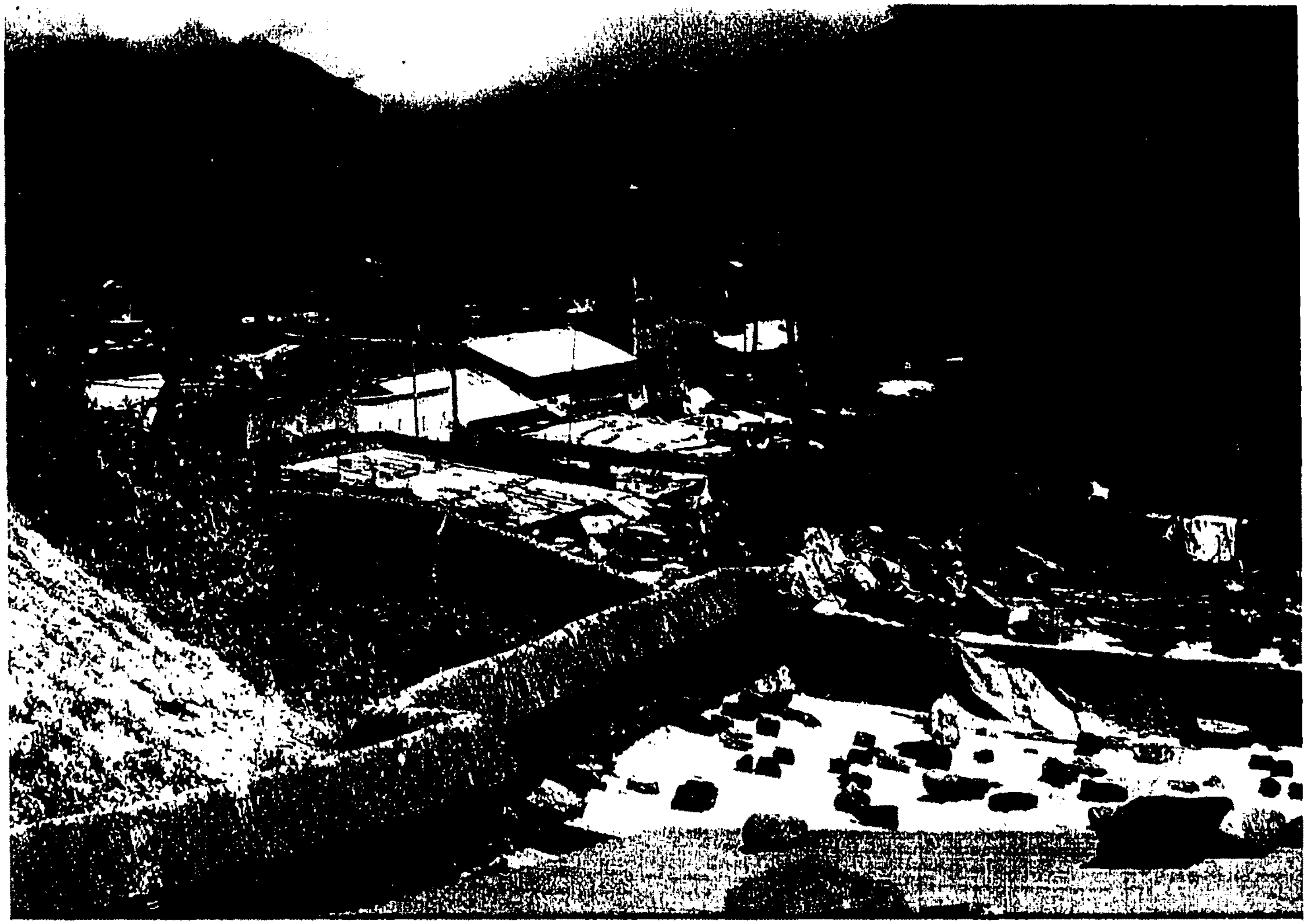

Figure 2.11 View of Ramhiti from hill above.

employees as it enables the carpet factory owners to keep their workforce on site while relieving the workers of the need to find and pay for housing. On the other hand, only one room is provided per family. For some small families, two parents and one child for example, this is adequate relative to Nepali housing density in general in both rural and urban regions. Many families, however, have more than one child and have dependent relatives - nieces, nephews, grandmothers and grandfathers, etc. - who must also live in these rooms. Needless to say, densely populated homes can be health hazards, as they aid the transmission of pathogens and can cause emotional and mental distress. Nevertheless, many Nepalis are used to living in tight quarters, sleeping communally with other siblings and parents. As Kathmandu is a temperate climate, many people spend most of their waking hours out of their room, either working, visiting, shopping or sitting outside on their doorstep, or in the case of the factory, in the compound (Figure 2.12). The room, therefore, is used for cooking and sleeping only.

In addition to the difficulties of living with poor community service infrastructure, there is the other side of life in Boudha and surrounding environs that is dynamic and hopeful. There is a constant hum of activity in the area as new houses are erected, sometimes opulent ones, built by those who have made money from their entrepreneurial activities in the carpet industry or other businesses (Figure 2.13). Trucks with wool and carpets go up and down the broken and sometimes muddy dirt roads, but in some cases new roads are paved as the demand for better infrastructure is heeded by city officials. Boudha itself is an interesting mix of religious and industrial life; at any given time, one can hear Buddhist horns resounding from Tibetan monasteries and the tap, tap, tap of the

Figure 2.12 Family sitting on the doorstep of the room provided to them by the carpet factory.

Figure 2.13 View of the Boudha stupa with surrounding urban sprawl and new housing construction.

carpet weavers hammering the weft down on the warp against a metal pole.

Part of this hopefulness and dynamism comes from the fact that many of the people in the area are newcomers, motivated to make better lives for themselves and their families in the city. The majority of people living in peri-urban communities are migrants, as this is where the employment opportunities are, as well as housing, either formal or make-shift in the form of shanty towns. Kathmandu itself has been growing since the 1970s, due not only to high fertility, but also to rural-to-urban migration. A recent survey of Kathmandu in 1994 estimated that approximately 40 per cent of the population residing in the city are migrants (KC 1995: 96). This proportion is even higher in the carpet industry (See Chapter 3, p.70) and probably in the peri-urban regions in general.

Nepal is still predominantly a rural country and migration in Nepal has been mostly rural-to-rural, with most of the movement in the last three decades flowing from hill regions to the Terai, as vast expanses of fertile agricultural land were opened up after malaria was eradicated there. In the last two decades, however, this is beginning to change, as the flow shifts to urban centres. In terms of migration, cities in the Terai are receiving the highest proportion of migrants because of the increase in manufacturing industries along the Indian border. In the 1991 census, it was estimated that 33.9 % of inter-regional migrants went to Kathmandu Valley towns compared to 56.8% who went to Terai towns (KC 1995: 90). It should be pointed out that not all of this urban growth is due to migration; a large amount of it stems from the natural increase of the population already living in the cities. This is especially the case for Kathmandu, the city in Nepal which has 28% of the country's urban population, the largest proportion of any city in Nepal (KC 1995: 80).

While voluntary migrants are often hard-working and industrious because they have goals associated with their relocation, they are also disadvantaged in the city environment for several reasons. The first is that they have very little formal education and in many cases are illiterate. The Demographic Sample Survey (DSS) of Nepal done in 1986/87 was designed especially to investigate inter-regional migration patterns. Regarding literacy, it was found that 24.1% of male rural-to-urban migrants from age 6 years and older were illiterate. The situation was much worse for women: 72.4% of female rural-to-urban migrants were illiterate. Migrants who are illiterate have employment barriers that they will never overcome; many of the mothers I spoke with hope that they will be able to give their children an education in the city.

The other difficulty for rural-to-urban migrants is their lack of knowledge about how the city works in addition to the loss of kin, friendship and ethnic networks which often are left behind in the village. There is some evidence that children of long-term migrant residents may have better nutritional status than those of recent migrants (Tam 1994; Moffat 1998), so there may be a transitional period during which migrants are able to improve their situations and knowledge.

Part of the difficulty in being a migrant, however, is not just at the individual or household level, but also at the community level. Migrants living in the peri-urban community are not officially recognized. Harpham et al. (1988) calls these areas the "unofficial" city and Wa'gombe (1995) describes a similar situation in sub-Saharan

Africa where peri-urban communities are not legally recognized by the municipal government, which is therefore not obliged to provide them with any services.

The migrant residents in Boudha and environs are viewed also in this way. Migrants to Kathmandu, even long-standing ones such as my Nepali language teacher who had lived with his wife and children in Kathmandu for the past ten years, still go home to their natal villages to cast their votes during national elections. Indeed, in the Nepali language when you ask someone where their home or *ghar* is, you are asking them not where they are resident at the time, but where they grew up or where the family home is. This is especially true for renters in the city, as a rented room or flat definitely is not considered a home, in the Nepali sense of the word. Carpet workers, moreover, are considered to be migrant labour and often are expected to return to their home villages when they have made money or when there is no longer any work. Many of them do, in fact, follow this pattern, and return to their villages throughout the year as they often have responsibilities to help their family in the village with the harvest or other duties. However, many do not, especially those without land, or those with children who find that they want to keep their children in school in the city. Some become long-term migrants who only visit their village during holidays, and even that is not always a regular pattern for women with small children in tow.

During interviews when I asked women when they thought they would go home, many said that they really were not sure, as they needed to keep earning an income and they definitely wanted to see their children grow up in the city where they would have more opportunity. Some envisioned going back in their old age when they were too old to work in the city as labourers. Some said that they could only retire to the village in old age, alluding to a compelling duty to return to their family home as well as the need for care that might not be available in the city. This means that many of these so-called migrant labourers will actually reside for most of their adult lives in the city and that their children may well stay there too. Despite this fact, migrants are not given the full respect of citizenship in the city to which they are perhaps more entitled than one might believe. The migrants themselves, however, also participate in this fiction: because they do not consider their new abode to be their "home", they are perhaps less apt to put energy into creating a stable community.

The migrant attitude towards the city is a mix of love and hate. On the one hand, some women say that they prefer the city because they do not have to do the back-breaking agricultural work that they have to do in the village. They also like the access to health care services, shops and films. One woman said she was happy that her children would grow up speaking Nepali rather than their indigenous language of Tamang, which in her opinion is not useful in the modern world. Some also said that in the village their children played in dirt, whereas they were much cleaner in the city.

The positive attitude towards the city is summed up by this woman's statement:

> Interviewer: Do you like city life?
> Woman: Yes. Everybody says they would like to spend their whole life in Kathmandu.
> Interviewer: Do you think your children's habits will be good in the city or in the village?
> Woman: Here is good. City is good.
> Interviewer: How come?
> Woman: Yes. How to say it? We can send them [children] to school in time. There's a very good place for the treatment. There are *jankris*

> (traditional healers). If we were in the village, we would have to carry loads. It is hard. If we were sick, we would have to bring the sick here [to the hospital in Kathmandu]. That is why it is not a good place for me in the village. We don't go there often.

Another woman voiced the same sentiment.

> If we stay in the village and if they are here, if they want to study here, we must send them to school, although we have to spend money. We wasted our time (in the village); we didn't study. We have to make them [children] their easy life, although it is very hard. This is my thought. I don't know what will happen.

On the other hand, one woman commented on the stale food and dirty water in the city, not found in her pristine village which she considered to be a much healthier environment in which to raise children. Another woman expressed her fears of raising children in the city.

> Here they go out, they give us trouble. We have to carry them. They will get lost. We're scared thinking of stealing. Nobody steals in the village. Maybe they'll fall down from the house. But we don't have traffic accidents in the village. We're not worried about our children. But we're worried here. Bicycles come, motorcycles come, vehicles come. It is very hard to save their life. People say children sometimes get lost. I sometimes think whether my son was taken. He goes out quietly and I always remember this. If my son was stolen, I think how could I find him? But in our village, children aren't stolen. If I can go home, that will be good. As long as we have money here, it is good here, otherwise...

The ambivalent view of this move from the village to work in the carpet industry in the city can be summed up in this interview:

> Interviewer: In your opinion, is the village life or the city life good for your family?
> Woman 1: If we can do work here, it is good here. But we haven't improved. As long as we want to stay, that's all. We have to have a house and land here to spend our life, otherwise we cannot.
> Woman 2: At the time of dying (old age), we have to go to the village to

spend our lives.
Interviewer: What did you get and lose after coming to Kathmandu?
Woman 1: We got only this, see... (points to her baby, everyone laughs) We came here after lying to our parents and running away. That's all that's happened so far!
Interviewer: What did you lose?
Woman 1: What to say? We are surviving up till now. What did we lose? We got married after coming here. We got kids. We haven't saved money. We only survive.

Summary

In many respects Nepal is a country which is currently undergoing enormous change in political, economic and social arenas. Despite important political turning points such as the democratic revolution in 1990 and the subsequent push for development by Nepali people, Nepal has been forced to change by growing economic pressures brought on by over population and environmental degradation, prompting many people to leave their villages and migrate to urban centres. Migration entails push and pull: for some it is the push from the village - the need to survive; for others there is a pull from the city - the desire to attain new goals and a more prosperous lifestyle. Both of these elements can be found in the carpet industry, and among the people involved in it.

Despite social barriers in the carpet industry for women, it is a major employer which has fundamentally changed the way women and their children live their lives in the city as wage labourers, often living in the factory compound. There is some variation in the work women do in the carpet industry, depending on whether they are weavers and spinners in factories or spinners in their homes. What they all have in common, however, is the larger peri-urban environment to which they migrated.

The new peri-urban environment, in which for the most part the children in this study are born and raised, is very different from the rural setting. There are both advantages and disadvantages. The advantages in the city are the opportunities for wage income, education and health care that are unavailable in most rural areas in Nepal and which many parents wish to provide for their children. It is clear from discussions with the women in this study that many of them, like the classic migrant, pin their hopes for a better life on their children. The disadvantages are the environmental problems arising from so many people living in a small area without adequate housing, water supply and sanitation. As I will argue, these conditions do have detrimental effects on the health of children under 5 years of age and loom larger than the socio-economic and environmental conditions specific to the carpet-making industry itself.

CHAPTER THREE

Study Design and Profile of Sample

The first part of this chapter is a description of the study design and research methodology. In it I explain the rationale behind the study design as well as some of the logistics involved in conducting the research. An outline of the study research methods is also presented. The second part of the chapter is a socio-demographic and economic profile of the women who participated in the study. It is meant to serve as background information as well as a guide to the rest of the thesis.

Study location

The choice of Boudha[3] as a general location for the study was influenced in part by my familiarity with the area but also by the strong focus of the carpet industry in this part of Kathmandu. Defining the study area in an urban setting is a challenge because, unlike the village setting where there is a finite number of households located in one place, in peri-urban Boudha there are a multitude of factories and households in a large area. I had to make choices, therefore, about how to bound the study area and how to

[3] Although Boudha proper is located near the stupa, the name Boudha covers the entire area located east of Kathmandu towards the outer perimeter of the peri-urban part of the city as seen on Figure 3.1

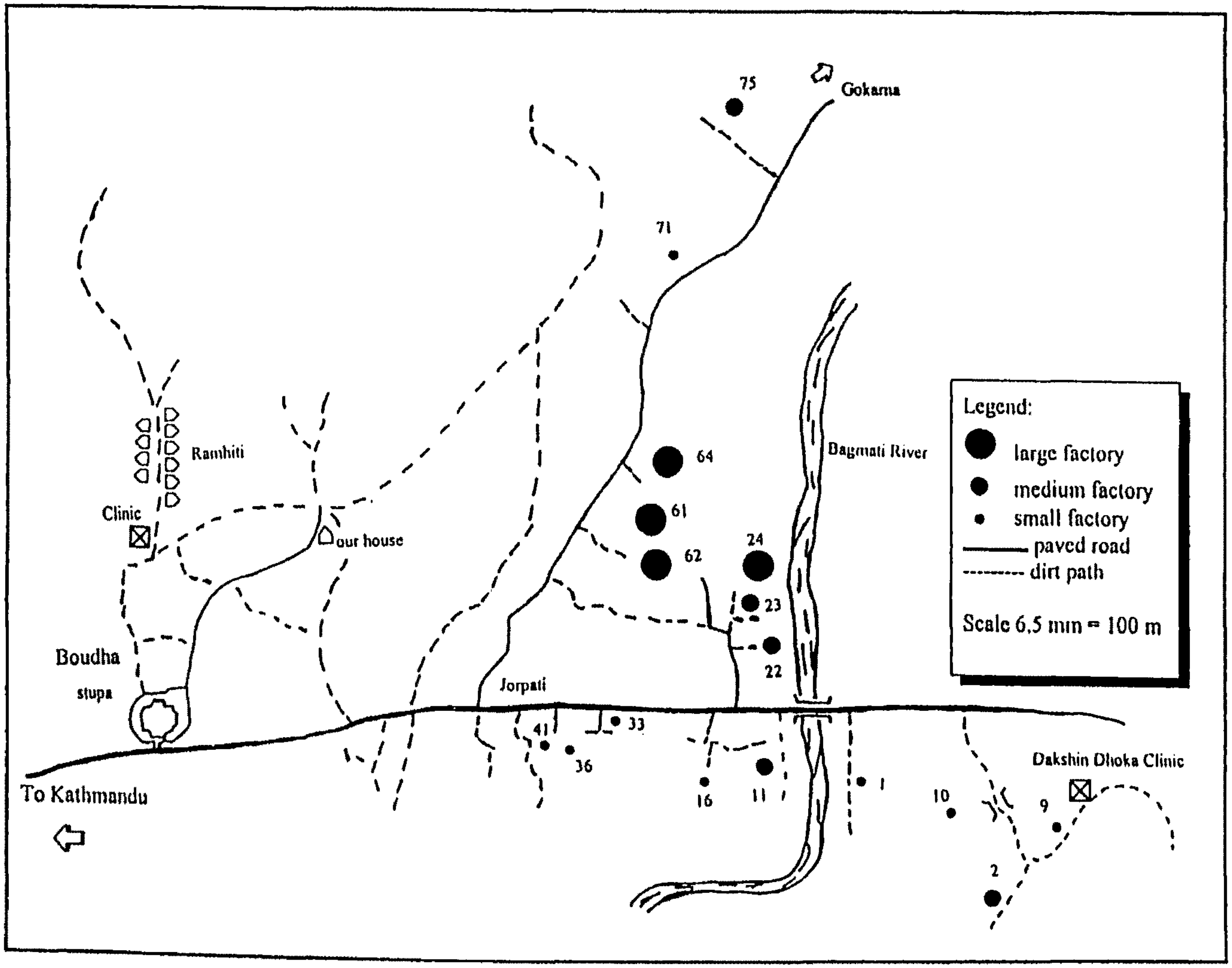

Figure 3.1 Field work site map showing study sample of factories, home spinners' neighbourhood of Ramhiti and two participating health clinics in Ramhiti and Daksin Dokha.

choose the households and factories that would be included in the sample.

I decided to attempt to affiliate myself with a clinic because I wanted an appropriate place to set up my anthropometric equipment and to be able to refer study participants to health services if they needed some health care advice or treatment. Daksin Dhoka Health Centre was receptive to my request to use their health education room to conduct growth monitoring and they also offered their laboratory services in which to do stool tests. Though I wanted to be associated with a clinic, I did not want a clinic-based sample, which can be biased because only the ill and those seeking medical treatment are included in the sample and because those who do not use medical facilities, perhaps because they are too poor to afford them, are excluded from the survey (Timaeus et al. 1988: 360). Therefore, I needed to survey the Boudha area in order to choose a sample.

Fortunately, in the fall of 1994 Tom O'Neill[4] had mapped the locations of all the carpet factories throughout Boudha and Jorpati. The carpet factories in Boudha are located at a great distance from the Daksin Dhoka clinic; thus, I used the Jorpati part of his survey for my study. As there were a number of factories located near the Daksin Dhoka clinic, I mapped this area (it was not included in O'Neill's survey) and used it as part of the study survey region (Figure 3.1).

The next step was to pick a random sample of factories from the survey on which

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[4] Tom O'Neill is my husband and research colleague who also conducted research on the carpet industry for his doctoral dissertation. His dissertation is concerned with the history and economic relationships found in the Tibeto-Nepali carpet industry (O'Neill 1997). Although our research studies were quite separate, we consulted one another throughout our fieldwork and shared resources when possible.

to base the study sample. There were approximately 80 factories in the circumscribed study area, which were numbered 1 to 80. Fifty factories were randomly selected out of the total. I deliberately picked a large sample because I knew there would be considerable difficulty in getting permission from the factory owners to do a study in their factories. Over a two-week period my research assistants and I canvassed 50 factories in the area in order to seek permission to enter the premises and conduct our study. Because of the bad publicity about child labour and the fear on the part of many owners of being harassed by foreign journalists and aid workers, I was initially worried about gaining entry. However, the bigger problem turned out to be absentee owners and the shutting down of factories within the several months between the time that they were surveyed and the time of collecting a study sample. No owner refused to allow us permission to speak to his employees, although five owners said they employed no mothers with young children. For several of these I wondered whether this was true or whether this was an indirect way of refusing permission. Thirteen factories were closed or were down to one loom in operation and for another 15 factories I was unable to contact the owner. Over several weeks I tried to contact owners either by going to their premises or by phone (if they had one) and if that failed after three attempts the factory was deleted from the list. In the end, I received permission to conduct my research on the premises of 17 factories. It should be noted from the study site map in Figure 3.1 that there is a mix of small (less than 20 employees), medium (20 to 50 employees) and large (over 50 employees) factories in the sample, representing the variable character of the industry.

One of the original research issues set out for this study was a comparison of the health of children whose mothers work in factories versus those who spin wool at home. Not only was it necessary to include home wool spinners in the sample for comparative purposes, it was also important to recognize home wool spinners as an important part of the carpet industry, a segment that is often overlooked because they are "invisible workers". The inclusion of home wool spinners was much more difficult because women spin wool everywhere in Boudha; it is often difficult to identify which households, moreover, are involved in the practice because the women are hidden inside their houses. Fortuitously, the neighbourhood of Ramhiti, located near to where we were living in Boudha (Figure 3.1), is heavily involved in wool spinning. Almost all of the households in the neighbourhood engage in wool spinning, making it an ideal sub-group for inclusion in the study. The community, moreover, is remarkable because it has a small government health clinic located within its boundaries and because it is a project that was organized by the government to provide housing to landless Nepalis.

This neighbourhood is much like a village because it is a spatially bounded community, nestled below a small precipice on one side, with fields on the other (See Chapter 2, Figure 2.11). After mapping the houses to the best of my ability (the ramshackle nature of the development meant that there were many alleyways and paths behind the main road where houses lay unbeknownst to me for the first few months), I counted 113 households and decided to try to survey them all for my study, as many of them would not have children under 5 years of age. In total 59 households participated in the study at least once during the 9 month period.

Participation guidelines

This research project was approved by the McMaster University Ethics Committee prior to its initiation. Mothers were asked to give oral consent for participation; written consent was not required as many of them do not read or write. The only criterion for eligibility in the study was that they have children under 5 years of age. I approached women with the help of my assistants to explain who I was, the nature of my research project and why I was interested in growth monitoring. I then explained that I would take height, weight and arm measurements of their children and ask them questions about their children's health and their work in the carpet industry three times over the span of one year. I told them that their names and those of their children would remain confidential. Perhaps most important, from their point of view, was my emphasis that they could drop out of the study any time they wished.

Research schedule and numbers of participants

The study was scheduled as three different data collection sessions throughout nine months, beginning in January, 1995 and finishing in September, 1995. The session schedule is shown in Figure 3.2.

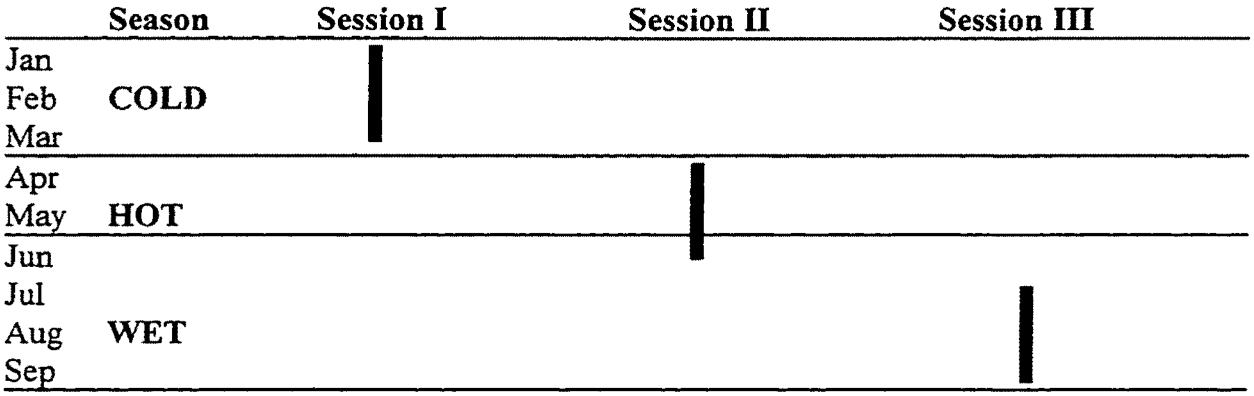


Figure 3.2 Data Collection Schedule by Month and Season, January to September 1995

I set up my anthropometric equipment in three different locations throughout each session: Ramhiti Health Centre, Daksin Dhoka Health Centre and at some individual factories located too far from either clinic (factories 75, 71, 64, 61, 62 and 24 on Figure 3.1). Thus, within each 3 month session, my research assistants and I did a rotation through each location, in the same order, so as to evenly space out the growth measurements.

Because of the transience of people in and out of the study area, I decided to enrol new children in the study at each session. Many mothers who initially participated in session I and/or II moved out of the area and therefore were not included in sessions II and III. The total number of participants who were included in one, two or all three sessions by location is presented below in Table 3.1. It should be noted that mothers and children are counted separately because some mothers had more than one child under 5 years of age.

Table 3.1 Mothers and Children Participating in Measuring Sessions from January to September 1995

Location	1 Session only		2 Sessions only		All 3 Sessions		Total (N) Individuals	
	Mothers	Children	Mothers	Children	Mothers	Children	Mothers	Children
Ramhiti households	14	21	25	32	20	26	59	81
Factories near Daksin Dhoka clinic	27	33	20	23	20	23	67	80
Factories	27	35	22	26	53	64	103	123
TOTAL N per cent	68 (30.1)	89 (31.4)	67 (29.3)	81 (28.6)	93 (40.6)	113 (39.9)	228 (100.0)	283 (100.0)

There were no refusals to participate in the study initially, although admittedly, since it was voluntary, any mother who did not want to participate merely had to make herself unknown to us at the time that we approached the factory. None of the mothers in Ramhiti households refused to participate on the first round. On the second and third rounds there were some refusals at both Ramhiti and the factories: two mothers were involved in family disputes when we approached them and they were forbidden by their husbands to participate; eight other women through rounds II and III said they were not interested in continuing, but did not give reasons. Fifty-four women and their children were lost to follow-up because they had moved out of the study area. We did manage to relocate three of these participants who had shifted to another factory that was within the boundaries of the research area.

Apart from the mothers, some of the children refused to be measured. Several of them refused altogether and they were not counted as study participants. Some others, however, refused to have certain measurements done, such as height or weight, and their measurements were noted as missing data rather than removing the children from the study sample altogether (See Chapter 4, p.107, for details on the growth data). Finally, four children and mothers were removed from the study sample data base because the children's stated ages were found on subsequent checks to be incorrect according to their birth dates (See Chapter 4, pp. 108-110, for details on obtaining accurate child ages from participants).

Study methods

A list of study tools and a brief summary of each are presented in Table 3.2. Further details for each method are presented in the appropriate chapters where the respective data are introduced and discussed.

Table 3.2 Methods used in study by location.

Location	Research Method
Ramhiti households	i. Child anthropometric measurements ii. Child health, nutrition and household surveys iii. Semi-structured interviews with mothers
Factories near Daksin Dhoka Health Centre	i. Child anthropometric measurements ii. Child health, nutrition and household surveys iii. Semi-structured interviews with mothers iv. Child stool tests
Factories	i. Child anthropometric measurements ii. Child health, nutrition and household surveys iii. Semi-structured interviews with mothers

I) Child Anthropometric Measurements

Measurements of a child's length or height, weight, upper arm circumference and upper triceps skinfold were taken at each data collection session. These were converted to indices and standard deviation scores or Z-scores using the Nutritional Anthropometry component of Epi Info, version 6 (CDC, 1994).

ii) Child Health, Nutrition and Household Surveys

At each child measuring session mothers were asked a series of questions from child health, nutrition and household surveys (See Appendix I for the surveys). In all three surveys there were a few core questions that were asked at each round, but each survey had a number of different questions in order to minimize the time spent interviewing mothers at each session. As we developed rapport with the participants, moreover, we asked increasingly sensitive questions about household incomes and education levels, which might have been too difficult to ask during our first encounter. Thus, total household and family information is only available for women who participated in all three sessions (Table 3.1).

iii) Semi-Structured Interviews with Mothers

In addition to the quantitative methods, a total of 23 tape recorded ethnographic interviews were also collected. These were conducted throughout the nine month study period, usually at the end of a measuring session in a particular location. After meeting a large number of women through the measuring sessions, we were able to ascertain those individuals who might be of interest for gathering more in-depth information, perhaps due to their particular status, occupation or circumstances, as well as their interest in our study and willingness to be interviewed. The first interview was conducted with a grandmother living in Ramhiti and the second was with a traditional healer living in and serving the same community. The second set of interviews were conducted with 13 mothers from the study sample working in carpet factories. The third set included eight mothers living in Ramhiti community who spin wool at home and who were also in the study sample.

The interviews were semi-structured, although at times we encouraged women with particular interests and circumstances to freely change the course of the interview. So, for example, one woman who had borne 15 children discussed extensively her knowledge and experience of childbirth. For each working mother I asked similar questions about their family history, their work and how they combined it with childcare[5]. I asked all mothers about the health of their children and their views on child health and nutrition. By the end of my field work period my research assistants had transcribed all of the interviews into Nepali and my Nepali teacher, Mr. Radhe Shyam Duwadi, translated them into English. I should note that I worked with Mr. Duwadi as he did the translations in order to improve my Nepali language skills and get a better sense of the interview material as I was doing the study.

iv) Child Stool Tests

Although I did not originally plan to conduct child stool testing, I realized early on in the research program that diarrhea and parasitism are very serious health problems for both children and adults in Nepal. The Daksin Dhoka Health Centre offered me the use of their laboratory facilities, for which I am extremely grateful. Due to the logistical task of

[5] At all times I endeavoured to conduct the interviews as much as I could in the Nepali language. Maya Sherpa, my assistant, however, was also involved in the interviews, reiterating questions when our consultants did not understand my Nepali or the gist of our questions and carrying on the interview when I lost track of the conversation so as to keep it flowing.

conducting stool tests - collecting samples, having them tested in the lab and delivering the results back to the children's parents - I decided to limit stool testing to the mothers in the study who were actually visiting the Daksin Dhoka Health Centre for their measuring and survey sessions (See Table 3.2). They were asked to bring a sample of their child's stool in at the time of each visit for all three sessions. Stool samples were tested by a trained laboratory technician at Daksin Dhoka for the first round of testing and for the second and third I took the samples to the Shi-Gan Pathology Laboratory in Kathmandu because Daksin Dhoka Health Centre temporarily lost the services of its laboratory technician. Mothers were informed of the results of the tests and after getting a prescription from a pediatrician, I bought the appropriate medication for the mothers to give to their children. Providing parasite medication for children was not only ethically important but also aided in understanding rates of reinfection for children after treatment.

In September, 1995 I learned of a carpet factory in Boudha that had a water chlorination system installed for the staff working and living at the factory. Because the drinking water in Kathmandu is considered to be a major cause of gastro-intestinal diseases, I thought that it would be worth comparing the stool analyses of children living at this factory with those tested from my study population. After gaining permission from the manager of the factory I brought the stools of twenty-six children (all the children under 5 years of age living at the factory) to the Shi-Gan Pathology Lab for testing. Again, as was done for the other stool tests, those children in need of treatment were given medication.

Finally, although participant-observation is not always listed as a specific research tool since it is usually not done in a formal way, it constitutes perhaps one of the major methods of obtaining important information in this study. My role as a child health researcher gave me an entrée into carpet factories that I might not have had otherwise, given the sensitivities around child labour issues in Nepal. By doing measuring sessions in the factories and popping in on mothers and children to take them to the health centre or deliver stool test results, I was also able to observe the daily rhythm of work and life in the factories. As the owners grew to trust me and know that I was not doing an exposé on child labour in the factory, I was able to observe the young children playing in the work area or mothers breastfeeding at the loom, and visit the small rooms where the workers live. Having said that, there was definitely more observation than participation on my part, as I did not work at a loom all day or try to raise a child in difficult circumstances; I can only gather through second-hand information what it must be like to live the life of a carpet worker and a mother, or a child of a carpet worker in Kathmandu.

Profile of the women in the study sample

The following section presents the demographic, socio-economic and ethnic profile of the sample of 228 women who participated in this study. As explained earlier in the study design section, I do not have complete socio-demographic data for the total sample of women, because some of them did not participate in sessions II and III when more information was garnered. The mother's place of birth, her age, the number of years she had lived in Kathmandu, the number of her living children and her ethnicity were all asked on survey I (Appendix 1) and therefore are reported for all 228 women.

The exception to this is mother's age, as six women did not report it either because they did not know it or did not want to say it.

The mean age for the 222 women is 24.12 years (S.D.=5.3 years) with a minimum age of 15 and a maximum of 48 years. Figure 3.3 shows the distribution of women by age group. They are mostly young women: more than half of them are under 25 years of age. This is reflected in their low parity. Their number of live children at the time of the study is presented in Table 3.3.

Table 3.3 Number of living children per woman at time of study, N=228

Number of Children	n	per cent
1	115	50.2
2	68	30.1
3	23	10.0
4	11	4.8
5	4	1.7
6	6	2.6
11	1	0.4

Half of the women in the sample have only one child, and another third have two children. This is understandable given that many of them are in their early twenties and have just recently married. It is important to bear in mind for the subsequent analysis that the majority of them are first and second order children; therefore, no analyses requiring completed families can be done.

There are some demographic differences between the Ramhiti group and the factory women. The Ramhiti women are, on average, an older group than the factory women. The average age for the 57 Ramhiti women is 26.5 years, whereas for the 165

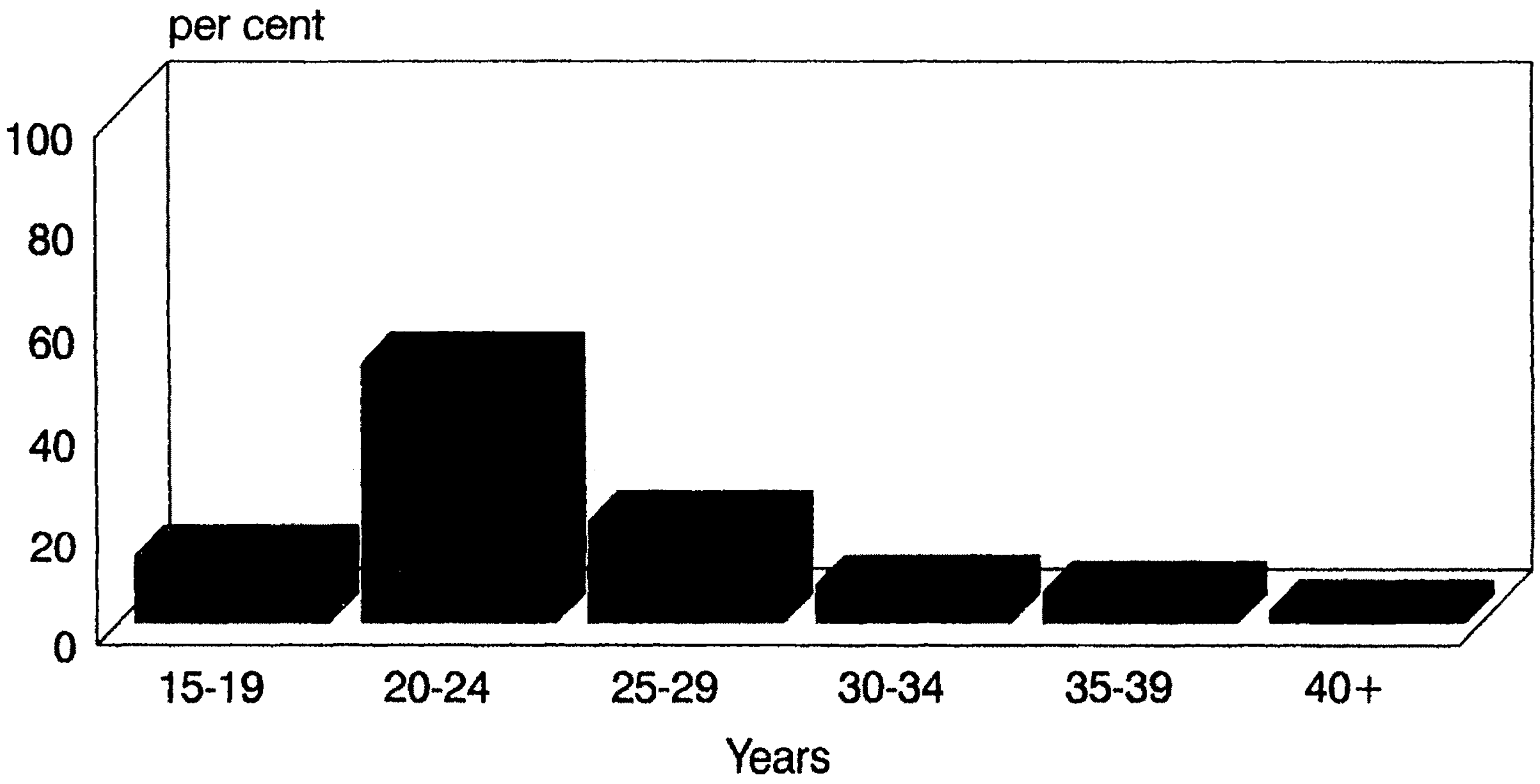


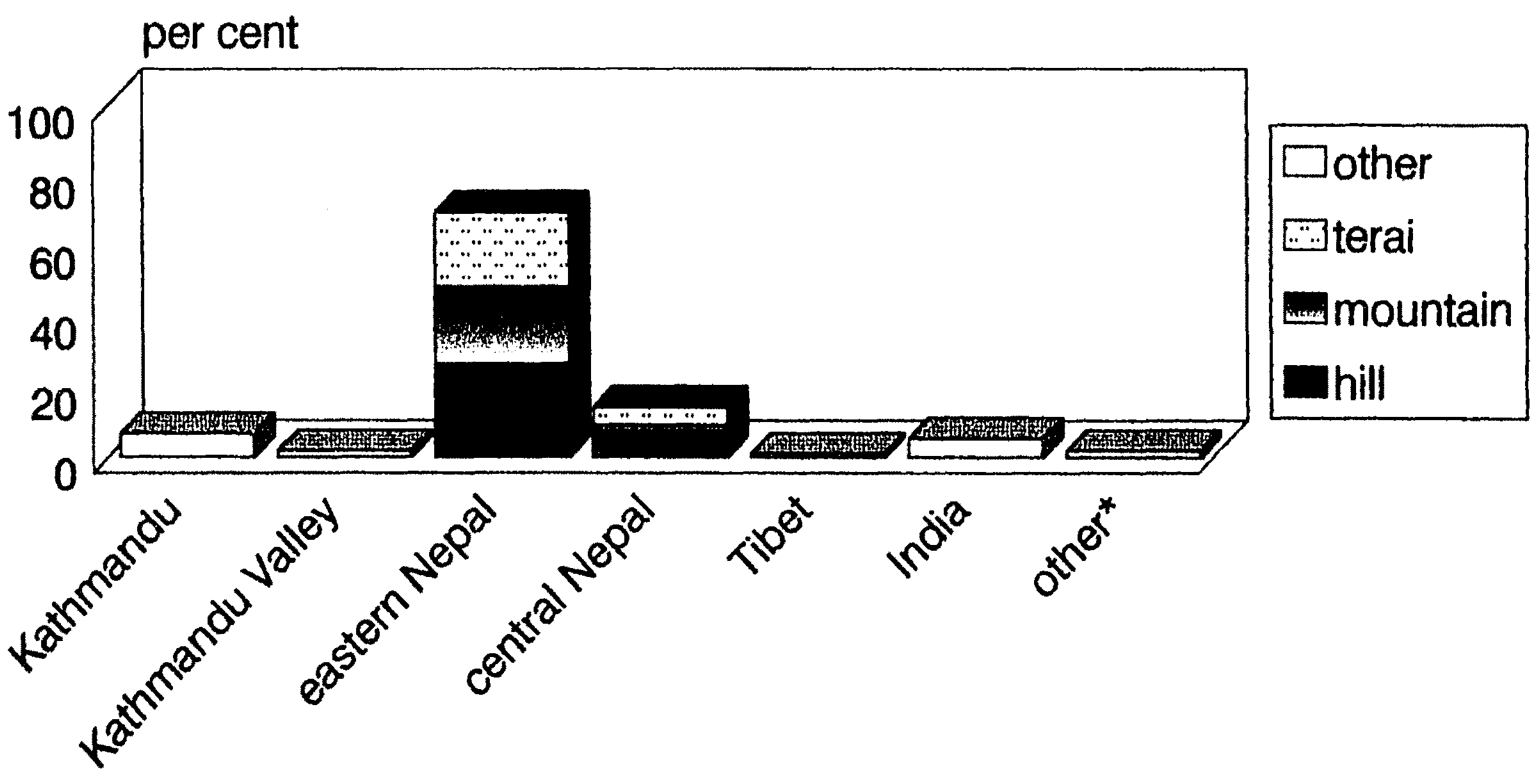
Figure 3.3 Age Distribution of Women in Study Sample, N=222.

factory women it is 23.3 years. This difference in age is statistically significant (t=3.3, d.f.=73.92 p=0.001), and is reflected in the average number of children per group, with the older Ramhiti women having a mean of 2.6 children compared to the younger factory women with 1.6 children on average (t=3.6, d.f.=65.5, p=0.001).

Analysis of the birthplaces of the women shows that 12 women were born in Kathmandu and the rest migrated to the city from other locations in Nepal and South Asia. Figure 3.4 shows the proportions of the sample from various regions in Nepal. The majority of the women are from eastern Nepal. This is primarily because of the region's proximity to Kathmandu, as well as the fact that the central and eastern hill and mountain regions are extremely over populated and there is a long tradition of out-migration for wage employment. Eighty-five per cent of the migrant women (N=217) migrated to Kathmandu within the previous ten years and 57% migrated within the previous five years. Thus, the majority of them migrated during adolescence and early adulthood.

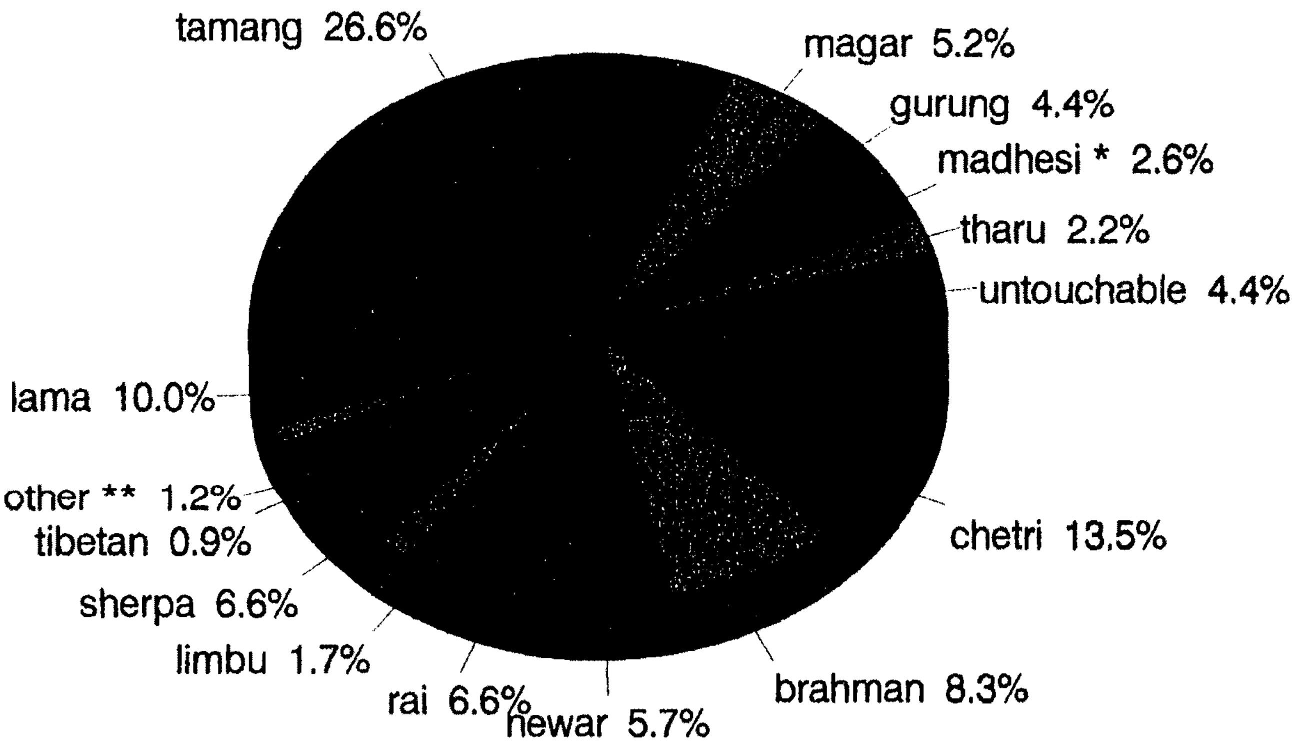
Because ethnicity is considered by Nepalis to be an important organizing principle in their social, cultural, political and economic relations, I asked the mothers their ethnic origin on the first survey. The ethnic composition of the women in the study sample is presented in Figure 3.5. It is a very diverse group, consisting predominantly of ethnic groups found in the central and eastern parts of Nepal. Ethnicity in Nepal is exceedingly complex and I offer the following thumbnail sketch of it in order to explain the social groupings presented here.

