MILK PRODUCTION IN CAÑETE, PERÙ: RESEARCH ON CHILD NUTRITION AND HEALTH

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
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To my family

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Malnutrition is a world wide problem affecting children all over the world. It manifests itself in the form of stunted, wasted or underweight children. In Peru, the problem is evident in stunted children. Worldwide research has shown the positive effects animal-based foods have on child growth. Therefore, my study was to analyze the effects on animal-based foods and child growth.

Does the consumption of animal products benefit or improve the health of children? I propose that children who consume animal-based foods and those children whose parents are part of the dairy project will benefit more than non-participant children. The dairy project was from 2002-2005 directed by Dr. Gomez of *Universidad Nacional Agraria La Molina.* Resources and education, when provided to program participants, increases dairy productivity and family wellbeing therefore positively affecting children's health.

Data collection was done at participants' homes from May-June 2005. Research was conducted in Santo Domingo, Peru; a small dairy community with limited resources. Twenty-seven families were analyzed about their household with a development indicator survey. Anthropometric data on height, weight and age of 41 children under than six years of age was gathered.

The results of my study showed a low incidence of wasted, underweight and stunted children in this community and no major difference was found between participant and non-participant children. The consumption of animal-based foods along with the availability of water, household size, location of residence and amount of dairy milk sold all played factors in the positive health of these children.

CHAPTER 1
INTRODUCTION

Statement of Problem

Malnutrition is a complex, multidimensional and interrelated problem. It affects millions of children around the world. Malnutrition causes a great deal of human suffering – both physical and emotional. Adults who suffer malnutrition as children are less physically and intellectually productive and suffer from higher levels of chronic illness and disability. The personal and social costs of continuing malnutrition on its current scale are enormous (Smith 1999).

In the past three decades, Latin America has undergone many transformations that have directly or indirectly influenced the health, nutrition and well-being of children and their families (Bartell 2001). Around 2000, the proportion of the Latin American population who were undernourished was 11% (nearly 54 million persons). Almost 8% of all children under five suffered from low weight for age. Almost 22% of the population suffered from undernutrition in terms of average calorie requirements. Twenty-one percent of the children had moderate to serious chronic undernutrition (Espindola 2005).

Despite significant progress made in health and nutrition during the last decades, a large proportion of Peru's population is still at a nutritional disadvantage. An estimated 18,000 children under five die yearly, more than 80% during the first year of life, often from preventable causes. Twenty five per cent of children under five – some 750,000 children – are stunted. These figures are significantly higher in the rural regions where poverty and a poor environment are constant threats (UNICEF Peru 2006).

Ruminant livestock ownership directly and indirectly affects the nutritional status of children in developing countries. The significant correlation between the quantity of milk consumed by children and the nutritional anthropometric variables corroborates the importance of protein food sources from animal origin to child growth. The nutritional status of children with low consumption of dairy products has been shown to improve with the intake of ruminant animal products (Tangka 2000).

Literature Review

Malnutrition

Malnutrition should not be confounded with undernutrition. Undernutrition and overnutrition are two sides of the same coin, called malnutrition. Several definitions of malnutrition exist. Macronutrient malnutrition results from an imbalanced consumption of energy providing foods, and includes under and overnutrition. Undernutrition is due to insufficient calorie (energy) intake. This is prevalent in many countries and is a major health problem. Overnutrition is due to excess calorie intake which can lead to obesity (Kataki 2002).

Measures of Malnutrition

The combination of inadequate dietary intake of protein energy and micronutrients, and infection, leads to malnourishment. For infants and young children, the extent of malnourishment is quantified by recording the weight, height and age of this population group and comparing them to a "reference population" known to have grown well. The measures of weight, height and age are used to obtain indices on the percent of this population group that are underweight, wasted or stunted (Kataki 2002).

Nutritional anthropometric (body measure) parameters such as weight-for-age (W/A), height-for-age (H/A) and weight-for-height (W/H) are commonly used as bases for assessing malnutrition and evaluating the effects of dietary treatments in children. Weight and height for

age are percentages of adequacy of each of these measurements based on the respective standards for the child's chronological age. Malnutrition is seen in chronic and acute forms. Anthropometric indicators for acute and chronic malnutrition are W/H and H/A standardized z-scores with two or more deviations below reference. Weight-for-age (underweight) is an intermediate measure of malnutrition that combines wasting and stunting. Acute malnutrition or wasting can result from short-term factors such as diseases or severe food shortages. It is most frequent among children below two years of age. Chronic malnutrition or stunting is more common than acute malnutrition, and reflects past food shortages or low food intake and recurring bouts of diseases. It is common among children older than one year of age (Tangka 2000).

Malnutrition usually entails a combination of an inadequate intake of total energy and micronutrients. In children, the most readily measured outcome of malnutrition is poor growth. Growth failure is also due to intake of low quality protein and vital minerals and vitamins. Where the quantity of total food intake is deficient, so is the intake of many micronutrients. The effects of inadequate intake are most pronounced during periods of rapid physiological change and during stages of accelerated growth such as in infancy and early childhood (Neumann 1999).

Others factors for Malnutrition

Apart from insufficient availability of food, child malnutrition is usually also affected by others factors associated with extreme poverty, such as lack of access to drinking water and sanitation. These factors contribute to infectious diseases and diarrhea which result in rapid weight loss. The most usual expression of hunger and poverty among children in Latin America is chronic undernutrition (moderate to serious deficits in height for age, or retarded growth). These deficiencies are serious because they represent the accumulated effect of lack of adequate food and nutrition during the most critical years of child's development (Espindola 2005).

Child Malnutrition in Latin America

Undernutrition (measured as low weight for age) has declined in Latin America, from 21% in 1970 to 6.7% in 1997. However, there is great disparity between Latin American countries. In Chile, Costa Rica and Cuba, less than five percent of the population is undernourished. In Guatemala, Honduras, Haiti, Ecuador and Bolivia, the range is from 15-33% (similar to several African countries). Rates of acute protein-energy undernutrition (measured as low weight for height) are very low in most countries and negligible in some. In a few countries, there is a relatively high rate of stunting (low heights for age), and in others stunting represents a regional problem that is more prevalent among rural populations. Stunting is recognized as an expression of chronic sub-lethal undernutrition (Stuart 1998).

Child Nutrition in Peru

Peru is a geographically diverse country of deserts, mountains, jungle and coast. This results in regionally diverse inequalities in services and living standards. Many programs in the country are unevenly distributed across Peru. This includes health programs (Peru Travel Adventures 2006). Socio-economic disparities and lack of access to health care affect children and adolescents who are not benefiting from the overall economic growth of the country (UNICEF Peru 2006).

In Peru, the prevalence of underweight children declined from 10.7% in 1991-92 to 7.8% in 1996. Wasting does not represent a problem at the national level since it has remained below two percent. The improvement in the nutritional status of children less than five years between 1991-92 and 1996, at the national level, is a decrease in stunting from 31.8% to 25.8% (FAO 2006).

Nutritional Value of Cow's Milk

Overcoming deficiencies in dietary quantity and quality are major nutritional challenges globally, particularly in developing nations. Dietary quantity is concerned with the availability and consumption of total food energy (kcal) and dietary quality with the ability of the diet to supply protein of high biologic value and adequate supplies of micronutrients. The micronutrients of major concern in the growth, development and health of children include calcium and vitamins A and B12 (Neumann 1999).

Animal-source foods are a source of digestible and quality protein and provide energy. They are calorically compact and an efficient source of micronutrients (Neumann 1999). Milk is a source of many nutrients. It is a source of calcium, phosphorous, vitamin B12 and vitamin D. It is also a good source of protein, fat, carbohydrate, vitamin A and niacin (Patton 2004).

However, there are claims that milk is not nutritious and harmful to people's health. It is argued that milk contains many "ingredients" that the consumer is not aware of. These "ingredients" include cholesterol, antibiotics and bacteria. For example, recombinant bovine growth hormone (rBGH) is a non-steroidal hormone injected into dairy cattle to increase milk output. A consequence of this injection is that it increases the growth hormone, IGF-I. IGF-I is thought to be a key factor in the growth and proliferation of cancer. In addition, it is claimed that milk contributes to heart disease and increases the risk of breast cancer (Cohen 1997).

Milk is a food that is mostly marketed for its calcium and its contribution to healthy bones. This is especially true for children because bone mass must be built before adulthood. It is argued that milk is an excellent source of calcium; however proteins in milk and lack of magnesium make it an inefficient source for proper calcium absorption (Cohen 1997).

However, it is generally believed that adequate amounts of milk and milk products are needed throughout the life cycle to promote bone health and contribute to overall health status.

The children in this study were six years or younger. Children in this age range obtain their calcium requirements by consuming milk and milk products. Calcium is needed throughout childhood to maintain existing bone and for bone growth. As discussed earlier, milk provides other important nutrients needed for good health (i.e. protein, phosphorus, potassium, vitamins A, B12, and D, riboflavin and niacin) (Miller 2000).

Vitamin D is an important factor in calcium absorption and metabolism. However, dietary sources are limited. It is essential for a healthy skeleton throughout life. Vitamin D is synthesized in the skin when exposed to sunlight and obtained from some foods (Miller 2000). In the community studied, outdoor exposure is frequent and daily. Activities are performed outside and the children join their parents in the farming activities. Also, these children walk to and from school, walk to and from obtaining water, and play outside. Therefore, sunlight exposure is abundant is this area and could be another explanation for the low incidence of stunting in this population.

Livestock Impacts on Children's Health

Livestock are a major component in agriculture in developing countries and produce much more than food. Livestock and their products provide direct cash income; they are a living bank for farmers and are critical to agricultural intensification via provision of power and manure for fertilizer and fuel. In addition, livestock provide other functions to the livelihood of their keepers. They are a food supply that can provide milk, butter, cheese, eggs and meat. Animal-based foods are high in protein and are an important source of energy, minerals and vitamins (Tangka 2000).