Some social scientists find it useful to classify Nepalis into two major groupings: 1) those who speak Tibeto-Burman languages and tend to live at higher altitudes (there



* Includes 3 women from Bhutan and 1 from Hong Kong.

Figure 3.4 Proportion of Women in Study Sample by Place of Birth, N=228.



* General term which includes several small ethnic groups from the Terai.

** Includes 1 muslim and 2 inter-ethnic marriages.

Figure 3.5 Composition of sample by ethnic identity, N=228.

are exceptions), and have religious beliefs considerably influenced by Buddhism (again, there are exceptions); and 2) those who speak Sanskrit-derived languages, live at southern and lower elevations and practice Hindu religious customs. Of the ethnic groups represented in this sample of women, the Tamangs, Lamas, Sherpas, Limbus, Rais, Newars, Magars, Gurungs and Newars are considered to be part of the Tibeto-Burman group. Those labelled Tibetan arrived in Nepal as refugees after 1959. The Tamangs (numerically the largest of the these groups) settled in the central hills of Nepal, the Limbus and Rais in the east and the Gurungs and Magars in the west (Rose and Scholz 1980: 771-72). The Sherpas, the northernmost group, are thought to have arrived last in Nepal, about 450 years ago from Tibet, with customs and religion, although unique, very similar to their Tibetan neighbours (Fisher 1990: 55). The Tharus, although classified by origins and language as Tibeto-Burman people, live in the Terai and predominantly practice the Hindu religion.

The most numerous of the Indo-Aryan peoples and the most populous ethnic group in Nepal are the Brahmans and Chetris (Kshatriya/warriors in the Hindu caste hierarchy). With unification of Nepal some 200 years ago they gained elite status in terms of political, social and economic power. The Hindu religious and social practices rooted in the caste system, as well as their Sanskrit-based Nepali language, were given supremacy in all national realms, including government, administration and education. The other *jats,* or ethnic groups, mentioned above, and about one dozen untouchable castes, were incorporated into a caste system that was codified as the *Muluki Ain* in 1854 (Sharma 1992: 7). As is the case in India, the untouchables remained the lowest of all caste groupings, but the Tibeto-Burman peoples occupied a more ambiguous place in the caste hierarchy. Being co-opted into the system comparatively recently, they did not really accept their place in it in the same way as untouchables. Some groups, like the Magars and Gurungs, were socially and economically promoted due to their involvement in the British Gurkha infantry. Others, like the Tamang, did not fare well in Nepal, both socially and economically; their position was lowest among the hill *jats* in the caste hierarchy and they were not allowed to enlist as soldiers in the army and were used as porters and slaves by elite Nepalis and the British (Tamang 1992; Fricke 1993: 31-32). This may explain their predominance as labourers in the carpet-making industry in Nepal (Tamang 1992), as is seen in my sample (Figure 3.5). This may also derive from the fact that the Tamangs are among the top three most populous ethnic groups in Nepal (CBS 1994: 20-23). Although caste and class roughly correspond, i.e., the Brahmans and Chetris occupy elite positions in Nepal and have traditionally been among the wealthy landowners, there are many poor Brahman and Chetri people found among the workers in the carpet industry (Figure 3.5). Again, however, it is not surprising that they form a large proportion of my sample of women as they are the largest ethnic grouping in Nepal (CBS 1994: 20-23).

As for the bifurcated system of ethnicity along linguistic and religious lines, there are, of course, many exceptions. This is particularly evident in the religious domain. Among the Newars, for example, there are followers of both Hinduism and Buddhism (Gellner 1992); so too, the Tamangs practice an amalgam of Buddhist, Hindu and Shamanistic religious customs (Holmberg 1989). This makes it very difficult to assign these groups to one or another category, as their cultural beliefs are not always distinct and sometimes there are pan-south Asian similarities that blur ethnic distinctions.

On the second data collection round, women were asked if they had spouses living with them. Of the 161 who were asked the question 153 answered yes and eight said no. Of those eight, the husband of one had died, one was divorced and the spouses of the rest were either working in another part of Nepal or in Kuwait as migrant workers. Two more women said they were still married, but their husbands also worked away from home; presumably, they were still in contact with them and were perhaps receiving some financial aid. The women were also asked if their marriage was arranged by their parents or if they had made the alliance themselves. In Nepali parlance the latter is called a "love marriage". The division between arranged and love marriages is a rough proxy for whether women came to the city and then met their husband (this often happens in the carpet factory) or whether they were married in their village first and then came to the city with their husband. The two situations are found almost equally: 51% of the 161 women said that their marriages were arranged and 49% said they were love marriages.

The majority of women, 73.9 %, reported that they had received no formal education, which means that they are illiterate; 21.7 % had anywhere from class 1 through to 8 and six women (3.7%) had gone to high school. In comparison, their spouses were better educated. Of the 158 women who reported on their husband's educational attainment, 40.5% of them said that they had no formal education, 43.7% had primary level education, and 10.8% had high school or college. The situation in this sample is a microcosm of the educational status of women in Nepal in general. Part of this problem is the bias against educating girl children. The lack of free, high quality primary education in Nepal, especially in many rural villages, means that girl children are often overlooked for schooling when a poor family has to pick one child to educate. The decision is a rational one: women have less access to good jobs with which to support the family into their old age; girls also do important farm and/or domestic chores, which take up much of their day. This poor level of education among women is borne out by an adult female literacy rate in Nepal which is 34 per cent that of the adult male literacy rate. From 1986-92 the ratio of males to females enrolled in primary school was 50 to 1 (UNICEF 1995: 78). Thus, it is no wonder that the majority of women in this sample are illiterate.

The occupations of this sample of women are shown in Table 3.4. Since this question was asked on the second data collection round, this information is missing for a significant number of people. There are, however, a limited number of occupations for women in either the Ramhiti or factory setting, so it is most likely that the unknown occupations were spinners in the Ramhiti sub-sample and spinners or weavers in the factory sample. In both sub-groups there is a proportion of women who listed themselves as housewives. They were usually former weavers or spinners who for various reasons, mostly because of personal health or childcare responsibilities, stopped wage work. Some of these women shift in and out of wage labour depending on their situation. In the case of the factory, they remain on site because a member of their family continues to work there.

One occupation that is listed in Table 3.4, but is not officially recognized as an occupation, is that of a factory contractor. Contractors gained a notorious reputation in the late 1980s and early 1990s because they went to villages and brought whole gangs of workers to the factories in Kathmandu, many of whom were children under the age of 14 years. Stories abound of contractors taking hefty proportions of workers' salaries, sometimes not paying them at all during the training period and often running off before the worker could get his or her due. Despite the contractors' bad reputation and their usual identification as males, I identified nine women who were working as contractors in weaving halls. I do not know if they were treating their workers unfairly, but they seemed to have been contracting for some time and appeared to be on friendly terms with the workers. These women work either alone or in tandem with their husbands to bring kin folk or friends, often young girls, from their village to their factory to teach them to weave. They also cook for them and provide them with space to sleep in the factory compound, sometimes their own room shared with their family. In exchange for these services, they take a portion of the workers' salaries and this enables the contractors to stop weaving themselves.

I interviewed three contractors, all of whom were also mothers of young children. They said that the cooking portion of their duties fit in well with their other domestic chores. It is interesting to note that two of the women were not forthcoming with me about their roles as contractors because of the semi-illegal status of their work. It took several visits and discussions with them for my assistant and me to piece their occupations together and for them eventually to make reference to their roles. In 1995, with child labour laws being enforced and the condemnation of contractors in the industry, many contractors did not want to reveal their status. Owners of factories also pretended that they did not have contractors in their business, but it is clear that contracting is persistent, as many owners do not have access to labour networks and often are not involved in the day to day practicalities of weaving on the shop floor, preferring to let the masters and the contractors do the business of management. What is interesting about the women's role in contracting is that, although this pathway is covert, it is the only way that women are able to move up in the industry, to make more money and to improve their status as workers.

Table 3.4 Occupations of women in the sample study.

Location and occupation	n	per cent
Ramhiti		
spinner	28	49.1
weaver	1	1.8
cafe owner	1	1.8
house wife	12	21.1
shop owner	1	1.8
tailor/spinner	1	1.8
traffic officer	1	1.8
unknown	12	21.1
total	57	100.0
Factories		
weaver	66	38.6
spinner	29	17.0
wool dryer	1	0.6
contractor	9	5.3
graph maker	1	0.6
housewife	9	5.3
shop owner†	1	0.6
unknown	55	32.2
total	171	100.0

† Her husband was a contractor in the factory and she ran a shop next to the factory.

The fathers' occupations were varied, although the majority of them (70.3% of the 158) were working in the carpet industry: 36% of these men work as weavers and the rest are masters, contractors, spinners, dyers, drivers, cutters, and wool dryers. The remainder of the sample had a wide variety of other occupations outside of the carpet industry including soldiers, taxi drivers, businessmen and carpenters.

Although all of the families in this sample are struggling to make ends meet economically, there is some diversity in the wage structure of the carpet-making industry. Spinners are the least well paid of the workers. In 1995 the going rate was 15 to 18 Nepali rupees (NRs) per kilo; in one day most women working at home spin from 0 to 2 kgs and earn approximately NRs 20 to 30, which is approximately 50 cents a day[6]. Most women who spin wool at home say that it covers some household food expenses or an odd personal item such as cigarettes or clothing, but it is by no means a major source of income. These women usually have husbands or other family members who are able to bring in enough income for the household. Spinners working in a factory earn slightly more rupees per kg (NRs 17) and told me that they could spin approximately 10 to 15 kg per week earning about NRs 500 to 600 per month, although the highest stated monthly income was NRs 1000.

Weavers work for a piece-rate and earn anywhere from NRs 340 to 450 per metre depending on the factory owner and the knots per square inch of the carpet woven. Sixty knots per square inch carpets, the lowest made, can be woven much more quickly than 100 knots per square inch, so they are usually paid the lowest rate. A good weaver can

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[6] In 1995 one US dollar was equivalent to 50 NRs.

weave a 60 knot square metre in three days; most women said that they completed about 1.5 to 2 metres a week. Most of the women in this study said they earned about NRs 1000 to 1500 per month, although some said NRs 2000 to 3000. Of course, the women themselves were estimating their wages because they varied from one month to the next depending on how much they were able to work. Although this may not seem like a good wage, it should be noted that all workers in Nepal earn very little compared to industrialized country wages. For comparison, a teacher at a private boarding school in Kathmandu earns 3000 NRs a month. A traffic police officer earns 1600 NRs per month, although the police are given food rations - basic staples of lentils, salt and flour - and they are able to get free health care from the police hospital. Carpet workers must pay for food and health care, but they are provided with free rooms, albeit very small ones, for the entire family. The factory wool spinners do not get rooms and they and their families must pay rent. The rent of a small flat in Boudha in 1995 was approximately 500 NRs per month.

The mothers' mean wages and per capita family income are presented in Table 3.5. Per capita income is derived by pooling all family income and dividing by the number of people in the household, including non-working dependents.

Table 3.5 Mothers' mean monthly earnings and mean per capita family incomes by work site.

Work site	n of women†	Mean monthly earnings in NRs	n of women	Mean per capita income in NRs
Home	28	648.21**	44	742.09*
Factory	102	1386.27**	115	925.11*

† Excludes women who said that they earned no income.
*Mean difference between Home and Factory groups statistically significant at $p<0.05$.
**Mean difference between Home and Factory groups statistically significant at $p<0.01$.

It is clear that women working in the factory make, on average, twice as much money as those living in Ramhiti who are predominantly spinning wool. Mean per capita family income is slightly, but statistically significantly higher for factory workers compared to Ramhiti dwellers. There is also some wage stratification within the factory setting. The mean monthly earnings for factory spinners (n=56) is 865.18 NRs compared to weavers (n=64) who make, on average, 1406.25 NRs.

Finally, as a rough measure of family support networks, women were asked if they had kin, other than their spouse and children, in Kathmandu: 36.6% said they had no kin with them and 63.4% said they had at least one other family member in Kathmandu. Of course, this question does not measure the number of kin, nor the quality of the relationship.

Summary

The research design of this study is such that it investigates a wide cross-section of families working in the carpet-making industry in Boudha. A variety of quantitative and qualitative methods were employed in order to investigate not only empirical measures of infant and children's health status, but also the household/work and wider peri-urban environments in which the families live.

The demographic and socio-economic profile of the study sample generally describes a cohort of young, primarily 15 to 29 year old, migrant women at the beginning of their reproductive careers, with the majority having only one or two children. They all come from the central and eastern parts of Nepal, although they are a very diverse group in terms of their ethnic backgrounds. Almost all of the women asked about their marriage status have spouses living with them. This is to be expected given that the cohort is so young and many of the marriages have been formed recently. The majority of these women are illiterate as are many of their husbands.

Most of the couples work together in the carpet industry, although some of the fathers have jobs outside of the industry. Their socio-economic status is quite homogenous and they can all be described as working poor. However, there is some diversity in their incomes. The highest wage earners in the study sample are the women who work in the carpet factories; the homeworkers, on average, earn considerably less. Ramhiti women are compensated by other sources of family income, although there appears to be a marginal disparity in per capita family income between factory families and Ramhiti families. Within the factory the women in the sample who work as weavers and contractors are making more than the spinners.

Having presented details of the socio-economic and demographic backgrounds of the mothers and their families in the sample, the following chapter focuses on the children under 5 years of age in the sample, specifically on their growth status and development.

CHAPTER FOUR

Growing Pains: Growth Faltering among Nepali Children

Trying to depict and decipher the growth of a population of children is a difficult task because growth is a relatively slow and yet dynamic phenomenon. As investigators, we spend a relatively short period of time in the field compared to the years of the children's growth and development. A cross-sectional view of growth, however, can partially reveal past patterns of growth, that is, before the investigator entered the field. Examining different age groups in the population also gives some idea of what may happen to the younger children as they proceed to develop in the same environment. Growth monitoring, moreover, even if only over the period of one year, opens a window on the pace of growth, which can be quite different from the static depiction given by cross-sectional data.

Investigating growth is fascinating in itself, although often, as is the case in this study, the purpose is to obtain a better understanding of child health and well-being. On the one hand, "epidemiological auxology" (Schell 1986) is a very inexact tool, as the causal factors of growth retardation are not well understood at this time. On the other hand, the study of children's growth can be a more sensitive indicator than morbidity and mortality statistics, since in one year in a small community there may be few deaths, and in a low-income country like Nepal many illnesses will not be recorded or will be considered unimportant.

This chapter outlines what is known and not known about linear growth retardation, and begins to tackle the thorny question of whether moderate-to-severe growth retardation can be called "malnutrition", and whether it is indeed a health concern. From there I go on to discuss the methods used to analyse preschool growth and summarize the literature on the growth of Nepali children. In the results section, I outline the methods that were employed in the anthropometric part of this study, and then present the findings of the children's growth measurements. Anthropometric measurements of height and weight are presented for the total sample of children, both cross-sectionally and longitudinally, to investigate growth velocity; a cross-sectional view of the anthropometrics of the upper arm is also presented and related to the body measurements. After anthropometric classifications of the children using epidemiological standards are presented, they are compared to evaluations of the children by their caretakers. Finally, some of the socio-economic and demographic aspects of the study sample presented in Chapter 3 are analysed as predictors of children's anthropometric measurements, in order to begin deciphering some of the underlying contributions to growth variation in the sample.

Why study growth?

Auxological epidemiology is a commonly used tool for community health assessment in low-income countries. Anthropometric measurements are usually nonthreatening, non-invasive and most parents in diverse societies have an understanding of growth trajectories and their relationship to health and development. Growth measures, moreover, are methodologically sound because they are not subject to recall error which can bias results (Schell 1986).

Children under five years of age are generally used in community health assessment because this time period is considered to be a vulnerable one. The first two to three years of life, moreover, have been identified as the riskiest in terms of growth faltering for the following reasons:

> 1) growth rates are highest in infancy, and adverse factors have a greater potential for causing retardation at this time; 2) younger children have higher nutritional requirements per kilogram of body weight; 3) young children are immunologically naive and, consequently, more susceptible to infections; 4) young children are less able to make their needs known and are vulnerable to the effects of poor parenting (Martorell 1995: 21).

Indeed, growth during early childhood is more rapid than in any other period in post-natal life. During the first three years children can potentially add 50 per cent of their birth length and 200 per cent of their birth weight. It is also a predictable period in the growth trajectory, both within and between populations (Bogin 1988: 26). Thus, a deviation in this trajectory is a sensitive indicator of poor community health.

Frank malnutrition, indicated by extreme thinness or clinical diagnoses such as kwashiorkor and marasmus, occurs mainly during times of famine or disaster and is relatively rare compared to the more ubiquitous moderate-to-severe protein-energy malnutrition (PEM). Formerly, PEM was graded according to the degree of underweight-for-age compared to percentiles of the median of reference data, called the

Gomez classification (Gibson 1990: 254-255). Because the Gomez system does not consider the height of the child, however, it cannot differentiate between those who are tall and very thin and those who are short but an appropriate weight for their height. To differentiate these types, (Waterlow 1973; Waterlow et al. 1977) introduced the terms "wasting" and "stunting" respectively, stunting being the more common of the two nutritional disorders. The highest prevalences of stunting are found in the southern hemisphere of the world, cutting across a variety of ethnic and "racial" identities (Keller 1988). It is important to note, because of the relevance to this research, that some of the highest prevalence rates of stunting worldwide are found on the South Asian subcontinent (WHO 1987; Victora 1992).

A common growth pattern has been found in numerous studies of diverse populations living in low-income countries (Anderson 1979; Costello 1989; Sastry et al. 1989; Watts et al. 1990; Dettwyler 1991; Neumann and Harrison 1994; Leonard et al. 1995; Ricci and Becker 1996). Essentially, linear growth tracks reference standards until approximately six months of age, at which point growth faltering is detectable and remains until two to three years of age. The second year of life is often the growth nadir (<-2 SD below the NCHS reference), although this can vary. If conditions are not too severe, there may be a "catch-up" period, when children begin to track reference standards again by age three or four (Martorell et al. 1994).

The exact inception and cessation of growth faltering is somewhat debatable because of discrepancies between cross-sectional and longitudinal studies (Beaton 1992). Indeed, since most growth studies have been cross-sectional in design, it has been assumed that the onset of growth faltering begins at six months. Some longitudinal studies show, however, that the *process* of growth faltering, i.e. a decrease in growth velocity, can begin earlier than six months, as early as the second to fourth month after birth (Naborro et al 1988; Neumann and Harrison 1994; Leonard et al. 1995; Waterlow 1988). In terms of lowered growth velocity, or the process of becoming stunted, the most intense period of growth retardation occurs generally between 3 to 12 or 18 months, although it has, in some populations, been known to extend into the third year or longer (Martorell et al. 1994).

It should be pointed out that the linear growth rate of healthy, so-called normally growing infants is not a continuous process, as demonstrated by close examination of the growth of individual infants (Lampl 1993). From careful daily, semiweekly and weekly measurements of a sample of 33 American infants, Lampl (1993) illustrates the pulsatile nature of infant growth, where there are intervals of stasis punctuated by growth spurts. The intervals of growth stasis are not correlated with illness and are indeed part of the normal growth pattern. Lampl demonstrates that growth rate is correlated with the amplitude of growth episodes and suggests that children with growth failure may experience episodic growth spurts of reduced amplitude and/or frequency (Lampl 1993: 650).

Karlberg and colleagues (1994) have postulated a mechanism of growth faltering based on the variable phases of the human growth trajectory. Overall, there are three phases of linear growth: 1) rapid postnatal growth which decelerates up to approximately three years of age; 2) a lower rate, decelerating until puberty, and ending with the adolescent growth spurt which peaks at puberty; and 3) decelerating growth until around 18 years of age when growth ceases (Bogin 1989). Pre-adolescent growth can be differentiated into two components: infancy and childhood. The infant phase is considered to be independent of growth hormone and completely dependent on nutrition, whereas the childhood phase is driven by growth hormone. The latter phase in normal healthy humans is thought to begin abruptly between 6 and 12 months and is marked by acceleration; the two overlap until the third year of life (Karlberg et al. 1994). Karlberg and colleagues (1994) theorize that a delay in the onset of the childhood phase results in growth faltering.

Although this may be the mechanism which determines growth faltering, it does not explain why it happens. It is important to note that linear growth faltering is currently thought to be a non-specific indicator of ill health and/or malnutrition. Small achieved size is a proxy for functional impairments but does not reveal the etiology of growth failure (Beaton 1992). The difficulty in trying to isolate individual causal factors such as deficiencies in various macro and micro-nutrients, as well as specific illnesses, will be discussed in later chapters.

Often "wasting", indicated by low weight-for-height, is described as "acute malnutrition", whereas low height-for-age is described as "chronic malnutrition". Waterlow (1973, 1988, 1994) argues that these terms may be misleading. He prefers the more neutral term "stunting", which implies deviation from "normality" but which does not imply an understanding of its cause. For now, we can say that growth retardation is best modelled multi-factorially, much like Mosley and Chen's (1984) model of child mortality, which takes into account both biological and behavioural variables.

The significance of stunting

Linear growth during the first two years of life determines, to a large extent, an individual's achieved height within genetic limitations (Martorell and Habicht 1986). In the early 1980s, international nutrition policy analysts began to ask whether being stunted and therefore small should necessarily be considered malnutrition. Out of this question arose the "small but healthy" hypothesis, first coined by Seckler, an agricultural economist (1980). The argument is based on optimization theory: small stature is not the result of chronic malnutrition, but rather is a physical adaptation to ecological conditions of low protein and energy intakes. Nutritionists and anthropologists are vehemently opposed - in my opinion justifiably so - to the "small but healthy" hypothesis (Beaton 1989; Martorell 1989; Messer 1989; Pelto and Pelto 1989; Scrimshaw and Young 1989), in part because it is based on a lack of evidence that being small is "cost-free".

Indeed, what is now known about the functional consequences of both the state of being stunted and the process of becoming stunted appears to be dire. Perhaps one of the most disturbing repercussions is a documented decrease in physical work and activity capacity for adults of small size and undernourished children (Spurr 1988, 1990). This can lead to a decreased ability to do agricultural or manual labour, a means of sustenance for many people in low-income countries. There is also a striking association between women of small stature and maternal mortality in low-income countries, which may be due to the difficulty of child birth for women with small pelves (Gopalan 1988; Martorell 1989). For children who are in the process of becoming stunted, there is an associated risk of child mortality (see Saunders and Hoppa 1993 for a summary of sources), which may be because of an increased susceptibility to infectious disease (Martorell and Ho 1984; Tomkins 1988). Studies of the immunological competence of malnourished children have discovered signs of malfunction (Reddy et al. 1976; Lunn 1991). Moreover, there is evidence of impaired cognitive ability in these children, which may not be directly due to growth retardation, but is at least strongly associated with it (Colombo et al 1988; Johnston and Low 1995).

The small but healthy hypothesis does bring up some important questions about the significance of stunting. As Beaton (1989) points out, over the past three decades stunting has become synonymous with the term "chronic malnutrition". It is important to differentiate the process of becoming stunted and the outcome state of smallness. Growth faltering and being stunted are both markers for malnutrition but not necessarily proxies, as being stunted is caused by a variety of environmental constraints.

In the final analysis, it is more plausible that growth retardation is, at best, a physical accommodation with attendant long and short-term health consequences, rather than a beneficial adaptation to a poor environment (Scrimshaw and Young 1989). Whether or not stunting is directly disadvantageous to individuals, or even populations, it is at minimum an excellent epidemiological tool for investigating community ill health in its broadest sense. Indeed, as infant and child mortality rates decrease in the world, due to increased coverage of biotechnology such as vaccinations, oral rehydration therapy and antibiotics, epidemiological auxology may replace mortality rates as a sensitive measure of a community's health and well-being .

Growth standards: to be or not to be?

When comparing population growth data, it is helpful to standardize them against a reference population. Obviously, international comparisons are much simpler if one reference standard is used. The World Health Organization recommends the use of data produced by the United States National Centre for Health Statistics (NCHS) because it meets most of the criteria set down for appropriate reference data (Gibson 1990). The reference population, moreover, is large and representative compared to growth charts in the past which were based on small samples of upper-middle class children of Northern European ancestry (Hamill et al. 1979).

Debate continues on the appropriateness of employing reference data from the United States to compare children from diverse ethnic backgrounds, who may differ genetically in body size and growth. In part, this charge has been countered by those who contend that differences in socioeconomic status (SES), or more specifically, access to nutritious food and prevention of infectious disease, are responsible for most differentials in absolute growth attained. Studies of growth during the first five years of life show minimal difference between growth curves for elites from low-income countries and growth curves produced in developed countries (Habicht et al. 1974; Graciter and Gentry 1981; Martorell and Habicht 1986). This may not be the case for children over five years of age, but as this study deals with preschool children, I will limit the discussion to that age group.

On the other side of the debate, Davies (1988) and Leung and Davies (1989) claim that Asian and American infant growth patterns deviate substantially . Using a sample of infants from Hong Kong, which are said to be healthy and well nourished, they show evidence for the onset of growth faltering from two months of age onwards. They believe that this pattern is genetically rather than environmentally determined, and may necessitate a unique Asian growth standard.

There are several counts on which I believe this evidence to be faulty. Firstly, Davies (1988) does not present any specific information about the living conditions of the Hong Kong sample, beyond saying that the parents are "middle class", nor does he provide the reader with any data to show that the children are in fact free from disease. Leung and Davies' (1989) study is better because it used a prospective design and the infants' nutritional intake was monitored and considered to be comparable to American infants' diets. They note in an aside that the infants were suffering from frequent diarrheal and respiratory diseases, but claim that they were not as severe as those found in low-income countries. The lack of quantification of the disease load begs the question of whether there could have been an inhibitory effect from disease on the growth of the infants. Secondly, growth data were collected in the 1960s and 1970s (Davies 1988). Due to secular growth changes, these data were out of date by the time the paper was presented in the late 1980s. Even data from the early 1980s (Leung and Davies 1989) may not be recent enough, as there may still be secular change occurring, as is currently the case in mainland China (Zhang and Huang 1988). Thirdly, to call for an "Asian" growth standard is perhaps as problematic as using one international reference because there are a multitude of ethnic populations in Asia, which may display a variety of growth trajectories.

Goldstein and Tanner (1980) and Macfarlane (1995) object to universal reference standards and contend that local reference populations should be employed. It is, however, currently beyond the means of poorer nations to collect reliable local reference data which must be constantly updated because of secular change (Johnston 1986). Even the choice of local reference standards is problematic, as Goldstein and Tanner (1980) argue that basing them on elite sub-populations within a nation is erroneous, since the children living in poverty may be best adapted to their own environment which leads to a different growth pattern. This argument is akin to the small but healthy hypothesis, and perhaps should be regarded as a philosophical and political polemic about whether or not every human being could and should have the opportunity to reach the same biological/social potential. If one does agree that this is a worthy goal, then using a local reference based on an elite population makes sense, except that the elite population may also have environmental constraints on growth. This is certainly the case in Nepal where even people from middle and high socio-economic classes are vulnerable to gastro-intestinal infections, as well as other types of infection, which are prevalent in Kathmandu. Perhaps it is best to stop debating which reference should be used and instead look at the purpose of reference data (Johnston 1986; Johnston and Ouyang 1991). Admittedly, if an individual's growth is being classified, NCHS data may be inappropriate; however, it is acceptable for comparing means of anthropometric measurements for populations and sub-groups of those populations (Eveleth and Tanner 1990).

In my opinion, the more troubling issue is the composition of the current infant growth reference population. The NCHS/CDC data, although presented as a whole from birth to 18 years of age, is actually comprised of measurements from two different study populations: the Fels Study and the National Health and Nutrition Examination Survey (NHANES I) conducted by the NCHS. The data from birth to two years comes from growth studies done by the Fels institute in Ohio between 1929 and 1975 on predominantly formula-fed infants. Studies comparing healthy breast-fed and formula-fed infants living under favourable conditions show that artificially fed infants have higher skinfold thicknesses and weight-for-length Z-scores after 3 months of age (Dewey et al. 1993); comparisons of length-for-age are less uniform across studies (Garza et. al. 1994: 4). Thus, the implication is that the reference population may not represent the growth of healthy breastfed infants and may exaggerate growth failure, at least in terms of weight gain. A comparison between the overlap of the three year olds measured in the Fels study and the three year olds in the NCHS population, moreover, showed that the Fels children on average were longer and leaner than the NCHS children (Gorstein et al. 1994). Unfortunately, although there is a need to update the WHO/CDC reference data, this update is unavailable at this time and for the sake of comparison to other studies this thesis utilizes the Fels/NCHS reference population.

Measuring and classifying growth

The most common measurements used for growth studies in low-income countries are length/height, weight, arm circumference and triceps skinfold. These are usually expressed as indices of height-for- age (ht/age), height-for-weight (ht/wt), weight-for-age (wt/age), upper arm circumference-for-age, triceps skinfold-for-age and upper arm muscle area-for-age[7]. As discussed above, these are compared to American NCHS data for height and weight (Hamill et al. 1979). Arm measurement data from the NCHS reference standards from the National Health and Nutrition Examination Surveys (NHANES I and II) of 1971-74 and 1976-80 have been published by Frisancho (1990). Velocity reference data by six month increments is based on the Fels Longitudinal Study and have been published by Baumgartner et al. (1986).

As mentioned earlier, two important concepts of distance or cross-sectional growth are "wasting" and "stunting". Wasting is indicated by low weight-for-height (wt/ht) and stunting by low height-for-age (ht/age). Stunting is the pathological end result of low linear growth, whereas wasting marks current, acute malnutrition (Waterlow 1973). Wt/ht is often used alone when researchers are unable to obtain accurate ages of children, because the index is effectively independent of age up to approximately five years of life (Hamill et al. 1979: 627). However, it is preferable not to use it alone because in many populations children may be stunted but not wasted and the child may appear to be normal because the wt/ht index cannot detect stunting (Chen et al. 1980;

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[7] Upper Arm Muscle Area (UMA) = $[C - (Ts \times \pi)]^2/(4 \times \pi)$, where C= upper arm circumference (cm) and Ts= triceps skinfold (cm) (Frisancho 1990: 20).

Dettwyler 1991).

The WHO Working Group (1986) recommends analysing growth data with standard deviations or Z-scores from the National Centre for Health Statistics (NCHS) reference median. The cut-off points for stunting and wasting are scores of -2 SD below the median (Gibson 1990). The use of -2 SD is to some extent an arbitrary decision. As Berti (1996) points out, the use of the -2 SD is a statistical cut-off point based on the normal distribution and there is no biological basis for it. Using anthropometric data from Ecuador, Berti (1996) discusses and evaluates some alternate schemes proposed by Mora (1989), Monteiro (1991) and Smith (1995), which are based on anthropometric distributions shifted to the left of the reference population's distribution and which take into account children who could be classified as false negatives and false positives. Berti (1996) concludes that, while informative, these classifications do not add much beyond the information already obtainable from Z-scores plotted against age. In this thesis, then, height and weight and arm measurements are presented as mean Z-scores as well as prevalences of stunting and wasting, i.e. the proportion of the sample below -2 SD of the reference median.

Growth in Nepal

Considering that Nepalis are documented as one of the smallest people in the world (Eveleth and Tanner 1990) and that much of the country's population lives in a high altitude environment, it is surprising that relatively few growth studies have been done in Nepal. This dearth is probably connected to the relative political and geographic isolation of the nation until the 1960s only after which the country was rendered more accessible through the establishment of transportation and communication lines. What is available is a mix of studies which reflect very different aspects of child growth in Nepal depending on the theoretical interests of the researchers involved as well as the geographic location of the study population.

In the 1970s physical anthropologists studying growth in Nepal tried to determine whether growth trajectories were more influenced by population genetics or by the environment. Pawson (1977) compared the anthropometrics of 237 Tibetan children aged from birth to 22 years from a refugee centre in Kathmandu to 382 Sherpas of similar age living in the Nepali highland region of Khumbu. He concluded that the two samples had almost identical growth trajectories, despite having grown up in dissimilar environments, i.e. urban versus rural and highland vs. lowland, which he attributed to a shared genetic ancestry. Farquharson (1976) also studied Tibetan refugees in Kathmandu and compared them to samples of children from selected ethnic groups living in the Kathmandu valley. She measured a total of 479 infants under two years of age and classified each individual as privileged and non-privileged in order to compare both ethnicity and socio-economic factors. Among the growth trajectories she documented, a difference was observed only between the privileged and non-privileged groups. The sample from the Tamang ethnic group, however, had higher weights and arm circumferences between 3 and 6 months. She attributed this difference to the addition of animal milk to their diet during early infancy. As well, the Tibetan refugee groups were, on average, bigger than the other ethnic groups during the first six postnatal months; their growth faltering began at a later point, around nine months. She admits that the description of this comparatively small group of Tibetan refugees was problematic, as they were a diverse group from markedly different regions of Tibet and of varying family wealth. This diversity was reflected in large deviations around the mean that when plotted did not form smooth curves. Nevertheless, she attributed the Tibetan children's more robust growth in early infancy to the Tibetan custom of feeding their infants *tsampa* or a barley porridge as early as two months of age, compared to the others who breastfed exclusively for 4 to 6 months. Finally, she concluded by stating that growth patterns of Nepali children show malnutrition in the second and third years of life and that even the privileged group did not evince the "true genetic growth potential of the race" (Farquharson 1976: 12).

Reflecting more recent interest in household determinants of child health, Huijbers and colleagues (1996) evaluated, among other variables, the association between retrospective sibling mortality and living siblings' nutritional status among children inhabiting the highland region of the Koshi Hill Zone in eastern Nepal. Of the 438 children in the sample under the age of 14 years, 61% were stunted and 12% were wasted. During the second half of the first year of the children's lives, all anthropometric parameters dropped, except triceps skinfold. These authors found no association between sibling mortality and nutritional status; the strongest predictor of nutritional status was household socio-economic status. They found, unexpectedly, that coming from a lower caste family and living at a higher altitude were factors which were actually positively and independently associated with good nutritional status. Unfortunately, because the authors did not collect ethnographic and morbidity data, Huijbers and colleagues were unable to explain either of these findings, although they speculate that the higher prevalence of parasitic infections at lower altitude and intercaste differences in childcare customs may account respectively for these results. It is possible that these unusual findings are related to the local historical and socio-economic dynamics of the villages under study.

Unfortunately, because Nepal is such an impoverished country, there have been few resources to conduct its own national nutrition surveys. In the 1970s, however, the United States Agency for International Development (USAID) and the Centre for Disease Control (CDC) in conjunction with the government of Nepal did a field assessment of the nutritional status of 6 to 71 month old Nepali children. The study was conducted in 1975 and reported by Brink et al. (1976). The survey collected height and weight data along with hemoglobin values of blood samples from 6501 preschool children living in 219 villages in rural areas. A smaller urban elite population of 486 children was also measured for comparison. Using National Academy of Sciences reference data and 80 and 90% of the reference median as cut-off points for weight-for-height and height-for-age respectively, they found that 52% of rural children were stunted, 6.7% were wasted and 3.8% were both stunted and wasted. By contrast, 2% of urban elites were wasted and 18.7 % were stunted. There was a significantly higher rate of stunted children in the hilly regions of the country compared to the Terai. As with the pattern in other low-income countries, Nepali children exhibited reasonably good physical growth shortly after birth, but with increasing age, showed a marked increase in stunting which peaked during the second year of life.

In 1983 Martorell and colleagues published a report of an anthropometric survey of 510 children ranging in age from 3 to 10 years conducted in rural villages of the Terai region. Using NCHS reference data, mean Z-scores for the entire group were -2.74 for height, -2.26 for weight and -0.92 for weight-for-height. Progressive stunting was indicated until about five years of age with improvement thereafter. Means for arm muscle area were within the NCHS 5th and 50th percentiles, but the arm fat area was substantially below the NCHS 5th percentile. They report that "(T)he extent of malnutrition found in this study is among the highest that has been reported outside of extraordinary deprivations occurring during events such as wars and famines" (Martorell et al. 1983: 82). Sixty-five percent of the children were classified as stunted, 4% wasted and 12% were less than Gomez 3 (60% of weight for age).

These data may be problematic as Martorell and his colleagues did not calculate children's ages from birth dates, but rather relied on reported ages. They admit that 83% of the children in their data set had reported ages that were multiples of 12 months. They point out that there is a disproportionate amount of "heaping around completed years", which results in comparing younger Nepali children to older children in the NCHS sample. They conclude, however, that as the average age is no more than 6 months off the mark, the bias is small. They compared "heapers" to "non-heapers" and found no differences. I have observed, as have others (Costello 1989; Panter-Brick et al. 1996), that Nepali parents do not just round up to the nearest year, but may actually add a whole year to the age. (This is discussed in more detail below). Therefore, Martorell and co-authors' (1983) age data may have been more inflated than reported.

In the winter of 1995 another national nutrition study of children from 0 to 36 months of age was conducted by UNICEF in conjunction with the Nepalese Government. Similar to the 1975 study, it covered all districts of the country; however, it was much more ambitious and comprehensive than the first. Besides anthropometric measurements, information was collected on breastfeeding, iodine deficiency, vaccination, morbidity, water and sanitation. In addition to surveying 14,934 rural households nationwide, this study also included a sample of 2336 urban households which were stratified by female literacy rates. Interestingly, although the two national surveys are not strictly comparable because of the use of different reference populations and cut-off points, it appears that over the last two decades there has been little in the way of secular change in the size of Nepali children. In the 1995 national sample, almost identical to the results of the survey done twenty years earlier, 50% of 6 to 36 month old children were classified as stunted and 6% were wasted (UN.

The majority of recent work on child growth and health has been conducted in rural Nepal. One major topic in this research is the effects of environmental seasonality on child growth. Naborro et al. (1988) employed data from a number of surveys conducted between 1975 and 1985, including the national survey discussed above, and some smaller ones done by various British aid organizations in both eastern and western rural districts of the country. Longitudinal data from these investigations indicate that linear growth retardation begins within the first couple of months after birth and becomes more pronounced within the first year. They also reported an interesting relationship between linear growth and weight gain. Peak weight gains for children aged 12-35 months coincided with the harvest of crops, mid-August and mid-October , and peak length gains of children 12-23 months were greatest between mid-December and mid-April, three months after the period of maximum weight gain.

Similarly, a study of growth velocity of 441 Nepali children aged 0 to 6 years in a remote rural area in western Nepal indicates that length/height gain is dependent on weight gain (Costello 1989). In this study, two rounds of measurements were taken six months apart - the first in August and the second in February. These two periods of data collection coincide with pre- and post-harvest periods, the times of the year presumed to be of minimal and maximal growth respectively. Like Naborro and colleagues (1988), Costello found that height velocity was lowest (below the 25th percentile of the NCHS reference population) from birth to 24 months and weight velocity until 18 months, after which both velocities tracked the 50th percentiles. To analyse the connection between height and weight growth Costello (1989) classified initial cross-sectional anthropometric data by wasting status to compare the influence of acute weight loss on growth velocity. There was a significant and positive relationship between initial ht/wt SD score and height velocity, i.e. the more wasted children had lower linear growth velocities. An inverse but weaker association was found for weight velocity. When the data were plotted by age category, the association was especially pronounced in the first two years of life. Costello (1989) concluded that wasting rates are highest among 12 to 23 month old children and that wasting probably plays a major role in linear growth faltering.

Panter-Brick (1997) examines the impact of seasonality on growth of children aged 0 to 49 months in a community of subsistence farmers in Nepal. She shows striking variation in both growth status and growth velocity depending on whether the measurement was taken in February (winter month) or August (monsoon). Interestingly, the prevalence of stunting is highest during the winter whereas the prevalence of wasting is highest during the monsoon season. She argues, based on monitoring monthly weight and height gains, that significant height and weight gains were made during February-March, due to a low disease burden and the December-February harvests of rice and finger-millet. Weight velocity falls in June-July and July-August during the monsoon. Children who lost weight, however, maintained height gains through the monsoon period, although this was tempered with a similar finding to that of Costello (1989) in that thinner and shorter children averaged significantly smaller height gains.

Panter-Brick (1997) also investigates the relationship between morbidity, seasonality and growth velocity. Reported morbidity was significantly higher in the monsoon compared to the winter. Although illnesses reported in any one month did not affect height or weight gains in subsequent or concurrent months, over the nine month study period there was a statistically significant difference in observed growth between children with high and low reported frequencies of illness. As Panter-Brick (1997) points out, the morbidity data were not precise enough to detect an impact on growth, given that illness categories, severity and duration were collapsed.

There has been little in the way of studies of child growth in urban Nepal, in part a reflection of the focus of human biologists and international health researchers working in low-income countries, but also because the majority of Nepal's population reside in rural habitats. An exception to this is Panter-Brick et. al.'s (1996) study of the growth of homeless urban boys compared to rural and urban controls. The controls are samples of village boys, urban boys living in a squatter community in Kathmandu and urban school boys. All four samples are of boys aged 6 to 14 years of age. Comparisons of relative height-for-age align village and urban school boys as most and least stunted respectively and urban squatter and homeless boys in between. Interestingly, homeless boys are significantly taller than village and squatter boys. A number of lifestyle factors are attributed to urban homeless boys' relatively better growth status, including an improved range of foods available to homeless boys who spend much of their daily earnings on food, as well as less demanding physical activity involved in begging and rag picking compared to rural agricultural and husbandry activities.

Taking anthropometrics

To comprehend the challenge of collecting anthropometric data in Nepal - and many other low-income countries for that matter - there must be an appreciation for the difficulties encountered in such a setting. The measuring sessions for this study were mobile as we alternated between two different clinics and multiple factory sites. Sampling at different locales necessitates the use of portable equipment, which is not as accurate nor as "child friendly" as a stationary balance scale or a stadiometer found at clinics. Moreover, many of the children had had little previous exposure to biomedical health care; often the only experience they had had was in getting vaccinations, which were frightening and painful. Most of the children had only ever been with Nepali people; as I am a Canadian of Northern European ancestry, I was quite an oddity to them.

For some children, measuring sessions were intriguing and amusing; for others, they were frightening.

Fortunately, the metric system is used in Nepal and many women were familiar with it because many items such as food in shops and wool in the factories are weighed in kilograms. They were most interested in knowing what their child weighed and we informed them regularly of their child's weight and height. If a child was measured two or three times throughout the nine months, at the end of the study period we provided the mother with a UNICEF "Road to Health" chart on which we plotted the weights at each session and connected them with a line. We explained the significance of the direction of the line to the mother, and she was given the chart at the final measuring session.

All measurements were done according to Lohman et al.'s (1988) standardized techniques. For each measurement children's shoes, socks and caps were removed, although total nudity was not permissible because of low temperatures in the cold season. Heavy sweaters and belts, however, were removed. Children's weight was measured with a portable suspended infant/child weighing scale (Perspective Enterprises, PE-HS-25, Kalamazoo, MI) to the nearest 0.1kg. The scale was set to zero at the beginning of each session and checked periodically throughout the sessions. The scales were calibrated bi-monthly with a 2 kg weight and there were no changes detected throughout the study period. Recumbent length was taken for children up to and including 24 months, and height was measured for those over 24 months with a portable wooden adult/infant measuring board (Perspective Enterprises, PE-AIM-101, Kalamazoo, MI) to the nearest millimetre. Arm circumferences were measured to the nearest millimetre with insertion slot measuring tapes (Perspective Enterprises, Kalamazoo, MI) and triceps skinfolds in millimetres with a Lange skinfold caliper (Beta Technology Incorporated, Cambridge, MD). For triceps skinfolds, three measurements were taken in quick succession and an average of the three was used as the measurement (Frisancho 1990).

Inter-observer error was completely eliminated since I took all measurements myself. I did not do an intra-observer error test because I did not feel comfortable repeating measures on any one child. The parents had no idea why I would want to repeat the measurements and I did not want to prolong the time spent participating in the study as they were already taking out time from their paid work. Moreover, the value of reporting an intra-observer error rate is questionable, in my opinion, as many of the intra-observer error rates cited in studies do not differentiate between tests of adults and children. Although taking anthropometric measurements from adults is a relatively simple procedure, taking them from children is altogether different. Many of the Nepali children were nervous about the equipment and for the reasons stated above, were frightened at the time of measurement. The promise of fruit and biscuits offered to them after (and sometimes during) sessions - not to mention the games to distract their attention played by their parents and my research assistants - went a long way to comfort them, but in many cases it was still a challenge to get an accurate measurement. An intra-observer error found for a passive child would not accurately reflect the real error found when measuring difficult ones. Having several research assistants, one to hold a child's legs down while taking recumbent length, for example, and another to occupy the infant, was essential in attempting to obtain accurate measurements.

There were a number of children who would not cooperate during measuring sessions. No child refused to have his/her weight measured, but 11 children (7 boys and 4 girls) ranging from 8 to 45 months would not have their height recorded. I do not believe there was any directional bias as to why these particular children refused. The measuring board was frightening to the children, perhaps for the older children because the board was lowered on their head as they stood, and for the younger ones because they had to be stretched out on a rather uncomfortable surface. Rather than eliminating these children altogether from the study, I simply excluded the height data.