Livestock directly and indirectly affects the nutritional status of children in developing countries. The nutritional status of children with low consumption of dairy products can be improved with ruminant animal product intake. The nutritional status of children may easily be

improved from dairy animals if all the milk produced is not sold. There is a misconception that dietary treatments of growth-retarded children are a waste, since the damage has already been done and cannot be improved upon. Although height is not as responsive as weight to nutritional interventions, there is evidence of rapid response of linear growth during a short period of treatment of malnourished children. Restoration of normal height is possible, up to the age of about 10. It has been found that the majority of the cases that have reported gains in height have been based on the use of milk or soya-based supplements. For children in boarding schools in Papua New Guinea, their growth response was proportional to the amount of milk in their dietary supplement (Tangka 2000).

Ownership of livestock and livestock technologies can give households more opportunities to improve the nutritional status of their children. There is much literature on the effects of animal products (especially milk) and the ownership of ruminant livestock on the nutritional status of children in developing countries. There are examples from Ecuador, Nepal, Uganda and Rwanda of the correlation between dairy animals and child nutrition. In a study conducted in rural coastal Ecuador, access to market foods, as measured by per capita food spending and livestock ownership, mostly cows, showed the strongest correlation with children's nutritional status (H/A, W/A). Children from farm families owning livestock were less likely to be growth retarded than children of farmers without livestock. A study from a rural community in Nepal found that households with a milk-producing buffalo had less chance of having a severely stunted child than households without lactating buffalo. Ownership of a cow was found to be a significant predicator of H/A (long-term) nutritional status in children in south-western Uganda. A study from rural Rwanda found that children between the ages of two and five years old from households with dairy animals (cattle and goats) were significantly taller than children from

households without these animals. The presence of well-nourished children in households with ruminant livestock is probably due to the availability and consumption of high quality protein and calories from dairy products (Tangka 2000).

Further correlation between livestock ownership and its impact on child nutrition has been found in a study in five Latin American countries. One study showed that milk intake is associated with better growth in children during the critical developmental stage from 12 to 36 months of age (Staal 2004). A study conducted in Managua, Nicaragua showed that the proportion of children stunted was lower for those who drank milk on previous day than those who did not. In Brazil, it was found that the consumption of milk increased height-for-age Z-score standard deviation units when selected other factors were controlled for (Nicholson 2003).

The role of milk consumption, both goat and cow, was found in Ethiopia to increase child growth in households raising livestock. Studies in such disparate locations such as China, Jamaica and Mexico found that children who consumed cow's milk or other dairy products obtained significantly greater lengths or heights. In school-age-children, where milk and other dairy product are low, the addition of milk to the diet was found to increase linear growth and reduce stunting. These results were observed in Malaysia and in Japan using school feeding programs. In both studies, rapid growth in height was noted (Neumann 1999). In the Dominican Republic, South Korea, Colombia, Indonesia and Province of Sudan, milk consumption was found to have a positive association with children's nutritional status (Tangka 2000).

Dairy Cows and Child Nutrition in Kenya

Several studies have been conducted on dairy cow ownership and child nutritional status in Kenya. In Kenya, nearly one-third of children showed evidence of chronic malnutrition in the mid 1990s. A major cause of malnutrition in Kenya is inadequate dietary intake, both in terms of quantity and quality. Animal-source foods, including dairy products, are an excellent source of

essential micronutrients and high-quality protein. However, it is unclear whether actual ownership of dairy cattle brings nutritional benefits to the children within a household. A more recent study attempted to shed light on this issue (Staal 2004).

The study was carried out in Coast and Central Provinces of Kenya. The project was carried out by the Smallholder Dairy Project and the Department for International Development of the United Kingdom. Household surveys were given to cattle-owing households and non-cattle-owning households to examine the impacts of dairy cow ownership on the nutritional status of pre-school children. The surveys included anthropometric measurements (including height and weight) of all household children under the age of five. It was found that children from cattle-owing households had a higher height-for-age, indicating lower levels of stunting (Staal 2004).

The benefits brought to the households and children were many. There is an increase in the amount of milk available for household consumption. The sale of milk can increase household cash income, which can then be used to purchase further nutrients. Also, the use of cattle manure may increase food crop yields (Staal 2004).

An additional study in Embu, Kenya by the Global Livestock Collaborative Research Support Program has shown that supplementation with animal-source foods had positive effects on Kenyan schoolchildren's growth and cognitive performance. The effect of milk supplementation was second highest next to meat supplementation (Staal 2004).

One further study conducted in Kenya analyzed dairy cow ownership and child nutrition. This study was done in the coastal and highland areas of Kenya. For the coastal sample, ownership of cattle had a statically significant positive effect on the mean height-for-age for the children of this area. For the highland sample, the cattle ownership has positive effects on

height-for-age as well. Cattle ownership does not have a significant impact on mean weight-for-height for either region. Therefore, cattle ownership has a large impact on longer-term child nutritional status (growth) but little or no impact on short-term nutritional status (Nicholson 2003).