The arm measurements were generally easier to take, but I did encounter some difficulties: two children would not allow their triceps skinfolds to be measured and five children refused both skinfold and upper arm circumference measurements. Again, I believe it was because of fear of the instruments, particularly for those who had a strong or recent memory of being vaccinated. I was reticent to use the skinfold calipers on very small infants (under 6 months). Sometimes when it came time to take measurements, they were either breastfeeding or sleeping and I did not want to disturb them. When I did attempt to measure a 6 to 12 month infant, I had difficulty determining the mid-point of the upper arm because I could not always identify the acromion (the bony protrusion on the posterior of the upper scapula) and/or the olecranon process of the elbow (tip of the elbow) by palpation. This may have been difficult because infants have more fat relative to the size of their skeletal frame. The inability to identify the mid-point of the upper arm decreases the accuracy of the upper arm measurements. Due to these doubts, only arm measurements for children over 12 months of age are presented.

Despite the expected difficulties of collecting anthropometric measurements from children under arduous conditions, I believe that the data were collected carefully and accurately. Having three sets of measurements on many of the children helped me to check for consistency; as a result of comparing the longitudinal measurements, some obvious errors, either because of a recording mistake or because the child moved during the measurement, were removed from the data set.

Determining the age of children

Determining the exact age in decimal fractions of months is essential for growth studies of children because they grow so quickly (Seefeldt and Harrison 1988). Nepali children have no official birth certificates, so the age of the child had to be ascertained from the parents or guardians. In all cases but one[8], parents knew the month and day on which the child was born. I compiled a Nepali calendar with corresponding Western dates for the previous five years (1990-1995) using the dates printed on the front of old issues of the daily English language newspaper stored at the Tribhuvan University library in order to easily and precisely translate Nepali birth dates. We asked the parents in all three rounds of measurement how old their child was in order to check the accuracy of recall. In two cases children's birth dates differed by one day; in another, a child's birth month was off by one month, but on subsequent recall in the third round, the mother repeated the same birth month stated in the previous round. This recall is excellent

[8] In this case the mother didn't know the day and was asked if it fell at the beginning, middle or end of the month. Since she stated that it was at the beginning, the 7th was chosen as the date.

considering that most of these parents are not literate and do not celebrate their children's birthdays as is the custom in the West. The accuracy is probably due to the South Asian interest in horoscope readings requiring knowledge of an individual's month and day of birth.

Ascertaining the year of birth was more difficult because parents do not keep a record of the year and it could only be inferred by matching the day and month with the child's reported age. One difficulty, perhaps peculiar to Nepal, is that when Nepali people state their age, they often increase it by one year. So for example, if a child is 2 years and 6 months, the parent may say 3 years and 6 months. Two, three and four year olds are often difficult to differentiate because of variability in size and development. During the first month of survey I was unaware of this problem and some children's ages had to be corrected on the subsequent round, i.e. they were a year younger than had been previously recorded. Three individuals' measurements were eliminated from the data set because, in one case, the mother was very confused about the age of the child and in the other two, the ages were suspect but could not be re-checked because the families had moved away from the study site after the first round of measurement.

Costello (1989) and Panter-Brick and colleagues (1996) all note the problem of assigning correct ages to Nepali children because of the habit of rounding up a year, although it has not been discussed more widely in the literature as a methodological problem. Again, I was fortunate to have three rounds of measurement to confer confidence that most of the children's ages are accurately recorded. An awareness of this issue is certainly needed for any researcher endeavouring to collect anthropometric measurements of children in Nepal.

A cross-sectional view of growth

This section presents an overall view of attained growth for all of the children who were measured at least one time throughout the study (N=283)[9]. The second set of cross-sectional growth measurements of those children measured two times (N=194) and the third set from those measured all three rounds (N=113) are presented in Appendix 2. It should also be mentioned that 50 mothers had two or more children under 5 years of age who were included in the sample. In order to test whether this biased the growth data, the eldest siblings were removed from the sample, leaving a remaining sample of 218 index children, i.e. one child from each household. Since there were no significant differences between this sample (N=218) and the overall sample (N=283), all the data for the whole sample are presented here.

Mean weights, heights and their standard deviations by sex are presented in Table 4.1, arm circumferences and triceps skinfolds in Table 4.2.

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[9] Portions of this sample (n=83) and (n=12) of this sample joined the study in rounds II and III respectively.

Table 4.1 Mean (± SD) height† and body weight of children (0-60 months) measured at first survey.

Age (months)	n	Height (cm)	n	Weight (kg)
		MALES		
0.0 - 5.9	18	61.8 ± 3.3	18	6.2 ± 1.0
6.0-11.9	15	67.4 ± 3.9	16	7.6 ± 1.4
12.0-23.9	40	74.8 ± 3.2	41	9.1 ± 1.1
24.0-35.9	21	81.4 ± 2.8	24	10.9 ± 1.2
36.0-47.9	24	88.5 ± 5.2	25	12.4 ± 1.4
48.0-59.9	10	92.5 ± 6.6	10	13.6 ± 1.8
		FEMALES		
0.0 - 5.9	22	57.5 ± 4.6	22	4.9 ± 1.4
6.0-11.9	25	65.9 ± 3.0	27	7.1 ± 0.8
12.0-23.9	37	75.0 ± 3.6	38	8.6 ± 0.9
24.0-35.9	23	80.0 ± 4.1	23	10.6 ± 1.3
36.0-47.9	25	87.4 ± 4.6	26	11.9 ± 1.7
48.0-59.9	12	90.7 ± 3.5	12	12.9 ± 1.1

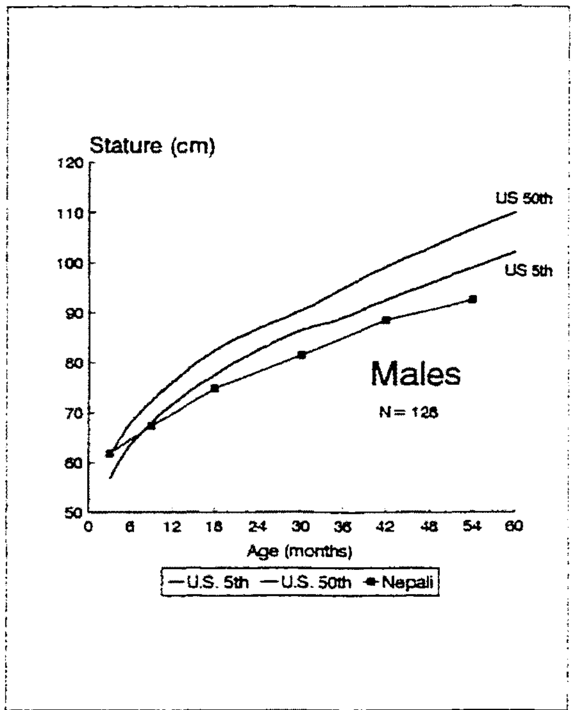
†Length for children under 24 months.

Table 4.2 Mean arm circumferences(C), triceps skinfolds (Ts) and Upper Arm Areas (UMA) of children (12-60 months) measured at first survey.

Age (months)	n	C (cm)	Ts (mm)	UMA (cm^2)
			MALES	
12.0-23.9	41	13.9 ± 1.2	10.2 ± 2.4	9.1 ± 1.7
24.0-35.9	22	14.3 ± 0.9	12.2 ± 2.5	8.7 ± 1.6
36.0-47.9	25†	14.4 ± 1.3	11.1 ± 3.4	9.7 ± 2.1
48.0-59.9	10	14.5 ± 1.1	11.0 ± 3.4	9.8 ± 0.9
			FEMALES	
12.0-23.9	37†	13.3 ± 1.1	9.6 ± 2.5	8.4 ± 1.8
24.0-35.9	22	14.1 ± 0.8	11.6 ± 2.9	8.7 ± 1.3
36.0-47.9	25	14.2 ± 1.1	12.1 ± 2.6	8.7 ± 2.0
48.0-59.9	12	14.7 ± 0.5	11.7 ± 1.7	9.7 ± 1.3

† There were 26 boys and 38 girls measured for upper arm circumference.

Figures 4.1 and 4.2 plot mean heights and weights by age against the NCHS 5th



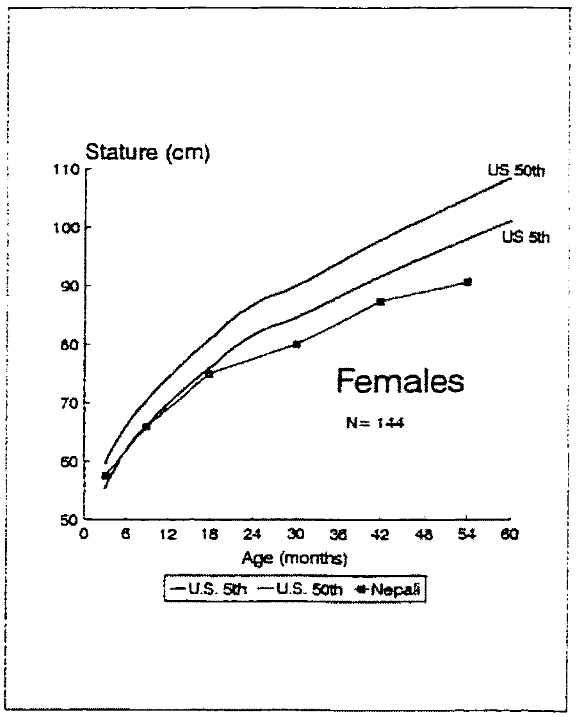
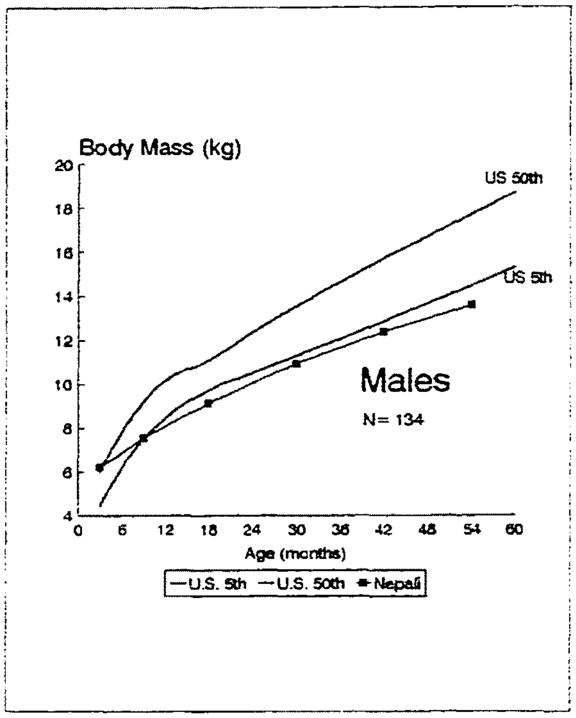


Figure 4.1 Mean stature of Nepali children measured at first survey in any round compared to U.S. 5th and 50th percentiles.



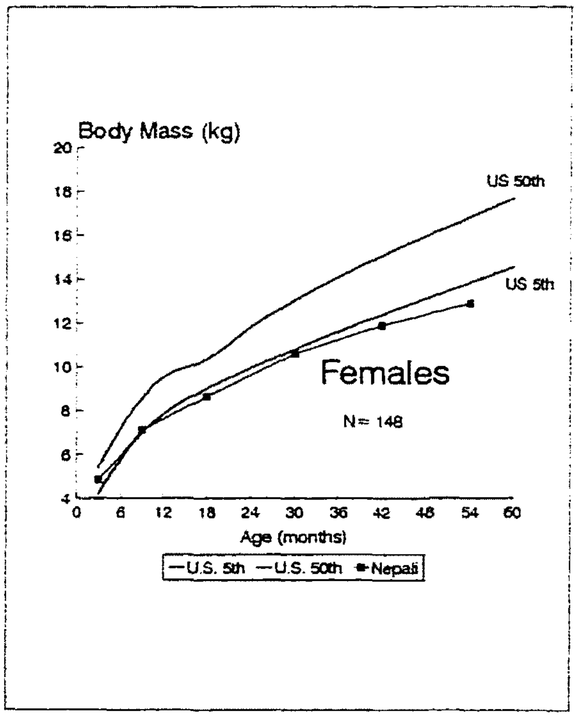


Figure 4.2 Mean body mass of Nepali children measured at first survey in any round compared to U.S. 5th and 50th percentiles.

and 50th percentiles. It is clear from these graphs that between 6 and 12 months of age, the mean attained heights and weights of this sample of Nepali children is maintained well below the U.S. 5th percentile.

Each height and weight measurement was converted in Epinfo version 6 software to weight-for-age (WAZ), height-for-age (HAZ) and weight-for-height (WHZ) Z-scores of the NCHS reference population for boys and girls. Mean Z-scores for each of the indices are presented in Table 4.3.

Table 4.3 Mean (± SD) Z-scores of HAZ, WAZ and WHZ for males and females (0-60 months) at first survey.

Age (months)	n	HAZ	n	WAZ	n	WHZ
			MALES			
0.0 - 6.0	18	-0.36 ± 0.75**	18	-0.23 ± 0.80**	18	-0.00 ± 0.77
6.0-12.0	15	-1.50 ± 1.36	16	-1.35 ± 1.47	15	-0.44 ± 0.92
12.0-23.9	40	-2.12 ± 0.89	41	-1.81 ± 0.95	40	-0.72 ± 0.95
24.0-35.9	21	-2.65 ± 0.95	24	-1.91 ± 0.79	21	-0.33 ± 0.81
36.0-47.9	24	-2.62 ± 1.21	25	-1.89 ± 0.74	23	-0.38 ± 0.78
48.0-59.9	10	-3.18 ± 1.27	10	-2.07 ± 0.73	10	-0.31 ± 0.72
Total Sample	128	-2.06 ± 1.31	134	-1.59 ± 1.08	127	-0.43 ± 0.87
			FEMALES			
0.0 - 6.0	22	-1.08 ± 0.88**	22	-1.06 ± 0.98**	22	-0.35 ± 1.01
6.0-12.0	25	-1.42 ± 0.88	27	-1.29 ± 0.71	25	-0.18 ± 0.76
12.0-23.9	37	-1.80 ± 0.96	38	-1.79 ± 0.62	37	-1.03 ± 0.75
24.0-35.9	23	-2.59 ± 1.03	23	-1.75 ± 0.92	23	-0.23 ± 0.60
36.0-47.9	25	-2.66 ± 0.94	26	-1.98 ± 0.97	25	-0.36 ± 0.70
48.0-59.9	12	-3.24 ± 0.94	12	-2.07 ± 0.69	12	-0.22 ± 0.76
Total Sample	144	-2.02 ± 1.15	148	-1.64 ± 0.87	144	-0.46 ± 0.83

** Mean difference between males and females is significant at $p<0.01$.

A comparison of mean HAZ, WAZ and WHZ scores by age in Figure 4.3 show

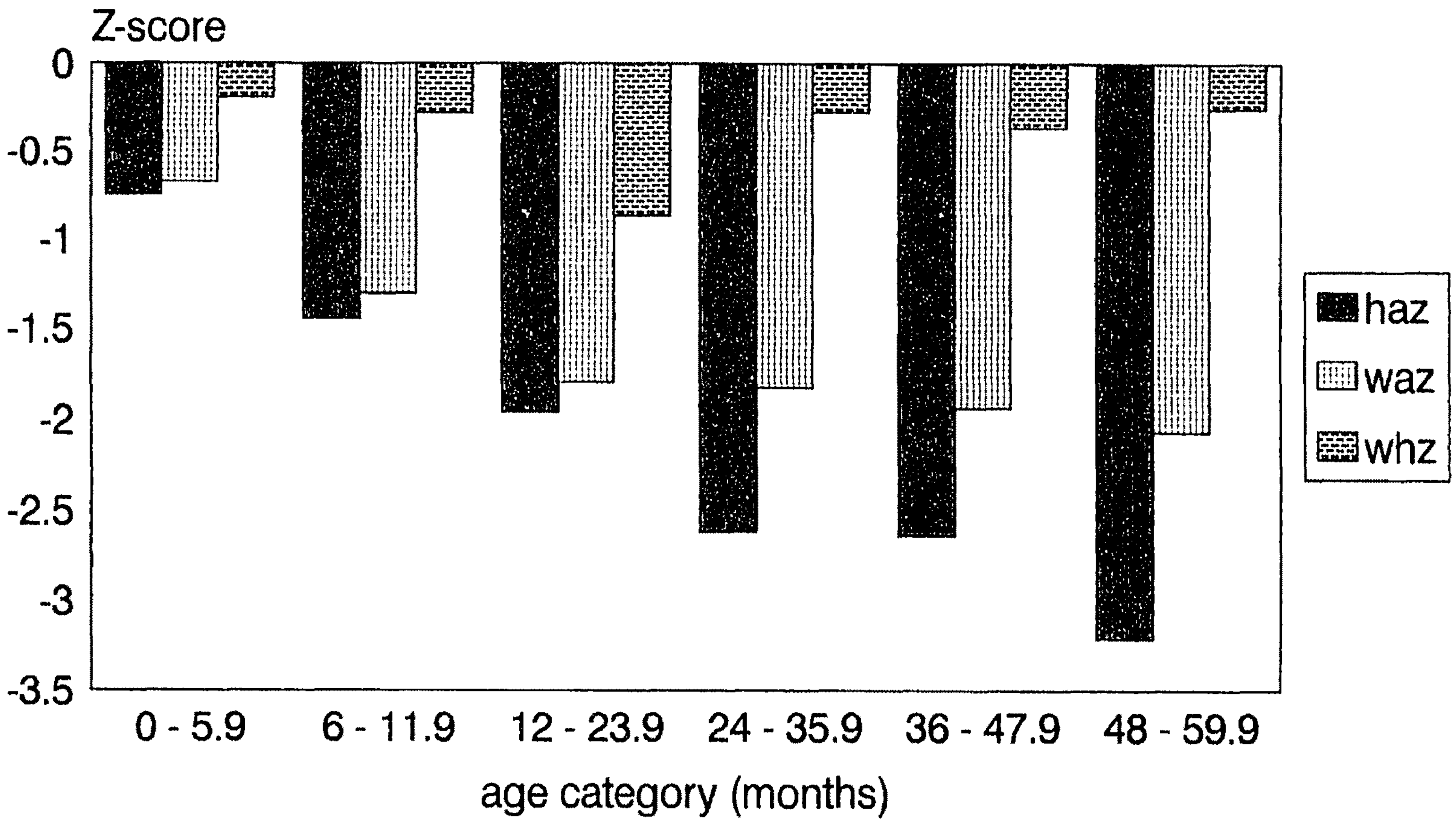


Figure 4.3 Mean Z-scores of indices by age category for all children measured for the first time (N=283).

that, apart from the infants, these children, on average, are moderately-to-severely retarded in terms of linear growth and mild-to-moderately underweight for age. Their WHZ scores, a measure of acute weight loss, however, are very close to the NCHS reference median, indicating that they are not wasted relative to their body frame.

Figure 4.3 shows the progressive decrease in mean Z-scores for all three indices as the ages of the children increase. One-way ANOVA tests of all indices show that the mean Z-scores for children in each age category are significantly different ($p<0.0001$). A Tukey-HSD post-hoc analysis of the means indicates that for HAZ, children under 6 months are significantly different from all other age groups; children from 6 to 12 months are significantly different from 2, 3 and 4 year olds and 1 year olds are significantly different from 2, 3 and 4 year olds. Infants (under 12 months) are significantly different from the other age categories for WAZ only. For WHZ all age groups differ significantly from the one year olds. This analysis indicates that under-weight-for-age and stunting peaks during years 1 and 2 respectively, and continues on through the fourth year of life. The most serious state of low WHZ, or wasting, occurs among the one year olds.

The only difference in mean Z-scores between the sexes is found for the mean HAZ ($t=2.74$, $df=38$, $p=0.009$) and WAZ ($t=2.91$, $df=38$, $p=0.006$) of infants less than six months of age (Table 4.3). In this case the mean Z-score is lower for females than males. It is surprising that female infants would be significantly smaller than male infants at such a young age, as gender differences in Z-scores usually signal preferential care of boys over girls. Infants under six months are being breastfed with little in the way of supplementation, so they would not have much opportunity for preferential treatment through better food. One reason may be that mothers are breastfeeding male infants more frequently than female ones, although it is hard to believe that this would be a conscious behaviour pattern. An alternate reason for the difference in size between males and females under 6 months may lie with the timing of the introduction of solid food. Many Nepali mothers believe that girls should receive supplementation earlier than boys. This issue is discussed in more detail in Chapter 5, pp. 155-160.

Upper arm circumferences were converted to muscle areas and then converted to Z-scores (ZAM) along with triceps skinfolds (ZTR) relative to the NCHS reference medians (Frisancho 1990) (Table 4.4).

Table 4.4 Mean (± SD) Z-scores for triceps skinfolds (ZTR), mid upper arm circumference (ZCIRC) and upper arm muscle area (ZAM) of children (12-60 months).

Age (months)	n	ZTR	ZCIRC	ZAM
		MALES		
12.0-23.9	41	-0.06 ± 0.81	-1.85 ± 0.96	-1.77 ± 0.72
24.0-35.9	22	0.74 ± 0.85	-1.54 ± 0.62	-1.68 ± 0.50
36.0-47.9	25†	0.45 ± 1.24	-1.77 ± 0.93	-1.79 ± 0.67*
48.0-59.9	10	0.67 ± 1.25	-1.91 ± 0.77	-2.42 ± 0.31*
Total sample	98‡	0.33 ± 1.04	-1.77 ± 0.86	-1.82 ± 0.66
		FEMALES		
12.0-23.9	37†	-0.25 ± 0.80	-1.86 ± 0.85	-1.69 ± 0.76
24.0-35.9	22	0.38 ± 1.00	-1.63 ± 0.62	-2.00 ± 0.55
36.0-47.9	25	0.59 ± 0.91	-1.72 ± 0.77	-2.34 ± 0.85*
48.0-59.9	12	0.48 ± 0.57	-1.60 ± 0.36	-2.04 ± 0.46*
Total sample	96‡	0.20 ± 0.92	-1.74 ± 0.73	-1.97 ± 0.75

† There were 26 boys and 38 girls used in calculation of ZCIRC.
‡ There were 99 boys and 97 girls in the total samples used in calculation of ZCIRC.
* Mean difference between males and females is significantly different at $p<0.05$.

Mid upper arm circumference Z-scores (ZCIRC) for all children range between -2 and -1 SD below the NCHS reference medians. Triceps skinfold Z-scores (ZTR), however, are all close to the reference median, i.e. they are "normal" or slightly above normal in terms of fatness for that area (Figure 4.4). The arm measurements corroborate what was found for height and weight measurements; that is, these children are small but not wasted. Low arm muscle area Z-scores (ZAM) indicate that there is more wasting of the upper arm muscle than there is of upper arm fat. This is evidence of protein-energy malnutrition; children may be obtaining enough calories, but not enough protein to build body muscle. It has been proposed that arm circumference be used as a quick and simple measure of malnutrition (Anderson 1979); nevertheless, arm circumference and arm muscle area do differ as shown by their respective Z-scores, ZCIRC and ZAM (Table 4.4). A child can appear to be better off because he/she is plump and has a moderate size arm circumference, but the child may still have poor muscularity as indicated by a low ZAM.

One-way ANOVAs for mean ZCIRC, ZTR and ZAM by age category indicate that ZCIRC does not differ significantly in terms of age. This conforms to the generalization that upper arm circumference can be used as a test of malnutrition independent of age, because it remains relatively constant from 12 to 60 months of age (Anderson 1979; Gorstein et al. 1994). Mean ZTRs do differ significantly by age category (p=0.00). A post-hoc Tukey's-HSD test at the significance level of 0.05 indicates that one year olds have a significantly lower mean ZTR than the older age groups. ZAM, which takes both ZCIRC and ZTR into account, is also significantly

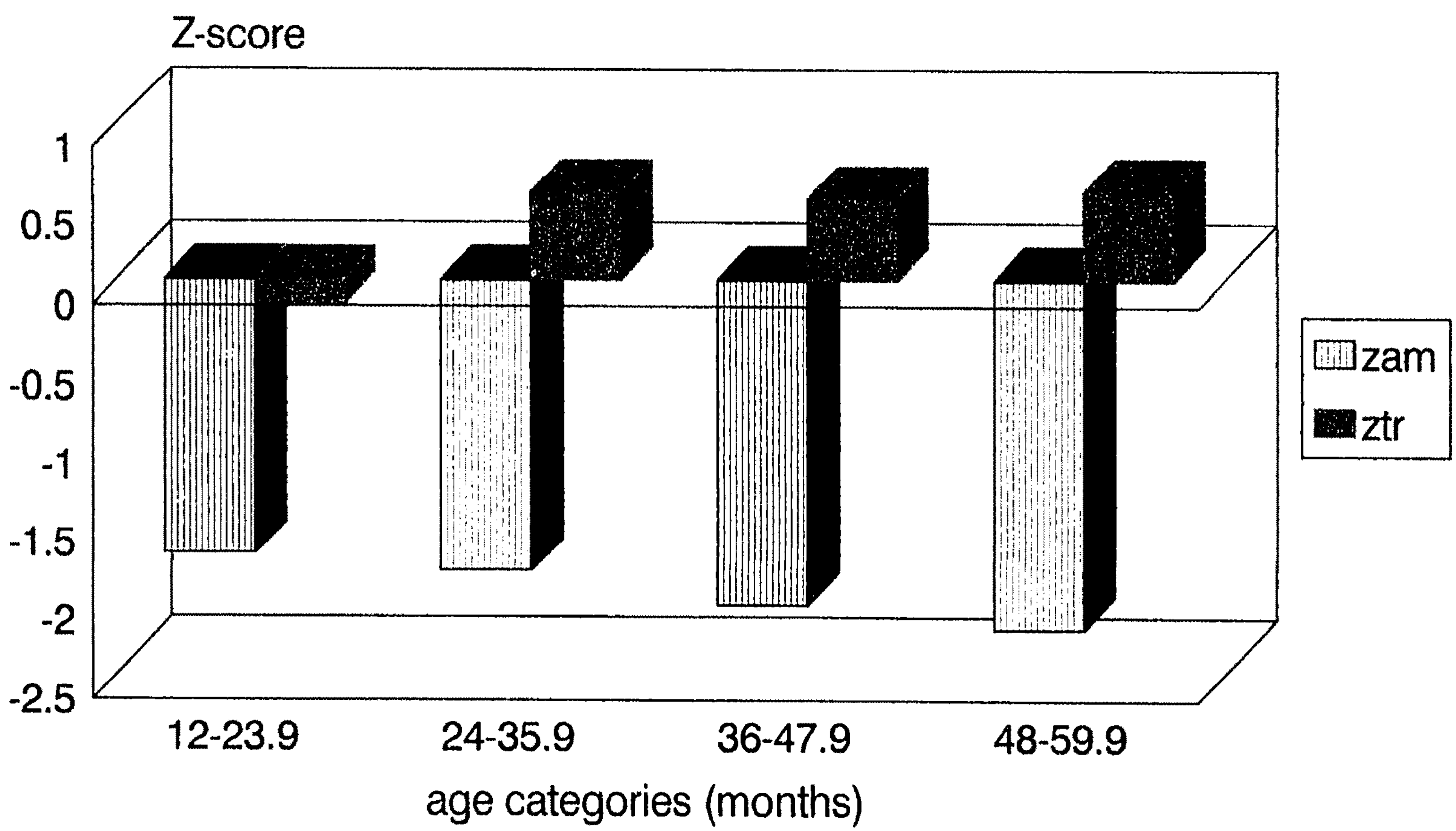


Figure 4.4 Mean Z-scores for upper arm muscle areas (ZAM) and triceps skinfolds (ZTR) for all children meausred for the first time (N=194).

different by age category (p=0.01): three and four year olds have significantly lower ZAM scores than one and two year olds. These age trends in arm measurements corroborate height and weight age trends. The lowest skinfold thickness occurs among one year olds which corresponds with the period of greatest wasting or low weight-for-height. The lowest mean ZAMs occur after the first year of life, mirroring the drop in mean WAZ and HAZ. After two years of age children remain short with low muscularity but not thin.

Bivariate correlations between ZAM and HAZ are positive and significant (r=0.32, p=0.00), but only moderately so. ZAM and WAZ are more highly positively correlated (r=0.47, p=0.00). Thus, children who are stunted and underweight are likely to have poorer muscularity and vice versa. The highest correlation of indices for children in India and Pakistan has been found between arm circumference (upper arm muscle area was not calculated) and weight (Anderson 1979). ZTR is also highly positively correlated with WHZ (r=0.47, p=0.00). In other words, on average, those who are wasted will have correspondingly low triceps skinfold scores. There is no significant correlation between ZTR and HAZ (r=0.-14, p=0.05) and a very weak one between ZTR and WAZ (r=0.22, p=0.002). This makes sense because both ZTR and WHZ are measures of thinness, whereas WAZ and HAZ are measures of body size.

Prevalence of stunting, wasting and low weight among infants and children

Since many studies report anthropometric findings in terms of prevalence of stunting, wasting and low weight (<-2 SD), it is important to report these results here. Moreover, although the mean Z-scores may show where the group as a whole stands, they do not indicate what proportion of the sample is in the lower range of the NCHS reference population.

The percentages of children below the cut-off point of -2 SD are presented in Table 4.5.

Table 4.5 Prevalence of low (<- 2SD) ht/age (stunted), wt/age (underweight) and wt/ht (wasted) for children (0 to 60 months).

	stunted		underweight		wasted	
Age (months)†	n	(%)	n	(%)	n	(%)
0.0 - 5.9	40	5.0	40	5.0	40	5.0
6.0 - 11.9	40	32.5	43	23.3	40	2.5
12.0 - 17.9	49	42.9	51	35.3	49	8.2
18.0 - 35.9	72	65.3	75	42.7	72	4.2
36.0 - 60.0	71	77.5	73	47.9	70	1.4
6.0 - 36.0	161	50.3	169	35.5	161	5.0

†The age categories are divided according to the UNICEF (1995) national surveillance report on the health and nutrition of Nepali children for the sake of comparison. For the total sample a rate for children aged 6 to 36 months of age is presented, corresponding to the age range used in the national study.

Again, it is apparent that similar to other studies of Nepali children discussed above, stunting is the major problem for these peri-urban children: half of them were classified as stunted, whereas only 5% of them were below cut-off point for wasting. Similar to the findings for mean Z-scores, there was a higher proportion of stunted and underweight children among the older compared to the younger children. Only 5% of infants under 6 months were stunted and/or underweight compared to 78% of children between 36 and 60 months.

Figure 4.5 compares the prevalences of stunting with 95% confidence intervals in this peri-urban sample to the national rural and urban prevalences found in the 1995

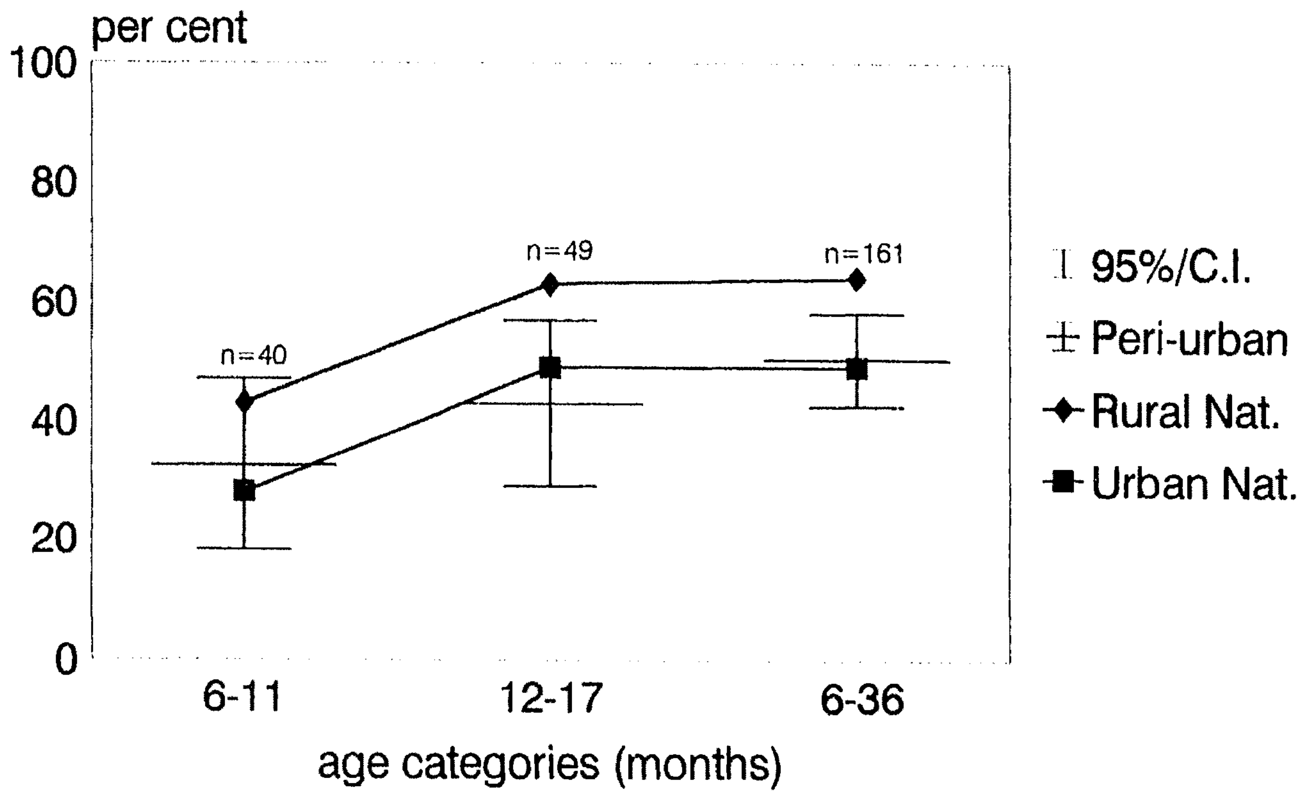


Figure 4.5 Stunting (HAZ<-2SD) prevalences by age category for Nepali national survey of urban and rural populations (UNICEF 1995) and peri-urban sample.

UNICEF (1996) survey. The rural prevalences are significantly higher than those of the peri-urban sample for the 12 to 17 month old children and the 6 to 36 month group. By comparison, the peri-urban and urban prevalences of stunting are within the same range for all age groups shown.

Caretakers' estimation of their children's body size

There has been little in the way of research on child growth which considers the appropriateness of growth references to the population of concern. One exception to this is Hardenbergh's (1996) study of Malagasy children's activity behaviour relative to international growth references. She argues that culturally appropriate children's physical activity must be taken into account when setting -2 SD of the reference to be considered inadequate growth status. Indeed, she finds that more sedentary behaviour starts for children above -2 SD (around -1 or -1.5 SD) for weight-for-height and energetic manual labour also diminishes at this level.

In this study, the cultural appropriateness of infant and children's size, as determined by their mothers, was tested relative to the growth reference. At the first measuring session of each child (before the Road to Health growth chart was provided) the caretaker, usually the mother, was asked whether she thought that her child was small, medium or large in size. The caretakers' judgements are compared to NCHS classifications of the measurement indices and are displayed as pie charts in Figure 4.6. It appears that wasting, or low WHZ, had the biggest impact on caretakers' judgements of size. All five children who were classified as being less than -2SD for WHZ, HAZ and

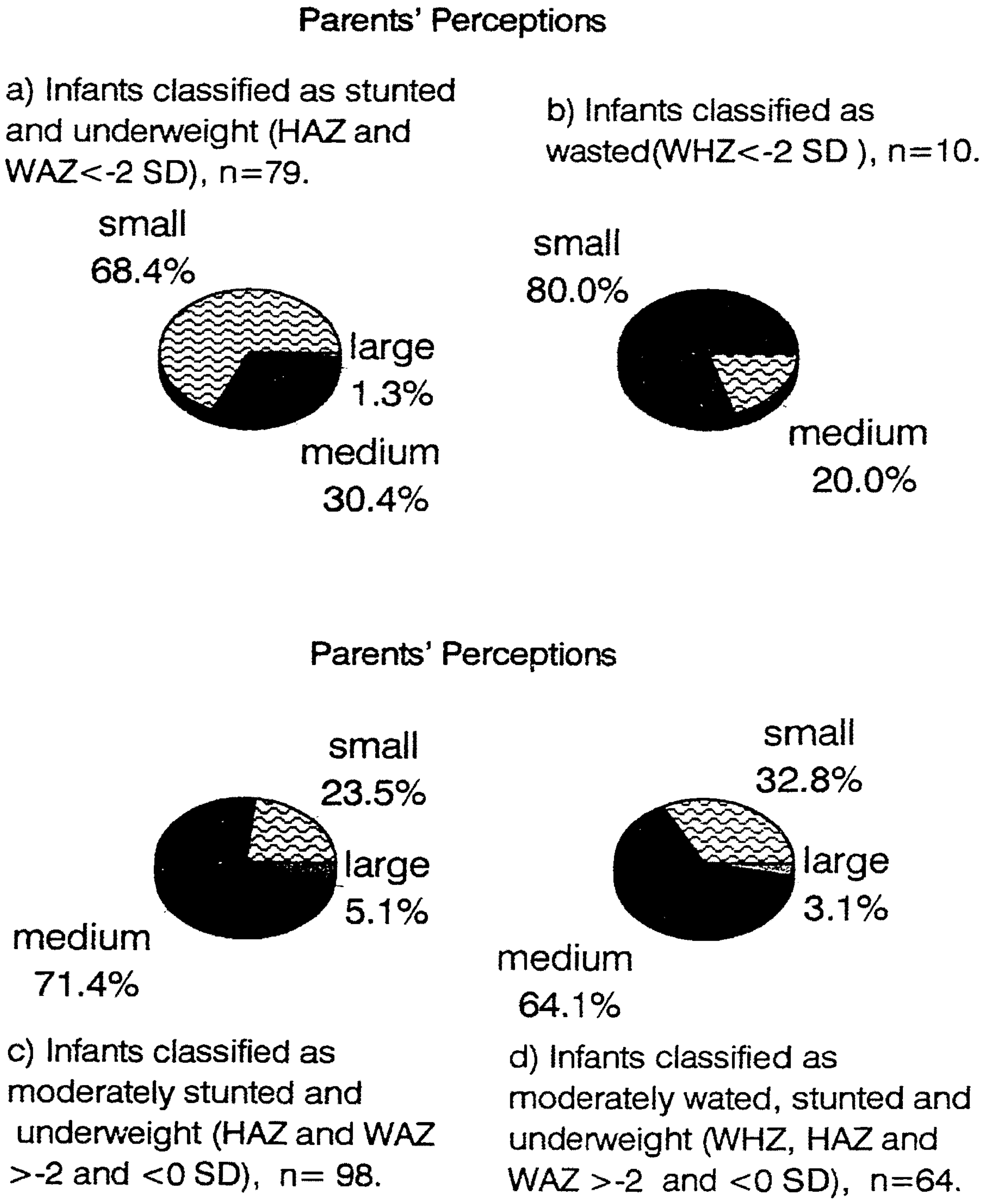


Figure 4.6 Size of children as judged by parents and classified by NCHS cut-off points.

WAZ were deemed to be small by their caretaker. Children less than -2 SD for HAZ and WAZ were classified as small by over two-thirds or 68.4% of caretakers (Figure 4.6a). Just under one-third or 30.4% of caretakers considered them to be medium in size, and one caretaker (1.3%) said her child was large (Figure 4.6a). When children were classified for WHZ< -2 SD alone, however, 80 % of caretakers said that their child was small and none were thought to be large (Figure 4.6b). Children who were classified as being mild to moderately malnourished, or between -2 SD and 0 for HAZ and WAZ, were mostly reported as medium in size (71.4%) by caretakers (Figure 4.6c). When WHZ< -2 SD was added to that classification, the majority of caretakers still deemed their children to be medium in size (64.1%), but slightly more said they seemed small (32.8%) (Figure 4.6d).

Interestingly, of the five children who were classified by WAZ, HAZ and WHZ greater than or equal to 0 (the reference median) three were considered to be medium in size and two were said to be small. All five of these children were under 12 months of age and four of them were under 6 months. It may be that mothers are concerned about their young infants, regardless of their physical size. Or alternatively, as will be discussed in the section below on longitudinal growth, they were aware that their infants were beginning to falter in growth velocity.

Longitudinal growth

Tables 4.6, 4.7 and 4.8 present longitudinal, age-specific, average growth rates for stature/length (cm/6 months) and body weight (kg/6 months) for males and females relative to U.S. reference data from the Fels longitudinal growth study (Baumgartner et al. 1986). Mean growth rates from Rounds I to III are shown in Table 4.6. The growth spans an average of 6.16 ± 0.32 months between rounds I (January to March) and III (July to September). Mean growth rates from Rounds I to II and Rounds II to III are found in Tables 4.7 and 4.8 respectively. The growth spans an average of 2.77 months from Rounds I to II and 3.42 months from Rounds II to III. Because infants grow very rapidly and there were no infants under the age of 6 months left in the sample by the end of round III, the difference in length and body weight for the 0 to 6 month old infants can only be calculated between Rounds I and II. The differences were divided by the exact time period in months between the measuring sessions to obtain an average monthly growth rate. These rates were then multiplied by six to make them comparable to the reference population's velocity over a six month period (See Leonard et al. 1995 for this method).

Table 4.6 Mean (± SD) growth rates of stature and body mass for children (6 to 60 months) between rounds I and III.

Age (months)†	n	Stature (cm/6 mos)	n	Body Mass (kg/6 mos)
		MALES		
6.0-11.9	7	7.71 ± 3.13	7	1.85 ± 0.67
12.0-23.9	19	4.17 ± 1.38	21	0.27 ± 0.52
24.0-35.9	12	3.22 ± 1.47	12	0.55 ± 0.53
36.0-47.9	12	3.59 ± 0.74	12	0.39 ± 0.32
48.0-59.9	9	2.90 ± 0.61	9	0.32 ± 0.57
		FEMALES		
6.0-12.0	7	10.89 ± 2.87	7	2.55 ± 0.96
12.0-23.9	12	4.93 ± 1.09	14	0.59 ± 0.49
24.0-35.9	13	3.21 ± 1.00	13	0.34 ± 0.63
36.0-47.9	10	3.59 ± 1.00	10	0.47 ± 0.55
48.0-59.9	8	3.02 ± 1.00	8	0.26 ± 0.33

† Age at second measurement.

Table 4.7 Mean (± SD) growth rates of stature and body mass for children (0 to 60 months) between rounds I and II .

Age (months)†	n	Stature (cm/6 mos)	n	Body Mass (kg/6 mos)
		MALES		
0.0 - 5.9	2	12.97 ± 4.77	2	3.26 ± 1.53
6.0-11.9	13	7.64 ± 3.19	14	1.22 ± 1.11
12.0-23.9	28	4.54 ± 2.39	30	0.33 ± 0.93
24.0-35.9	12	3.68 ± 1.65	14	0.63 ± 0.87
36.0-47.9	18	4.05 ± 1.64	19	-0.17 ± 0.97
48.0-71.9	14	3.81 ± 1.68	14	0.46 ± 0.70
		FEMALES		
0.0 - 6.0	6	15.36 ± 6.25	6	3.73 ± 1.59
6.0-12.0	14	7.61 ± 2.66	14	1.22 ± 1.11
12.0-23.9	26	4.78 ± 3.82	28	0.42 ± 0.62
24.0-35.9	18	2.84 ± 1.37	23	0.40 ± 0.77
36.0-47.9	18	3.56 ± 1.05	19	0.44 ± 0.73
48.0-71.9	10	3.50 ± 1.62	10	-0.04 ± 0.78

† Age at second measurement.

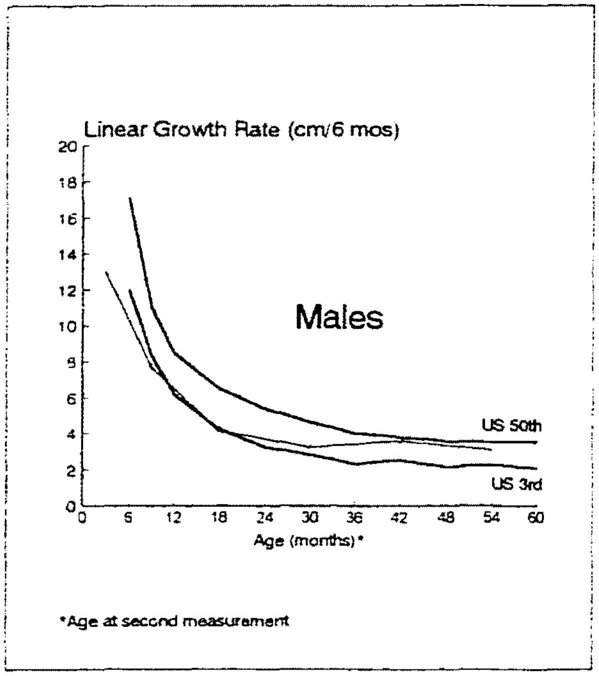
Table 4.8 Mean (± SD) growth rates of stature and body mass for children (6 to 60 months) between rounds II and III .

Age (months)[†]	n	Stature (cm/6 mos)	n	Body Mass (kg/6 mos)
		MALES		
6.0-11.9	7	5.54 ± 3.91	7	1.59 ± 0.52
12.0-23.9	17	3.51 ± 2.25	21	0.30 ± 0.70
24.0-35.9	11	2.90 ± 2.91	12	0.77 ± 1.41
36.0-47.9	12	2.68 ± 1.64	12	0.65 ± 0.79
48.0-59.9	8	1.94 ± 1.04	9	0.19 ± 1.00
		FEMALES		
6.0-12.0	7	9.29 ± 2.46	7	1.59 ± 0.52
12.0-23.9	14	5.61 ± 2.22	14	0.76 ± 0.74
24.0-35.9	13	3.57 ± 1.83	13	0.42 ± 1.55
36.0-47.9	10	3.43 ± 1.73	10	0.16 ± 0.86
48.0-71.9	6	3.14 ± 1.83	8	0.46 ± 0.68

[†] Age at second measurement.