Body Size: Adaptation and Function

Economist David Seckler proposed the "small but healthy" hypothesis. A child who is short but not thin is "small but healthy." Reynaldo Martorell in "Body Size, Adaptation and Function," argues against this hypothesis. A major criterion for judging child's health is whether the child is growing as expected. Failure to grow is an indication that something is wrong. Growth retardation is widely recognized as a response to a limited nutrient supply at the cellular level. The maintenance of basic metabolic functions takes precedence and resources are diverted away from growth and physical activity (Martorell 1999).

Poverty affects growth as poverty affects nutrition and infection. The components of poverty will always lead to low dietary intakes and/or infection which result in decreased nutrient availability at the cellular level which then gives rise to growth retardation. The diets of these children are generally lacking in both quantity and quality. Nutrient metabolism is directly affected by infections which lead to poor nutrient metabolism and nutrient utilization. Therefore, the basic cause of stunting is poverty and the effects on size are mediated through poor diets and infection (Martorell 1999).

In the case of Latin America, moderate linear growth retardation is observed, whereas wasting is rare. At severe levels of deficiency, linear growth ceases altogether and it becomes necessary for the body to use its tissues reserves. These reserves serve as an energy and nutrient source to maintain vital functions. However, in less severe stages, normal mass to length

dimensions will be maintained. Dietary deficits are coped with by slowing down in growth and decreasing physical activity (Martorell 1999).

Peru and Santo Domingo

Peru is located in western South America, bordering the South Pacific Ocean, between Chile and Ecuador (VirtualPeru.Net 2004). It has a population of about 27,562,000 million people (UNICEF Peru 2006). The country is divided into 24 "departments," and the constitutional district of Callao. The capital of the republic is Lima. The official languages are Spanish and Quechua, but a recognized regional language is Aymara (VirtualPeru.Net 2004). Research was conducted in Santo Domingo, a providence of Cañete (Figure 1-1).

Figure 1-1: Cañete, Peru Location. (Canete Government 2007)

The Study: Santo Domingo, Peru

Cañete is a 24,000 ha valley on the west coast of Peru, one of the driest deserts in the world. The land is highly parceled; there are about 5,000 farms and 80% of them are in hands of small landholders (10 ha or less). Usually, small farms are family-centered households, where

the main source of labor comes from family members and the farm and the house are highly interrelated (Cabrera 2002).

The site of this research was in the area of Santo Domingo, Cañete, Peru. Santo Domingo is located in the lower populated area of Herby Alto, in the district of San Vicente, providence of Cañete, in the department of Lima-Peru. There are a total of 54 families in this community in a total population of 152,379 valley residents (Cabrera 2000). Twenty-seven families and their children under the age of six were studied. Dairy production is the main activity for the inhabitants in Santo Domingo.

In the community of Santo Domingo, none of the households have water or electricity in the home. Sanitation conditions are low and diets for the people of this community is limited. However, out of the children studied in this analysis there was low prevalence of stunting. Of participant children, 93% of children were in normal range for their height and age. Of non-participant children, 81% were in normal range for their height and age. This low prevalence of stunting in this community is being attributed to the presence of animal foods in the diet of the children. These foods include meats, eggs and milk. In addition, the low prevalence is also being attributed to other factors such as location of residence, number of times water is obtained, mother's care and household size.

Research Problem and Objectives

The overall purpose of this study was to conduct a cross-sectional study in Santo Domingo, Cañete, Peru. A portion of the inhabitants of Santo Domingo are participants of a dairy program aimed to assist dairy farmers. This program is sponsored by the Universidad de La Molina. The research seeks to establish a baseline anthropometric assessment (height, weight, age) for under-six child growth status of children whose parents are participants of a regional dairy project, compared to those children whose parents are not participants in the dairy project. In addition,

the study provides a rapid ethnographic assessment of "development indicators" at the household level that includes household items and number of livestock owned. An objective of this study is to determine the nutritional impact of this dairy project and the impact of animal-based foods on child health. It is hypothesized that animal products are a daily part of these children's diet and especially for the children of the participant families, therefore the incidence of underweight and wasted children will be low but stunted children will be high.

The general objectives of this research are to: (1) enhance the understanding of the benefits or lack thereof of agricultural change for household nutrition; (2) enhance the knowledge about family livestock ownership and the effects on child nutrition; and (3) examine the nutritional effects of milk and sun exposure on children's health.

Methodology

This field study combined anthropometric data along with an assessment of the development indicators of the household. The study involved 1) measurement of height and weight of children under six, whose parents are participants of the dairy project, compared to children whose parents are not participants in the dairy project and 2) conduct a survey of development indicators at the household level. Nutritional anthropometrics parameters such as weight-for-age (W/A), height-for-age (H/A) and weight-for-height (W/H) were used as bases for assessing malnutrition and evaluating the effects of dietary treatment in the children.

Conclusion

Malnutrition in Peru is present in the form of stunting and in some cases underweight and wasted children. Research has been conducted in several countries around the world that supports the theory that an animal-based diet improves the health status of children. This theory was applied to my research conducted in Santo Domingo, Peru; a small dairy community with limited resources. My study's overall purpose was to conduct a cross-sectional study between

families who are part of a dairy project compared to those who are not. Anthropometric data along with a development indicator survey was performed at each study household to assess the health status of the children in Santo Domingo.

CHAPTER 2
BACKGROUND: PERU, SANTO DOMINGO AND DAIRY FARMING

Santo Domingo, Cañete, Peru: A Milk Producing Region

Lima's Milk Situation

Like other developing countries, Peru has experienced strong urban growth during the last few decades. In 2000, 72% of its 25 million inhabitants lived in cities. Metropolitan Lima alone makes up 30% of Peru's total population. Urban consumer preferences are significant in determining domestic agricultural production, not only in terms of what is produced, but also how and where it is produced. The proximity between the production region and the market thus becomes particularly meaningful for milk, a bulky, perishable product with a high market value (Bernet 2000).

Milk producers on the coast of Lima (such as in Cañete and Santo Domingo) currently have favorable market conditions, as milk prices are much higher than in other regions of the country. Increased competitions among local milk buyers, who are confronted with unused processing capacities, are unable to meet demand from their "local" market in the city of Lima (Bernet 2000).

Cañete and Santo Domingo

Santo Domingo is a province of Cañete. Cañete is a valley in the central coast of Peru within the department of Lima (Cabrera 1999). It is located 62.14 miles south of the city of Lima (Gomez 2002). The valley is irrigated by the Cañete River water. The weather is desert-like; there is little rain. The temperature varies from 53.6˚F in the winter to 89.6˚F in the summer, with an average of 64.4˚F (Cabrera 1999). Average precipitation is 2mm/year (Gomez 2002). There are approximately 150,000 people living in Cañete; 41,000 of them constitute the rural population (Cabrera 1999).

Santo Domingo is an annex of Cañete. Dairy production is the main activity for inhabitants of Santo Domingo. The community borders past the Cañete River therefore vegetation growth stops where the river ends. There are no businesses to purchase household items, feed for the animals, food or to obtain medical care. It is a community of limited resources with no running water, electricity or sewage system in any of the homes. This community differs greatly from the bustle of Cañete. Cañete is filled with local businesses such as a bakery, post office, library, eateries and pharmacies. There is the local open market for the purchase of clothing, household items and food. There is also the local hospital and private doctor offices. Cañete also contains a bus station that operates buses to and from different locations in Peru, especially to and from Lima. Homes and businesses have indoor plumbing and electricity. The differences between Cañete and Santo Domingo are of the basic needs for survival which Santo Domingo's inhabitants and community does not possess.

Arequipa and Cajamarca

Since the 1940s, Arequipa and Cajamarca have been the largest milk producers in the country (Bernet 2000). Arequipa is about 700 miles from Cañete and the second largest city in Peru (Peru Traveler 2006). Cajamarca is around 433 miles from Cañete (Globe Feed 2006). It is located in the northern highlands of Peru. Both cities are well-known for their fine cheeses and dairy products (British Council Peru 2007).

Lima has also remained an important milk-producing region. The reason is its own vast market and the fact that the other two milk areas have high transportation costs for perishable and bulky dairy products taken to the Lima market. The fact that Lima City, with its more than seven million inhabitants, has continued to grow at more than six percent annually in recent years explains its expanding demand for fresh dairy products. Comprising more than 80% of national consumption for industrially processed dairy products, Lima is considered "the market"

for the milk processing industry. Consequently, as a production region, Lima has the advantage in that its market is "next door." It is this geographic advantage that has led to the recent establishment of additional milk processing plants by different companies in peri-urban Lima (Bernet 2000) (Figure 2-1).

Figure 2-1: Cajamarca, Arequipa and Cañete Locations Relative to Lima. (Shunya 2007)

Health in Santo Domingo, Cañete, Peru

None of the homes of the families studied have access to electricity. Families do not have in-home access to adequate water for human or animal consumption. All water is obtained two to three times a week from the *puquio* (natural ground water reservoir) using donkeys and at times horses for the 20-30 minute walk. The water obtained is kept in reservoirs constructed in each household. The water obtained is for human and animal use (Figure 2-2).

Figure 2-2: Santo Domingo, Cañete, Peru. (Author 2005)

Medical personal of Santo Domingo includes one doctor, one nurse, two nursing technicians, and one obstetrician. Demand for medical services in the area does not meet the supply of medical staff. The main problems that affect the population of Santo Domingo include respiratory infections and diarrhea infections. Sharp watery diarrhea infections occur mainly during the summer months. In addition, there is multi-resistant tuberculosis (TB), malnutrition and parasites (Gomez 2004).

Population and Health Statistics

Basic Indicators

Use of anthropometry requires two essential items: an anthropometric indicator and a cut-off point. The indicator, often called an anthropometric index, is a measurement or a combination of measurements made in the field, such as weight and height, or the combination

of measurements with additional data, such as age. Different indices reflect different components of nutritional status. The index weight-for-height indicates thinness, and because acutely undernourished persons generally lose body weight but not height, weight-for-height decreases with acute undernutrition. Young children with chronic undernutrition may not be thinner than normal children, but may have retarded growth in height. Chronic undernutrition may not be severe enough to cause weight loss, but does interfere with normal linear growth. As a result, height-for-age is decreased, and children become stunted. Weight-for-age reflects both acute and chronic undernutrition because both thin children and stunted children are underweight (Woodruff 2000).