The mean growth rates from Table 4.6 (Rounds I to III) plotted in red against normative data from Fels longitudinal study (Baumgartner et al. 1986) for linear growth velocities (cm/6 months) and body weight growth velocities (kg/6 months) are shown in Figures 4.7 through 4.8. In this sample Nepali males have a slow linear growth rate compared to U.S. males; the Nepali means track the 3rd percentile until the third year of life, after which they approach the 50th percentile. On the other hand, the mean linear growth rate for females declines precipitously from 6 to 18 months, passing from the 50th down to the 3rd U.S. percentile. As with the males, the mean linear growth rate increases after the third year of life, approaching the 50th percentile again.

While females begin growth faltering after 6 months of age, males appear to have slower growth rates earlier in the infancy period (Figure 4.8). The females under six



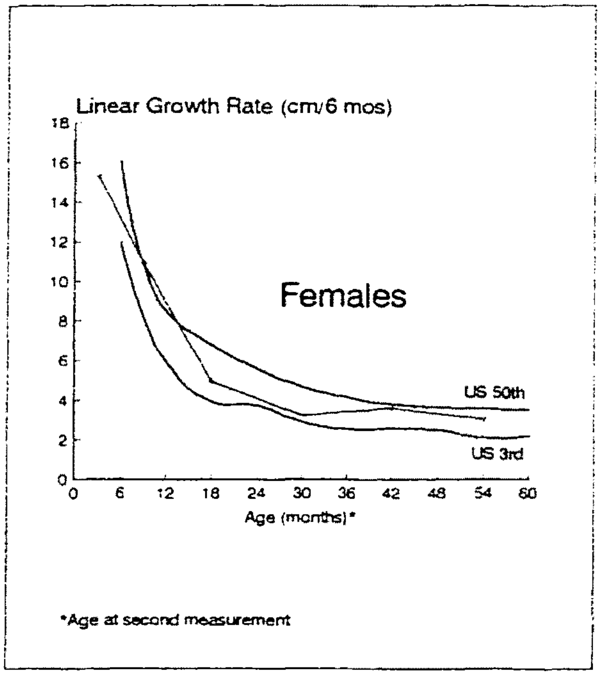
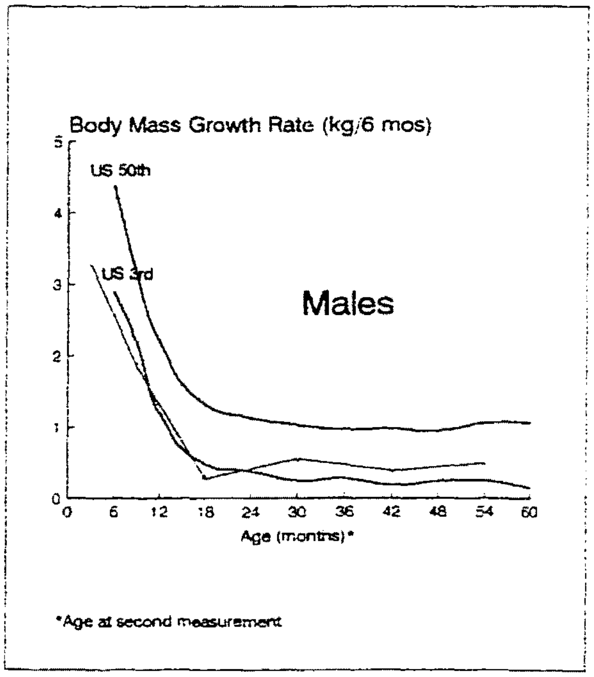


Figure 4.7 Stature velocities (round I to III) relative to U.S. longitudinal data (50th and 3rd percentiles).



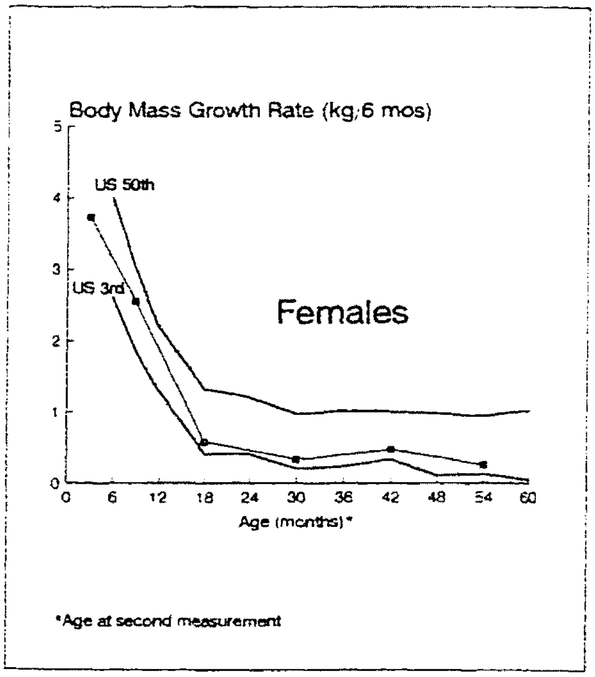


Figure 4.8 Body mass velocities (round I to III) relative to U.S. longitudinal data (50th and 3rd percentiles).

months of age, as discussed above, are significantly smaller than their male counterparts. Therefore, the faster female infant growth velocity may be due to post-natal (in the first 6 months) catch-up growth and regression to mean[10]. That is, they may have been growing faster during the infancy period to make up for deficits in size at birth. This may explain why they are comparable in size to the males in later years. Unfortunately, without birth weights, it is difficult to test this hypothesis[11].

There appears to be an increase in linear growth velocity for both male and female three and four year olds. This corresponds with what is often termed catch-up growth for three and four year old children in low-income countries (Martorell et al. 1994). In terms of body weight, both males and females show slight improvement after the second year of life, but unlike linear growth rates, mean body weight growth rates never approach the U.S. 50th percentile.

The longitudinal growth data can be used to investigate seasonal variation in mean growth as measurements were taken in cold, hot and rainy seasons (See data collection schedule, Chapter 3, Figure 3.2). This can be done for both attained growth measured in each season and growth velocity data from Table 4.7 (Round I to II, winter) and Table 4.8 (Round II to III, summer). Both types of analysis require the use of repeated measures ANOVA, since the same children's measurements are compared in each season. The repeated measures ANOVA tests use child's age at the second and third

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[10] See Baumgartner et al. (1986: 722) for explanations of these phenomena.

[11] Birth weights were unobtainable for this sample because more than half of the children were born at home and no birth weight was recorded. Those born in the hospital were not given a record of their birth weight.

measurements as a covariate because growth velocity and mean HAZ-scores decrease with increasing age. Since "child's age" was not a significant covariate for WHZ, it was not included in the repeated measures ANOVA test for differences in mean WHZ by season (Table 4.9).

Table 4.9 Regression analysis of growth measures versus age.

Measure	B	Beta	Std. Error	t-value	Sig. of t
HAZ	-0.03	-0.45	0.01	-5.20	0.00
WAZ	-0.01	-0.21	0.01	-2.21	0.03
WHZ	0.01	0.16	0.01	1.62	0.11
Htvel	-0.09	-0.56	0.01	-6.66	0.00
Wtvel	-0.02	-0.42	0.01	-4.90	0.00

Table 4.10 Repeated measures ANOVA tests for differences in mean HAZ taken for children measured in rounds I, II and III and covaried by age at measurement (N=107).

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Within+Residual	19.93	211	0.09		
Regression	0.16	1	0.16	1.64	0.20
Season	0.17	2	0.09	0.91	0.41

Table 4.11 Repeated measures ANOVA tests for differences in mean WAZ taken for children measured in rounds I, II and III and covaried by age at measurement (N=113).

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Within+Residual	23.84	223	0.11		
Regression	0.63	1	0.63	5.87	0.02
Season	0.49	2	0.25	2.31	0.10

Table 4.12 Repeated measures ANOVA tests for differences in mean WHZ taken for children measured in rounds I, II and III (N=107).

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Within+Residual	33.30	212	0.16		
Season	10.62	2	5.31	33.81	0.00

Table 4.13 Repeated measures ANOVA tests for differences in mean stature velocity from rounds I -II (winter) and II-III (summer) and covaried by age at measurement (N=100).

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Within+Residual	98	566.69	5.78		
Regression	1	0.01	0.01	0.00	0.97
Between Seasons	1	0.16	0.16	0.03	0.87

Table 4.14 Repeated measures ANOVA tests for differences in mean body mass velocity from rounds I -II and II-III and covaried by age at second measurement (N=113).

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Within+Residual	127.41	111	1.15		
Regression	0.01	1	0.01	0.01	0.92
Between Seasons	0.01	1	0.01	0.01	0.92

As can be seen from the results of the repeated measures ANOVA tests (Tables 4.10, 4.12 and 4.13), there are no statistically significant differences in HAZ and WAZ in cold, hot and rainy seasons nor in mean growth velocities for the children over the winter versus the summer months. Mean WHZ, however, does vary by season (Table 4.11). Mean WHZ scores for children measured in the winter, hot and rainy seasons respectively are as follows: -0.40, -0.72, -0.84. On average, the children's WHZ scores declined throughout the change of seasons from winter to summer. This result is in keeping with the studies of seasonality in weight gain in rural Nepal (Panter-Brick 1997; Costello 1989; Naborro et al. 1988).

Variation in growth status

In order to investigate whether the mother's and child's workplace environment and/or the socio-economic and demographic characteristics of the child's household affects child growth status, two separate analyses were performed on the sample. The first is the influence of workplace - small factory, big factory and home - on stunting and wasting. One-way ANOVA is used to test for differences in mean HAZ for children living in each of these workplace categories: N=283 (home, n=79; small/medium factories, n=112; large factories, n=92).[12]

Table 4.15 One-way ANOVA summary for comparisons of children's mean HAZ by mother's workplace.

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Between Groups	0.97	2	0.48	0.32	0.73
Within Groups	403.79	269	1.50		
Total	404.75	271	1.49		

[12] A two-way comparison of children's anthropometric indices for home and factory groups was tested. As no significant differences were found, a further three-way comparison of home, small and large factories was analysed and is presented here.

Table 4.16 One-way ANOVA summary for comparisons of children's mean WHZ by mother's workplace.

Source	Sum of Squares	D.F.	Mean Squares	F Ratio	F Prob.
Between Groups	0.18	2	0.09	0.12	0.88
Within Groups	193.66	268	0.72		
Total	193.84	270	0.72		

As seen by the non-significant F probabilities shown in Tables 4.14 and 4.15, the comparison of children's mean HAZ and WHZ by work place environment did not uncover any statistically significant differences among the three groups of children.

Some standard socio-demographic variables which are proposed to account for differences in health and nutritional status among children in low-income countries were analysed using multiple regression analysis. The model investigates the influence of some maternal characteristics and socioeconomic variables that have been associated with stunting among urban children in Asia (See for example, Ricci and Becker 1996). The independent variables used here in the linear regression analysis are: birth order, parity, mother's level of education, mother's age, monthly per capita family income and mother's monthly earnings (See Chapter 3, pp.67-81 for a summary of these characteristics) and the dependent variables are HAZ and WHZ . Bivariate correlations among independent variables show that parity and birth order are highly correlated ($r=0.99$, $p=0.00$), as are mother's age and parity ($r=0.70$, $p=0.00$). Thus, mother's age and birth order were not entered into the multiple regression analysis as predictors of growth status.

Table 4.17 Multiple regression analysis of maternal and family socioeconomic variables as predictors of HAZ.

Multiple R=0.54
R Square = 0.29
Adjusted R Square = 0.27
Standard Error = 1.01
N=145†

Analysis of Variance:

	Sum of Squares	DF	Mean Squares	F ratio	F prob.
Regression	59.08	5	11.81	11.51	0.00
Residual	144.79	141	1.03		

------------------------------------Variables in the Equation------------------------------------

Variable	B	SE B	Beta	T	Sig T
Child's age	-0.04	0.01	-0.50	-6.79	0.00
Parity	-0.07	0.06	-0.09	-1.15	0.25
Mother's ed. level	0.01	0.03	0.02	0.23	0.82
Per capita income	0.00	0.00	0.06	0.72	0.47
Mother's earnings	-0.00	0.00	-0.03	-0.42	0.68
(Constant)	-0.99	0.28		-3.49	0.00

† Only the youngest child from each family was used in the analysis.

The age of the child is a significant predictor of HAZ, an obvious conclusion given the results shown earlier for the progressive increase in stunting with increasing age category (Table 4.16). None of the other maternal and socioeconomic variables used in the multiple regression analysis were significant predictors of HAZ. The results were similar for the multiple regression analysis of WHZ as the dependent variable, except that none of the independent variables were significant predictors at the p=0.05 significance threshold, not even the age of the child.

Conclusions

Linear growth retardation or stunting is one of the most prevalent forms of growth faltering affecting children in low-income countries. It is estimated that approximately 50 to 70% of preschool children in South Asia are growth stunted (WHO 1987; Victora 1992). This is also the case in Nepal (UNICEF 1996), as well as for the peri-urban sample reported here.

Waterlow (1992) was adamant that linear growth retardation and wasting are separate physiological processes, although he has since acknowledged that there is evidence that episodes of wasting may precede stunting (Waterlow 1994). Naborro and colleagues (1988), Costello (1989) and Panter-Brick (1997) all show evidence that the thinnest children in their samples gained relatively more body weight than other children in succeeding months, but at the expense of growth in stature. In terms of cross-sectional growth, this relationship can be seen from the differential age pattern of growth status in my sample of peri-urban Nepali children. Like many other studies in low-income countries cited earlier, the lowest mean WHZ occurs from 12 to 24 months of age. This thinness is corroborated by a significantly lower mean ZTR for this age group. Notably, this state precedes the peak in low mean HAZ, or stunting, from 24 months onward.

Longitudinal growth patterns lend a more dynamic view of child growth. Although cross-sectional or attained growth indicates that the Nepali children in this sample were not stunted until after the sixth month of life, boys from early infancy have low linear mean growth velocities. Girls' mean velocity, however, only drops after the first year. As mentioned above, this may be due to the latter being significantly smaller at birth. Lack of birth weights is a drawback of this study, as there is evidence that birth weights may determine the pace and absolute size of early infant growth (Chen et al. 1980). Early infant growth faltering, moreover, may be regulated by deficient *in utero* nutrition and poor micronutrient stores at birth rather than the postnatal environment (Allen 1994).

Growth velocities do improve after the third year of life, when both males and females approach the 50th percentile of the U.S. normative data. This contrasts with cross-sectional growth which shows that 3 and 4 year olds have the lowest mean HAZ scores and the highest prevalences of stunting. The difference in these two types of measures illustrates the distinction between the *process* of stunting and the *state* of being stunted. The process of stunting began at 6 months (3 months for boys) and lasted through to 36 months, but the children were stunted from 36 months onward. This state of being stunted is also corroborated by significantly reduced upper arm muscularity for 3 and 4 year olds compared to the younger children.

Results from arm measurements indicate that there is more wasting for these children in upper arm muscle compared to mid-upper arm body fat. This is further evidence of protein-energy-malnutrition; children may be obtaining enough calories, but not enough protein to build body muscle (Frisancho 1990). Unlike mean HAZ, WAZ and WHZ, there appears to be some sex differences in arm measurements. This is found for the children measured at least once during the study (Table 4.4) for mean upper arm muscle area (ZAM) among 3 and 4 year olds and for children measured at least twice (Appendix 2, Table 4) among 4 year olds. Interestingly, among the 4 year olds measured at least once (Table 4.4), it is the girls who have slightly higher mean ZAM scores, whereas in every other instance of a significant difference between the sexes, the boys have higher mean ZAM scores. Finally, in children who are measured in all three rounds (Appendix 2, Table 8), the girls have significantly lower mean triceps skinfold Z-scores (ZTR) for the whole sample. This indicates that there may be some difference in growth status between boys and girls, which is not severe enough to show up in the whole body measurements, but does manifest itself in the arm measurements.

There is no doubt that discrimination against girl children is an important issue in South Asia and evidence of preferential care of males over females has been highlighted in studies of household food allocation in Nepal; however, differences are found only during adolescent and adult years (Gittelsohn et al. 1997). The fact that no sex differences in body size were found in this peri-urban sample concurs with results of growth studies in Nepal (Panter-Brick 1997) and Himalayan India (Himmelgreen et al. 1991). Himmelgreen and colleagues (1991), in fact, argue that the assumption of female nutritional disadvantage in northern India should be reevaluated given their lack of difference between sexes in their findings. There is evidence from an Andean community in Peru that infants and preschool children of both sexes are buffered by nutritional stress due to child preferential food allocation within the household (Leonard 1991). Thus, sex differences may be more pertinent to adolescent age groups than infants and pre-school children.

It is worthwhile to investigate mothers' opinions of their children's body size, since they are the ones who ultimately have to make nutritional decisions for their child.

To my knowledge no other researcher has included this as part of their study of child growth, but it is an important issue in considering growth monitoring as a public health tool. If comparison to the NCHS standard can be considered a "real" categorization of malnutrition, then mothers were generally accurate about their children's state. Interestingly, their estimation of their children matches the distribution of body size for the whole sample, which is shifted to the left of the NCHS reference population's distribution. This is reasonable given that they are not judging their children relative to American children, but to other children in their community. For example, the majority of those children between -2 and 0 SD of the reference population were considered by their mothers to be of medium size, even though by North American standards they would be considered to be small because they fall below the reference median. Despite this, what is classified as stunted and underweight-for-age (<-2 SD) by NCHS standards was also deemed to be small by 68% of the mothers. Wasting or low wt/ht was the most salient indicator for mothers that their child was small. This makes sense as acute malnutrition or sudden weight loss is more visible than low linear growth rates, a slower and less discernible process.

Although this study did not set out to test differences in growth between urban and rural children, some of the available studies lend themselves to some preliminary comparisons. Panter-Brick's (1997) anthropometric data from children living in a Himalayan foothill village in Nepal is comparable to the anthropometric data presented in this chapter. Figure 4.9 compares mean HAZ and WHZ scores for the children (0 to 49 months of age) measured in both studies. The measurements shown for the village

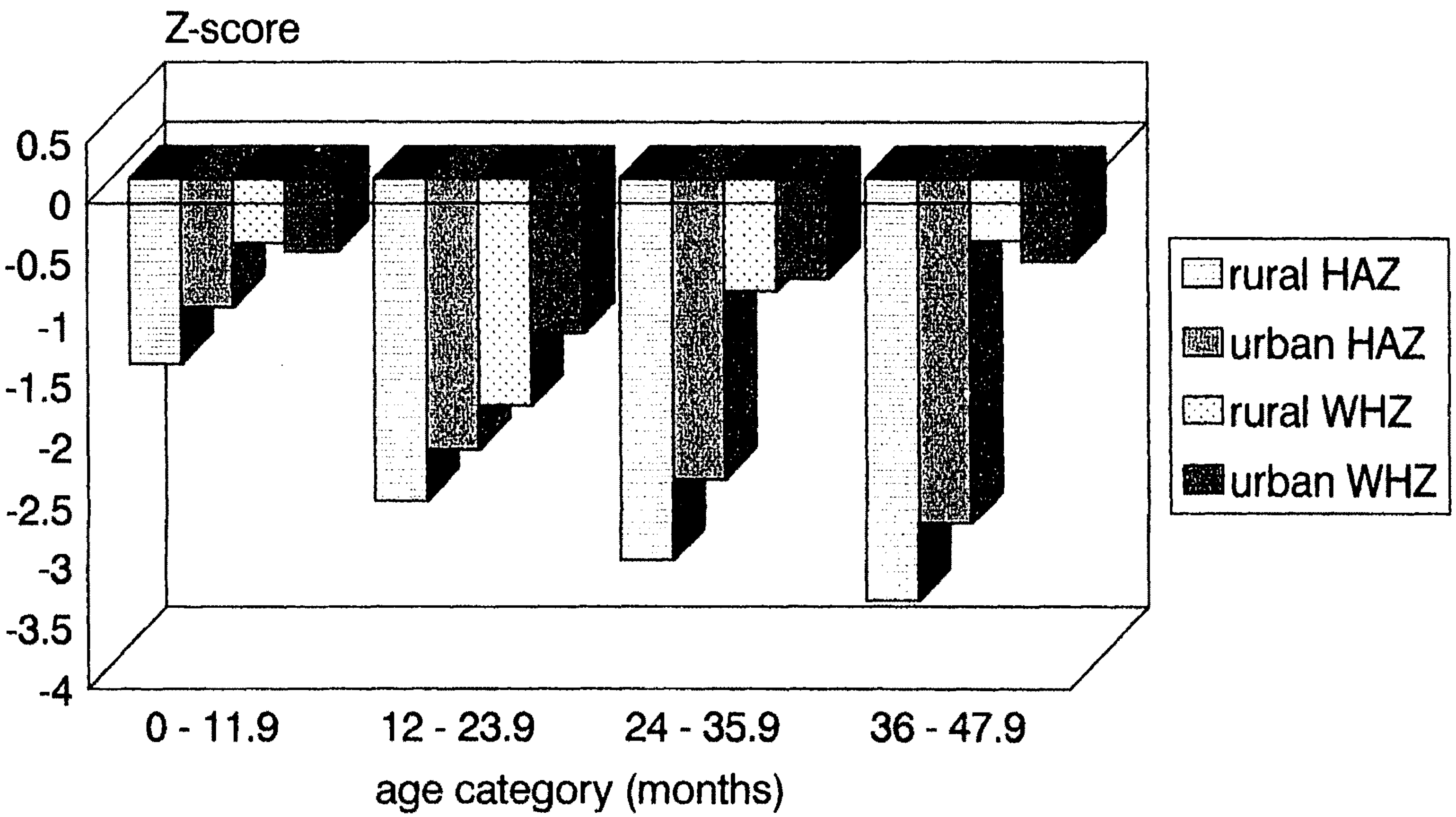

Figure 4.9 Mean HAZ and WHZ scores for peri-urban Nepali children measured in August and September (Round III, N=96) and village Nepali children nmeasured in August (N=70, Panter-Brick 1997).

children were taken in August, which is comparable to the cross-sectional measurements taken in this study during Round III of data collection (August-September) (Appendix 2). In each age category the village children appear to have lower mean HAZ scores than those of the peri-urban sample, although that is not the case for mean WHZ. Since the data were collected more than 10 years apart and not by the same researchers, I will refrain from making any large generalizations about urban-rural differences. Nevertheless, it does point to the possibility of slightly better linear growth status for the peri-urban children, a result which is often found for comparisons of urban and rural children in many other low-income countries (WHO 1988; Williams 1990). Perhaps a more appropriate investigation of urban-rural differences in Nepal is made in comparing the results from this peri-urban sample to those from the 1995 Nepali National Health Survey. The children in this peri-urban sample, at least for those over 12 months of age, have stunting prevalences in the same range as urban Nepali children; both of these groups have lower prevalences of stunting than the rural Nepali children (Figure 4.5).

One way that growth retardation may manifest itself similarly in rural and urban environments in Nepal is in terms of seasonal variation. Like the results of seasonal growth variation among children in Nepal found by Costello (1989) and Panter-Brick (1997), the most pronounced effect of seasonality was the significantly lower mean WHZ scores during the summer months. Costello (1989) attributes this drop in weight to the dearth in food availability before the harvest; Panter-Brick (1997) examines a combination of factors including harvest cycles and child illness. Mean HAZ, WAZ and stature velocity do not change with season. It is surprising that weight velocity does not also decrease, given the decrease in mean WHZ with the hot and rainy seasons. The lack of seasonal growth rate variation could be attributable to averaging effects that occur when only three measurements are collected throughout the whole year, as opposed to monthly increments.

Finally, an attempt to explain some of the variation in growth status in terms of maternal and socioeconomic characteristics of the sample yielded little in the way of significant predictors. Age of the child was the most significant predictor of mean HAZ and contributed the most to the regression model. Some of the variables that might be expected to influence child growth such as mothers' earnings and education level do not appear to influence child growth status. I conjecture that the lack of any significant results is due to the fact that these families are fairly homogeneous in their demographic and socio-economic status. The children's immediate environment (i.e., mothers' workplace) also had no discernible impact on growth status. This is explained by the fact that the factory compound functions as a home for the families who work in the carpet industry so that the division between home and factory originally hypothesized to be a potential influential variable affecting children's health and nutritional status is a moot issue. As well, the differences between the large and small factory environments are irrelevant in the discussion of the children's immediate environment.

There is no doubt that whether stunting occurs in rural or urban environments, it stems from an environment of chronic deprivation. In low-income countries it is most likely due to a combination of high disease load and low quality food, although the extent to which these factors play a role depends on the specific environmental context.

Having eliminated socio-demographic characteristics of the mothers and workplace setting as irrelevant factors in the discussion of children's growth status, the remainder of this thesis investigates children's nutrition and morbidity as it relates to the wider environment in order to explain why these children experience growth faltering[13].

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[13] A larger statistical model incorporating socio-demographic characteristics, workplace setting, and other factors such as morbidity and breastfeeding status was not attempted. The employment of such a comprehensive statistical model is untenable with the relatively small sample of children in this study. Further, my focus is on child morbidity and infant feeding practices as they are influenced by the wider environment rather than by the more immediate household context.

CHAPTER FIVE

The Biocultural Determinants of Breastfeeding and Weaning and the Role of Infant Nutrition in Growth Retardation

Infant feeding is clearly related to growth and development and is an issue of utmost importance in the analysis of growth retardation. During early infancy breastfeeding is vital nourishment, even more so for children in low-income countries because it is a free and clean[12] source of food. Weaning, however, is an equally important issue in infant nutrition because eventually a child requires nourishment from sources other than breast milk (South-Paul 1987; Wharton 1992). Weaning can be partitioned into two parts: the first begins at the regular introduction of non-breast milk foods to the baby, during which time the child may be breastfed for months or even years; the second, is the actual termination of breastfeeding. Weaning, then, is considered to be a process. In order not to confuse the term, the point at which breastfeeding ends will be referred to henceforth as the complete cessation of breastfeeding[13].

The timing and practice of infant feeding (including breastfeeding and weaning) is thought to be crucial to the growth and development of the human infant, and although

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[12] Some chemical toxicants (Jeliffe and Jeliffe 1978; Sinaiko 1981) and some viruses, including HIV can be transferred to the infant through breast milk (Davis 1990).

[13] For a discussion of the difficulties in defining the term "weaning", see Dettwyler and Fishman (1992: 175).

there has been some attempt to find the best method using both biomedical knowledge (Lutter 1992) and evolutionary theory (Dettwyler 1995a), there seems to be a great deal of variation from one human population to another (Dettwyler 1986, 1987; Panter-Brick 1991; Harrison et al. 1993; Bohler and Ingstad 1996; Gray 1996) and throughout human history (Fildes 1982, 1995). Indeed, biomedical advice has changed from one decade to another through the 20th century (Dettwyler and Fishman 1992: 191), so it is often difficult to know the truly "best" method. In my opinion, and following Gray (1996), rather than looking for a universal human strategy, the "best" method will be contingent on the local environment, cultural customs and the particular situation of the mother and infant.

Because women are primarily responsible for infant feeding, their other activities are naturally of paramount importance when examining the issue. Women's productive work is certainly a factor for consideration, both for women in rural areas where they engage in agricultural labour (Panter-Brick 1989, 1990, 1991, 1992; Levine 1988) and in urban areas where they participate in both formal and informal wage labour (Huffman 1987; Leslie 1988; O'Gara 1989). Finally, there has also been a great deal of interest in how mothers' cultural beliefs, knowledge and intention about breastfeeding and weaning affect practice (Dettwyler 1987; Pelto 1987; Harrison et al. 1993; Wright et al. 1993; Bohler and Ingstad 1996; Gray 1996).

Much attention has been paid to the issue of changing breastfeeding behaviour in economically developed and developing countries around the world. In industrialized nations there has been a downturn in breastfeeding in the last fifty years and there is evidence that this is also happening in some industrializing nations, particularly those that have been rapidly developing economically (Huffman and Lamphere 1987: 109-110; Winikoff and Laukaran 1989). This downswing is, in part, due to increased numbers of women in the formal labour force, but is also linked to issues of urbanization, modernization and the concomitant increase in the consumption of infant formula (VanEsterik 1989; Popkin et al. 1989). In the past twenty years there has been a concerted effort by many people in North America and Europe, primarily from middle and upper socioeconomic levels, to return to breastfeeding (Dettwyler 1995b: 167-168). This culturally and politically based shift has also turned its gaze on poorer nations of the world, where breastfeeding is perhaps more crucial, because of the lack of money to pay for infant formula and the risk of contamination with unclean drinking water (Winikoff and Laukaran 1989). The mothers described in this thesis are particularly interesting because they live in a culture which fully endorses breastfeeding and they are also engaged in wage labour in an urban setting.

As Pelto (1987) has reminded researchers, the weaning process is an equally important part of infant feeding and must be investigated with the same weight and attention as breastfeeding. Indeed the two aspects of infant feeding, breastfeeding and weaning, are inseparable and thus both are addressed in this chapter.

Figure 5.1 illustrates the stages of infant feeding followed by the majority of the Nepali mothers and children in this study. The exact timing in postpartum months varies from one mother and child dyad to another; rather, the purpose of the diagram is to point out the long overlap in time between the introduction of non-breast milk foods and the

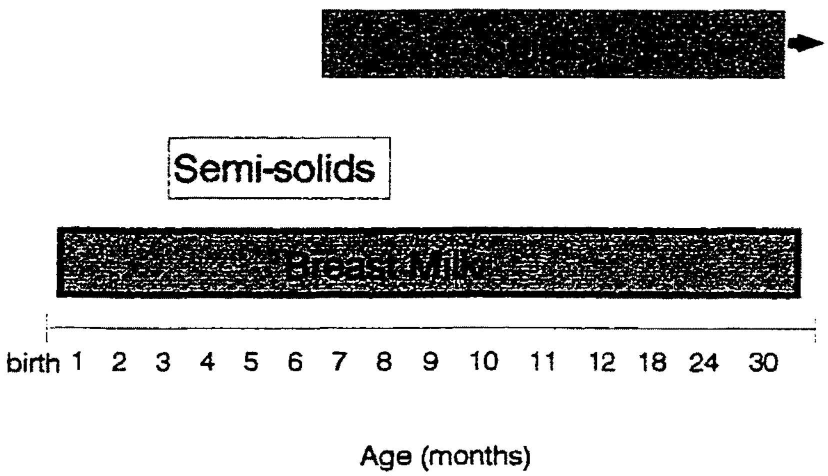

Figure 5.1 The order and timing of breastfeeding and the introduction of non-breast milk foods.

continuation of breastfeeding. Thus, infants in Nepal are for the most part in this transitional weaning stage. As Greiner (1996) points out, the length and importance of this transitional time for many mothers and infants in the world is sometimes a difficult concept for North Americans to fathom, since we usually conceive of non-breast milk foods as a replacement for breast milk rather than a complement to it.

This chapter is organized in the chronological order of the infant feeding stages: from exclusive breastfeeding to weaning parts one and two, which include the introduction of non-breast milk food and the cessation of breastfeeding respectively. In each part, there is a discussion of cultural beliefs and customs compared to actual practices; an investigation of the impact of productive work on infant feeding practices; and finally, an analysis of how this aspect of infant feeding affects child growth and health. Because of the complexity of infant feeding, there are no concrete facts and many more questions asked than answered. The issues raised, however, do call into question some assumptions about infant feeding and give some new directions for research.

Breastfeeding

Breastfeeding in Nepal is fully endorsed and accepted by all people as a natural and necessary way of nurturing infants. It is practised on demand through the day and night while infants sleep with their mothers. In contrast to North American practices, my observation of Nepali practices is that there is no shame or discretion in showing the breast while breastfeeding and no prohibitions as to when and where it should be practised (See Dettwyler 1995b for a discussion of North American breastfeeding taboos).

In order to examine closely and quantify breastfeeding practices, specific questions about breastfeeding were included in the infant feeding and child health survey (See Appendix 1). Mothers were asked if they were currently breastfeeding their child. A status quo method of inquiry was used rather than a retrospective questionnaire, because the children in this study ranged from 0 to 5 years and were therefore at different stages in their infant feeding regimen. Recall questions about infant feeding transitions, moreover, are known to be subject to a high rate of error (Quandt 1987). It should be noted that all the quantitative results presented in this chapter are cross-sectional in nature, i.e., they come from the data gathered on the first survey for each of the 283 children in the sample.

The perception that breastfeeding is culturally valued in Nepal is indeed borne out in actual practices surveyed in this study. All but two of the 40 children in the 0 to 6 month category were breastfed: one had suffered from meningitis as a young infant and as a consequence had neurological damage which rendered him incapable of suckling a breast; the other infant's mother was not forthcoming as to why she was not breastfeeding, but she stated that the child was underweight, sickly, and suffered from chronic diarrhea. Several months after the survey, this latter child was reported by co-workers to have died while the parents were en route to their home village in the hills. Over 90% of children in the 12 to 24 month age category, in fact, were still breastfeeding, after which the proportion of children being breastfed declined to 0% by 54 months of age (Figure 5.2).

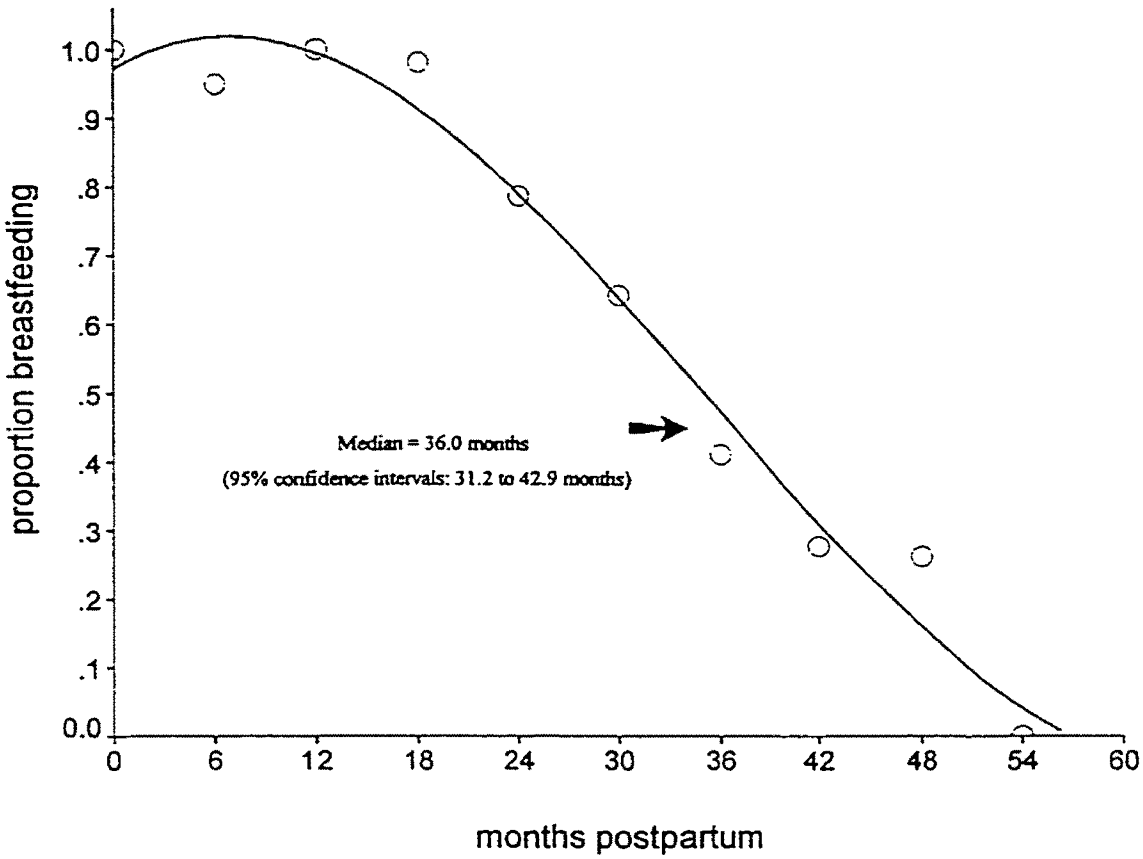

Figure 5.2 Proportion of children being breastfed at 0 to 60 months at time of first survey (N=283).

The median age at which breastfeeding ceased was determined from the status quo data using probit procedures (following Tracer 1996). Probit models are appropriate for dependent variables that have binary all-or-none outcomes, in this case either breastfeeding or not at the time of survey. For a probit transformation, the observed proportions at each stimulus (the stimulus in this case is the infant's age category) are replaced by the value of the standard normal curve below which the observed proportion of the area is found (Norusis/SPSS 1994: 249). Using probit analysis for this sample of infants (N=283) , the estimated median duration of breastfeeding in months postpartum is 35.97 with 95% confidence intervals around the median of 31.18 and 42.90 months.

As mentioned earlier, there has been a great deal of concern about how women's participation in wage labour affects breastfeeding (VanEsterik and Greiner 1981). This concern did not originate in the 20th century in regard to women in low-income countries, but was prevalent in industrializing countries during the 19th and early 20th centuries when social welfare movements were targeting high rates of infant mortality. Social welfare workers and doctors concluded that women's wage labour caused infant mortality, not on the basis of any empirical evidence, but rather because of ideological considerations which deemed that women should only be caregivers, ignoring the vital role women played in contributing to family income, sometimes as the sole bread winners (Dyhouse 1978; Ball and Swedlund 1996). In today's case of women in low-income countries, researchers who investigate breastfeeding and wage labour do not always acknowledge the heavy toll of productive work that women do in the domestic setting and in their agricultural endeavours. Panter-Brick (1989, 1990, 1991, 1992) has documented rural Nepali women's breastfeeding practices while working in the fields both planting and harvesting, underscoring the challenges for so-called "traditional" women in negotiating productive and reproductive work. She explains that during peak seasons in agricultural work, women must bring their infants to the fields where they are able to breastfeed only during work breaks. Levine (1988: 235) also studied childcare in a mountain village of Nepal and she observed that women placed great emphasis on productive labour and arranged childcare around it.

Ironically, women's work in carpet factories in Kathmandu may be more compatible with breastfeeding than agricultural work, since many women work and live within the same factory compound. Their work, moreover, is sedentary, requiring frequent breaks from the repetitive task of weaving or spinning wool. Women often breastfeed their infants simultaneously as they weave at the loom or spin wool (Figure 5.3). Indeed, a comparison of the estimated median duration of breastfeeding determined by the probit procedure for infants whose mothers work at home versus those who work in the factory show that the factory children actually seem to be breastfed longer than the home workers' children, although that difference is not statistically significant. The median duration of breastfeeding for factory workers' children is 37.15 months postpartum with 95% confidence intervals of 32.67 and 43.12 months; the median duration for home workers' children is 32.77 months postpartum with 95% confidence intervals of 25.40 and 40.68 months. As the confidence intervals overlap they cannot be deemed significantly different.

Thus, carpet factory work for these women in Kathmandu is not an impediment to

Figure 5.3 Woman spinning at home while breastfeeding her child.

breastfeeding their children. For that matter, living in an urban setting has not decreased the duration of breastfeeding for this sample of women. Reports of breastfeeding duration for women in rural Nepal indicate that breastfeeding two to three years postpartum is the norm (Levine 1988; Panter-Brick 1992).

Weaning part I: the introduction of non-breast milk food

The WHO's stand on breastfeeding is that it should be continued exclusively for four to six months post-partum (Lutter 1992). In recent years other medical experts, including midwives and physicians, question whether it is necessary to introduce non-breast milk foods at six months, arguing that the growth of exclusively breastfed infants with access to the breast on demand is adequate up to 9 and even 12 months postpartum (Borresen 1995). Ethnographic data from a variety of countries world wide and through time, however, has shown that weaning practices, to a large extent, are determined by both social and physical aspects of the environment in which people live (Bohler and Ingstad 1996; Dettwyler 1995a; Fildes 1982, 1995; Gray 1996; Harrison et al. 1993; Jackson et al. 1990; Levine 1988; Panter-Brick 1991). Variation occurs in the timing of the introduction of foods to infants and in the types of foods given.

The ethnic and cultural variety within the nation of Nepal is reflected in the diversity of weaning practices. I will begin by describing the weaning customs of the Hindu, Indo-Aryan peoples, as they represent the majority of people in the nation; moreover, the Hindu religion - the national religion of Nepal - has a profound influence on all Nepalis' lives.

Breast milk and solid food for infants is, like many aspects of the Hindu religion, interpreted in terms of purity and pollution (See Dumont 1970). Breast milk is considered to be pure and while the infant is only drinking breast milk, he or she is not yet polluted as are adults (Paneru 1981: 49). Exclusive breastfeeding, therefore, is considered to be ideal until the infant is around 5 or 6 months of age. It is said, in fact, that girls should begin eating non-breast milk food at 5 months and boys at 6 months (Paneru 1981: 45). When asked why, most people said it was because girls need solid food earlier than boys, although why girls need it earlier was not stated. The first introduction of solid food is celebrated as an important milestone in a child's life and it is the custom to hold a party for family and friends called the "rice feeding ceremony", *pasni*.

I was invited to attend a *pasni* by one of the families in the study. Their son had just turned 6 months old and the ceremony was held one morning in their home. A Hindu priest officiated at the ceremony, which consisted of prayers and blessings for the child and family. The priest, and each member of the family thereafter, fed the child a dab of rice pabulum using a gold coin like a spoon (See Figure 5.4). As in a baby shower or a Christening ceremony, guests gave the parents presents for the infant and everyone partook in a large meal. The family who hosted this ceremony is Brahmin and the grandfather is a master weaver in a carpet factory. The grandfather was very concerned about matters of Hindu religion, and as he was a "master" (middle management) in the carpet factory, he had the financial resources to host the ceremony. Other people in the study sample, however, when asked whether they had held a rice feeding ceremony for

Figure 5.4 The Rice Feeding Ceremony. The baby is fed rice pabulum with a gold coin by a Hindu priest.

their children, said that they had not done so because they could not afford to host the party and were concerned about the deluge of friends and relatives who would expect good food. Some other nominal Hindus - that is, those ethnic groups who participate in some Hindu customs but also have their own tribal customs - may not have been so concerned about celebrating this rite of passage, although even some Brahmins did not celebrate it because they were too poor. Nevertheless, the belief that it was a good thing not to feed an infant solid food until he is five or six months was agreed upon by most Indo-Aryan peoples in my study.

Tibeto-Burman people - Sherpas, Limbus and Rais among others - who are not Hindus, made a point of stating that they did not practice the rice feeding ceremony, as it is not part of their belief system. During an interview one Sherpa woman told me that Sherpas begin feeding their children grain porridge when they are 5 or 6 days old. Indeed, they seemed less concerned about withholding food from a baby until a certain age, and did not worry about purity and pollution with regard to breast milk and non-breast milk food. It is interesting to speculate on why Tibeto-Burman and Indo-Aryan peoples may have diverging customs. One possibility is that Tibeto-Burman peoples come mainly from higher altitudes where it is colder and their children may need a higher calorie intake to compensate for the rigorous environment[14]. Alternatively, or in combination, it may have something to do with women's activity patterns which for Tibeto-Burman peoples, in contrast to many Hindu women's domestic focus, tend to be

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[14] Gray (1996) makes a similar argument to explain why Turkana pastoralists begin feeding butter fat to their infants soon after birth.

more concerned with agricultural productive work located away from the home. Tibeto-Burman mothers may have less time to breastfeed and therefore may have brought to the city a tradition of supplementing their infants' diets at an earlier age with non-breast milk foods[15].

Despite ethnic ideals of normative behaviour, there are discrepancies when peoples' practices are actually investigated. In the infant feeding survey each mother was questioned about whether her infant had ever been given solid food or liquid other than breast milk. Table 5.1 categorizes children under 7 months of age on a gradient from exclusive breastfeeding (no non-breast milk food given), to partial breastfeeding (breast milk and non-breast milk foods given), and to not breastfeeding (only non-breast milk foods and/or infant formula given). After 3 months it appears that exclusive breastfeeding until 6 months is more the exception than the norm.

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[15] This difference in women's activity, however, may actually have the opposite effect. In Panter-Brick's (1991) study, which contrasts breastfeeding practices of Indo-Aryan Kami (low-caste) women with Tibeto-Burman Tamang women, she found that Kami women, who spend more time at home, actually introduce non-breast milk foods to their infants at an earlier age than Tamang women.

Table 5.1 Number of children by breastfeeding status for infants under 7 months of age.

Age (mos.)	n not breastfeeding	n partially breastfeeding	n exclusively breastfeeding	total
0.0 - 0.9	0	1	3	4
1.0 - 1.9	0	1	2	3
2.0 - 2.9	0	0	5	5
3.0 - 3.9	0	5	5	10
4.0 - 4.9	2†	7	3	10
5.0 - 5.9	0	6	2	8
6.0 - 6.9	0	5	3	8

†One child had meningitis and was unable to suckle after 3 months of life (given his exceptional circumstances, this child was removed from the sample for further analysis); the other child died 4 months later.

When breastfeeding status is analysed by ethnic identity (i.e. Indo-Aryan versus Tibeto-Burman peoples), there is surprisingly no difference in the proportion of infants under 6 months of age who were exclusively breastfeeding. Of the 39 children under 6 months of age in the sample, 20 were of Indo-Aryan background and 19 of Tibeto-Burman background. Despite Hindu prohibitions against feeding non-breast milk foods before the *pasni*, 55.0% of the Indo-Aryan infants had been fed non-breast milk food before 6 months, as had 42.1% of the Tibeto-Burman infants. This difference in proportions is not statistically significantly different ($\chi 2=0.65$, d.f.=1, $p=0.42$).

Another factor which is thought to accelerate the introduction of non-breast milk food is a mother's work situation. In Leslie's (1988) review of studies of women's work and child nutrition in economically developing countries, one of the most consistent findings is that women who are working in wage labour are more likely to accelerate the timing of the introduction of non-breast milk food or supplemental infant formula. Again, however, there was no statistically significant difference in the observed number of infants who were given non-breast milk foods before 6 months of age depending on whether their mothers worked at home (54.5%) or in a factory (45.4%) ($\chi 2=0.21$, d.f.=1, p=0.65).

Finally, in Nepal, the infant's gender is also said to be an influential factor in the timing of the introduction of non-breast milk food, as mentioned earlier. There was, however, no statistically significant observed difference in the number of boys who were introduced to solid food before six months (52.9%) compared to girls (45.5%) ($\chi 2=0.22$, d.f.=1, p=0.64).

Therefore, actual infant feeding practices are not affected by factors which are thought to influence the timing of the introduction of non-breast milk food to infants. Indeed, when mothers were asked individually during in-depth interviews when they thought it was a good time to introduce food, they never referred to any rules, but treated the matter on a case by case basis. The most common response that was repeated almost word for word in many interviews was: "it is not necessary to give food if milk is enough; if milk is not enough, we must feed". The implication of this statement is that the longer you can breastfeed the child the better, but sometimes the quantity of breast milk is deemed to be insufficient. This approach to feeding on an individual basis occurred even within families. For example, several women said that they introduced non-breast milk foods to one of their children from 3 months of age on because they did not have enough breast milk, but they exclusively breastfed another for 6 months because they did have enough. Interestingly, this reason for early introduction of non-breast milk foods has been reported by women in other studies located in rural Nepal (Levine 1988: 243; Moser et al. 1986: 98), as well as a variety of other parts of the world (Dettwyler 1987: 639; Haider et al. 1996; Harrison et al. 1993: 1067; Segura-Millan et al. 1994).

The issue of the so-called "insufficient milk syndrome" (IMS) seems to be a world-wide phenomenon and is viewed as a public health concern because in some cases it prompts mothers to discontinue breastfeeding and switch to infant formula. In low-income countries where water supplies and food are often contaminated by pathogens, the early introduction of non-breast milk food is a risk factor for malnutrition and death among infants. Much of the literature on IMS considers it not to be a biological phenomenon, but rather a psycho-social issue. The syndrome is labelled as "perceived insufficient milk" (PIM) because the mother is thought to be unsure of her ability to breastfeed as she believes that she does not provide enough milk (See for example Segura-Millan et al. 1993). Other researchers argue that it is a biocultural phenomenon in that the "modern" pattern of scheduled feeds and/or the introduction of non-breast milk foods - especially infant formula - reduces breast suckling frequency, which in turn through hormonal mechanisms diminishes the quantity of breast milk produced (Gussler and Briesemeister 1980; (Greiner et al. 1981).

This latter view of IMS is not plausible in Nepal where breastfeeding is practised on demand throughout the day and night. In regard to maternal lack of confidence, this also does not hold for the mothers in this study because all of them had already been breastfeeding for three months before they recognized insufficient milk. Breastfeeding, moreover, as already stated above, is highly valued and the norm in Nepal; there was never any hint that other people were pressuring mothers to choose artificial feeding or early supplementation of non-breast milk foods. Greiner et al. (1981) also argue that mothers may use IMS as an appropriate excuse to stop breastfeeding in societies where there is strong pressure to breastfeed. The Nepali mothers who said that they did not have enough milk, however, did not entirely abandon breastfeeding their child, but rather merely introduced non-breast milk foods earlier than 6 months of age and continued to breastfeed for up to 24 months, as is common throughout Nepal.

An alternative biocultural explanation for IMS is that it may be linked to maternal malnutrition. For example, Henly et al. (1995) hypothesize that IMS could be precipitated by iron deficiency anemia. This may operate through fatigue, a common complaint associated with anemia, thereby lessening a mother's intention to breastfeed or her ability to respond to infant demand; or alternatively, through low hemoglobin and fatigue which could actually diminish milk production. Given the high prevalence of iron deficiency anemia among women of reproductive age in Nepal (Gittlesohn et. al. 1997; UNICEF 1992: 84-85), this explanation may account for some of the IMS reported in this study.

Mothers did not explain how they determined whether they did not have enough milk, but they stated it matter-of-factly as if it were a given that any mother could recognize if her baby is not getting enough milk. Frequent crying and fussiness may be some of the indicative cues. None of the mothers mentioned the size or weight of her child to be a signal to supplement, except one mother who stated that her son was very thin and she decided to supplement his diet with rice pabulum in order to make him better. Despite the explicit lack of reference as to why they were supplementing breast milk with non-breast milk foods before 6 months of age, it may be the case that the mothers who began to introduce supplements as early as the third month of life were reacting to a genuine need on the part of their infant to obtain more calories and nutrients than were being obtained through breast milk alone. Although in general it has been found that a mother's nutritional status must be severely compromised before milk volume or quality is reduced (Prentice and Prentice 1990), there might be some variability in output of milk and/or in the requirements of infants.

Indeed, the issue of when to introduce non-breast milk food to an infant's diet is rather ambiguous. As stated earlier, the WHO's policy is that breastfeeding should be continued exclusively until 6 months post-partum; however, the point up to which exclusive breastfeeding is considered to be adequate is deemed to be between 4 and 6 months of age. That age range allows for some inter-individual variability, which is bound to exist in any population of infants (Zumrawi et al. 1987: 383). This period has been described as the "weanling's dilemma" (Rowland et al. 1978): on the one hand, the introduction of food exposes the infants to the contamination that otherwise would be avoided by exclusive breastfeeding; on the other hand, non-breast milk foods start to become a necessary component of an infant's diet to sustain adequate growth.

In order to evaluate both sides of this dilemma, growth indices for children aged 3 to 7 months (n=34) are compared according to whether they were exclusively breastfed (EBF) or partially breastfed (PBF) (Table 5.2). The two infants who were not being fed any breast milk (See Table 5.1) were excluded from this analysis. By 7 months all children were receiving some form of supplementation so the issue is moot after that age.

Table 5.2 Comparison of measurements of growth for EBF (exclusively breastfed) and PBF (partially breastfed) children aged 3 to 7 months.

Measure	n	Mean for EBFs	n	Mean for PBFs	t-value	Sig.
HAZ	13	-1.13	21	-0.67	1.41	0.17
WAZ	13	-0.66	21	-0.69	0.09	0.93
WHZ	13	0.30	21	-0.24	2.19	0.04
Wtvel†	4	1.96	13	1.90	0.11	0.92
Htvel†	4	9.35	13	9.92	0.22	0.83

†Weight and height velocities (Wtvel and Htvel) measured between Rounds I and II; breastfeeding status noted at Round I survey.

Comparisons between these groups in terms of growth indices show no difference in mean Z-scores for HAZ and WAZ; however, mean WHZ is significantly higher for EBFs than PBFs at the $p<0.05$ level. Mean height and weight velocities do not differ between EBFs and PBFs, indicating that any weight loss for PBFs may have taken place at the initial introduction of non-breast milk foods, but did not appear to be affecting them adversely at the time of the survey.

It is difficult to know whether a decline in weight prompted mothers to begin supplementing their infants or whether the supplementation precipitated weight loss due to the inadequate nourishment of weaning foods and/or an increase in diarrheal diseases due to contamination of the weaning foods. The latter reason is not borne out by the results of the point prevalence of diarrhea: a comparison of the point prevalence of diarrhea during the first survey indicates that 47.6% of PBFs were reported by their mothers as having diarrhea compared to 46.2% of EBFs ($\chi2=0.01$, d.f.=1, p=0.93). One day of survey, however, may not be enough to detect differences in diarrheal prevalence. As almost half of the exclusively breastfed infants were reported to have diarrhea, it is possible that even exclusively breastfed infants are subject to diarrheal infection through putting dirty hands in their mouths, being bathed in contaminated water, or the occasional feeding of water. Five infants whose mothers reported that they did not give them any non-breast-milk foods did say that they fed them water sometimes.

Other studies which compare the growth and morbidity status of EBFs and PBFs show contradictory results. Popkin and colleagues (1990), for example, found in a longitudinal study of 3080 mothers and their singleton infants in the Phillippines, that exclusively breastfed infants had a significantly lower relative risk of diarrhea compared to those who were fed non-breast milk foods before 6 months of age. In a similar study in urban Brazil, albeit employing a smaller sample of infants (N=400), Martines et al. (1994) observed that EBF infants living in unhygienic conditions had better growth and a lower mean incidence of diarrhea, but only up till the fourth month of age. They found, moreover, that by 5 months of age, the growth of EBF infants lagged behind other groups (partial, predominantly and non-breastfed) and behind the WHO/NCHS reference. Partial breastfeeding was, however, protective for diarrhea for infants through 6 months of life. Thus, they recommended a combination of breastfeeding and non-breast milk foods be introduced at 5 months post-partum. On the other end of the spectrum, Zumrawi et al. (1987), among a sample of 436 infants in Khartoum province, Sudan found that from 1 to 6 months there was no difference in the incidence of growth faltering between EBFs and PBFs. They noted that there is so much variability in when mothers begin to supplement their children that it is difficult to produce any clear-cut policy about when non-breast milk feeding should begin among breastfed children (Zumwari et al. 1987: 392). It must be emphasized that, contrary to many Western health care workers' fears, supplementation with weaning gruel and/or commercial formula or pabulum and/or animal milk, does not necessarily mean that infants will be taken off the breast altogether. Many will continue to receive a large proportion of their nutrition from the breast. Indeed, among children living in extreme conditions of poverty breast milk may continue to have a protective effect on the infant through the ingestion of immune system properties, which may decrease the risk of infection (See for example Briend et al. 1988), although this remains to be confirmed by other studies.

Non-breast milk food consumption patterns

Because the children in this sample live in a peri-urban area with families who earn wages, there is very little in the way of seasonal variety in food consumption, as there is for many rural peoples of the world (Ferro-Luzzi et al. 1987). Children living in rural Nepal have seasonal differences in food intake. Panter-Brick (1992), for example, found that children in the village of Salme had significantly lower food consumption during the pre-harvest spring season compared to after the harvest of maize in August/September. Children have been found to lose weight during the pre-harvest part of the year and catch-up their growth during the harvest season (Naborro et al. 1988: 171-172).

Even in rural communities, however, market forces and socio-economic stratification mitigate and complicate any simple model of seasonal variation in dietary intake (See for example Leonard 1992), but in contrast to rural communities, carpet workers in Kathmandu rely totally on the market for their food requirements. If they have the means, people in Kathmandu have the ability to buy foods all year round, as there is a plentiful supply of fresh foods imported from the warmer climes of India in all seasons. Although some of the types of vegetables and fruit vary according to season, there are always copious amounts available in the markets around Boudha.

Since a significant drop in mean WHZ was found for children during the hot and rainy seasons (Chapter 4), it is worth questioning whether even in this wage labour setting families have less access to food during the summer months. My attempts to investigate seasonality in the carpet making industry were difficult, as 1995 was a recession year for the industry and it seemed that there were no consistent seasonal trends in when and how much work was available since much depended on individual carpet factory owners' ability to get contracts from foreign buyers or sub-contracts from larger factories. It should be pointed out that my sample was biased since those whom I contacted at the factory were not the ones who had been laid off. To accommodate the sometimes erratic ebb and flow of the carpet-making market, moreover, it is a common practice for workers to establish accounts with local shopkeepers or their employers so that they can buy food staples on credit. Therefore, even if a family is not working for a period of time, the fact that they remain living at the factory means that they are able to buy food on credit. Nevertheless, it was said by many owners and workers anecdotally that the rainy season is the "off season" for the carpet industry[16], so it is possible that a decline in purchasing

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[16] This "off-season" is based on European demand for thick pile Tibeto-Nepalese carpets which is greater in the fall and winter compared to the spring and summer.

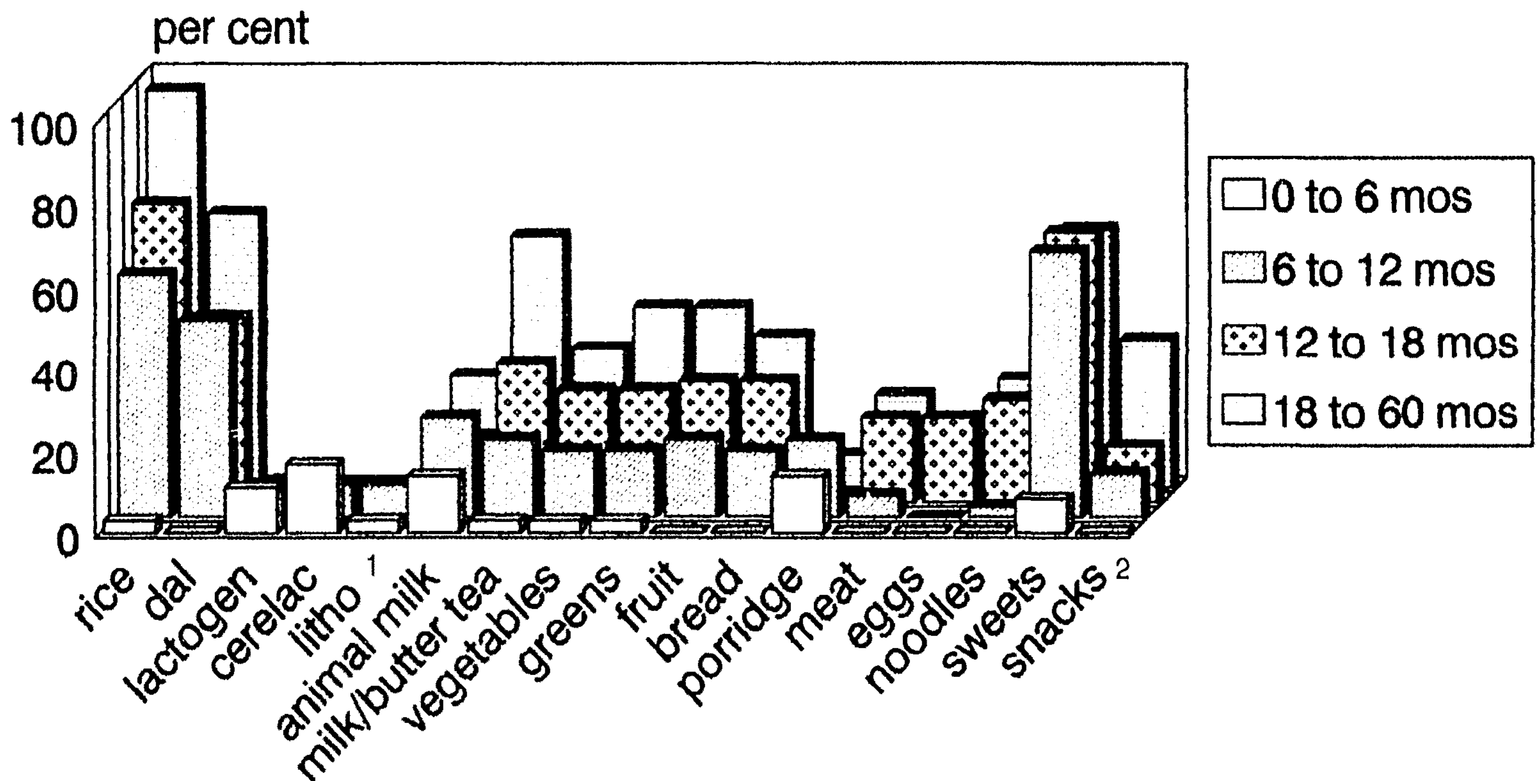
power during this time could be related children's weight loss.

In order to assess the variety of food that was consumed by the children in the study, a modified 24-hour recall survey was conducted with primary caregivers, usually the mother, during the infant feeding survey (For a discussion of this method See Gibson 1990: 37-39). Many mothers found it difficult to recall what their child had eaten, and after conducting the first 37 surveys, I modified this procedure by creating a list based on the types of food participants had mentioned and on my own and my assistants' ethnographic knowledge of Nepali foods. The food frequency list was read to each mother and she then answered whether her child had eaten the item during the previous day (See Appendix 1, Child Nutrition survey.) Obviously, there is some loss of data when a list is used, since any food eaten by the child that is not on the list will go unreported. The list, however, produced a far more comprehensive summary of the food eaten by the child than was possible to gather from a straight recall. Because most mothers were unable to specify the portions fed to their children and because respondent burden is always a concern when doing a survey, the quantity of the food ingested was not measured. Therefore, the results of the survey can only be presented like those of a food frequency questionnaire (Gibson 1990: 42-47). As mentioned above, the first 37 surveys were not based on the food frequency list; therefore, food data are presented for 246 children only.

Although it is impossible to calculate the energy intake for the children, a qualitative assessment of the variety of foods ingested indicates where there might be nutrient deficiencies. It should be noted that this is only a sample of the children's diets, i.e., it represents only one day of a child's life. The survey was conducted on a work day, and does not represent what might be ingested on a weekend or on a holiday. Although data for two other seasons were collected, they are not presented here because they deviate very little in terms of the variety of food categories consumed.

As seen from Figure 5.5, in addition to breast milk, infants under 6 months are mostly eating weaning gruels, commercial infant formula or pabulum and animal milk. One mother explained that in the village if a mother does not have enough breast milk, she will feed her baby *litho*. *Litho* is a rice flour mixed with water and sugar and fried in ghee. If a mother has to supplement her child early in Kathmandu, she can buy lactogen (infant milk formula) or cerelac (weaning porridge) in a tin, although not all of the women in the sample chose or could afford to feed their babies commercial products and they continued to use *litho* or an alternative porridge as a weaning food. Many of the people who came from higher altitudes, where they do not grow rice, make porridges from other grains common in the Himalayas such as barley flour.

Weaning porridge has been the focus of some health and nutrition campaigns in Nepal because *litho*, although good for an early introduction to solid food, is not nutrient-dense enough for infants after 5 or 6 months of age. One mother explained that *litho* could be augmented with ground-up chickpeas, soya or millet, but the majority made a quick and simple *litho* with rice flour only. In some rural areas of Nepal there has been a public health campaign to encourage mothers to provide a fortified porridge to their children called *sarbottam pitho*, which literally means super flour. It consists of roasted and ground whole-grain cereals - maize, rice, barley or wheat - and a source of protein



1 rice, corn or soya flour fried in ghee.

2 Include dried corn, soya beans, beaten rice and potato chips.

Figure 5.5 Proportion of children eating non-breast milk foods on the day previous to the first survey by age group, 0 to 6 mos (n=36), 6 to 12 mos (n=37), 12 to 18 mos (n=44) and >=18 mos (n=129) such as soya beans or another pulse such as lentil (Adhikari and Krantz 1989: 63-64). Adhikari and Krantz (1989) promote this as being inexpensive, easy to prepare and sustainable, since it incorporates foods which mothers are already familiar with and use in their own cooking. It should be noted that a few of the children were introduced to rice, and some vegetables before 6 months of age, but most infants had not been introduced to these types of foods yet. Many babies were given biscuits almost daily and that accounts for the relatively large intake of sweets shown in Figure 5.5.

Whether or not mothers were exclusively breastfeeding in the first half of infancy, all infants in the sample were receiving non-breast milk foods by the end of the sixth month of life. After 6 months most children continued eating *litho* or porridge in conjunction with the gradual introduction of other types of soft food such as mashed fruit, vegetables, rice and dal. While most of the children were introduced to rice and dal from about 9 to 12 months of age, not all were eating fruits and vegetables, very few had eaten meat[17] and none had been given eggs. The diet of this population in general, however, does not include much in the way of meat because it is a luxury food, reserved for one dinner a week or on holidays. Eggs are prohibitively expensive in Kathmandu, and most people eat them sporadically. As they can be bought individually at the market, however, it is possible to introduce the occasional egg into the weekly household menu.

The children aged 12 to 18 and 18 months and over continued to eat much of the same types of food as the 6 to 12 month old children, but a greater proportion of the older

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[17] The most common sources of meat in Nepal are chicken, buffalo, pork and goat. It is illegal to sell and buy beef because of the laws governing the Hindu state.

children (over 12 months of age) were reported to have eaten these foods on the day before the survey was conducted (Figure 5.5). This is probably because the amount of breast milk the older children drank was waning or else they had stopped breastfeeding altogether. It is disturbing, however, that only approximately one third of the 6 to 12 month old babies ate foods such as vegetables and fruit on the day of survey, although approximately half of them had eaten rice and lentils. Even among the 12 to 18 month olds, 20% of the children did not eat rice on the day of survey. Most of this is accounted for by eating alternative food such as noodles, porridge, bread and meat; however, for 7 children out of 44 in the 12 to 18 month old age group mothers reported that they ate very little on the survey day. In these cases they ate a snack, or a piece of fruit, or a couple of pieces of bread, for example. It was clear from the mothers' responses that their children were free to choose not to eat. That is not to say that the mothers did not care about this situation, as they specifically noted how little their child had eaten. Indeed, many mothers said that the child was ill and therefore had not wanted to eat.

Milk tea and less frequently butter tea is an important source of calories and protein for the older children; milk tea, consisting of equal proportions of milk and boiled tea along with plenty of sugar, is made in Nepali households in the morning and afternoons daily. It should be noted that almost all of the older children ate rice and approximately 80% also ate dal. *Daal bhaat*, rice and lentil soup, is the Nepali national meal and is eaten twice a day without fail. Usually a vegetable or two made into a curry is served as a third item along with a spicy chutney or pickle on the side for flavour.

Some mothers said that after one year of age, children ate whatever the rest of the family was eating. In other words, no special meals were prepared for them. This has been noted by nutritionists as problematic for children of weaning age because often, as is the case in Nepal, diets in low-income countries consist mostly of bulky grains which require large servings to obtain the requisite nutrients. As children have difficulty ingesting large portions at one sitting, they require more frequent small meals throughout the day (Martorell and Habicht 1986). Nepalis generally have two meals a day: one at 10:00 a.m. and another in the evening around 8 p.m. Their breakfast, usually eaten at 5 or 6 a.m. consists of milk tea and a *roti*, which is unleavened bread made from wheat flour and water. Some mothers did mention that their children ate *daal bhaat* three and sometimes four times per day, but others only had it twice a day with the rest of the family. Fortunately, snack items eaten by children between meals, including dried and roasted corn, soya beans, beaten rice and potato chips, are quite nutritious. Panter-Brick (1992) has also noted that snack items are an important component, both in terms of calories and nutrients, of children's diets in Nepal. Unfortunately, as seen from Figure 5.5, the majority of children under 18 months did not eat these snack items, probably because they are quite difficult to chew and digest.

It should be noted that green leafy vegetables were separated out from other types of vegetables in the food categories presented (Figure 5.5) because they are good sources of vitamin A among other micronutrients. Vitamin A deficiency, manifested in severe cases by xeropthalmia or night blindness, is common among preschool children in Nepal (UNICEF 1992: 65). Like other types of vegetables, leafy greens were introduced from late infancy onwards and were eaten on the day of survey by more than half of the children over 18 months of age. Also remarkable from this recall survey is the large proportion of children over 6 months of age eating sweets (Figure 5.5), mostly in the form of biscuits and sweet pastries. These items are cheap and easy to come by in Kathmandu and parents feed them to their children regularly. Although this might be problematic in causing dental caries, they do provide extra calories in the form of fat and carbohydrates.

Weaning part II: the cessation of breastfeeding

The end of the weaning period occurs when the child stops breastfeeding altogether. As already noted, most children in the sample were breastfed through their second year of life, but some continued beyond that age, until 48 months (Figure 5.2). It should be underlined that the cessation of breastfeeding occurred for all children when the feeding of non-breast milk foods had become routine. Thus, the cessation of breastfeeding is a gradual process in that the amount of breast milk decreases as more non-breast milk food and drink is added to the child's diet.

All the mothers in the sample who had stopped breastfeeding their child (n=82) were asked during the infant feeding survey why they had stopped. The responses are shown in Figure 5.6. Interestingly, the stated reason for why more than half the women decided to discontinue breastfeeding was because they were pregnant again. This has also been found worldwide by other researchers (Bohler and Ingstad 1996; Dettwyler 1986; Gray 1996). Bohler and Ingstad (1996: 1812), who investigated weaning processes in Bhutan, found that mothers felt that pregnancy turned breast milk "to rot" and that it would harm the child. Hormonal changes in the mother during pregnancy do diminish

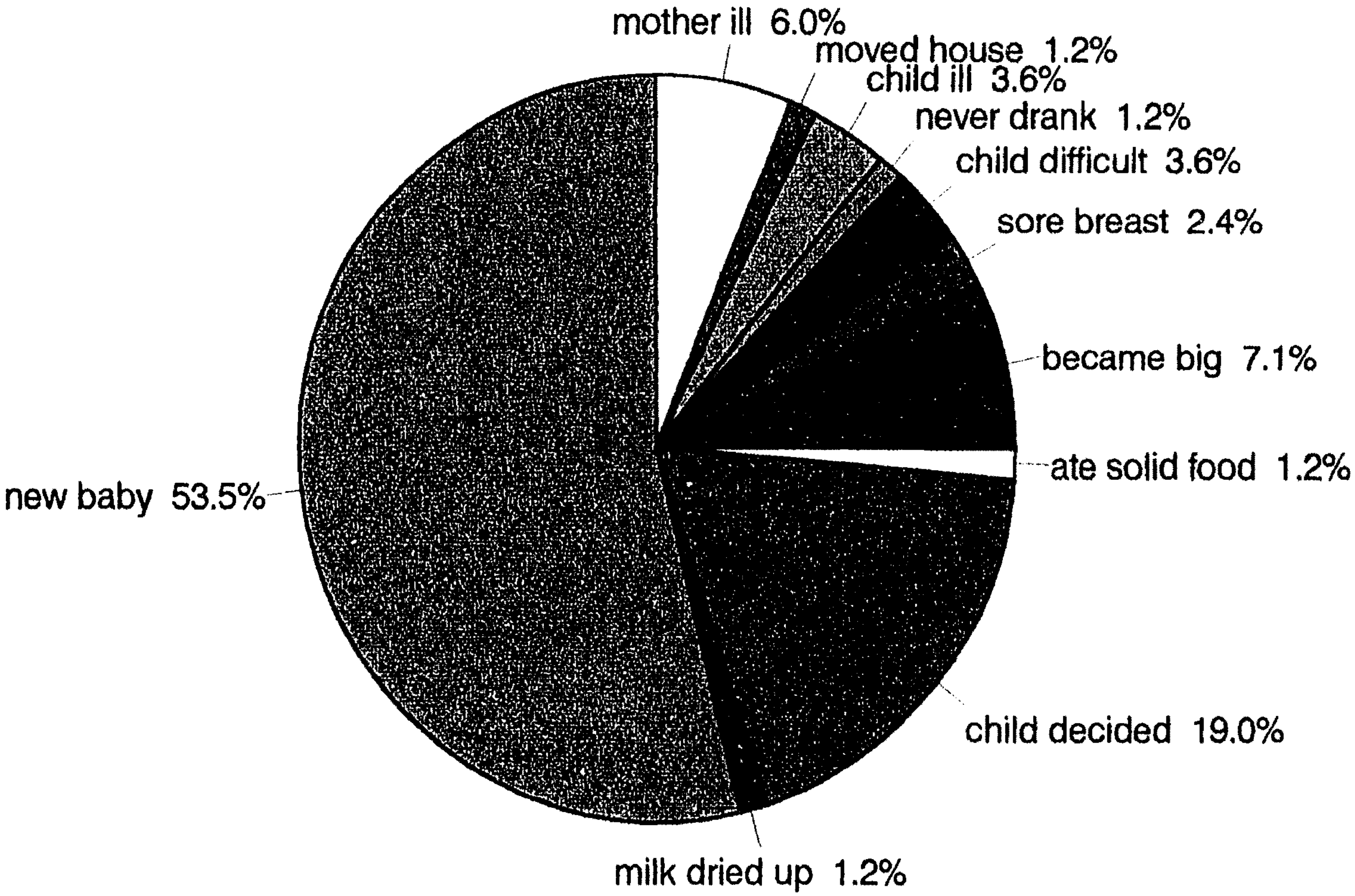


Figure 5.6 Reasons why mothers stopped breastfeeding infants (N=82).

both the quantity and quality of breast milk (Vis and Hennart 1978). An aside to this issue is the contribution of breastfeeding to post-partum anovulation. Obviously, the fact that mothers get pregnant while they are breastfeeding means that the effect does not last interminably. This may have something to do with the decrease in lactation frequency as the child ages and eats complementary foods (Ellison 1995).

Nineteen per cent of the 82 children who had been completely weaned at the time of the survey had actually "stopped themselves", as the mothers phrased it. Another reason stated (7%) was that the child had "become big"; i.e., it was deemed that he/she was old enough to stop. Another five mothers (6.0%) said that they had taken ill and were no longer able to breastfeed (Figure 5.6).

There is some controversy about how long the weaning process should endure before cessation of breastfeeding occurs. In some ways this is a moot issue because, for the mothers in this sample, as evidenced by the reasons for stopping, the decision to stop very likely rests on what is happening in the mother's life - e.g., having another baby - rather than whether or not it is good for the child. Nevertheless, since there is some variability in the spectrum of age at cessation, it is interesting to compare the growth status of those groups who stopped relatively early, before 18 months of age, versus those who stopped relatively late, after 18 months of age.

A scatterplot of age by weight-for-height Z-scores is shown in Figure 5.7. Fitted lines for children who are breastfeeding and those who are not cross over each other at about 18 months of age, indicating that there is interaction between age and mean WHZ scores. Breastfed children under 18 months of age, on average, appear to have higher

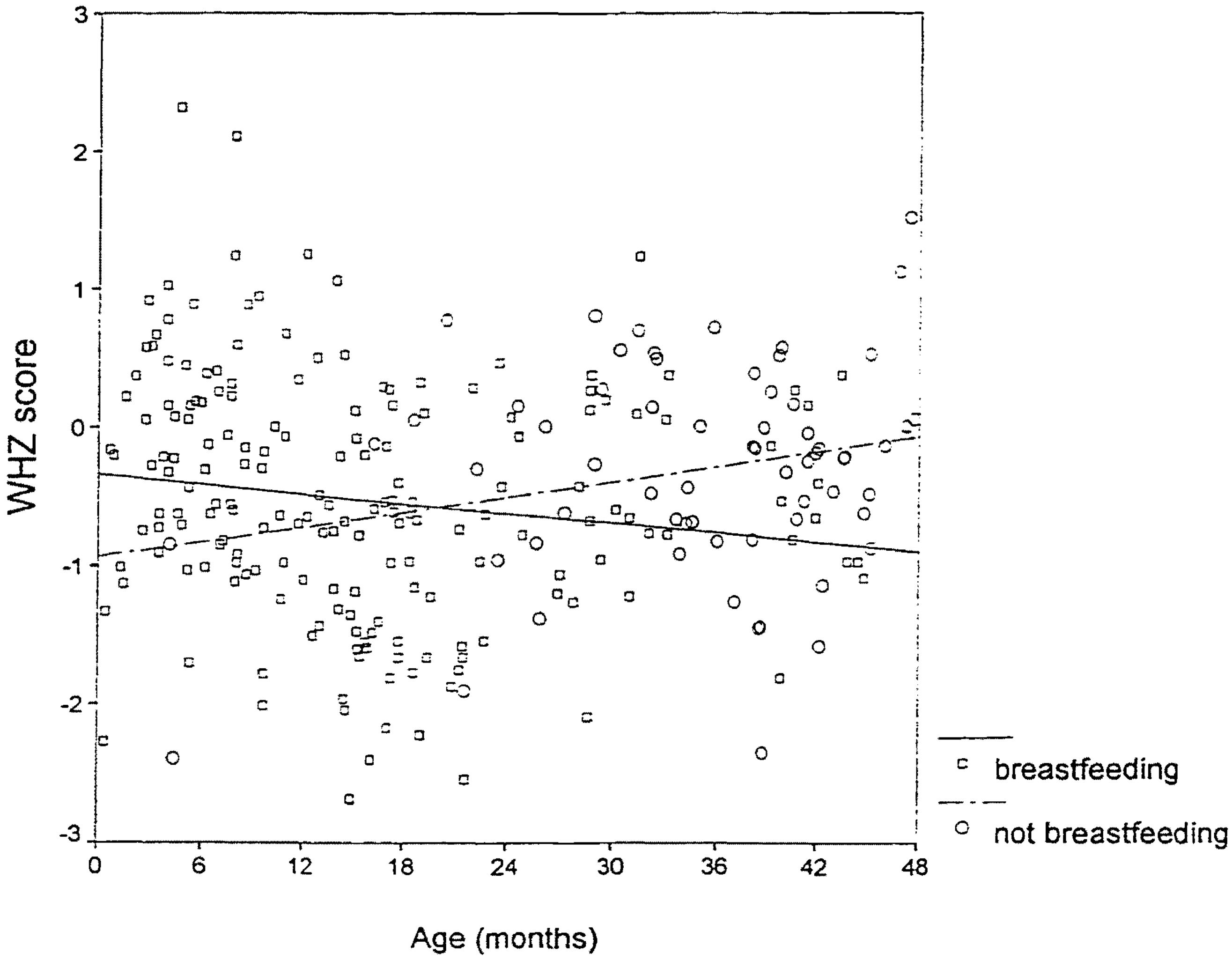


Figure 5.7 WHZ scores by age of child for breastfeeding status at time of first survey (0 to 48 months).

mean Z-scores. This is an obvious conclusion as there are only two children under 12 months who were not breastfed and they were both very ill. After 18 months, however, the Z-scores of breastfed children, on average, are lower than those who are no longer breastfed. To test whether this difference is statistically significant, only children over 18 months and under 48 months (when all children have stopped) were included in two-tailed t-tests (Table 5.3).

Table 5.3 Comparison of measures of growth between breastfeeding and non-breastfeeding children aged 18 to 48 months at time of first survey.

Measure	n	Mean for breastfeeders	n	Mean for non-breastfeeders	t-value	Sig.
HAZ	58	-2.54	63	-2.51	0.14	0.89
WAZ	61	-2.00	65	-1.76	1.64	0.10
WHZ	58	-0.67	62	-0.27	2.88	0.01
ZCIRC	58	-1.82	65	-1.55	1.92	0.06
ZTR	58	0.27	64	0.49	1.26	0.21
ZAM	58	-1.90	64	1.84	0.40	0.69
Wtvel†	46	0.48	47	0.03	2.61	0.01
Htvel†	40	3.42	44	3.61	0.57	0.57

†Measured between first and second measurement. Breastfeeding status noted at Round I survey.

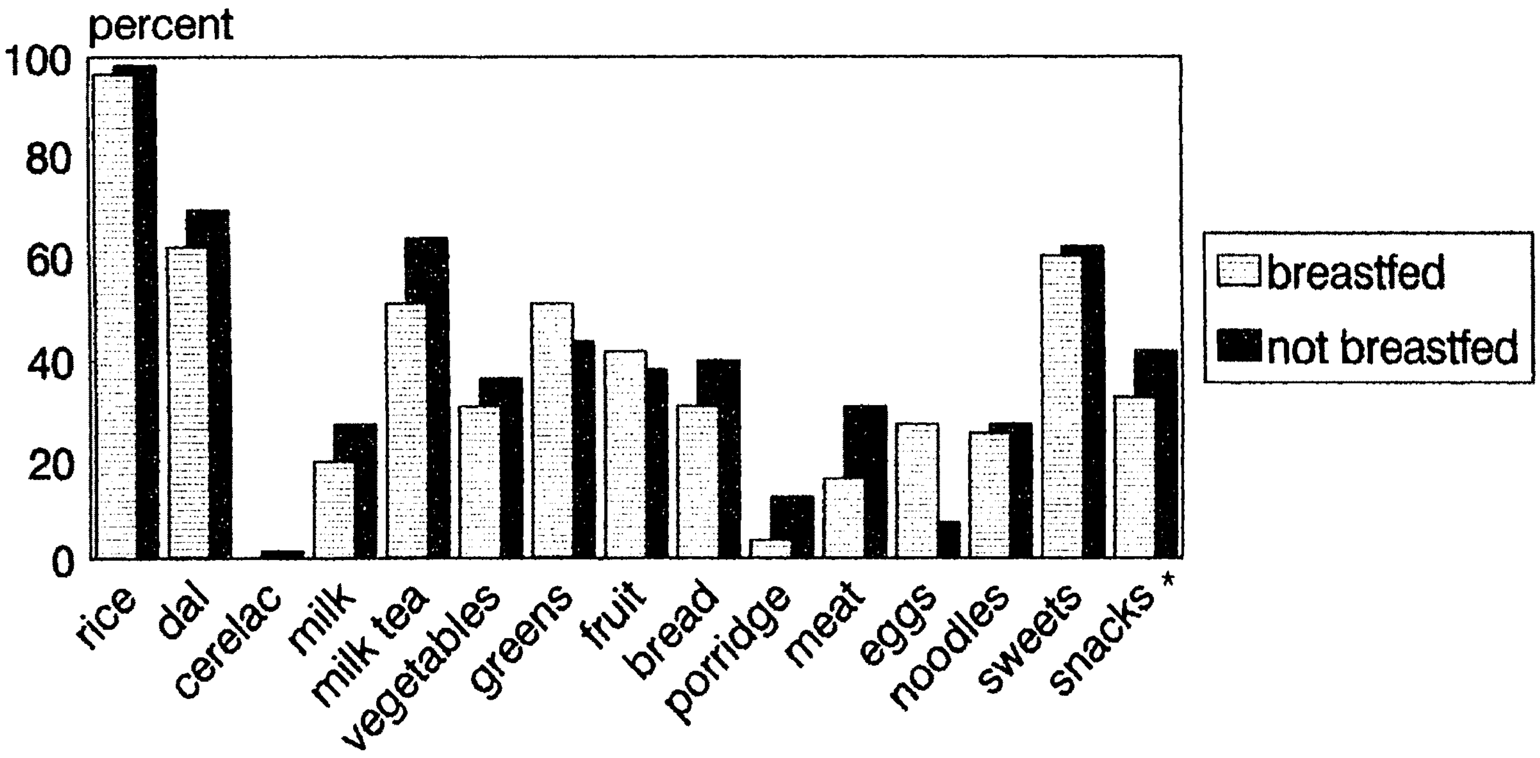
Of all the cross-sectional growth indices only mean WHZ is significantly different at the 0.05 level for breastfeeding and non-breastfeeding children (Table 5.3). The difference between mean Z-score for upper arm circumference (ZCIRC) is marginally statistically significant at p=0.06. In other words, on average, the children who are breastfed after 18 months are slightly more wasted than those who are not. Interestingly, children who are breastfeeding actually have significantly greater mean weight velocity between their first and second measurement than children who are not breastfeeding. It is difficult to interpret this finding, as it is not clear at what point these children stopped breastfeeding. It is possible, however, that the decision to continue breastfeeding past 18 months might be based on the fact that the children are perceived as being too thin and the continuation of breastfeeding does in fact help to increase their growth in body mass.

There is little agreement on whether breastfeeding after 18 months (prolonged breastfeeding) is helpful or harmful to children. Briend (1990), for example, found that children in Bangladesh who continued to breastfeed after 18 months were nutritionally better off than those who did not, although admittedly the most significant findings were for those children who were already severely malnourished. Prentice (1994), in her review of research from China, concluded that breastfeeding between 12 and 18 months is beneficial, but the effects do not last past that time. Others have argued that anthropometric status declines for children who continue to breastfeed after 18 months of age. Brakohiapa et al. (1988), for instance, found this result in a study of 202 children living in the city of Accra, Ghana.

It is difficult to come to any definitive conclusions, given that the studies of this issue are in such diverse locations and that there is still little understanding of why prolonged breastfeeding might be deleterious or why mothers may or may not breastfeed after their infant is 18 months old. One hypothesis about the possible deleterious effects of prolonged breastfeeding is that children who are still breastfeeding after 18 months could be consuming less complementary food and therefore might not grow as well (Dettwyler 1987: 643). A look at the differences in types of food being consumed by breastfeeding and non-breastfeeding children aged 18 to 48 months in this study sample indicates that, at least in terms of food variety, both groups have similar diets (Figure 5.8). It is possible, however, that it is not a lower quality of the diet but rather the diminished quantity eaten that could lead to lower mean WHZ scores for breastfeeding children over 18 months.

Caufield et al. (1996) and Jakobsen et al. (1996) suggest that mothers may choose to continue breastfeeding their children because they are small or because they are ill and therefore their anthropometric status is not lower because they are being breastfed, but rather because they were already in that state or heading towards it. This is an interesting point and one worth investigating. Instead of asking mothers, then, why they stopped breastfeeding, it is also important to ask mothers who continue to breastfeed why they do so. It is possible that the 19% of mothers who said that they stopped breastfeeding because their child was big enough meant that they had determined that he/she was healthy enough to stop. However, linguistically that answer is somewhat ambiguous since the word *thulo* used by mothers means both big in terms of size and in terms of maturity. For example, a *thulo maanche*, literally "big man", does not mean a big man in terms of his physique, but rather an adult person, regardless of physical size. It must be emphasized, though, that more than half of the children stopped breastfeeding because their mothers became pregnant, and in these cases, their growth status would not have been taken into account.

Another hypothesis is that mothers who decide to continue to breastfeed are socioeconomically worse off and therefore cut down in food expenses by prolonging breastfeeding. There is some evidence that this may in fact be happening for this group



* Include roasted corn, soya beans, beaten rice and potato chips.

Figure 5.8 Proportion of children aged >=18 and <48 months eating non-breast milk foods by breastfeeding status, breastfed (n= 55) versus not breastfed (n=55) of women and children. A comparison of mean monthly earnings for mothers who breastfed their children after 18 months compared to those who stopped breastfeeding them indicates that the latter group had higher mean monthly earnings than the former: 1186.96 versus 845.65 Nepali rupees. These mean earnings are significantly different ($t=2.26$, d.f.$=90$, $p=0.03$). The direction of this relationship, however, is still obscure, as many women may have earned less wages because they were still breastfeeding and therefore had less time to produce their piece work, either in the form of kilos of wool or metres of carpet. Mothers told me repeatedly that they were not able to work as much when they were caring for young children. So it is possible that breastfeeding slowed their productivity and their earning power somewhat. This situation, then, could be harmful to a child because by earning less, the mother would not have the extra cash to buy nutritious food items for the household. Alternatively, they may not have the opportunity, for other reasons, to earn as much money and for this reason must continue breastfeeding their children to make up for a shortfall in non-breast milk foods.

Conclusion: the biocultural context of infant feeding

Part of the anthropological method in approaching this topic is to *observe* how mothers feed their children rather than trying to establish how they *should* be feeding them. In other words, in the anthropological approach there is an assumption that there is a biocultural context to the way infant feeding is practised and that mothers have agency in child rearing. Gray (1996), in her research on the early introduction of non-breast milk foods to infants among the Turkana people of Kenya, has come to a similar conclusion:

> ...it seems reasonable to assume that this strategy indeed has been adaptive in some way. Furthermore, this view may have greater explanatory power than one that argues that mothers persistently and perversely pursue infant feeding strategies that have only adverse effects on their offspring and hence on their own reproductive success (Gray 1996: 439).

While I think it is dangerous to get caught in circular arguments about the adaptive benefits of practices (it is practised therefore it is adaptive), as well as romantic notions of indigenous knowledge being superior to scientific knowledge, it is worth asking whether mothers know more about child rearing and the health of their children than is often assumed. This is especially true, as Gray makes clear, when the people in question have lived in an environment for a long period of time and have an understanding of it that might not be readily apparent to the researcher who does a short field work stint in the region.

This theoretical approach is especially pertinent to the finding among this study sample that many infants are introduced to breast milk supplements as early as the third month of life due to the mother's decision that her milk is insufficient. Researchers in other low-income countries have suggested that mothers are somehow misguided and pressured by urban, modern deterioration of breastfeeding or the availability of commercialized infant formula to supplement early; however, the situation in Nepal appears to be based more on a concrete evaluation by the mother on a case by case basis. It is possible that poor nutrition and hard work might be affecting a mother's ability to continue exclusive breastfeeding for a full 6 months. Alternatively, some infants after 3 months post-partum may indeed require more calories and nutrients than their mother's breast milk is able to afford. Definitely, there is room to consider variability among infants in nutritional needs as one of a multiplicity of reasons to explain IMS.

Despite the need to consider IMS as a valid concern among breastfeeding mothers, it is important to note that there appears to be some decline in mean weight-for-height Z-scores among PBFs. Again, however, I would reserve judgement on whether the supplementation causes weight loss, as it is possible that these infants were already heading in this direction before their mothers began to introduce non-breast milk foods to them.

Another important finding from this research is that wage work is not inhibiting women in terms of their breastfeeding practices. This is the case not only because breastfeeding is so widely practised and culturally normative in Kathmandu, but also because the carpet-working industry is so flexible in its labour practices[18]. Since carpet workers are paid a piece-rate wage, they can set their own hours and arrange work around their other family responsibilities.

There are, however, some differences between work at home and in the factories. Women do earn more in factories (See Chapter 3, Table 3.5). In part this is because weaving, done only in factories, is more highly skilled than spinning and therefore more highly renumerated. Women also work more hours in factories because they are often under pressure to produce and because they want to earn more money. Many women did explain that they earned less money when they were caring for a young baby because they

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[18] According to Baral (1998: 6), not all factories are as free about public breastfeeding as the ones owned by Tibetans and Nepalis in Boudha. She visited some factories in Kathmandu that were owned by Indians, where she said it is deemed inappropriate for women to show their breasts in the public work space. Women, therefore, were discouraged from breastfeeding while working.

could not keep up with their co-workers when working on a carpet. (Two to four people, depending on the size of the carpet, weave simultaneously row by row at one loom.) Nevertheless, these differences are not borne out in comparisons between breastfeeding practices among home workers and factory workers, testimony to the ability of both groups to combine productive and reproductive tasks.