There are several indicators used to evaluate the condition of children. Basic indicators and body size indicators are used in this study. Basic indicators used are total population, life expectancy at birth, under-5 mortality rate, infant mortality rate, annual number of births and annual number of under-5 deaths (Table 2-1).

Some definitions are necessary for clarity:

Under-five mortality rate (U5MR) - probability of dying between birth and exactly five years of age expressed per 1,000 live births (UNICEF Peru 2006).

Infant mortality rate (IMR) - probability of dying between birth and exactly one year of age expressed per 1,000 live births (UNICEF Peru 2006).

Life expectancy at birth- the number of years newborn children would live if subject to the mortality risks prevailing for the cross-section of population at the time of their birth (UNICEF Peru 2006).

Statistics from five countries are used to compare to Peru which are Argentina, Bolivia, Colombia, Costa Rica and Mexico. The following are notable:

Costa Rica has the best basic indicators for its population. Out of the five countries analyzed, it had the lowest total numbers for under-five mortality rate of 13, infant mortality rate of 11 and annual number of under-5 deaths at 1,000. Costa Rica has the highest life expectancy at 78 years in 2004.

Bolivia has the highest basic indicators for its population. It had the highest number for under-five mortality rate of 69, infant mortality rate of 54 and annual number of under-5 deaths at 18,000. Bolivian's have the lowest life expectancy at 64 years in 2004.

Infant mortality is used to compare the health and well-being of populations across and within countries. In the developing world, about half of newborn deaths were from infection, tetanus and diarrhea (Green 2006). Peru's basic indicator for U5MR is 29. It is a country still developing and in need of better health care and state involvement. Although not a true indicator of nutritional status, infant mortality rates do give some insight into the living conditions of children in a community. There have been substantial improvements in most Latin American countries, but there still exist disparities among them. Costa Rica, for example, has the infant mortality rate of a developed country, while Bolivia still has unacceptably high figures (Bartell 2001).

The under-five mortality rank is a critical indicator of the well-being of children (UNICEF Peru 2006). Five diseases - pneumonia, diarrhea, malaria, measles and AIDS - account for half of all deaths in children under five. Most of these lives could be saved by expanding low-cost prevention and treatment measures. These include exclusive breastfeeding of infants, antibiotics for acute respiratory infections, oral re-hydration for diarrhea, immunization, and the use of insecticide-treated mosquito nets and appropriate drugs for malaria. Ensuring proper nutrition is also part of prevention, because malnutrition increases the risk of dying from these diseases

(Child Info 2006). Peru's U5MR is 29. As with infant mortality rate, Peru is nowhere near Costa Rica in terms of health care and reducing childhood diseases, but Peru's infant mortality is not as serious as Bolivia's.

Table 2-1 Basic Indicators Latin America Countries (2004)

	Total Population (thousands)	Under-5 mortality rate	Infant mortality rate	Annual no. of births (thousands)	Annual no. of under-5 deaths (thousands)	Life expectancy at birth (years)
Argentina	38372	18	16	685	12	75
Bolivia	9009	69	54	265	18	64
Colombia	44915	21	18	970	20	73
Costa Rica	4253	13	11	79	1	78
Mexico	105699	28	23	2201	62	75
Peru	27562	29	24	627	18	70

Source: UNICEF State of the World's Children 2006

Body Size Indicators

Another indictor used is body size. Body size indicators used are underweight: moderate and severe; underweight: severe; wasting: moderate and severe; and stunting: moderate and severe (Table 2-2). Body size is generally the best indicator of physical well-being in children, because inadequate food intake, poor nutritional quality of the diet, and various infections affect growth. The most common measure of undernutrition in children are weight and height – either individually or combined (Martorell 1995).

Definitions are necessary for clarity:

Underweight: moderate and severe- below minus two standard deviations from median weight for age of reference population (UNICEF Peru 2006).

Underweight: severe- below minus three standard deviations from median weight for age of reference population (UNICEF Peru 2006).

Wasting: moderate and severe- below minus two standard deviations from median height for age of reference population (UNICEF Peru 2006).

Stunting: moderate and severe – below minus two standard deviations from median height for age of reference population (UNICEF Peru 2006).

The same five countries statistics are used to compare to Peru's. The results are:

Argentine and Costa Rica have the lowest occurrence of underweight: moderate and severe for children under five at five percent. Bolivia has the highest at eight percent.

Costa Rica has the lowest occurrence of underweight: severe at zero percent, while all the other countries had an indicator of one percent.

Bolivia, Colombia and Peru all had the lowest indicator for wasting: moderate and severe at one percent. The highest was at three percent for Argentina.

Costa Rica had the lowest indicator for stunting: moderate and severe at six percent. Bolivia had the highest occurrence at 27%.