There was no indication that women ever stopped breastfeeding because of work pressures. Not one of the women surveyed mentioned work pressures as a reason to wean her infant completely from the breast. Indeed, in just over half the cases of children who had stopped breastfeeding, the reason for ceasing was because of another pregnancy. This is an important point as it means that for half of the cases the reason to stop breastfeeding is not always a planned decision on the part of the mother nor does it take into account the status of the child. Fortunately, however, births were spaced widely enough apart that most of the infants were breastfed at least until 24 months of age, a remarkably long period of time relative to Western norms and even to those of many other less industrialized nations.

It is more difficult to ascertain what children are eating in addition to breast milk, because only a limited food frequency survey was done. The variety of the food and the proportion of each age group that was eating the foods, however, does indicate to some extent that many children in the second half of infancy (6 to 12 months) have limited diets, especially with regard to sources of complete proteins, as well as fruits and vegetables. Although the variety of foods included in children's diets increases as they grow older, a substantial proportion of 12 to 18 month old group continued to be missing complete proteins, vegetables and fruits on the day of survey. This age group is caught between needing special weaning foods and not being able to partake in the regular family meals. The one year old children were shown in mean WHZ to be the most significantly wasted of all the age groups under 5 years of age (See Chapter 4, p.116), and therefore, it appears that special attention should be directed at them in terms of dietary intake.

Micronutrient deficiencies have recently been identified as possible causal factors involved in linear growth retardation. Protein, zinc, calcium and vitamin A have all been identified as candidates (Fraser 1988; Golden 1988; Allen 1994). As Allen (1994) points out, it is most likely that multiple, rather than single, growth-limiting nutrient deficiencies exist in the same children and are responsible for stunting. It is likely that many of the children in this sample suffer from inadequate intakes of all nutrients mentioned above. Although rice and legumes are a complete source of protein that also contains zinc, not all children in the sample appear to be eating them on a regular basis. Animal sources of protein and zinc such as meat, eggs and animal milk are consumed infrequently due to their high cost. Although breast milk is a good source of calcium, it is not adequate for the older child. Other types of milk are consumed, but children do not drink it on a regular basis. Fortunately, many children drink tea daily, which does provide them with some more milk.

Nepalis eat a large variety of vegetables and/or dark leafy greens with every meal. These foods are important sources of vitamin A and other vitamins. Although it is encouraging to see that approximately half of the children ate a vegetable, a leafy green or both, on the day of survey, one wonders if that translates into a regular practice for all of the children in the study sample. Finally, as Allen (1994) notes, dietary intake of good foods is not the limiting factor in nutritional status. Bioavailability of nutrients is poorest when diets have a high content of phytate and fibre, and parasitic and gastro-intestinal diseases can cause nutrient malabsorption. Early growth faltering may also be related to suboptimal fetal endowment with nutrients during pregnancy rendering stores low at birth.

The final stage of infant nutrition dealt with in this chapter is the cessation of breastfeeding. Although the majority of infants in the sample were breastfed well into their second year of life, there was some variability, after 18 months, in the age at which children were completely weaned from the breast. Prolonged breastfeeding is associated with some short-term wasting, in terms of mean weight-for-height. The only significant factor found to be associated with prolonged breastfeeding was mothers' mean monthly income, which was lower for prolonged breast feeders. It is possible, then, that women who make less money, whether they be home or factory workers, have less cash to spend on food for the household, and might be using breast milk as a supplement to other non-breast milk foods. Alternatively, mothers may be making less money because they are breastfeeding and therefore produce less wool and carpets than would otherwise be possible. Unfortunately, without specifically aiming to address this question, the answer is impossible to garner from this study's data. The latter hypothesis, however, seems less plausible to me since an older child breastfeeds less frequently than a younger one, and given the flexibility of the work hours, it seems that breastfeeding an older child would not unduly impede a woman's productivity, unlike a young infant. Assuming that the former hypothesis is correct, then, prolonged breastfeeding becomes a last resort and perhaps a lifesaver in bad circumstances, although it is certainly not an ideal situation.

Although infant nutrition plays an important role in growth retardation, it definitely is not the only underlying factor in this multifactorial condition, nor is dietary intake the sole arbiter of child health status. The other major consideration in child health and nutrition is child morbidity, the topic of the following chapter.

CHAPTER SIX

The Meaning of Microbes: Childhood Illness in a Pathogenic Environment

In low-income countries children under five years of age are disproportionately burdened by mortality relative to other age groups. The leading killers of children are acute respiratory infections (ARI) and diarrheal diseases (WHO/UNICEF 1986); the same conditions hold in Nepal (UNICEF 1992). Levels of child mortality from these diseases, however, have begun to decline in many regions of the world because of oral rehydration therapy (ORT) and antibiotic treatment. Nevertheless, morbidity remains high, incurring suffering, strains on family finances, and impaired child learning and development (Huffman and Steel 1995).

Infectious disease is also implicated in child growth retardation and malnutrition (Martorell et al. 1973; Mata et al 1977; Rowland et al. 1977; Martorell et al 1980; Black et. al. 1984; Eccles et. al. 1989). As growth and development is the focus of this thesis, this chapter explores the extent to which morbidity affects the nutritional status of this sample of children in Boudha. I argue from the analysis of this peri-urban sample of children that morbidity from infectious disease is a major contributor to growth retardation. I contend, moreover, that this problem is best understood as an environmental health issue.

This chapter begins with a discussion of the methodology I used to investigate child morbidity. The results are then presented as a general survey of illness in this sample with a particular emphasis on gastrointestinal infections. This is followed by an evaluation of the effects of disease on growth retardation using various lines of evidence from the anthropometric and survey data. The final section describes and discusses health care in Boudha, mothers' explanatory models of illness and how both influence children's health status.

Documenting disease in the sample

In order to investigate morbidity among the children, three types of methods were used: health surveys, stool testing, and semi-structured interviews with mothers. Each of these methods yielded different types of quantitative and qualitative information, but the results complement one another and help to elucidate both an insider's and outsider's perspective of child illness in the community.

At each child measuring session, mothers were asked several questions related to their child's health experience (See Child Health Survey in Appendix 1). In order to ascertain the prevalence of morbidity, mothers were asked to recall any illnesses within the previous two weeks. This is a standard measure of general morbidity used in health surveys in low-income countries. This method is preferable to clinical records because it includes families that do not visit health care facilities and focuses on individuals rather than case episodes. The drawback of maternal illness reports is that precise clinical diagnoses are not obtainable (Timaeus et al. 1988). In the survey I conducted in Boudha, some of the illnesses, such as respiratory diseases, were not subdivided into more precise diagnostic categories like influenza or colds. As Nichter (1993: 58) points out, part of the difficulty in labelling involves ambiguity in indigenous and biomedical terms. For example, Nepali mothers often said that their children had "pneumonia", but as there was not always a clinical diagnosis made by a medical professional, I was not sure whether or not to assume that their use of the word coincided with the biomedical diagnosis.

I also asked mothers if their child was currently experiencing diarrhea at the time of survey, following WHO (1991), yielding point prevalence estimates. I added this question to the survey because diarrhea is a common occurrence for children in Nepal and I reasoned that ascertaining current diarrheal status could minimize under reporting from recall error. The question, moreover, enabled me to probe the mother regarding the frequency and consistency of the child's stool, as well as the duration of the bout up to the time of survey.

Unfortunately, epidemiological definitions of diarrhea vary from one survey to another, although a common definition is three or more stools in a 24 hour period or one liquid or explosive stool (Gracey and Rowland 1991). In many surveys the mother's definition of diarrhea is followed because the mother is considered to be the most competent judge of departures from normal (Rowland 1983). The mother's definition of diarrhea, however, should be explored and not assumed to match the epidemiological one. In order to test this, if the mother stated that the child had diarrhea, we asked her to report the frequency of the stools per day and to describe the consistency of the child's stool (water, yogurt, thin, thick, etc.). With the exception of six cases, the mothers' definitions of diarrhea matched the epidemiological one stated above. In those cases where the definitions were incompatible, I did not count them as diarrhea, as I thought the mother may have been confused about the question.

One difficulty with defining the prevalence of diarrhea concerns newborn, exclusively breastfed infants. These babies usually pass more than three soft bowel movements per day, and therefore according to the above definition, will be improperly classified as having diarrhea (Gracey and Rowland 1991). Of the 14 children aged less than 6 months with diarrhea in the sample, however, only one was less than 1 month old; the other 13 were 3 months of age and older, and therefore were probably not young enough to be misdiagnosed by their mothers.

A sub-sample of the study children had their stools tested for GI parasites (See Chapter 3, pp. 65-66, for the details of the study design). The first round of stool tests (n=35) were taken to the laboratory at the Dakshin Dhoka Rural Health Centre. In the spring of 1995 the lab technician left his position there, and the following two rounds of stool tests (n=55 and n=44 for rounds II and III respectively) were taken to the Shi-Gan pathology laboratory in Boudha.

The stools were examined by trained laboratory technicians for signs of cysts, trophozoites, larvae, and eggs, depending on the particular parasite's life cycle. Due to the limitations of the laboratory facilities available, common diarrhea-causing pathogens - bacteria, rotaviruses and some protozoal parasites like *Cryptosporidium,* which require more sophisticated and expensive procedures for detection (Grove 1991) - could not be identified. Therefore, no conclusions can be made about the prevalence of these pathogens. Because some parasites, like the protozoan *Giardia lamblia*, do not always shed cysts in every stool, three consecutive stool samples for every individual should be collected (Bradley and Keymer 1984). Unfortunately, given the rigours of sample collection, this protocol was impractical. Thus, the findings presented for this sample should be considered an underestimate of the true prevalence of parasitism in the sample.

After the stool sample results were obtained from the laboratory, the parents were informed and medication, as prescribed by a pediatrician, was given to the parents for the child's treatment. This was done for ethical reasons. It did mean, though, that succeeding stool test results were influenced by our intervention and were thus different from the initial stool test done for each child; hence, results from stool testing are presented for the children who were tested for the first time in any of the three rounds (n=71), although results from second and third tests are subsequently discussed in order to speculate about parasite re-infection and/or medication failure.

In September 1995, near the end of the study period, I learned about a factory that had installed a water chlorination facility. This factory and these children were not included in the original sample of factories, but I thought that it could serve as an interesting comparison group because none of the factories or households in the study had a water treatment facility. The employees with children under five years of age working at this factory agreed to have their children's stools tested in return for treatment for any intestinal parasites found. All employees with children under five (n=26) participated.

The third research method used to investigate morbidity was in-depth, semi-structured interviews with mothers and a traditional healer. This served to expand on answers from several questions in the health survey regarding the mother's health care choices, her understanding of the causation of diarrheal diseases and the treatment of diarrhea. These interviews proved to be crucial for understanding the mothers' explanatory models, or EMs (Kleinman 1980), of illness causation and treatment recourse.

Illness profile

The illness survey was completed at each measuring session. The proportion of children reported to be ill during the first, second and third surveys conducted was 59.7%, 71.7% and 58.4% respectively. Since the second and third surveys were repeated measurements of the children from survey I, the cross-sectional results presented here are for the first survey, i.e., the children measured for the first time in any of the three rounds. Although approximately half of them entered the study during the first measuring session in January, February and March of 1995, others entered later in the year during the second and third rounds. The data from the first survey, therefore, yields a general, year round illness profile (See Chapter 3, pp. 60-61, for study design details).

Of the total sample of 283 children, 59.7 % (n=169) of them were reported to be ill within the previous two weeks of the survey. The two most frequently reported primary illnesses in the sample were gastrointestinal infections (55.0%) and respiratory infections (29.6%) (Figure 6.1). These results reflect worldwide and Nepali-specific morbidity data which indicate that the highest proportions of illness for children under five years of age comes from ARI and diarrheal diseases (WHO/UNICEF 1986; Snyder and Merson 1982).

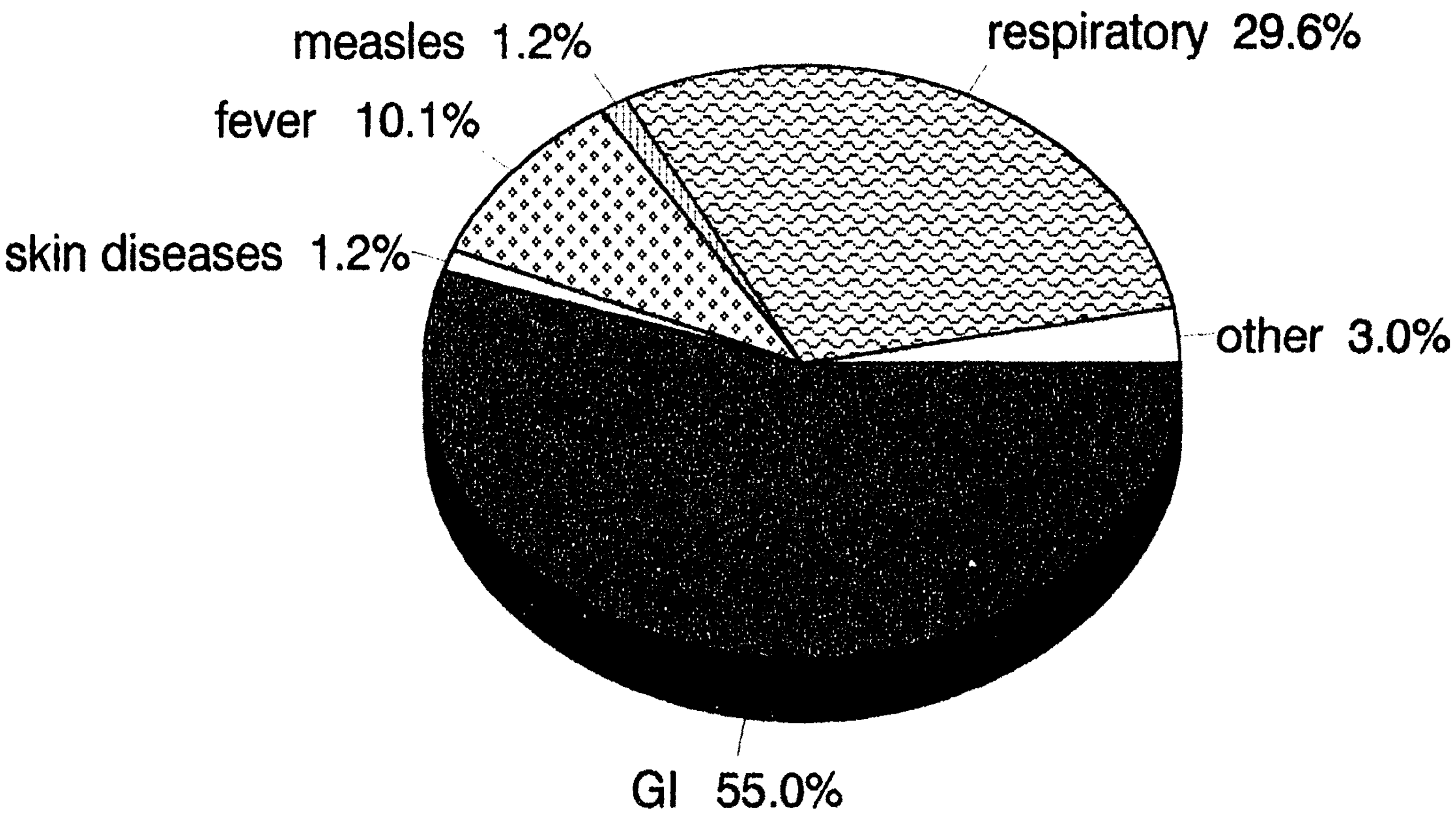


Figure 6.1 Primary illness in previous two weeks as reported by parent at first survey in any round (N=169).

Approximately one third of those reporting an illness (n=56) had suffered from a respiratory infection in the previous two weeks (Figure 6.1). This includes both upper and lower and acute respiratory infections (ARI) and non-acute ones such as colds. For 10% of the sample, "fever" was reported with no other illness mentioned in conjunction with it. It is possible that many of these unspecified "fevers" are a symptom of tuberculosis or ARI (Nichter 1993: 58), but with no other information available they were left in the category of non-specific fever. Of the children who were reported to have suffered from a respiratory disease, either as a primary or secondary illness in association with another illness, a larger proportion were reported during the cold season, compared to the hot and rainy seasons ($\chi^2 = 7.38$, d.f.= 2, p=0.02) (Table 6.1).

Table 6.1 Cross tabulation of frequency of reported respiratory infection by season with standardized residuals in brackets.

	Reported Respiratory Infection		
Season	Absent	Present	Row Total
Cold	142 75.9% (-0.7)	45 24.1% (1.3)	187 66.1%
Hot	53 85.5% (0.5)	9 14.5% (-0.9)	62 21.9%
Rainy	32 94.1% (0.9)	2 5.9% (-1.8)	34 12.0%
Column Total	227 80.2%	56 19.8%	283 100.0%

A small number of children had skin diseases (1.2%) reported as a primary illness (Figure 6.1), although another four cases were listed as secondary illnesses. There were only two cases of an infectious disease other than respiratory or diarrheal diseases and they were both measles. Indeed, throughout the whole nine month survey of these peri-urban children only three cases of measles were reported.

More than half of the children reporting an illness (n=93) suffered from GI illness within the previous two weeks of survey (Figure 6.1). A further 13 children had a GI infection listed as a secondary illness in conjunction with a respiratory disease. A breakdown of the different types of GI disease, as described by the mothers, is outlined in Table 6.2.

Table 6.2 Type of gastrointestinal illness as reported by mother.

Type	Nepali Term	N	Per cent
diarrhea	*pakhaalaa, chherne*	63	67.7
vomiting	*chaaDne*	6	6.5
diarrhea and vomiting	*jaadaa baanta*	13	14.0
bloody stools	*ragat maashi*	8	8.6
worms/bloated stomach	*jugaa/pet phuleko*	3	3.2
TOTAL		93	100.0

The types of diarrhea shown in Table 6.2 tell more about symptoms than aetiology, although in some cases a diagnosis can be made from symptoms. For example, bloody stools indicate dysentery, either amebic or bacterial in origin. Diarrhea and vomiting together may indicate cholera, which is endemic to the region; however, without laboratory diagnosis of *Vibrio cholerae* no conclusive diagnosis can be made here. Many of the mothers know the tell-tale signs of worms or helminth infections such as a distended stomach, or a mature worm seen in their child's feces. Of the 68% of cases that are listed simply as diarrhea, however, many possible pathogens can be implicated, including bacteria, rotaviruses, and protozoa.

The point prevalence of diarrhea for the entire sample of children measured for the first time (N=283) in any of the three rounds is 29% (n=83). Mothers were asked the number of days that the diarrhea had lasted up to the point of the survey. Thirty per cent (n=25) of those with diarrhea had experienced it for more than 14 days. This duration is considered in epidemiological terms to be chronic diarrhea (Gracey and Rowland 1991).

The age distribution of diarrhea is presented in Figure 6.2. Although it appears from the graph that the point prevalence of diarrhea was highest for 6 to 11 month old children, there are no statistically significant differences by age category ($\chi^2 = 6.75$, d.f. = 5, p=0.24). Diarrhea is common among all children under five years of age.

There appears to be a seasonal pattern for diarrheal infections in general. A cross-tabulation of all children surveyed for the first time in three different seasons (cold, hot and rainy) indicates that season and diarrheal point prevalence are not independent of one another ($\chi^2 = 10.8$, d.f.=2, p=0.004). There are more children with diarrheal disease in the hot and rainy seasons compared to the cold season (Table 6.3).

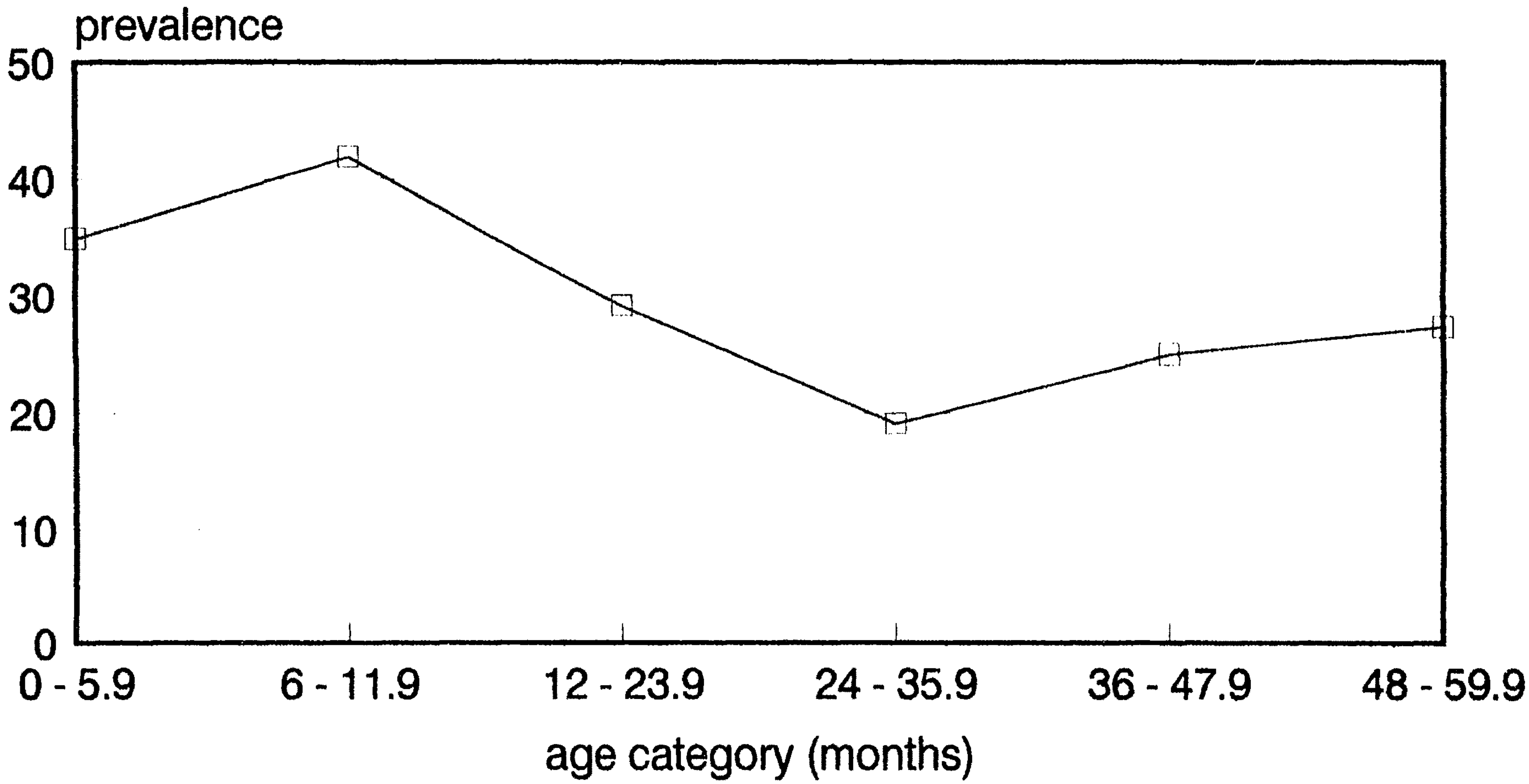


Figure 6.2 Point Prevalence of diarrhea by age category for children measured for the first time in any round (N=83).

Table 6.3 Cross tabulation of frequency of reported diarrheal infection by season with standardized residuals in brackets.

Season	**Reported Diarrheal Infection Status** Absent	Present	Row Total
Cold	144 77.0% (1.0)	43 23.0% (-1.6)	187 66.1%
Hot	37 59.7% (-1.0)	25 40.3% (1.6)	62 21.9%
Rainy	19 55.9% (-1.0)	15 44.1% (1.6)	34 12.0%
Column Total	200 70.7%	83 29.3%	283 100.0%

This finding is not extraordinary, as the occurrence of diarrhea in tropical environments is highest during the hot and rainy seasons (Rowland and Barrell 1980). Diarrheal causing strains of bacteria including enterotoxigenic *Escherichia coli* and *Vibrio cholerae* have been found in Bangladesh to have distinct seasonal peak occurrences in the hot and monsoon seasons (Black et al. 1983). The hot season in Kathmandu is a time of acute water shortage when water is at a premium, with the result that environmental hygiene standards inevitably decline. During the monsoon season excrement is washed by heavy rains and flooding into water reservoirs causing contamination of water sources.

Of the 71 children whose stools were tested for the first time in all three rounds, 30 of them (42.3%) had at least one intestinal parasite identified in their sample. As discussed previously, this is probably an underestimate of the true prevalence. The types of parasites identified by the laboratory stool analysis are listed in Table 6.4.

Table 6.4 Parasites identified in stool samples of (N=71) children.

Parasite	n	Per cent
None found	41	57.7
Protozoa:		
Giardia lamblia	17	23.9
Entamoeba histolytica	3	4.2
Iodamoeba butschlii	1	1.4
Subtotal	21	29.6
Nematoda:		
Ascaris lumbricoides (round worm)	7	9.9
Trichuris trichiura (whip worm)	1	1.4
Strongyloides stercoralis†	1	--
Enterobius (pin worm)	1	1.4
Subtotal	10	14.1
TOTAL TESTED	71†	100.0

† 31 parasites were found in 30 individuals as one child had *S. stercoralis* in combination with *Giardia*.

Protozoal infections made up 68% of the identified parasites in stools from children in this study. Of those, *Giardia* was most commonly identified. It is estimated that 200 million people worldwide are infected by *Giardia* (Grove 1991: 93). It is spread via water, food and person-to-person contact. It is endemic in many low-income countries, although outbreaks have occurred in industrialized countries when there is a breakdown in the water supply system. Some of its clinical features include chronic diarrhea, bloating, anorexia and nausea (Stevens 1982). *Entamoeba histolytica*, estimated to be found in 500 million people worldwide (Grove 1991: 93), was detected in 10% of the parasitized stools found in this sample. Its clinical features cover a wide spectrum from the most acute form of amebic dysentery - frequent stools containing blood and mucus - to a milder form of abdominal discomfort accompanied by watery diarrhea. *E. histolytica* can spread extra- intestinally in the human body to the liver and in rare cases to the lungs, pericardium, brain and skin. *I. butschlii*, a non-pathogenic parasite, was found in one child's stool (Grove 1991).

Helminthic infection is also common (32.3%) among these parasitized children. *Ascaris*, the large round worm, was the most commonly found worm and was detected in 22.6% of abnormal stools (Table 6.4). Worldwide, its estimated frequency of infection is 900 million people per year (Walsh and Warren 1979 cited in Black 1984: 169). It is not generally associated with diarrhea, but when the worms have grown large, they cause extreme bloating of the stomach and vomiting. *Ascaris* is also thought to impede absorption of nutrients, as it has been found to be associated with Vitamin A deficiency and iron deficiency anaemia (Mahalanabis et al. 1976; Mahalanabis et. al. 1979; Curtale et. al. 1993; Curtale et al. 1995). Three other worms, *Trichuris*, *Stronglyoides* and *Enterobius* were found in three children's stools. *Trichuris*, or whip worm, is sometimes associated with diarrhea, whereas *Stronglyoides* is strongly associated with diarrhea and can be quite extreme depending on the intensity of the infection (Grove 1991). *Enterobius*, or pin worm, is a more benign parasite, which causes some itching and discomfort around the anus (Brown and Neva 1983).

Unlike the point prevalence of diarrhea, variation of intestinal parasitism is not distributed evenly throughout the age categories in this sample (Table 6.5). Parasitized children under 12 months of age are significantly under represented in the sample, and parasitized children over 24 months are significantly over represented ($\chi^2 = 14.9$, d.f.=2, p=0.001).

Table 6.5 Parasitic infection by age category for (N=71) individuals with standardized residuals in brackets.

Age Category (months)	**Parasite Absent**	**Parasite Present**	Row Total
0 - 12	21 87.5% (1.9)	3 12.5% (-2.2)	24 33.8%
12 - 24	12 52.2% (-0.4)	11 47.8% (0.4)	23 32.4%
24 - 60	8 33.3% (-1.6)	16 66.7% (1.8)	24 33.8%
Column Total	41 57.7%	30 42.3%	71 100.0%

Of the three out of 24 children aged less than 12 months who were parasitized, one of them, aged 5 months, had *E. Histolytica*, and the other two, aged 7 and 8 months, had *Giardia*. It is clear that infants under 5 months, perhaps because they are breastfeeding, either exclusively or predominantly, are protected from parasitic infection.

Of the first round of stool tests presented in Table 6.4, 17 of the stools with parasites were tested during the cold months (from January to March). Any comparisons in parasitic infection to the other seasons of the year, however, is difficult to obtain from the data in this study because stool sample analysis was done on the same children throughout the year and after each test children were treated with antimicrobial therapy, thereby influencing the subsequent stool test . Farthing et al. (1986) studied *Giardia* among a sample of children in Guatemala during the 1960s without giving any antimicrobial therapy to the subjects. They studied the course of the infections prospectively over a three year period and found that *Giardia* attack rates were consistent throughout the year, although they noted that prevalence rates tended to be higher during the cooler and wetter months, perhaps because these conditions are conducive to cyst survival. Therefore, unlike some diarrheal diseases, such as cholera, dysentery and typhoid, which are most frequent during the hot and rainy season, protozoal infections are likely to be present all year round.

In order to try to elucidate the source of GI parasitic infections, stool samples from children under 5 years of age (n=26) from the carpet factory with a water chlorination treatment facility were analysed for comparative purposes. Presumably, if drinking water were a major source of infection, these children would be less parasitized than their study sample counterparts living without chlorinated water. The results of the tests indicate that 11 of the 26 children (42.3%) were parasitized, the same proportion found for the study sample . *Giardia* (n=5), *E. histolytica* (n=2), *Ascaris* (n=6) and *Hominis nania* (dwarf tapeworm) (n=1) were the parasites detected.

This result is not surprising on several counts. First, protozoal cysts are destroyed when water is boiled, but they are resistant to chlorination (Grove 1991). Second, studies of intestinal parasite transmission have shown that improvement of water quality has low to negligible effects on the transmission of protozoal diarrhea and most worm infections. The control measures most important for these parasites are improvement in water supply quantity/convenience and personal and domestic hygiene. Good excreta disposal and food hygiene are highly important ways of controlling the transmission of most worms, and moderately important in the case of protozoal diarrhea (Blum 1985; UNICEF 1988). The chlorination of the water, however, may have aided in decreasing the prevalence of diarrhea, as improvement in water quality is an important factor in controlling bacterial diarrhea transmission. This, however, could only be verified by a detailed study of the rate of diarrheal attacks among the 26 children living in this factory, an undertaking beyond the scope of this project.

It is important to point out that although the children in the study sample were given antimicrobial medication after each test if a parasite was found, some of these same children harboured either the same or different GI parasites in subsequent tests. Table 6.6 presents the data from each round of testing on the same children.

Table 6.6 The presence of parasites in multiple stool tests.

	N	n with parasite present once	n with parasite present twice	n with parasite present thrice
Tested once only	71	30 (42.3%)	---	---
Tested twice only	24	10 (41.7%)	2 (8.3%)	---
Tested all three times	21	12 (57.1%)	5 (23.8%)	2 (9.5%)

It should be emphasized that 19 of the 21 children who were tested three times during the study period tested positive for a parasite at least once. Of the 21 children who were tested three times, 5 of them tested positive for *Giardia* twice (Table 6.6): 3 children were *Giardia* positive between two subsequent rounds and 2 children were *Giardia* positive between rounds I and III. It may be that some of the children were not given the medication at all, or were given it improperly; alternatively, the medication may not have been effective the first time it was given. The other possibility, however, is that reinfection occurred after the parasite was expelled from the GI tract. It is impossible to verify whether these were cases of persistent infection or re-infection; nevertheless, they underscore the difficulty of living in the peri-urban environment with a variety of endemic parasites, and the challenge of treating parasites with medication.

The impact of disease on growth

The impact of disease on child growth has been documented over the past twenty-five years. Studies in a variety of low-income countries have indicated that the presence of infectious disease significantly reduces child weight gain (Mata et al. 1977; Rowland et al. 1988; Eccles et. al. 1989; Becker et. al. 1991) as well as length/height gain (Martorell et al. 1973; Rowland et. al. 1977; Black et. al. 1984). In all of these studies diarrheal diseases have been a major focus of interest, although in some cases respiratory diseases - specifically lower respiratory tract diseases like pneumonia - and measles are also implicated in growth retardation. It is important to note, as Cole (1989) points out, that the impact of an infectious disease will vary with the particular environment which includes the prevalence of the disease, the level of health care, and the socio-economic conditions in that community.

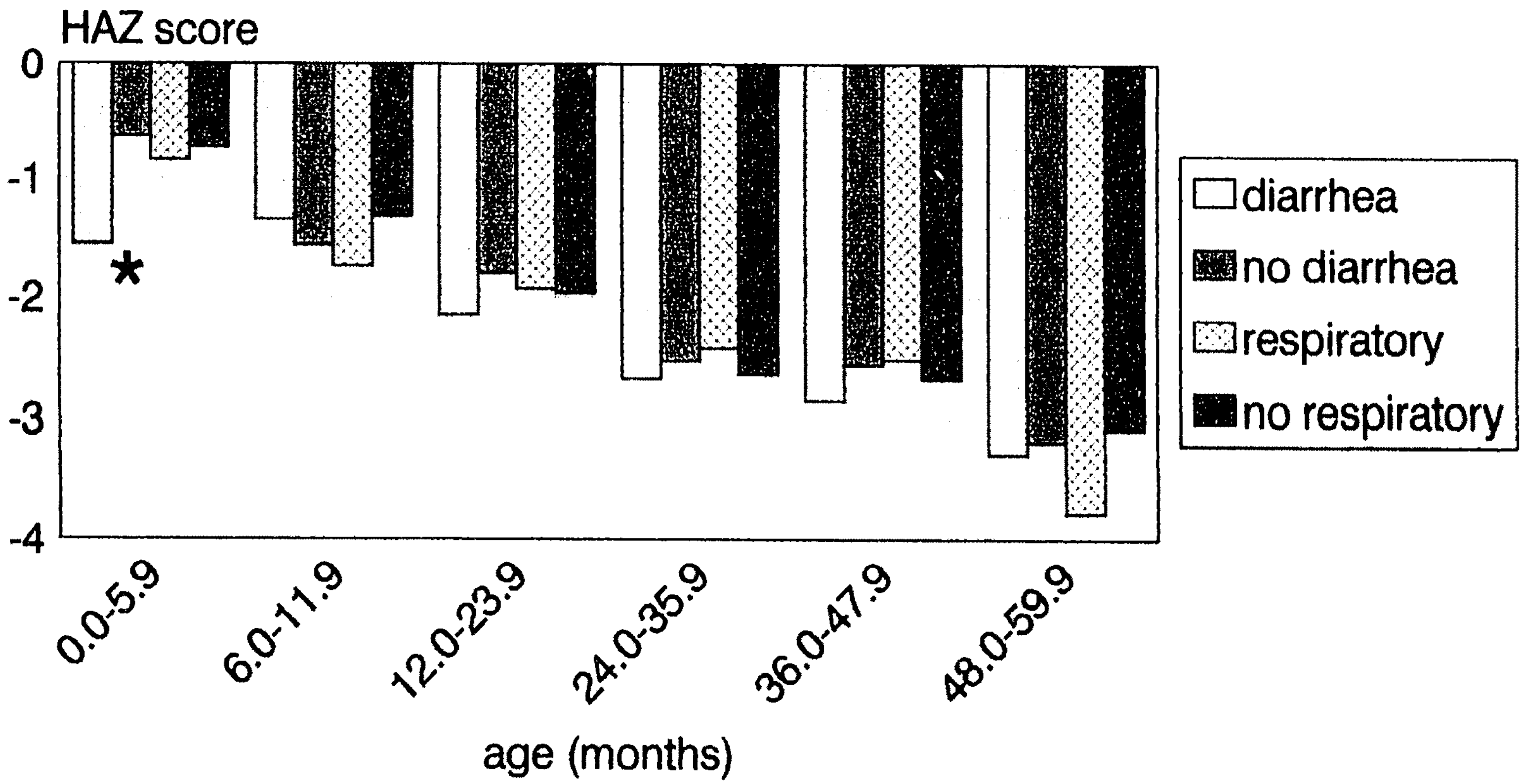
Diarrheal diseases have been most closely scrutinized because of their known biological means of causing malnutrition (Chen 1983). Like ARI and measles, diarrhea can be an appetite depressant, leading to statistically significantly reduced food intake among children (Mata et al. 1977; Martorell et al. 1980). Unlike ARI and measles, however, acute diarrhea can also cause malabsorption and loss of important nutrients such as protein, nitrogen and fat (Mann et al. 1990).

Although the relationship between infectious disease and short-term malnutrition has been demonstrated, the impact of infection on long-term growth retardation is controversial. On the one hand, Mata et al. (1977) have argued that in low-income countries acute infection plays a more important role than dietary intake in the nutritional status of children. This has been more cautiously supported by Martorell and Ho (1984: 52), who state that "...infections are as important a cause of malnutrition as is the limited availability of food". On the other hand, Briend et al. (1989), Briend (1990), Moy et al. (1994) have argued that the effects of infection on nutritional status are impermanent when catch-up growth is taken into consideration in the long-term perspective of growth at the community level.

As already illustrated above, the children in this sample suffer from frequent bouts of diarrheal and respiratory diseases. Both of the illnesses have been identified in other studies of child growth in low-income countries to be significantly associated growth failure. In order to assess the impact of these diseases on growth, both cross-sectional and longitudinal measures of growth were compared for those children who were reported to have had diarrhea and/or respiratory illness two weeks prior to their first survey. The mean measures of growth and the results of t-tests for differences in the means for each age group are presented in Figures 6.3 through 6.7.

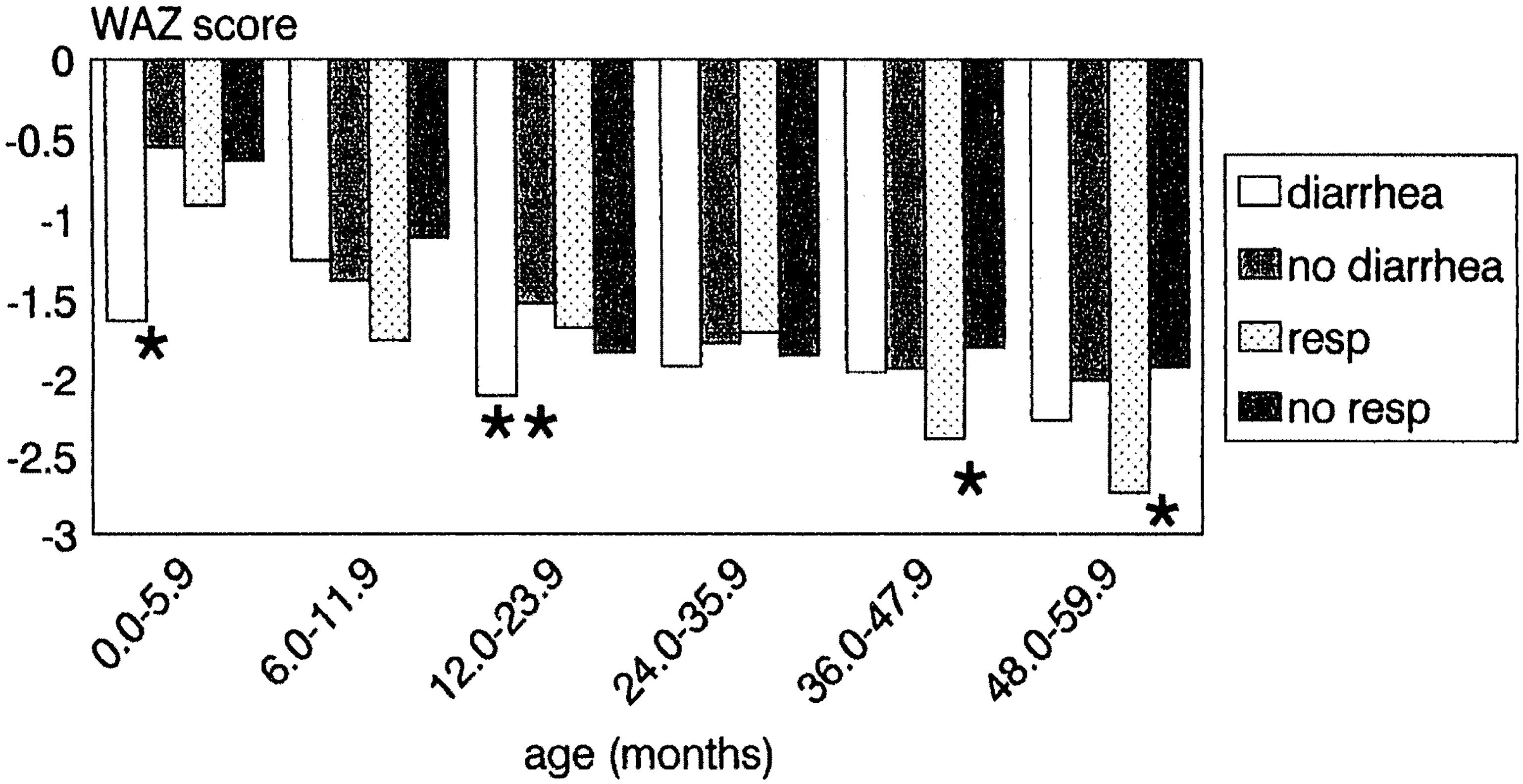
Statistically significant differences in mean growth indices between children with and without diarrhea and respiratory infections within the previous two weeks of survey are found for some of the age groups for all three cross-sectional indices. Only weight, in terms of mean WHZ and WAZ, is negatively affected by both respiratory and diarrheal illnesses, with the exception of infants under 6 months whose mean HAZ score is significantly lower for children with diarrhea than without it. The lower mean WAZ and WHZ scores for children who were reported to have suffered from diarrheal and/or respiratory infections indicate some short-term weight loss associated with these illnesses. This weight loss within two weeks of the illnesses is not reflected in decreased body mass velocity for the three months following the survey (from first to second measurement) except among infants under 12 months; this latter difference is statistically significant only for those infants who were reported to have diarrhea. Infants under 12 months also show a significantly lower mean stature velocity following the incidence of diarrhea. Interestingly, children aged 12 to 24 months with diarrhea actually had significantly higher rates of growth in both body mass and stature compared to those without diarrhea reflecting perhaps a tendency for catch-up growth in the subsequent three months after they have recovered from the diarrheal illness.

A methodological difficulty in assessing the impact of GI diseases on child growth is the lack of discernment among underlying pathogens. Diarrhea is a symptom common to many different pathogens and diseases, and studies rarely differentiate it by type



* statistically significant at $p<0.05$

Figure 6.3 Mean HAZ scores for children with and without diarrhea and/or a respiratory infection reported by mothers as a primary or secondary illness at the first survey (N=271).



*statistically significant at p<0.05; ** statistically significant at p<0.01

Figure 6.4 Mean WAZ scores for children with and without diarrhea and/or a respiratory infection reported by mothers as a primary or secondary illness at the first survey (N=281).

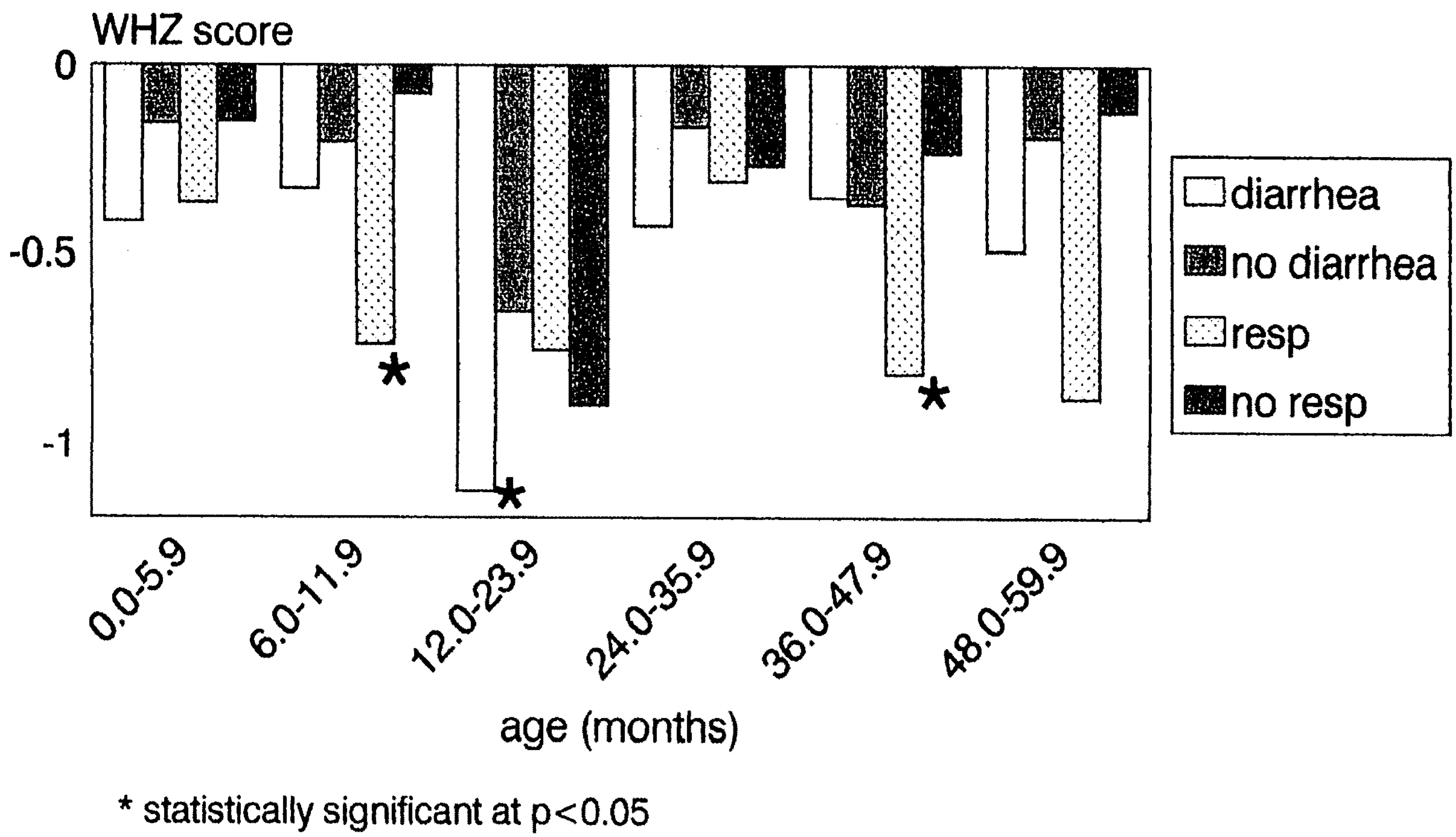
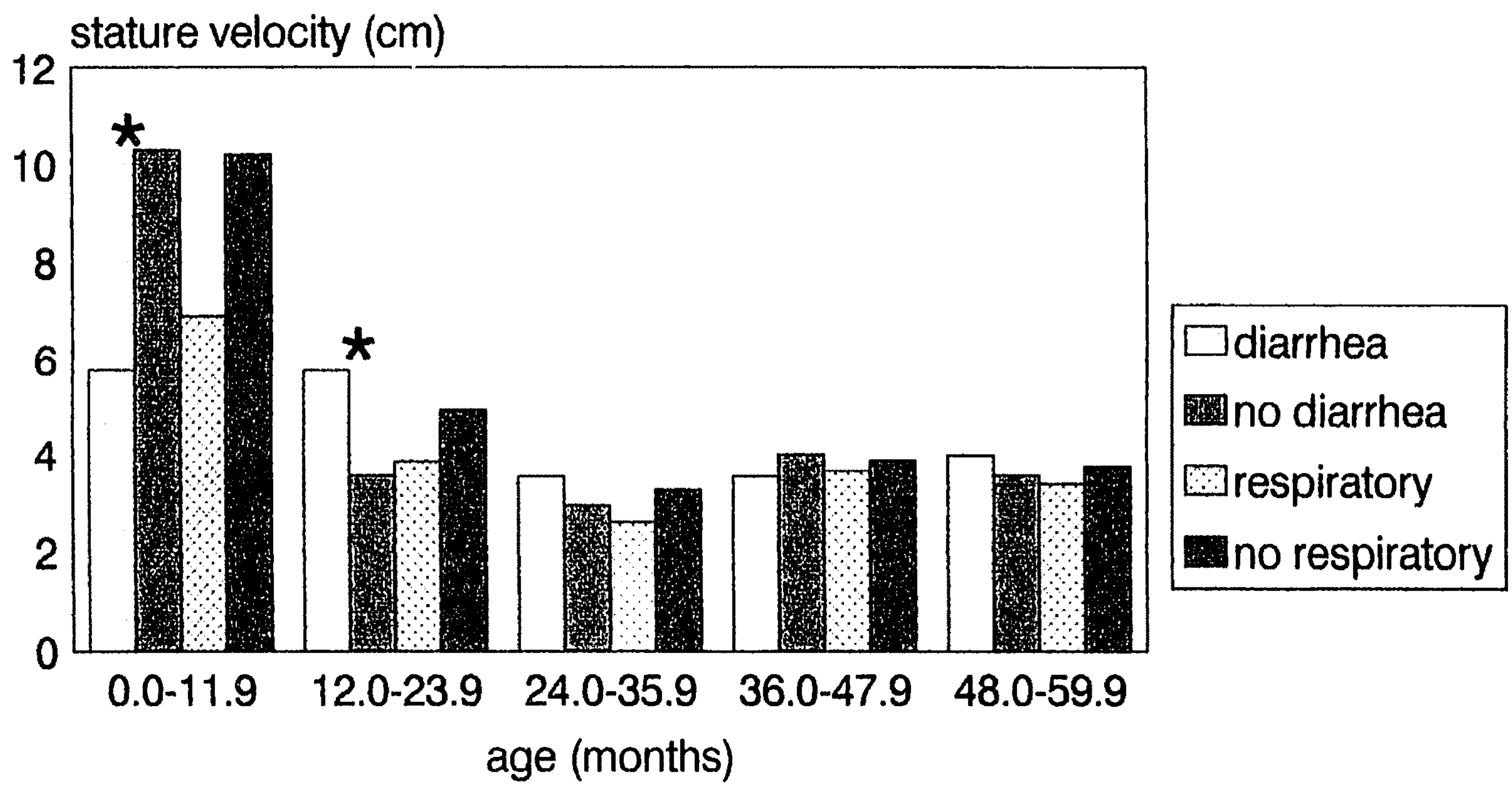
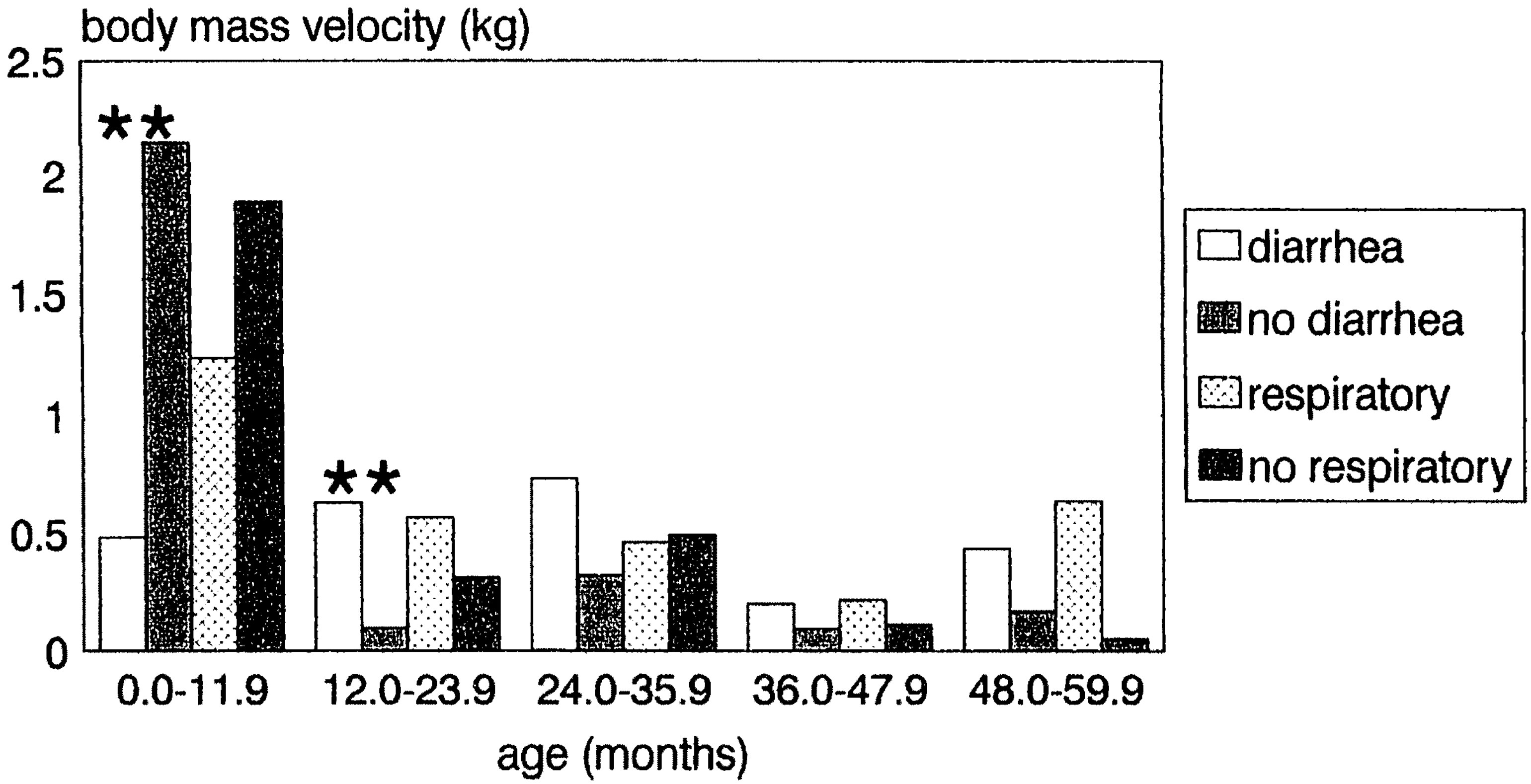


Figure 6.5 Mean WHZ scores for children with and without diarrhea and/or a respiratory infection reported by mothers as a primary or secondary illness at the first survey (N=271).



*statistically significant at p<0.05

Figure 6.6 Mean stature velocity (between first and second measurements) for children with and without diarrhea and/or a respiratory infection reported by mothers as a primary or secondary illness at the first survey (N=176).



**statistically significant at at p<0.01

Figure 6.7 Mean body mass velocity (between first and second measurements) for children with and without diarrhea and/or a respiratory infection reported by mothers as a primary or secondary illness at the first survey (N=291).

(Henry et al. 1987). Most studies compare children with diarrhea (or more frequent episodes of diarrhea) to those without (or less frequent episodes). They do not include information about the duration, intensity and accompanying symptoms. It appears, moreover, that persistent or chronic diarrhea is more likely to impact negatively on nutritional status than acute bouts of diarrhea (Brusner et al. 1991). Although diarrheal diseases affecting children in this study could not always be differentiated by their underlying pathogenesis, the results of stool tests indicate that many children had protozoal intestinal parasites such as *Giardia lamblia* and *Entamoeba histolytica* (28.1%) (Table 6.4), which are prime causative agents of chronic diarrhea among children (Mata et al. 1984). There has been little in the way of research on the way these parasites affect human nutrition (Diamond 1982; Solomons 1982). One of the few studies to date measured the effects of giardiasis on growth retardation among a highland sample of children in Guatemala (Farthing et al. 1986). The authors of this study tentatively conclude that giardiasis does contribute to growth faltering, but admit the difficulty in proving causation in populations where polyparasitism (i.e., presence of multiple parasites) is common.

Since most children suffer from bouts of diarrhea throughout their lives in Nepal, comparing those with or without diarrhea over a short period of time does not necessarily elucidate their long-term impact on child growth. The presence or absence of protozoal parasites such as *Giardia* and *E. histolytica*, however, may indicate experience of chronic diarrheal disease, which may have contributed to chronic growth faltering. For this reason, I undertook to evaluate the influence that protozoal infections alone may have had on the growth status of the affected children in the sample.

As the prevalence of parasitism varies by the age of the child (Table 6.5), in order to test the difference in mean growth status between those children with and without these parasites, it is necessary to adjust for the age of the child, since the age group with the lowest prevalence of parasites (children under 12 months of age) is also the one in the sample with the best cross-sectional linear growth status, as discussed in Chapter 4. In order to control for age, an Analysis of Covariance (ANCOVA) was used to determine the influence of parasite status on HAZ with age as a covariate. One assumption of ANCOVA is that there is no significant interaction between the factor and the covariate (Norman and Streiner 1994: 124). Table 6.7 shows the results of ANOVA with the interaction term protozoa status by child's age for HAZ. Since the interaction term is not statistically significant at the p=0.05 significance level, ANCOVA is an acceptable test. The relationship among age of child, HAZ and protozoa status is graphically represented in Figure 6.8.

Table 6.7 ANOVA test for HAZ by interaction term of protozoa status by age of child.

Source of variation	SS	DF	MS	F	Sig of F
within + residual	79.22	66	1.20		
protozoa status * age	3.64	1	3.64	3.03	0.09
(Model)	3.64	1	3.64	3.03	0.09
(Total)	82.85	67	1.24		

The ANCOVA summary table for testing the mean difference in HAZ by protozoa status is presented in Table 6.8. The statistically significant p-value for protozoa status

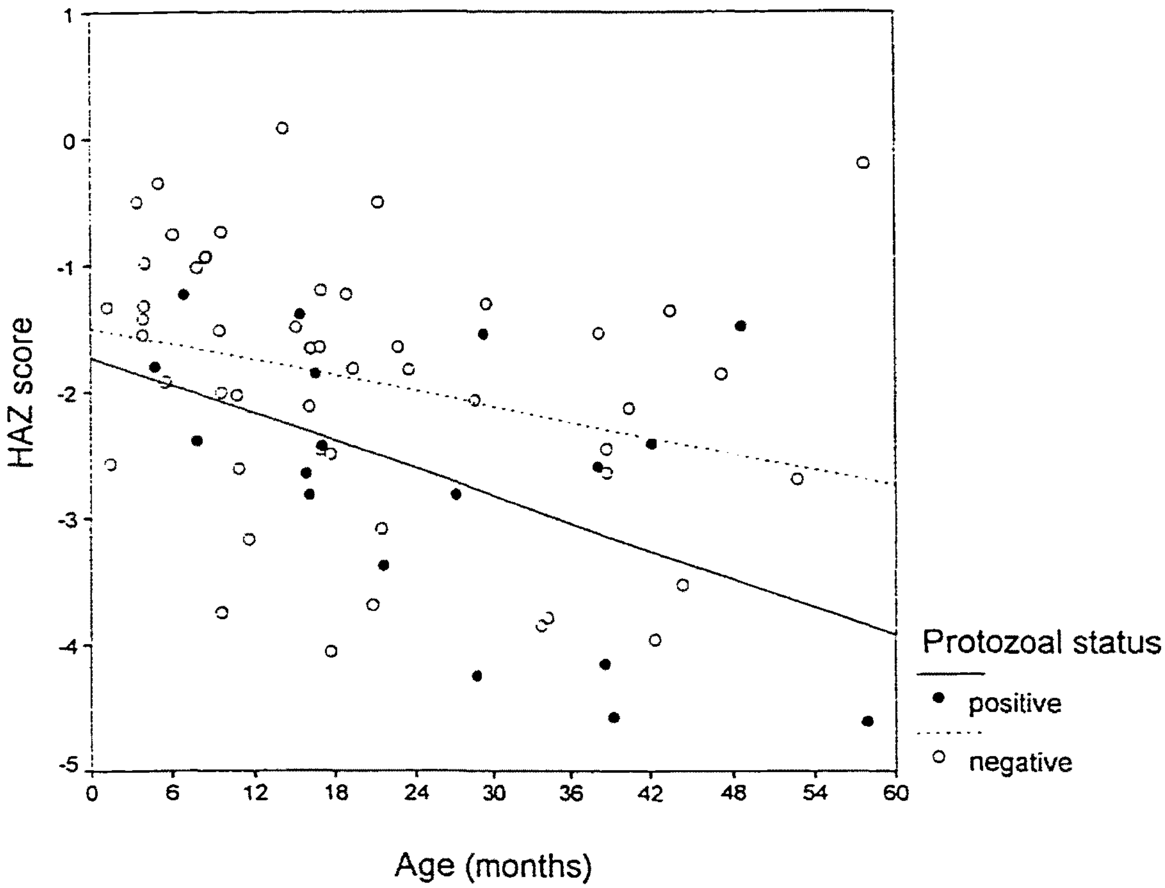


Figure 6.8 HAZ scores by age of child according to protozoal status at first survey (N=71).

indicates that it has an impact on mean HAZ status in the sample.

Table 6.8 ANCOVA summary table for mean HAZ by protozoa status covaried by age of the child.

Source of variation	SS	DF	MS	F	Sig of F
within + residual	65.76	65	1.01		
regression	9.16	1	9.16	9.06	0.04
protozoa status	4.92	1	4.92	4.87	0.03
(Model)	17.10	2	8.55	8.45	0.00
(Total)	82.85	67	1.24		

As the covariate age is not statistically significant for WAZ and WHZ in this sub-sample of children tested for parasites (Table 6.9), t-tests were used for the whole sample to test the differences in mean WAZ and WHZ. The mean Z-scores are shown in Table 6.10.

Table 6.9 Significance of covariate of Age for HAZ, WAZ and WHZ.

Index	B	Beta	Std. Error	t-value	Sig. of t
HAZ	-0.02	-0.34	0.01	-3.01	0.00
WAZ	-0.01	-0.17	0.01	-1.44	0.15
WHZ	-0.00	-0.01	0.01	-0.07	0.95

Table 6.10 Mean HAZ, WAZ and WHZ-scores for protozoa positive and negative children.

Index	Protozoa Positive	Protozoa Negative
HAZ†	-2.61*	-1.99*
WAZ	-2.26*	-1.65*
WHZ	-0.77	-0.59

† Means adjusted by age of child.
* Difference between means of positive and negative protozoa groups is significant at $p<0.05$.

Measures of long-term or chronic growth retardation, mean HAZ and WAZ, are significantly lower for children with protozoa positive status than without. Of course, these differences do not prove causality; being infected by *Giardia* and *E. histolytica* parasites may simply mark other disadvantageous factors that cause growth retardation. Moreover, the children may be more susceptible to giardiasis and amebiasis because of their malnourished state, although there is yet no convincing epidemiological evidence that this is the case (Solomons 1982; Diamond 1982). There are some plausible biological reasons, though, why giardiasis and amebiasis could contribute to growth retardation. As mentioned above, the presence of these infections can cause anorexia due to bloating and apathy, which leads to reduced dietary intake. *Giardia* parasites invade an individual's small intestine, and although the exact mechanisms are still not well understood, clinical evidence has shown that *Giardia* infection can cause chronic malabsorption syndrome leading to hypoalbuminemia (an abnormally low concentration of protein in the blood) and loss of vital nutrients, including fat, carbohydrates and vitamins A and B_{12} and folic acid (Solomons 1982; Farthing 1984). Amebiasis can induce colitis, and in the case of systemic invasion can severely deplete body protein stores (Waterlow and Tomkins 1992).

Another line of evidence for investigating growth retardation among this sample of children is the parents' opinions about why they consider their child to be small. As explained in Chapter 3, 40% of the children in the sample (n=283) were deemed to be of "small" size by their mothers when asked to choose whether they were "small", "medium" or "large". Their responses to why they thought their child was small are presented in Figure 6.9. Fifty-nine per cent of children were deemed to be small because of a non-specific illness; an additional 10% were said to be small specifically because of GI problems. Another 9% of children were reported as not wanting to eat (labelled anorexia on Figure 6.9), a state which is known to accompany illness, although there may be other reasons for children not wanting to eat. In total, then, 69% of the mothers believed that illness directly contributed to their children's growth retardation, compared to 12% of the children who were reported to be small because of diet related reasons, including lack of breastfeeding.

Again, there is some biologically plausible reasons why childhood illnesses, particularly acute respiratory infections and diarrheal diseases may in general contribute to growth failure. Solomons et al. (1993) make the analogy between children growing and developing in underprivileged country environments and poultry livestock raised in unsanitary conditions in what they call the "dirty chicken" model. They point out that dirty chicks grow poorly and require antibiotics in their feed to attain growth rates similar to those chicks raised in ultra sanitary conditions. They go on to suggest that frequent infections among children may not only reduce dietary intake, but may also inhibit growth. They base this hypothesis on research which shows that chicks under constant immunologic stress manifest metabolic changes which support immune response and disease resistance and divert nutrients away from growth and skeletal muscle accretion.

Of course, based on this type of model, one should not assume that there is a one-way causal relationship between infections and growth; malnutrition and disease operate synergistically and it is difficult to know the temporal relationship between the two states, i.e. whether malnutrition or disease strikes first. In all probability, the interplay among

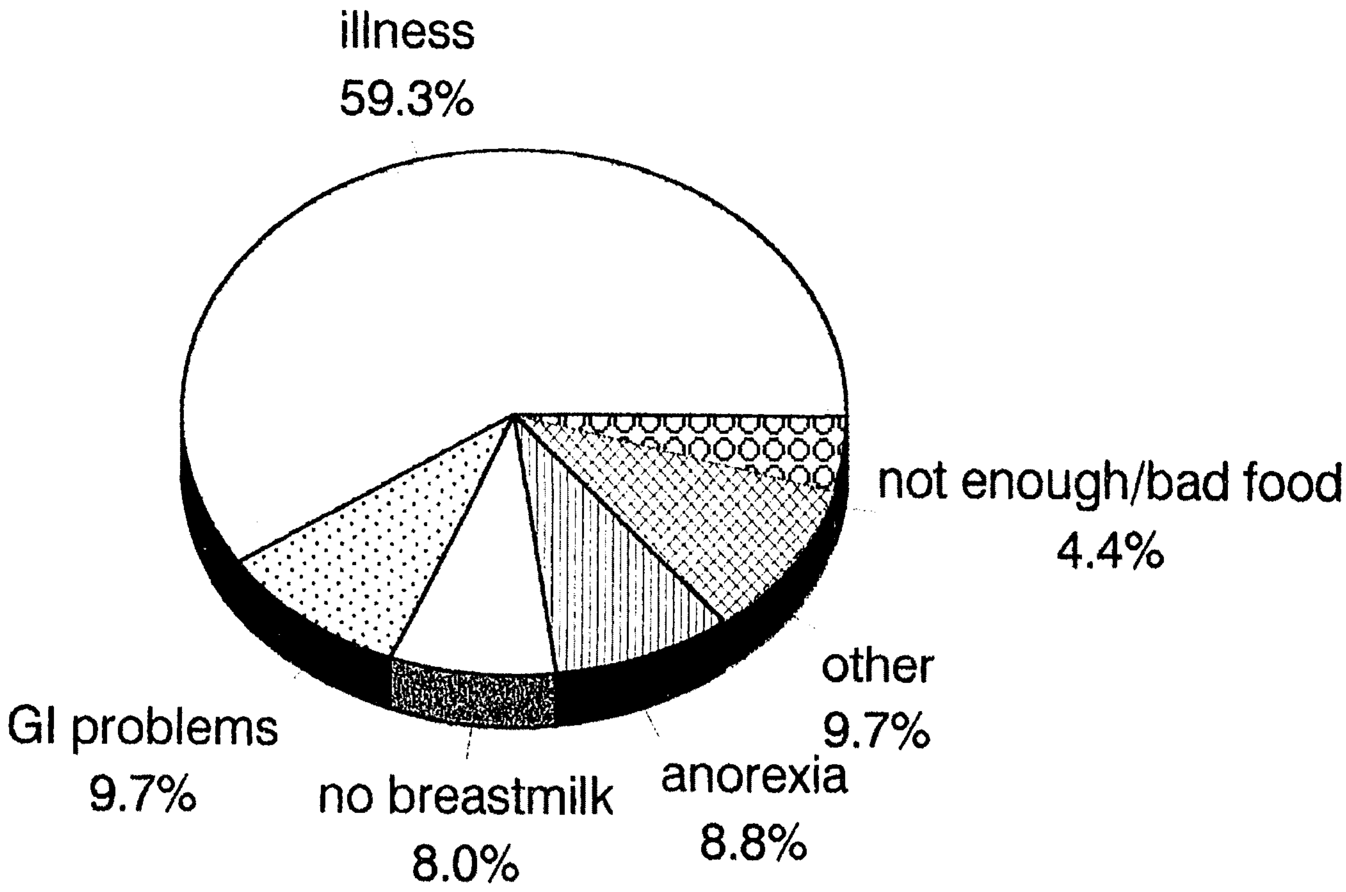


Figure 6.9 Parents' responses to why they think their child is small (N=113).

malnutrition, immune system function and infectious disease is multi-directional and synergistic (Waterlow and Tomkins 1992). This is illustrated by Lutter et al. (1989), who found from their study in Bogota, Colombia that the impact of diarrheal diseases on growth retardation is mediated by children's initial nutritional status and dietary intake. Thus, in all likelihood, the children in this study sample who were already vulnerable because of the difficult transition during the weaning period, were further compromised by a heavy disease load, particularly protozoal gastrointestinal infections.

Health care in Boudha and explanatory models of health

As humans we have developed elaborate systems of health care which we use to counteract and buffer ourselves from the deleterious effects of illness. This is the situation for families in Boudha where parents attempt to use health care to promote the survival and well-being of their children and therefore it is an important part of the social environment to consider when investigating child health and illness.

The health care system in Nepal, as in many other low-income countries around the world, is a pluralistic system consisting of traditional healers, private clinics, international donor agency and government funded public hospitals and clinics, pharmaceutical dispensers, and family home care (Dixit 1995; Justice 1986).

The Nepali traditional healer, or *jankri,* is a healer who offers a combination of spiritual practice and herbal remedies. The *jankri* I interviewed told me that some of his tools of the trade consist of grains of rice for illness divination, medicinal herbs, and Vic's "vapo rub", among others. A *jankri* usually finds his/her calling early in life and practices in the community lifelong. One *jankri* had a shop stall near a cluster of carpet factories that I visited. During the day his wife sold tobacco and fruit while he ministered to the needs of carpet factory workers and others who sought his divination skills and treatment. I observed, over the course of several visits, that his counsel to patients was usually spiritual in nature; often he advised them to attend to various household or natal village Gods, who perhaps had been ignored and had to be given *puja* or ritual worship (Figure 6.10).

The biomedical practices available in the study area consisted of one government funded sub-health centre located in the Ramhiti housing project; the Dakshin Dhoka Rural Health Centre, funded by a Japanese donor agency; and the Shanta Bhawan clinic, funded by an American service organization. Government sub-health posts in Nepal are intended to focus on family planning plus maternal and child health services (Dixit 1995: 73). Ramhiti sub-health post, however, only dispensed birth control, mainly in the form of Depo Provera[19], although it also constituted a location for Ministry of Health child vaccination clinics held for one day every three months. The Japanese and American clinics consisted of a group of doctors, nurses and lab technicians who supplemented their regular practices at private clinics and hospitals by working at these foreign donor agency clinics for poor people. Patients paid a nominal price for medical services. Some mothers only took their children to biomedical centres in cases of extreme illness, in which case they would go to one of the major government hospitals in downtown

[19] Depo Provera is the trade name for medroxyprogesterone, an injectable method of birth control which is taken every three months.

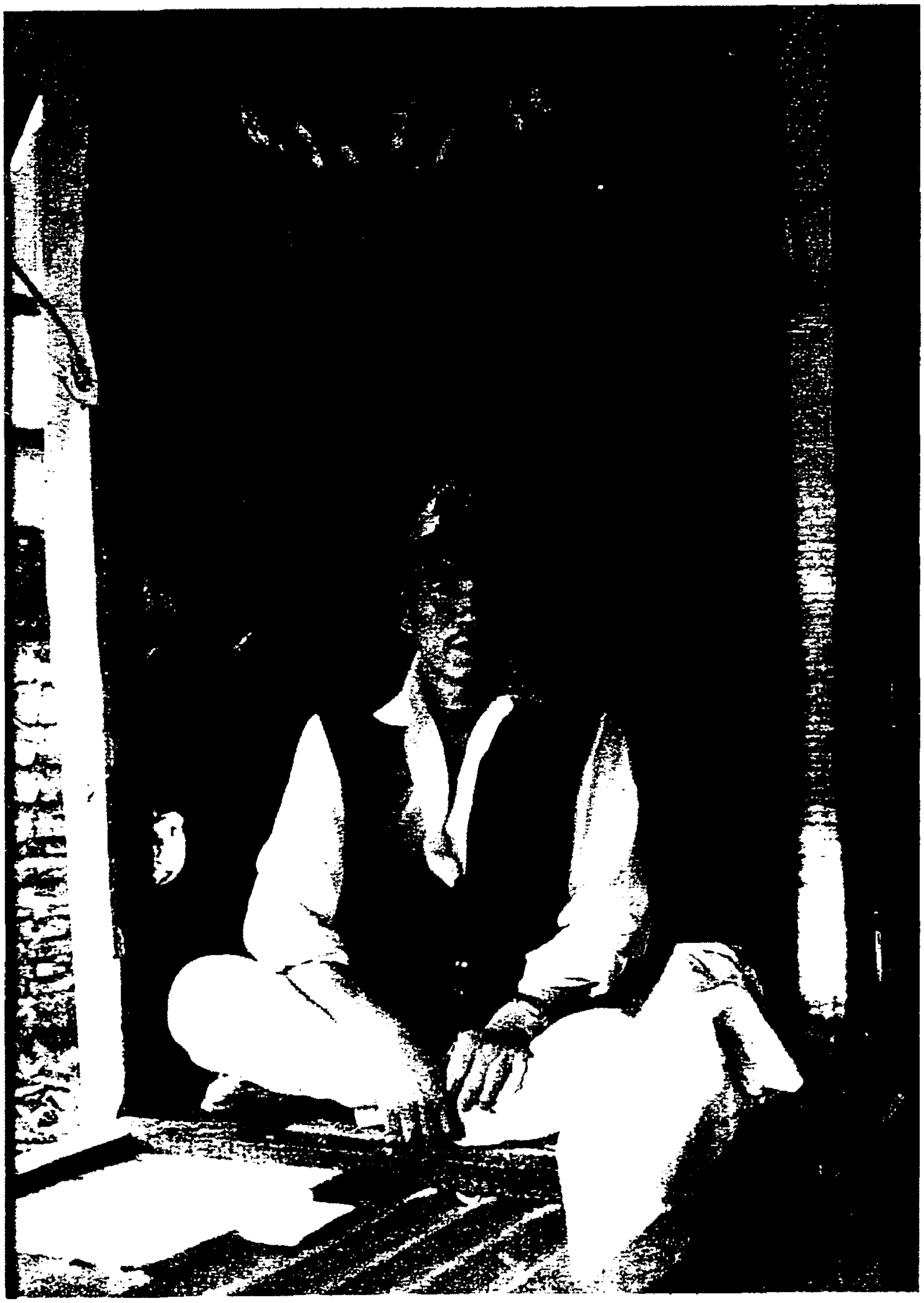


Figure 6.10 *Jankri* sitting in his shop/clinic where he sells his wares and his traditional healing services.

Kathmandu.

People in Boudha are fortunate in that they are close to Kathmandu and have access to major hospitals and clinics that are not available in remote parts of the country. The hospitals and clinics in the city, however, are always crowded and people must spend whole days waiting for service; this means that taking a child to a physician entails not only spending money for transportation to the clinics and for medical services, but also losing a day's wages. Private health care clinics with better service do exist in Boudha, but they are only affordable to middle and upper-income earning Nepalis and were well beyond the means of the families under study in my project.

One of the most popular forms of health care is the pharmacy retail store, called *medical* in the Nepali language. It is usually owned and run by a pharmaceutical dispenser who has taken a short training course (Dixit 1995: 31). Sometimes there are laboratory facilities and doctors who set up their offices in conjunction with these centres, but in the majority of shops, the dispenser alone advises patients as to what medication they should buy based on the reported symptoms. All medications, including antibiotics, are available over the counter without a prescription from a doctor. Thus, with the advice of the dispenser, a patient can treat him or herself without having to pay a doctor to mediate the transaction (Figure 6.11). Many people seem to prefer the dispenser to medical doctors, because they do not charge for their services and they are often integrated in the community and able to relate to the customers on a more personal level. Of course, the disadvantage of this method is that patients can haphazardly treat themselves with medication, which may or may not be appropriate for their particular

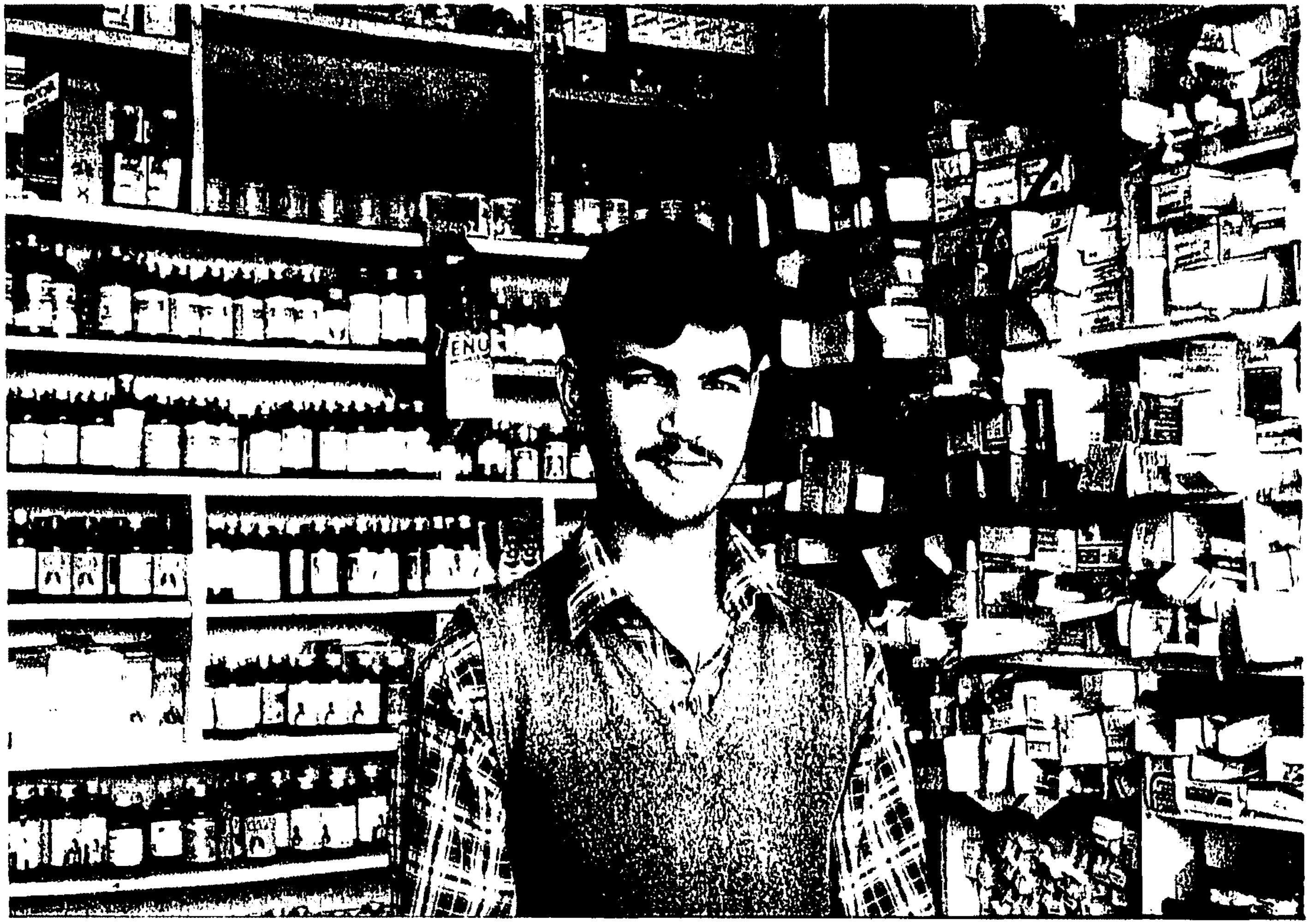


Figure 6.11 Pharmacy dispenser in front of his wide array of medicines for sale.

condition.

Medical anthropologists have demonstrated for some time now that people worldwide have no conflicts in moving from one health care sector to another, seeking alternative treatments either serially or simultaneously (Stone 1992). Medical pluralism was clearly indicated in the health survey when mothers responded to where they take their children when they are ill (Appendix 1). A majority of mothers (60 %) sought out both doctors and traditional healers to treat their children's illnesses; 23% went to doctors only, and 10% went to traditional healers only; a further 7% had been to neither service. During qualitative interviews some mothers explained that they sought the help of traditional healers initially and if the problem did not clear up, they took the child to a clinic or hospital. Others mentioned the reverse order of treatment.

There were several particular illnesses that mothers believed warranted the treatment of a traditional healer. For example, one mother said that if the child's diarrhea was green in colour, then she would take her child to the *jankri*. A child who is *runche* - cries continuously, is generally irritable and does not eat well - would also be a prime candidate for the *jankri*, because the child could be possessed by a spirit or could have lost his/her soul. In general, however, most people are pragmatic about their use of medical systems and they use whatever works.

The following vignette about one of the children from the study sample is based on my field notes and exemplifies some of the difficulties parents have in attempting to effectively care for their children when negotiating the many layers of health care.

Bishnu was a plump, jolly looking eight month old baby when I first met him. He was the adored only son and grandson of an extended family, and he was obviously a great joy to his grandmother. Some ten days later his grandmother told me that Bishnu had a fever and had been vomiting for several days. She said that they had taken him to the Children's Hospital in downtown Kathmandu where they had reported to the doctor that Bishnu was suffering from diarrhea and general malaise. The doctor there gave them metronidazole, a treatment for giardiasis and amebiasis, common causes of diarrhea among children in Nepal. After using this medication for several days and finding that his situation was not improving, the family decided to try another treatment facility. They took him to the Shanta Bhawan clinic in Boudha, where he was given a broad spectrum antibiotic. They were now giving him both types of medicine and found that he was vomiting and not getting any better.

I visited the Shanta Bhawan clinic and spoke to the doctor who had treated Bishnu. He said that they did not find any Giardia cysts in his stool, so they had decided that the diarrhea was being caused by bacteria and prescribed the antibiotic. The doctor said that he had told the grandmother to stop giving Bishnu the metronidazole and to give him the antibiotic for five days instead. Unfortunately, the grandmother had decided to continue on with the metronidazole in addition to the antibiotic and it seems that Bishnu may have become even more ill because of the combination of medications.

The grandmother told me that she thought the illness was originally caused by a chill. They had also taken him to one of the major religious sites in Kathmandu, Swyambu stupa, where they had prayed for him to get better. Some days later I heard that they had seen a jankri who told them Bishnu was possessed by evil spirits. They had performed a ritual which consisted of laying pieces of his hair and dal on the main road in their neighbourhood. The grandmother said Bishnu was feeling much better after that.

Biomedicine has been very effective in Boudha on two fronts. The first is immunization. Government campaigns to vaccinate children include free vaccination clinics, held at local health care centres and government hospitals. A high proportion of children aged over 9 months (88.4 %, n=216) in the sample were vaccinated for all three DPT (diphtheria, pertussis and tetanus) boosters and given oral polio drops. These boosters are given initially at 6 weeks of age and then again two more times at 1 to 6 month intervals. Measles vaccine is given at 9 months of age up to 36 months to children who have not had measles (Adikhari and Krantz 1989). The vaccination coverage for measles was also very good at 79.6% of children over 9 months of age. This proportion compares favourably with the Nepali national measles vaccination coverage of 59% and is in line with the urban coverage of 74% (UNICEF 1995).

As Nichter (1995) points out, vaccination coverage is often successful in Third World countries because of heavy pressure on people from health care professionals rather than because of community demand. Sometimes, however, this strategy breaks down. A minority of mothers in this study sample did not have their child vaccinated, or began the series, but did not return for the second or third boosters. I asked one mother why she did not continue with the series of vaccinations and she told me that now that the child was 18 months old, she did not want to return with him to the clinic because she was afraid that the nurses would scold her for being tardy and negligent. This fear exemplifies some of the strained relations between health care professionals and poor, illiterate mothers, and explains to some degree why these women prefer to seek treatment from traditional healers and pharmacy dispensers. Nevertheless, the vaccination program in Nepal has gone a long way towards decreasing many of the childhood infectious diseases, which in the past contributed to high levels of child mortality. As stated earlier, I observed and heard of only a few cases of measles throughout the study period.

The second impressive biomedical advance is the promotion and use of Oral Rehydration Therapy (ORT) to prevent extreme dehydration from diarrheal diseases. In Nepal the government-made oral rehydration solution (ORS) - a package of crystals composed of sodium chloride, sodium bicarbonate, potassium chloride and glucose, which is dissolved in water (Santosham and Reid 1986) - is called *Jeevan Jal*, literally meaning "life water" in Sanskrit. When asked what they give their child when he/she has diarrhea (Appendix 1), 46% of the mothers said Jeevan Jal, 29% said medicine, and 18% said nothing at all. The remainder of mothers gave their children liquid soups and drinks, herbal medicines, breast milk and a home-made version of Jeevan Jal consisting of salt, sugar and water. According to the national survey, 27% of children in Nepal were given Jeevan Jal during diarrheal episodes, the proportion was higher in the urban areas at 37% (UNICEF 1995).

There is no doubt that the use of ORT is contributing to decreased infant and child mortality from diarrheal diseases. It seems that many people have adopted the treatment due to educational promotions by the Ministry of Health, which advertises Jeevan Jal regularly on Nepal radio. ORS packets, moreover, are readily available at all medical shops at minimal cost. ORT prevents dehydration, which can lead to severe illness and death in some cases; it does not, however, destroy the pathogen that caused the diarrhea in the first place. Some mothers were disappointed by the fact that ORS did not stop their child's diarrhea, which they anticipated would be the end result after giving it to their child.

Despite the excellent vaccination coverage and the reduced mortality from diarrheal diseases, acute respiratory and diarrheal infections continue to plague children under five years of age. Of the 283 children who were measured at least once, three died during the nine month study period. Two children were reported by friends of the family to have died while the families were returning home to their villages, so the circumstances surrounding their deaths are unknown. I did, however, speak to one mother whose three year old only daughter died mid-way through the study.

On my second round in the Dakshin Dhoka area I went to what we called the "Sherpa factory", as it was run by Sherpa people and most of the workers were Sherpas. I asked some workers if they had seen Lakhpa Sherpa, one of the mothers participating in the study. They told me that Lakhpa's daughter had died last month. I was shocked, but finally summoned the courage to seek her out personally to give her my condolences and ask her how it happened. My research assistant and I were confused about what she was saying, but finally pieced together what we thought had occurred. Apparently, the child had had difficulty breathing in the late afternoon, and as the local clinic was closed, they took her to the Children's Hospital downtown. The parents insisted that an x-ray should be taken of her chest, but the doctors refused to do this. They sent them away with a prescription for an antibiotic. That evening the child died, perhaps of pneumonia or maybe she had tuberculosis; the parents did not name the disease. I felt outraged that the hospital had sent them away without treating the girl -- another unreported child death.

Part of the difficulty in managing children's illnesses in Nepal is that parents and health care professionals operate with divergent explanatory models (EMs). A good illustration of this can be seen with diarrheal diseases. In the health survey I asked mothers what they thought caused diarrhea. While 40% of the children's mothers said that they did not know, 32% thought it was contracted through the damp or cold. In addition to belief in malevolent spirits and a cosmic understanding of illness, the principle of hot and cold is a very strong aspect of Nepali peoples' understanding of disease causation and illness.

This hot-cold EM of disease prevails in a variety of ethnomedical theories throughout the world, both in Asia and in Latin America (See Laderman 1987 and Foster 1979 for example). In essence, it is based on a humoral theory of health and illness based on a balance of opposites; in the case of hot-cold principles, both food and surroundings are equated with hot and cold forces which can cause imbalances in the body resulting in illness.

Nepali mothers categorize illness, food and drink according to their heating and cooling properties. For example, when I offered an orange to a child after her mother told me she had an upper respiratory infection, I was told that this was inappropriate food for this kind of illness because it is "cold" in nature (what is also called a cold in English) and oranges are a "cold" food. When I tried to warm the fruit up with my hands, they laughed at me because they considered cold and hot to be not just a matter of temperature, but an inherent property of the food.

It should be pointed out that although the hot-cold principle is common among many different peoples of the world, the exact folk variety of categorization may differ among nations, villages and even families. Stapleton (1989), for example, sent out questionnaires to health workers, both Nepalis and expatriates, who worked with families in rural Nepal to ask them about Nepali beliefs regarding diarrhea causation. Her results show that diarrheal diseases were considered to be both hot and cold diseases. None of the mothers in my sample, however, mentioned the idea that diarrhea could be caused by heat. It is possible, though, that her findings are different because she asked about all age groups, whereas my question referred to children only.

During interviews I asked mothers to explain how cold causes diarrhea among their children. Many of them said that if children sat on the cold floor, the cold/damp would travel up to their stomachs and they would get stomach pains and diarrhea. Cold drinks were also said to precipitate this as well. In addition to cold, 14% of mothers surveyed said that stale or bad food could cause diarrhea. Interestingly, one woman said that food that was cooked in the morning and then left to become cold and served at night would cause diarrhea, thereby conflating both ideas of causation.

The hot-cold understanding of disease is perhaps one reason why ORT has been successfully adopted by many Nepali women. When administering ORT, mothers are advised to boil the water first before adding the crystals. This is recommended in order to sterilize the water, but for Nepali mothers it makes sense in terms of heating and cooling properties. When asked whether they boil water for their children, many mothers stated that they only gave their children boiled water when they were ill to counteract the cold illness. Boiling water is not viewed in terms of prevention to kill bacteria and other pathogens in the water, even though health care workers continuously urge people to practice this, especially during the monsoon months when cholera and dysentery are problematic. Some mothers also explained that their children did not like the taste of boiled water[20]. They never said that they thought it would be a waste of expensive kerosene to boil all drinking water, but I believe that this practice would be an enormous strain on household resources, since kerosene, a necessity for cooking food, is an expensive commodity in Kathmandu.

Despite diverging models of illness, people can conceive and intertwine what seem like very disparate EMs of disease causation. In an interview with one mother, we asked her about diarrheal illness.

> Interviewer: "Before you said, if the baby is frightened, he will have diarrhea. How can this be?"
>
> Mother: "The baby was scared and had diarrhea, he was caught by the evil

[20] See Nichter (1989) for a discussion of similar issues in Sri Lanka.