Table 2-2 Body Size Indicators Latin America Countries (2004)

	Percent of under-fives (1996-2004) suffering from:			
	Underweight		Wasting	Stunting
	Moderate and severe	Severe	Moderate and severe	Moderate and severe
Argentina	5	1	3	12
Bolivia	8	1	1	27
Colombia	7	1	1	14
Costa Rica	5	0	2	6
Mexico	8	1	2	18
Peru	7	1	1	25

Source: UNICEF State of the World's Children 2006

Weight-for-Age

Weight-for-age reflects body mass relative to chronological age. Weight-for-age is also a good indicator of the nutritional state of a child. Weight increases or decreases more rapidly than height. The metrics used for this index are overweight, normal, and undernourished. A child is classified as overweight if s/he is in the range of +2 or greater standard deviations (SD). Normal range is from -2 to +2 SD and undernourished is under -2 SD (Reyes, 2005). Low weight-for-age is described as “lightness” or “underweight.” While high weight-for-age is described as “heaviness” (WHO 1995).

The underweight indicator for Peru was on average the same as other Latin American countries. Low weight-for-age is not as severe a problem in Peru as it is in other regions of the world, e.g. Sub-Saran Africa. The prevalence in 1990 for underweight children was eight percent in South America (Martorell 1995). The share of underweight children actually increased from 28.8 to 31.1 % between 1990 to 1995 in this region of Africa (Smith 1999).

Weight-for-Height

Low weight-for-height and high weight-for-height are two growth indicators for children. *Wasting* or thinness usually indicates a recent and severe process of weight loss. This is usually associated with acute starvation and/or severe disease. It is also possible that wasting is the result of a chronic unfavorable condition. The prevalence of wasting is usually below five percent even in poor countries. Low weight-for-height shows a peak in the second year of life (WHO 1997). Any child with low weight for their height is undernourished (Reyes 2005).

At the opposite end of the spectrum is high weight-for-height. "Overweight" is the preferred term to describe high weight-for-height. There is a strong correlation between high weight-for-height and obesity. However, greater lean body mass can also contribute to high weight-for-height. On a population wide basis, high weight-for-height can be considered as an adequate indicator of obesity (WHO 1997).

The weight-for-height indicator for Peru (1) was on average the same compared to other Latin American countries. Wasting is not a severe problem found in Latin American countries as compared to countries in Asia. High levels of wasting are found in Asia, probably due to lower energy intakes than in Latin America (Martorell 1995).

Height-for-Age

Children with very low height for their age are termed as *stunted*. Low height-for -age is the result of reduced skeletal growth (Keller 1991). High levels of stunting are aociated with

poor socioeconomic conditions and increased risk of frequent and early exposure to adverse conditions such as illness and/or inappropriate feeding practices. Prevalence starts to rise at the age of about three months; the process of stunting slows down at around three years of age (WHO 1997).

Latin American children are often faced with chronic but moderate deficiencies of nutrients. They may respond by growing less in height without altering weight-for-height rations (Martorell 1995). In Latin America, there is high prevalence of chronic malnutrition expressed as stunting. Stunting is always more prevalent in rural populations than in urban ones (Bartell 2001). Peru's stunting indicator at 25% is the second highest behind Bolivia's at 27%. Stunting is a health problem concern for Peru.

This research is based on a dairy project in the area of Santo Domingo, Peru directed by Dr. Carlos Gomez Bravo, an animal nutritionist professor at the *Universidad Nacional Agraria La Molina* in Lima. Fifty-four families in this area are involved in dairy farming as their principal source of income. A sample of 18 small dairy farmers were selected for the project based on the number of dairy cattle owned; however 17 resulted in participating in the project. These farmers had Holstein genotype dairy cows and have been established in the area for the last 10 years (Gomez 2005).

Phases of the Project

Rapid Participatory Rural Appraisal Phases (October 2002-Septemenber 2003)

Phase I of this dairy project consisted of a survey of total producers in the area (three field visits) followed by selection of producers (two field visits) invited to a participatory workshop and follow up project activities (Gomez 2005).

Phase II encompassed a meeting with the farmers on their site with the purpose to have a participatory workshop where they expressed the situation of their production systems (Gomez 2005).

The workshop was carried out in the *Universidad Nacional Agraria La Molina's* nearby research facility in October 2002. The university in 1999 established a nearby research site in Santo Domingo nearby to the farmers of this area. This research site consists of a dairy unit of about 100 cows for the purposes of teaching, research and extension purposes. The Kellogg Foundation funded an extension project which has supported initial activities with dairy farmers of Santo Domingo. In addition, students are involved in various development activities (Gomez 2002).

In this workshop, 20 small farmers participated. The workshop went as follows:

- Presentation was made to the participants.
- Participants were divided into four groups.
- Each group was given paper, pencils and any other needed materials to draw and present their dairy production system.
- Each group presented and explained their production system.

After the presentation of each group, it was established that the negative factor affecting these farmer's production systems were forage availability, livestock management technical deficiencies, lack of water supply and health and reproductive problems.

Eighteen farmers of the 20 were in agreement with the work plan presented. The field activities were finalized and included training in organization and basic record keeping.

Two graduate students also visited the research site twice a month, for 12 months. Data were collected on milk production, herd dynamics, the feed system, reproduction, health and social economic aspects.