> spirit, things like that people say. But I don't know. They shit and pee outside. According to the *jankri*, they meet evil spirits and gods; they play games to make children sick with the children's shit and pee."

This woman's explanation nicely illustrates how she views children's diarrhea as caused simultaneously by malevolent spirits and poor environmental hygiene. Although germ theory is not part of mothers' EMs, the EM in the previous example does incorporate environmental sanitation, which is where health care professionals and mothers' beliefs might converge. Regardless of health beliefs, improving environmental conditions is probably the most fruitful approach for reducing diarrheal disease because, as illustrated above, drug treatment usually leads to reinfection and preventative practices such as boiling water or small scale water chlorination schemes are not practical or effective.

Conclusion

It is clear that childhood disease plays a critical role in the lives of children in this community in terms of morbidity and sometimes mortality. Parents are very aware and concerned about the impact that disease has on their children's growth and development; however, they are often unable to treat their children's diseases because of a lack of affordable high quality health care facilities, and because of the problematic environmental conditions that lead to an overwhelming infectious disease burden. Although biomedical technology has been somewhat successful in preventing mortality from these diseases, it is comparatively weak in alleviating morbidity, particularly in regard to diarrheal diseases and ARI.

In addition to undue suffering and disruption of childhood development, infectious diseases contribute to growth retardation among children in Boudha. The ability to quantify the latter directly is hampered by the lack of specific information about the illnesses, their severity and duration. In this study, I tried to be as specific as possible by utilizing only respiratory and gastrointestinal diseases. Using the division "ill" and "not ill" might be too nebulous, as an illness such as "skin disease" may not have any impact on growth whatsoever; nevertheless, further specificity in the diseases is necessary. For example, some studies differentiate between upper and lower respiratory tract diseases, finding the latter illness has a more profound influence on growth (Rowland et al. 1988; Eccles et al. 1989). It is difficult to conduct this type of analysis using maternally reported morbidity data and therefore only the category of "respiratory infection" could be employed. Nevertheless, mean growth among some of the age groups from the sample of children in this study was negatively impacted by the presence or absence of respiratory diseases.

A lack of detailed morbidity data is a problem in many studies of the effects of diarrheal diseases on growth. Although a negative association between the presence of diarrheal infection and linear growth retardation was found for children under 12 months, most of the negative impact for diarrheal diseases is seen in short-term weight loss. It is possible that more of an association between growth stunting and diarrheal diseases could be found with more specific gastrointestinal morbidity data. Most studies have not disaggregated the types of diarrheal diseases that children experience. In particular, they have ignored the differential impact on growth of acute episodes of diarrhea versus chronic diarrhea. The significant negative association between the presence of a protozoic parasite and mean HAZ and WAZ suggests that *Giardia* and *E. histolytica*, prime aetiological agents of chronic diarrhea, may indeed be implicated in chronic growth faltering. Proving direct causality, however, is a methodological challenge, perhaps even an impossibility because of the multi-factorial nature of growth failure.

Finally, it appears that any type of approach that aims to improve the environment that leads to childhood infectious diseases, needs to take into account the complexity of the human ecosystem and its relationship with infectious diseases. Experiments such as testing children living with water a chlorination treatment system for gastrointestinal parasites illustrate that a single factor such as water is not the only agent of disease. No doubt water quality contributes to acute diarrheal diseases caused by bacterial and viral pathogens; however, gastrointestinal parasites, such as worms and protozoa, leading to chronic gastrointestinal illnesses, are more closely linked with sanitation, sewage and food preparation practices. Any investigation of these types of behaviourally related practices requires input from the people who live in this community in terms of their understanding of their environment and how it is in turn related to childhood diseases.

CHAPTER SEVEN

Conclusion: An Environmental Approach to Child Health

The children in this study are located in a specific socio-historical moment in Nepal in that they are part of new generations of migrant families who have come from rural Nepal to Kathmandu to work in the carpet-making industry. Their health issues are unique in that in many cases they have left the poverty of rural villages, but are confronted with new challenges of both urban poverty and the peri-urban environment. In other ways, however, these children's experience of growth and development is all too common to many other children in the low-income nations worldwide. Chronic growth failure in the form of stunting is documented throughout these countries. There is, of course, variation in the degree to which this occurs, depending on the region, the country and the communities within the nations.

Among this sample of children in the peri-urban community of Boudha, growth stunting is common; approximately half of the children between ages 6 and 36 months are less than 2 SD below the NCHS reference median for height-for-age. Longitudinal measurements show that growth velocity is at its nadir between 6 and 24 months of age. Linear growth velocity increases between 24 and 60 months of age, but not enough to make a difference to cross-sectional height-for-age growth status; on average, children are stunted between 24 and 60 months of age. This is also reflected in low upper arm musculature, indicating protein-calorie deficiencies for children over 24 months of age. Thus, these children have experienced chronic growth faltering with little in the way of catch-up growth after they have become stunted. Although wasting, or acute weight loss, generally is not a problem for this sample of children, among 12 to 24 month old children the mean WHZ score does approach -1 SD, a significantly lower mean than for any other age group in the sample. The same finding applies to upper arm skinfold measurements. This may be specific to this cohort of children, but it is more likely to be related to the on-going process of growth faltering, since among one year old children it is the point when linear growth velocity is at its lowest.

Not only does this study document growth faltering among this sample of peri-urban children, it also elucidates mothers' awareness of this health problem. When asked to describe their children's physical state, the majority of mothers in the study classified their children as "small", in agreement with the WHO/CDC categorization of children as growth retarded below the -2 SD cut-off point. This result is gratifying because it means that not only are the biological/medical standards and maternal perceptions in concordance in this situation, but that using a single international reference population is not as ethnocentrically biased towards North American standards as some might believe. I support the continued use of an international reference for growth researchers, and I recommend to international health workers that growth monitoring be used as a tool for both for their purposes and for the benefit of parents.

In trying to understand some of the underlying factors contributing to chronic growth failure, I began by investigating variation in growth status within the sample using maternal and socioeconomic characteristics of the children's families, but found that the most salient predictor of poor growth status for this sample is increasing age of the children from birth to five years. So too, the mother's place of work, be it at home or in a large or small factory, appears to have little influence on children's growth status. Hence, growth failure is a phenomenon common to all of these children, reaching beyond the carpet-factory environment into the wider peri-urban community.

Although socio-demographic and socio-economic characteristics do not significantly affect the growth of the children in this sample, maternal care practices such as infant feeding do. Breastfeeding is initiated and maintained fully by this sample of mothers. Hypotheses that urbanization and/or wage labour for women discourages breastfeeding in all cases are fully discredited by this study. In Nepali society in general, both urban and rural, breastfeeding is supported and encouraged as a natural and healthy practice for mothers and infants. As it is currently configured, the carpet-making industry, moreover, is flexible enough in its labour practices to allow women to maintain both productive and reproductive responsibilities without hampering either activity. With increasing foreign attention on child labour issues in the workplace and pressure on bigger factories to become more "modern" - by organizing labour, maintaining regular work hours, removing all non-workers (infants and pre-school children) from the weaving and spinning halls - women and their children may be in danger of losing some of the flexibility that has allowed breastfeeding and carpet work to be practised concurrently. In 1995, because of worries about boycotts on Nepali carpets due to the use of child labour in the industry, many carpet factories claimed not to allow children under the age of 14 years in the factory compound. Fortunately, this policy was not strictly enforced; if children are forbidden to be present in work areas, their lives may actually be in even greater danger due to their inability to breastfeed on demand. Conversely, if women with young children are unable to work and retain their positions and homes in the carpet factory, there will be a substantial loss of income to families, which ultimately hurts the children. What seems like a natural and proper way of "developing" industry to North Americans and Europeans thus may not be appropriate in a country like Nepal. Certainly, when developing industries in Nepal, especially those like the carpet industry which employs a large number of women, development experts should consider all the ramifications of their policies.

Physicians, public and international health workers are continuously making and revising proclamations about how long women should breastfeed exclusively and non-exclusively, rather than investigating what women are actually doing. In this sample the median age of breastfeeding duration is 36 months postpartum. Half of the mothers who had already stopped breastfeeding their infant at the time of the first survey said that their decision to stop breastfeeding was determined by the timing of their subsequent pregnancy. As there was variation in breastfeeding duration, so too was there variation in the timing of the addition of non-breast milk foods to infants' diets. Infants are not generally fed non-breast milk food before 3 months of age, but between 3 and 7 months there is some variation. None of the infants in this sample was exclusively breastfed past 7 months. There appear to be no other determinants of when a child is first introduced to non-breast milk food other than the mother's appraisal of whether her child needs it or not. Although some might argue that the mother is misguided in this decision, an alternative hypothesis is that mothers' milk really is inadequately supporting the growth of the child or they themselves are physically unable to support breastfeeding practice.

Although mean HAZ and WAZ scores are not detrimentally affected by non-exclusive breastfeeding before 7 months postpartum, mean WHZ is lower for partially breastfed infants compared to exclusively breastfed infants between 3 and 7 months of age, indicating a negative effect. It may be that children, on average, have lower WHZ status because they are supplemented early, or alternatively that mothers may detect growth faltering and then make the decision to supplement their children. The fact that there were no significant differences in mean growth rates for stature and body mass for exclusively and partially breastfed infants indicates that the latter explanation may be reasonable.

By the seventh month of life when all children are receiving non-breast milk foods as part of their diet in addition to breast milk, this issue becomes moot. Interestingly, those who are breastfed beyond 18 months of age have, on average, significantly lower mean WHZ scores and upper arm circumference Z scores compared to those who are completely weaned from the breast and no longer receive breast milk. The fact that the breastfeeders actually have significantly higher mean weight velocities three months after the first survey when breastfeeding status was ascertained suggests that the mothers may continue breastfeeding after 18 months because they deem their child to be too small to survive the complete cessation of breast milk. The lower mean monthly earnings for women who continue to breastfeed suggests that the mothers may need to feed their children the breast milk because they are unable to buy animal milk and other high protein food products and thus breast milk is relied on as an important source of food in the child's diet.

One theoretical conclusion from this research is that women are making rational choices about their breastfeeding strategies that may be more closely related to their perceptions of the features of their local environment and their own health status rather than to the larger forces of urbanization, modernization and economic globalization. This point should be taken into account when investigating global breastfeeding practices and setting WHO guidelines.

Part of the confusion surrounding breastfeeding and weaning is the imposition of a North American (or perhaps an "old school" biomedical model) that they are two discrete processes: that is, that the introduction of non-breast milk food is a replacement for breast milk rather than a complement and that weaning is always an abrupt rather than a potentially gradual process.

Where breastfeeding is virtually universal in a place like Nepal, it is more important to target the weaning process for study and intervention. Even though the amounts of food eaten by the children on the day previous to the first survey were not measured, the variety of food eaten by the children indicates that a substantial number of children aged 12 to 18 months were not eating important food sources such as lentils, vegetables, porridge and nutritious snacks like soya beans and dried corn. Whether this is a problem of being caught between infancy and the stage where a young child can participate in household meals, or whether children are beginning to suffer more regularly from GI infections and are unable to or unwilling to eat all of their food, remains to be answered. As the 12 to 24 month age group stands out in the growth analysis as the only children who show significant signs of wasting, the weaning process certainly merits further attention. This is an area where in-depth dietary intake research is necessary, as well as anthropological research on how these mothers approach this age group in terms of infant feeding practices. This group is an important target for health educators and nutrition intervention projects. Perhaps because breastfeeding has been the focus of attention in international health and anthropology, weaning has been largely ignored and deserves more attention given the importance of the process to child growth and development.

Perhaps equally or more significant than dietary intake, but working synergistically with the influences of infant nutrition during the weaning transition period, is the heavy infectious disease load on these children. Respiratory and gastrointestinal infections are associated with significantly lower mean WHZ scores for some age groups in this study. While respiratory infections affect both infants and older children, diarrheal illness affects only the children under 24 months. Children under 12 months, moreover, have significantly lower mean HAZ scores and mean stature and body mass velocities associated with diarrheal illness at the time of the first survey. These results are noteworthy since children under 24 months are experiencing the lowest mean growth velocities relative to reference standards compared to children over 24 months of age.

Although diarrheal illness in general is shown to be an important determinant of growth, this study more closely examines the types of gastrointestinal illnesses that may be related to linear growth retardation. Approximately 30 per cent of children at the time of the first survey were suffering from diarrhea and some of them had endured it for more than 14 days rendering it chronic in nature. Indeed, the acute bouts of diarrheal diseases caused by such bacterial pathogens as *E. coli*, *Shigella* and *V. cholerae*, common in the hot and monsoon months, may not be the real culprits in terms of chronic diarrheal infections. Stool tests show that some children in this sample are infected with intestinal parasites such as protozoa (e.g. *Giardia* and *E. Histolytica*); they are common among children in this sample in all seasons, not just during the hot and monsoon seasons, and can precipitate chronic gastrointestinal illnesses. A comparison of children with and without protozoa present in their stool tests at the time of the first survey indicates that those harbouring protozoa have significantly lower mean HAZ scores. This indicates that the presence of a protozoal parasite is at least a marker of stunting and may be associated with the stunting process.

There is biological plausibility for this claim. Gastrointestinal parasites interfere with absorption of nutrients during the passage of food through the intestinal tract, weakening the child's ability to garner important macro and micro nutrients from his or her diet. Chronic diarrheal infections suppress children's appetites, further decreasing their food intake. Indeed, mothers frequently complained that their children did not eat at all or ate very little on the day before the survey because their child was ill. When asked why mothers thought their children were small, the majority reported that it was because of illness related reasons, rather than because they thought their children were not eating enough quantity or high quality of food. It has been hypothesized that a heavy disease burden, causing even subclinical infections, can put undue stress on a child's immune system, impairing mechanisms of growth and development (Solomons et al. 1993). Certainly, the children in this study are prime candidates for this sort of effect given the high level of morbidity among them.

Because of the ubiquitous presence of morbidity in terms of respiratory and gastrointestinal diseases in this group of children - but also in many low-income countries worldwide - the issue must be reframed as a concern of environmental health rather than a problem that can be addressed through biomedical intervention alone. Certainly, parasites of the type described here are environmental contaminants which can be eliminated with restructuring of the physical environment. This requires inter-disciplinary work among public health workers, engineers and microbiologists to name a few of the pertinent disciplines. As shown for this study, there are a multitude of different environmental media for pathogens that must be assessed. Water is but one of those, but not the only one, since protozoa and nematodes are contracted by hand-to-mouth contact with excreta as well as via the food borne route of transmission. This then requires a complex rendering of environmental problems which include not only alterations to the physical environment but also behavioural, economic and social changes. This is no easy task, but one in which anthropologists can play a critical role. Unlike nutrition studies, where anthropologists (both biological and social-cultural) have made considerable inroads over recent decades, they have been much less involved in research about infectious disease. While medical anthropologists have contributed enormously to ethnomedical conceptions of illness, biological anthropologists have been involved to a much lesser degree in infectious disease studies.

I think it is important to state here that any debate about whether dietary intake or infectious disease is the more important causal agent in child growth stunting is irrelevant given both the highly interrelated and synergistic nature of the two factors as well as the fact that every situation will be different given its environmental context. For this sample of children, I argue that infectious diseases, particularly gastrointestinal ones, are more important causal agents than dietary ones per se, but this is specific to the peri-urban environment of Boudha in which they have been raised. Although growth stunting may manifest itself similarly in children living in a wide variety of low-income countries, the underlying determinants of it no doubt differ in each individual community.

The health and growth of these children is affected both positively and negatively by different aspects of the urban environment. Certainly, in Nepal, rural poverty is pervasive due to both the diminution and degradation of fertile land and the dearth of health and educational services. Hence, the urban environment offers more resources such as a constant supply of food and other basic needs, not the least of which is the opportunity for a family to take their children to a hospital or clinic for the sake of survival if they are critically ill. In terms of growth and nutritional status, it appears that this sample of children has a prevalence of stunting that is in line with children living in urban regions of Nepal and somewhat lower than those found among rural Nepali children. No doubt the steady supply of food available to children whose parents are working in the carpet-making industry is part of their advantage. It should be pointed out that all of the children included in this study had parents who were earning a living; that is, none of them was destitute.

On the other hand, the children described in this study still have low mean HAZ and WAZ scores and a high prevalence of stunting. Compared to Panter-Brick's (1997) sample of village children, they have marginally better linear growth status but otherwise strikingly similar growth profiles. I argue that this lack of significant improvement in growth is due to the fact that these families face new challenges in the peri-urban environment : a large number of people living in a small area that lacks adequate water and sewage treatment with inadequate housing, resulting in a high pathogen load. These challenges are met with deficient coping mechanisms, such as wages that are stretched to buy food, clothing and health care, among other basic needs.

This study emphasizes the growing need for both local officials in Nepal and other low-income countries and academic researchers to recognize the exigencies of urban habitats. Just like any other ecosystem, they are complex, but unlike some other ecosystems they are changing at a rapid rate. Considerable planning and development of infrastructure, particularly for peri-urban communities, is urgently required. As urban environments are made by people, intervention strategies for child health need to take into account peoples' perceptions of how they think the environment is detrimental to their children's health and how they believe it could be changed to improve it. Certainly, any changes in water quality, sewerage, disposal of waste and housing, must be made at the community level, but they also require the input of individuals and families to implement them successfully.

The determinants of the health of this group of children has been re-cast not as a workplace issue (i.e., the fault of the carpet-making industry) or a problem with maternal care (i.e., working for wage labour or lack of knowledge) or variation in socio-economic status within the sample, but rather as an environmental health issue. This study suggests that in particularly impoverished peri-urban (and perhaps other) environments, macro-environmental factors appear to overwhelm micro-environmental differences.

Research designs that examine micro-factors without taking macro-factors into account are missing a large part of the picture and risk giving a biased view of the problem. For example, had I chosen to focus solely on carpet factory children without comparing them to other children in Boudha, I could have concluded that the carpet factory environment is detrimental to the health of infants and children. Similarly, intervention strategies that focus on micro issues only - such as educating mothers about how to feed their children and take care of them when they are ill - probably do little or no good for mothers and children who face overwhelming difficulties within their local environments. Ultimately, the education and micro development approach amounts to blaming individuals and families for forces which are beyond what can be controlled within their household. That is not to say that household studies are not crucial to the understanding of these issues, but that they must be balanced by views of the larger picture.

APPENDIX I

CHILD MEASUREMENT, NUTATION, HEALTH AND HOUSEHOLD SURVEY (Round I)

IDENTIFICATION:

Number Code of Workplace ________
Name of Mother ________________
Mother's Age__________
Age at Child's Birth_________
Name of Child__________________

Child's Date of Birth Bachchaa ko janmaa miti kati ho? ___________

Age in Years_________ kati bharsa bayo? Months_________ kati mahina bayo? Sex of Child (chora ki chori?)_________

MEASUREMENTS:

weight _____________ kg Notes_______________________________

height ______________ cm

upper arm circumference_____________ cm

triceps skinfold________mm _________ mm _________ mm

1) Birthweight (if known)? Janmanda kati kilo thiyo? _________ kg

2) Do you think your child is healthy? Tapaaiko bichaarmaa tapaaiko nani swastha (nirogi) chha?

Yes ☐ No ☐

3 a) Do you think your child is too big or too small?
Tapaaiko bichaarmaa tapaaiko nani dherai Tulo ki dherai sano ki tikaa?

Tulo ☐ Sano ☐ Tikaii ☐

b) why? kina?

4) Which immunizations has your baby had? Tapaaiko nanile kun kun swihi (kop) lagaae sakhyo?

DPT 1st (2mos) ☐ 2nd (3mos) ☐ 3rd (4mos) ☐
Polio drops with DPT? ☐
BCG ☐ Measles (after 9-15 mos) ☐

5 a) In the past two weeks has your child been sick? Yes ☐ No ☐
Gaeko dui haptaamaa tapaaiko nani birami bhayo?

b) which sicknesses? kun kun rog?_______________________________

Number Code of Workplace____________
Name of Mother____________
Name of Child____________

6a) When your child is sick, where do you take them?
Jaba tapaaiko nani birami hunchha, taba khaa le janu bo? ____________

Doctor ☐ Jankri ☐ Phukne manche ☐

b) When you go to the jankri, why do you go? ____________
Ke hudakheri jankri kahaa lai jaanu hunchha?

7) Has your child had any major illness? Nani naramro songa bhirami bhayo?Yes ☐ No ☐

8) During which months does your child mostly get sick?
Derijaso kun mahinamaa badi biraami hunchha? ____________

9a) Does your child have diarrhea at present?
ahile bachchaalaai pakhala lageko chha? Yes ☐ No ☐

b) How is the stool? disaa kasto chha?____________

c) How many stools per day? ek dinmaa kati paTak disaa lagchha?____________

d) If he is, for how many days? kati din bhayo?____________

e) What do you give to your child to make diarrhea better?
Pakhala rukhna ke dinu hunchha? ____________

f) In your opinion, what is the reason for diarrhea? ke ke kaaran le gardaa pakhala lagchha________

10. Who looks after your child most of the time? Derijaso kosle bachchha hercha?

____

11a) How many children do you have? Tapaaiko kati chora chori hunuhunchha? ______

b) Birthorder of children? Pahilo, dosro, tesro, chautho, pachau, aadi? ________

12. Have any of your children died? Tapaaiko kunai bachchha bityo? ____________

age of child at death? kati bharsa bhayo? ________
boy or girl? chora ki chori? ________
which year? kati bharsa? ________
which disease? kun rog? ________
which month? kun mahinamaa? ________

13 a) Place of Birth? Kahaan jan miko?____________
b) Mother's Place of Birth? Tapaai kahan janmaanu bhaeko? ____________
c) What is your caste/ethnic affiliation? Tapaaiko jat ke ho?____________
d) When did you come to KTM? Tapaai kahile Kathmandumaa aunuubhaeko?____________

14. Where did you give birth to your child? Tapaaiko nani kahaan jan mako?
Hospital, ghar (home) etc?____________

Number Code of Workplace___________
Name of Mother___________________
Name of Child____________________

15a) Did you begin breastfeeding right after your child's birth?
Tapaaile bachcha janmane bittaikai bachchalai aaphno dudh kaawaunu thalnu bayo?

Yes ☐ No ☐

b) If no, why not? kina khuwaaunu bhaena?______________________________

c) Are you currently breastfeeding your child?
Ahile, tapaaiko nanilai aaphno dudh khuwaanuhundai hunu hunchha?

Yes ☐ No ☐

d) If no, when did you stop breastfeeding? Kahile dudh khuwaanuhunu chaDnubhayo?

____

e) Why did you stop breastfeeding? Kina ChaDnubhayo?______________________

f) How many times a day do you breastfeed (including night feeding?)
Dinmaa kati patak dudh khuwaaunu hunccha? rhatti sumat gharara? ___________

16) Usually, who feeds your child? Dheraijaso, bachchaalai kasle khuwaanu hunchha? __________

Number Code of Workplace____________
Name of Mother__________________
Name of Child____________________

17) Yesterday and the day before, what did your baby eat? hijo ra asti ke ke khayo?

	ASTI (2 days ago)	HIJO (yesterday)
chiya tea	______	______
paani water	______	______
dudh milk	______	______

chiya, dudh haleko ☐ nahaleko ☐ ? Do you put milk in the tea?

bhat rice	______	______
daal dal	______	______
tarkari (vegetables)	____________	____________
simi beans	______	______
lactogen infant formula	______	______
cerelac	______	______
DhiDo barley porridge	______	______
roti	______	______
pauroti commercial bread	______	______
chou chou noodles	______	______
biscut cookies	______	______
aanda egg	______	______
masu meat	______	______
phalphul fruit	______	______
dahi yogurt	______	______
makai corn	______	______
baatmaas soya beans	______	______
chiura dried rice	______	______
paap doughnut	______	______

18a) Does your child use a cup or a bottle? Bachchhaale cup ki botelmaa khanchha?

cup ☐ bottle ☐

b) Do you boil the water? paani umaalnu hunchha?

Yes ☐ No ☐

6a) Has your baby had the rice feeding ceremony yet? Bachchha ko pasne bhayo?

Yes ☐ No ☐

Date of Survey________________

CHILD MEASUREMENT, HEALTH, NUTRITION AND HOUSEHOLD SURVEY (Round II)

IDENTIFICATION:
Number Code of Workplace ________
Name of Mother _________________
Mother's Age__________
Name of Child____________________

Child's Date of Birth Bachchaa ko janmaa miti kati ho? ___________

Age in Years_________ kati barsa bhayo? Months__________ kati mahina bhayo? Sex of Child (chora ki chori?)_________

MEASUREMENTS:

weight ______________ kg Notes____

height ______________ cm

upper arm circumference_____________ cm

triceps skinfold________mm _________ mm _________ mm

1) In the last 3 months which immunizations has your baby had? gaeko tin mahinaa bhitraamaa nanilaai kun kun swihi (kop) lagaae sakhyo?

DPT 1st (2mos) ☐ 2nd (3mos) ☐ 3rd (4mos) ☐
Polio drops with DPT? ☐
BCG ☐ Measles (after 9-15 mos) ☐

2 a) In the past two weeks has your child been sick? Gaeko dui haptaamaa tapaaiko nani birami bhayo? Yes ☐ No ☐

b) which sicknesses? kun kun rog?____

3a) Does your child have diarrhea at present? ahile bachchaalaai pakhala lageko chha? Yes ☐ No ☐

b) How is the stool? disaa kasto chha?________________________

c) How many stools per day? ek dinmaa kati paTak disaa lagchha?______________________

d) If he is, for how many days? kati din bhayo?__________________

e) In your opinion, what is the reason for diarrhea? ke ke kaaran le gardaa pakhala lagchha________

Number Code of Workplace___________
Name of Mother___________________
Name of Child____________________

4) How many people live in your household? And who, including children? Tapaaiko gharmaa kati jana chha? ko ko, sapai bachchaa samet?

relation/ nataa chha?	*sex*	*age / umer*	*occupation/ ke kaam garcha?*	*literate/ pardeko*

5) Where did you meet your husband? tapaai ra tapaaiko shriman kahaa betnu bhayo?

____

6) Are you currently breastfeeding your child?
ahile, tapaaiko nanilaai aaphno dudh khuwaadai hunu hunchha? Yes ☐ No ☐

7) Yesterday and the day before, what did your baby eat? hijo ra asti ke ke khayo?

	ASTI (2 days ago)	HIJO (yesterday)
chiya tea	______	______
paani water	______	______
dudh milk	______	______

chiya, dudh haleko ☐ nahaleko ☐ ? Do you put milk in the tea?

	ASTI (2 days ago)	HIJO (yesterday)
bhat rice	______	______
daal dal	______	______
tarkari (vegetables)	________ ____	________ ____
simi beans	______	______
lactogen infant formula	______	______
cerelac	______	______
DhiDo barley porridge	______	______
roti	______	______
pauroti commericial bread	______	______
chou chou noodles	______	______
biscut cookies	______	______
aanda egg	______	______
masu meat	______	______
phalphul fruit	______	______
dahi yogurt	______	______
makai corn	______	______
baatmaas soya beans	______	______
chiura dried rice	______	______
paap doughnut	______	______

Number Code of Workplace____________
Name of Mother__________________
Name of Child___________________

8) At what age did you first give your baby water and tea?
tapaaile tapaaiko bachchha kati umer ko hunda paani ki chiya dinu bhayo?__________

9) At what age did you first give your baby solid food?
tapaaile tapaaiko bachchha kati umer ko hunda saaro khaana dinu bhayo?__________

10) In your opinion what is the best time to start giving your child food other than breastmilk?
tapaaiko bichaarmaa, bachchha laai kati umer ko hunda khaana kuwaaunu ramro hunchha?

____

11a) In one month, how much do you earn? ek mahinaa maa kati paisa kamaauna hunchha?________

b) Before did you spin wool at home? Pahile ghar maa un kaateko? Yes ☐ No ☐

c) Why did you stop? kina tapaaile choDnu bhayo hola?____________________

SPINNER Yes ☐ No ☐

a) How much wool do you spin per day? ek haptaamaa kati un kaatnu hunchha?__________

b) How much money do you get for 1 kg of wool? ek kilo un ko, kati paisa dinchha?__________

c) How many hours does it take to spin 1 kg of wool? ek kilo un kaatna, kati ghanta lagchha?______

WEAVER Yes ☐ No ☐

a) How much do you weave per week? ek haptaamaa kati sq. meter bunnu hunchha?__________

b) How much money do you get for 1 sq. meter? ek sq. meter, kati paisa dinchha?__________

c) How many hours does it take to weave 1 sq. meter? ek sq. meter, kati din lagchha?__________

d) What kind of carpet do you weave? kun kisimko galaichha bunnu hunchha?__________

e) How long have you been weaving? galaicha bunneko, kati barsa bhayo?__________

12a) Do you rent or own your home? tapaaiko ghar aaphno ghar ki deraa?____________

b) If you rent, how much do you pay? deraa chha bhane, kati tirnu huncha?____________

13a) Do you own land in KTM? tapaaiko aaphno jaggaa KTM chha? Yes ☐ No ☐

b) Do you own land in your village? tapaaiko aaphno jaggaa gaumaa chha? Yes ☐ No ☐

14) Do you have a garden? tapaaiko tarkaari baari chha? Yes ☐ No ☐

Number Code of Workplace____________
Name of Mother____________________
Name of Child_____________________

15) Do you have any livestock? gaivastu chha? Yes ☐ No ☐

chicken? kukurra? Yes ☐ No ☐

16) Who else contributes to your household income? tapaai baahek, pariwarmaa ko ko kamaaunu hunchha? ____

17) Do you own a radio? tapaaiko kothaamaa radio chha? Yes ☐ No ☐

18) Do you have a toilet? tapaaiko toilet chha? Yes ☐ No ☐

19) Where do you get your water? paani kahaa bataa aucha?____________________

Date of Survey________________

CHILD MEASUREMENT, HEALTH AND HOUSEHOLD SURVEY (Round III)

IDENTIFICATION:
Number Code of Workplace__________
Name of Mother__________________
Mother's Age____________
Name of Child__________________

Child's Date of Birth? Bachchaa ko janmaa miti kati ho?_______________

Age in Years____________ kati barsa bhayo? Months?__________ kati mahinaa bhayo? Sex of child (chora ki chori?)________

MEASUREMENTS:

weight_______________kg NOTES:____

height_______________cm

upper arm circumference_______________cm

triceps skinfold_________mm ___________mm __________mm

1) In the last 3 months which immunizations has your baby had? gaeko tin mahinaa bhitraamaa nanile kun kun swihi (kop) lagaae sakhyo?

DPT 1st (2mos) ☐ 2nd (3mos) ☐ 3rd (4mos) ☐
Polio drops with DPT? ☐
BCG ☐ Measles (after 9-15 mos) ☐

2 a) In the past two weeks has your child been sick? gaeko dui haptaamaa tapaaiko nani birami bhayo? Yes ☐ No ☐

b) which sicknesses? kun kun rog?____

3a) Does your child have diarrhea at present? ahile bachchaalaai pakhala lageko chha? Yes ☐ No ☐

b) What is the stool like? disaa kasto chha?______________________

c) How many stools per day? ek dinmaa kati paTak disaa lagchha?____________________

d) If he is, for how many days? kati din bhayo?_________________

Number Code of Workplace____________
Name of Mother________________
Name of Child_________________

3) What is the reason for diarrhea? ke ke karaan le gardaa pakhala lagchha?

____

4) Are you currently breastfeeding your child?
ahile, tapaaiko nanilaai aaphno dudh khuwaadai hunu hunchha?

Yes ☐ No ☐

5) Yesterday and the day before yesterday, what did your baby eat? hijo ra asti ke ke khayo?

	ASTI (2 days ago)	HIJO (yesterday)
chiya	____	____
paani	____	____
dudh	____	____

chiya, dudh haleko ☐ nahaleko ☐ ?

	ASTI (2 days ago)	HIJO (yesterday)
bhat	____	____
dhal	____	____
tarkari (ke?)(kati patak)	____ __	____ __
simi	____	____
lactogen	____	____
cerelac	____	____
DhiDo	____	____
roti	____	____
pauroti	____	____
chou chou	____	____
biscut	____	____
aanda	____	____
masu	____	____
phalphul	____	____
dahi	____	____
makai	____	____
baatmaas	____	____
chiura	____	____
paap	____	____

6) Tapaaiko chora chori ko ko chha: Who are your sons and daughters?

sex	*age/umer*	*schoolmaa jancha? Do they go to school?*	*kun class? which grade?*

7) Do you currently weave carpets?
aajaa bholi tapaai galaaicha bunnu huncha? Yes ☐ No ☐

8a) If no, did you weave before?
bundaina bhane, pahile bunnu bhaeko? Yes ☐ No ☐

b) If yes, why did you stop?
galaicha bunnu bhayo bhane, kina tapaaile choDnu bhayo hola?______________________________

9) What other work do you do? aru kaam, ke garnu huncha?______________________________

10) Do you own land in your village?
gaaumaa tapaaiko aaphno jaggaa chha? Yes ☐ No ☐

APPENDIX II

ANTHROPOMETRIC DATA FROM SECOND AND THIRD DATA COLLECTION SESSIONS

Table 1 Mean (± SD) height† and body weight of children 0-60 months measured for a second time (Rounds II or III).

Age (months)	n	Height (cm)	n	Weight (kg)
		MALES		
0.0 - 5.9	2	64.4 ± 1.4	2	7.1 ± 0.8
6.0-11.9	14	69.9 ± 2.4	14	8.1 ± 0.8
12.0-23.9	29	75.9 ± 3.2	30	9.1 ± 1.2
24.0-35.9	13	82.7 ± 3.9	14	10.9 ± 1.3
36.0-47.9	18	86.9 ± 4.6	19	11.7 ± 1.2
48.0-59.9	11	93.5 ± 3.9	11	13.7 ± 1.5
60.0-71.9	3	98.8 ± 8.8	3	15.1 ± 1.8
		FEMALES		
0.0 - 5.9	6	60.1 ± 4.0	6	5.4 ± 1.1
6.0-11.9	15	67.0 ± 2.7	15	6.9 ± 0.6
12.0-23.9	28	74.2 ± 4.1	28	8.4 ± 0.8
24.0-35.9	21	80.5 ± 3.9	23	10.3 ± 1.2
36.0-47.9	18	88.7 ± 4.6	19	12.2 ± 1.1
48.0-59.9	10	93.5 ± 3.9	10	13.5 ± 1.3
60.0-71.9	0	----	0	----

† Length for children under 24 months.

Table 2 Mean arm circumferences(C), triceps skinfolds (Ts) and Upper Arm Areas (UMA) of children 12-60 months measured for a second time (Rounds II or III).

Age (months)	n	C (cm)	Ts (mm)	UMA (cm^2)
			MALES	
12.0-23.9	28†	13.3 ± 1.0	10.1 ± 2.3	8.2 ± 1.7
24.0-35.9	13	13.9 ± 0.9	11.8 ± 2.8	8.3 ± 1.7
36.0-47.9	19	14.0 ± 1.0	12.0 ± 2.6	8.3 ± 1.8
48.0-59.9	11	14.7 ± 0.9	12.5 ± 2.5	9.2 ± 1.3
60.0-71.9	3	15.0 ± 0.6	13.0 ± 3.5	9.5 ± 1.2
			FEMALES	
12.0-23.9	28	13.0 ± 0.8	9.7 ± 2.3	8.0 ± 1.7
24.0-35.9	22†	13.5 ± 0.9	11.4 ± 2.8	7.8 ± 1.4
36.0-47.9	19	14.0 ± 0.8	11.6 ± 1.7	8.6 ± 1.5
48.0-59.9	10	14.5 ± 0.7	12.0 ± 2.7	9.3 ± 1.2
60.0-71.9	0	----	----	----

† There were 29 boys and 23 girls measured for upper arm circumference.

Table 3 Mean (± SD) Z-scores of HAZ, WAZ and WHZ for males and females 0-60 months measured for a second time (Rounds II or III).

Age (months)	n	HAZ	n	WAZ	n	WHZ
			MALES			
0.0 - 6.0	2	-0.51 ± 0.63	2	-0.21 ± 0.27	2	0.14 ± 0.48
6.0-12.0	14	-0.90 ± 0.97	14	-1.09 ± 0.88	14	-0.58 ± 0.99
12.0-23.9	30	-2.30 ± 0.85	30	-2.12 ± 0.91	30	-1.16 ± 0.90
24.0-35.9	14	-1.47 ± 3.40	14	-1.93 ± 0.89	14	0.05 ± 2.96
36.0-47.9	19	-2.30 ± 3.11	19	-2.24 ± 0.66	19	-0.18 ± 2.58
48.0-59.9	11	-2.85 ± 0.86	11	-1.94 ± 0.69	11	-0.37 ± 0.71
60.0-71.9	3	-2.53 ± 1.92	3	-1.74 ± 0.84	3	-0.27 ± 0.44
Total Sample	93	-2.00 ± 2.11	93	-1.89 ± 0.92	93	-0.54 ± 1.79
			FEMALES			
0.0 - 6.0	6	-0.51 ± 0.15	6	-1.17 ± 1.39	6	-0.45 ± 0.80
6.0-12.0	15	-1.44 ± 0.73	15	-1.78 ± 0.69	15	-0.81 ± 0.74
12.0-23.9	28	-2.05 ± 1.03	28	-2.00 ± 0.62	28	-1.09 ± 0.86
24.0-35.9	23	-1.46 ± 3.74	23	-1.97 ± 0.82	23	0.44 ± 3.06
36.0-47.9	19	-1.76 ± 2.98	19	-1.86 ± 0.66	19	-0.18 ± 2.58
48.0-59.9	10	-2.75 ± 1.16	10	-1.82 ± 0.87	10	-0.26 ± 0.57
60.0-71.9	0	----	0	-----	0	----
Total Sample	101	-1.78 ± 2.34	101	-1.87 ± 0.77	101	-0.36 ± 1.97

Table 4 Mean (± SD) Z-scores for triceps skinfolds (ZTR), mid upper arm circumference (ZCIRC) and upper arm muscle area (ZAM) of children 12-60 months measured for a second time (Rounds II or III).

Age (months)	n	ZTR	ZCIRC	ZAM
		MALES		
12.0-23.9	28[†]	-0.10 ± 0.79	-2.32 ± 0.85	-2.17 ± 0.72
24.0-35.9	13	0.60 ± 0.97	-1.82 ± 0.62	-2.38 ± 0.59
36.0-47.9	19	0.79 ± 0.97	-2.10 ± 0.75	-2.21 ± 0.57
48.0-59.9	11	1.23 ± 0.91	-1.81 ± 0.66	-2.62 ± 0.49*
60.0-71.9	3	1.32 ± 1.12	-1.49 ± 0.32	-2.15 ± 0.58
Total sample	71[‡]	0.47 ± 1.01	-2.10 ± 0.78	-2.19 ± 0.65
		FEMALES		
12.0-23.9	28	-0.21 ± 0.73	-2.06 ± 0.59	-1.88 ± 0.75
24.0-35.9	22[†]	0.29 ± 0.96	-2.11 ± 0.66	-2.38 ± 0.59
36.0-47.9	19	0.43 ± 0.58	-1.86 ± 0.58	-2.39 ± 0.63
48.0-59.9	10	0.58 ± 0.90	-1.70 ± 0.44	-2.20 ± 0.43*
60.0-71.9	0	----	----	----
Total sample	79[‡]	0.18 ± 0.84	-1.98 ± 0.60	-2.18 ± 0.67

† There were 29 boys and 23 girls used in calculation of ZCIRC.

† There were 72 boys and 80 girls in the total samples used in calculation of ZCIRC.

* Mean difference between males and females is significantly different at $p<0.05$.

Table 5 Mean (±SD) height† and body wieght of children 0 to 60 months measured for a third time (Round III).

Age (months)	n	Height (cm)	n	Weight (kg)
		MALES		
0.0 - 5.9	0	—	20	—
6.0-11.9	7	70.4 ± 1.2	7	8.2 ± 0.8
12.0-23.9	21	75.9 ± 3.3	21	9.1 ± 1.1
24.0-35.9	12	81.7 ± 4.1	12	10.6 ± 1.0
36.0-47.9	12	87.3 ± 4.5	6	11.9 ± 1.2
48.0-59.9	6	94.0 ± 4.6	3	14.1 ± 1.1
60.0-71.9	3	100.1 ± 8.3	3	14.3 ± 2.4
		FEMALES		
0.0 - 5.9	0	—	0	—
6.0-11.9	7	68.4 ± 3.8	7	7.4 ± 1.0
12.0-23.9	14	74.3 ± 3.9	14	8.2 ± 0.9
24.0-35.9	13	80.8 ± 3.5	13	10.0 ± 1.1
36.0-47.9	10	87.9 ± 5.0	10	11.8 ± 1.1
48.0-59.9	8	94.9 ± 4.2	8	13.9 ± 1.4
60.0-71.9	0	—	0	—

†Length for children under 24 months.

Table 6 Mean arm circumferences(C), triceps skinfolds (Ts) and Upper Arm Areas (UMA) of children 12-60 months measured for a third time (Round III).

Age (months)	n	C (cm)	Ts (mm)	UMA (cm^2)
			MALES	
12.0-23.9	20	13.6 ± 1.1	9.8 ± 3.1	9.0 ± 2.1
24.0-35.9	12	14.3 ± 0.8	10.5 ± 3.1	9.8 ± 2.3
36.0-47.9	12	14.4 ± 0.6	9.9 ± 2.6	10.1 ± 1.4
48.0-59.9	6	14.9 ± 0.7	11.3 ± 3.1	10.2 ± 1.7
60.0-71.9	3	14.2 ± 2.1	11.8 ± 4.3	8.7 ± 1.2
			FEMALES	
12.0-23.9	14	13.0 ± 0.8	9.2 ± 2.5	8.2 ± 1.5
24.0-35.9	13	13.4 ± 0.9	8.3 ± 2.9	9.3 ± 1.4
36.0-47.9	10	13.9 ± 0.6	10.0 ± 2.4	9.3 ± 1.7
48.0-59.9	10	14.5 ± 0.7	12.0 ± 2.7	9.3 ± 1.2
60.0-71.9	0	—	—	—

Table 7 Mean (± SD) Z-scores of HAZ, WAZ and WHZ for males and females 0-60 months measured for a third time (Round III).

Age (months)	n	HAZ	n	WAZ	n	WHZ
			MALES			
0.0 - 6.0	0	----	0	----	0	----
6.0-12.0	7	-1.33 ± 0.49	7	-1.42 ± 0.57	15	-0.62 ± 0.69
12.0-23.9	21	-2.41 ± 1.00	21	-2.16 ± 0.87	21	-1.15 ± 0.98
24.0-35.9	12	-2.25 ± 0.89	12	-1.97 ± 0.70	12	-0.72 ± 0.78
36.0-47.9	12	-2.98 ± 0.93	25	-2.21 ± 0.53	12	-0.70 ± 0.56
48.0-59.9	6	-2.93 ± 1.06	6	-1.83 ± 0.59	6	-0.12 ± 0.51
60.0-71.9	3	-2.42 ± 1.64	3	-2.23 ± 1.02	3	-1.15 ± 0.88
Total Sample	61	-2.42 ± 1.04	61	-2.02 ± 0.75	61	-0.81 ± 0.83
			FEMALES			
0.0 - 6.0	0	----	0	----	0	----
6.0-12.0	7	-0.80 ± 0.83	7	-1.13 ± 0.73	7	-0.62 ± 0.69
12.0-23.9	14	-1.96 ± 0.75	14	-2.22 ± 0.62	14	-1.47 ± 0.64
24.0-35.9	13	-2.68 ± 0.99	13	-2.37 ± 0.75	13	-0.93 ± 0.82
36.0-47.9	10	-2.65 ± 0.87	10	-2.12 ± 0.59	10	-0.66 ± 0.51
48.0-59.9	8	-2.20 ± 0.92	8	-1.52 ± 0.77	8	-0.25 ± 0.65
60.0-71.9	0	----	0	----	0	----
Total Sample	52	-2.16 ± 1.04	52	-1.99 ± 0.79	52	-0.87 ± 0.76

Table 8 Mean (± SD) Z-scores for triceps skinfolds (ZTR), mid upper arm circumference (ZCIRC) and upper arm muscle area (ZAM) of children 12-60 months measured for a third time (Round III).

Age (months)	n	ZTR	ZCIRC	ZAM
		MALES		
12.0-23.9	20	-0.21 ± 1.08	-2.07 ± 0.94	-1.85 ± 0.93
24.0-35.9	12	0.17 ± 1.05*	-1.47 ± 0.59	-1.33 ± 0.72
36.0-47.9	12	0.03 ± 0.95	-1.80 ± 0.34	-1.65 ± 0.47
48.0-59.9	6	0.77 ± 1.14	-1.68 ± 0.47	-2.25 ± 0.63
60.0-71.9	3	0.95 ± 1.40	-1.96 ± 1.16	-2.57 ± 0.32
Total sample	53	0.11 ± 1.09*	-1.82 ± 0.75	-1.77 ± 0.79
		FEMALES		
12.0-23.9	14	-0.38 ± 0.80	-2.07 ± 0.63	-1.78 ± 0.64
24.0-35.9	13	-0.75 ± 1.00*	-2.16 ± 0.71	-1.74 ± 0.72
36.0-47.9	10	-0.14 ± 0.83	-1.94 ± 0.41	-2.11 ± 0.69
48.0-59.9	8	0.00 ± 0.85	-1.53 ± 0.37	-1.66 ± 0.68
60.0-71.9	0	----	----	----
Total sample	45	-0.37 ± 0.89*	-1.97 ± 0.60	-1.83 ± 0.68

* Mean difference between males and females is significantly different at $p<0.05$.

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