Phase III consisted of a meeting held in January 2003 as a follow up participatory workshop. Any project advances were evaluated and any adjustments that were needed were noted (Gomez 2005).

Intervention Phase (October 2003-September 2004)

During October and December of 2003, field visits were conducted to prepare for the intervention phase of this project. Four farmers began using concentrated feed that was prepared at a nearby commercial feed mill. These four farmers were indicated on the appropriate quantity and handling of the concentrated feed during the months of January-March 2004. By July 2004, a total of nine farmers were purchasing the concentrated feed and by the end of the month, 11 families were utilizing the feed. Bulletins were also prepared and distributed among the participants of the project (Gomez 2005).

During this phase, the number of lactating and dry cows in each herd was compared to the previous year and the numbers stayed about the same. Artificial insemination use remained the same, although no specific activity was conducted in order to change this issue. Farmers did however express a high interest in its implementation. In addition, there was no significance difference in the price of milk received from the buyer for milk sold by the farmers. Milk production also remained fairly the same and the costs of inputs (Gomez 2005).

Dairy Production System

The production systems of the participants of this project were established at low potential levels. The participants of this project were established to have a large number of bulls and growing males which limits total milk production and consumption of resources (Gomez 2005). Weight on the dairy cattle was 20-40% below expected body condition and was at an inadequate level for all. Farmers did not maintain records on lactation length, calving intervals or lactating

and dry cattle. In addition, no records on calf mortality, parasites and any other health problems affecting the herds were kept (Gomez 2002).

Families whose property is located closer to the water channel own more cattle than those whose property is located farther away from the channel. Hand milking was observed in all of the units. There is no use of artificial insemination (AI) and each family owns their own bull for reproduction purposes or shares one with the neighbor (Gomez 2002). General difficulty was observed in the availability of appropriate bulls for service. Success of pregnancy is a problem for the herds of Santo Domingo. During an evaluation conducted in May of 2003, the number of cows in the sample was 112 and during the period of evaluation (245 days) 21 calvings occurred. The result is a 19% natality rate. Rectal palpation was conducted and only eight percent of the cows were pregnant. The main problem is lack of ovarian activity due to low body condition in the dairy cattle (Gomez 2005).

In addition, the feed provided to theses herds were of poor quality and limited quantity. Poor quality forage was being fed such as sweet potato foliage and corn stover. Some households were feeding supplementary concentrates to their cattle but it was of very limited amount. Also, there is limited availability of a constant water supply available to these cattle (Gomez 2002).

Most of the income supporting the families in Santo Domino comes from the selling of milk. There is no data to show where money earned from income received goes however the percentages of the expenses related to dairy farming was obtained. Expenses related to maintaining dairy herds are broken down as such: 48% for forage expenses, 28% manual labor, 22% concentrate purchases and one percent each for facilities and other expenses.

Constraints for Gomez's Project Success

Dairy producers of Santo Domingo were restricted to receive financial support and the herd size was a constraint for improvements. With possible intervention of this project, improvements were possible. Possible interventions were the introduction of quality feed and an adequate supply to the cows. This would assist in the undernutrition of the cows in this community. Also, reproductive management needs to be revised in order to tackle the problem of the large number of non-lactating dry cows. Therefore, this project planned to impact these farmers and their herds by an increase in total milk production due to greater milk production per cow and more cows per herd (Gomez 2002).

Goals of Gomez Dairy Project

The main goal of the project was to improve dairying in the Cañete region. The project began in 2002 and operated until the end of 2005. The objectives of the project were to: (1) identify the priorities, constraints and opportunities of selected dairy farmers in the Cañete region; (2) determine the important limiting factors; (3) develop intervention strategies and assess the economic impact of the project; and (4) develop methodologies for recording and demonstrating the economic impact of the project (Gomez 2002).

The objectives of Gomez's project inter-related to my objectives for my research. Both projects aimed to assess the economic impact of the dairy project to this community. As Gomez looked to identify issues that face the dairy farmers, I searched to identify the nutritional issues of this community that could be affected by the limited resources and production of the dairy farmers.

My Research on Santo Domingo Dairy Farmers

The dairy farmers who are part of the Gomez dairy project are labeled as "participant" families for this study. These farmers were selected for this program based on the number of

dairy cattle they owned. The dairy farmers who did not have the number of dairy cattle to meet the requirements of the program are labeled as "non-participant" families for this study. All of participant families rely on dairy farming as their main source of income. Eighty-two percent of non-participant families rely on dairy farming as their main source of income. The 18% of those families who do not rely on dairy farming rely on other sources of income such as working on others farm land.

The price of milk during my study was twenty-five cents (*0.83 centimos/litro*) per liter of milk. An average of 20 liters of milk per day is sold per family. Therefore, families are living off an average of $5.15 per day.

The population studied lives in the rural area of Santo Domingo. Of seventeen families involved in a dairy project monitored by Gomez eleven had children six or under. One family refused to participate in the study. Thus only 10 families were studied. All children (15 in total) under age six in these 10 families were subjects. They were measured for weight and height, and surveys were administered to each mother of the household. The date of birth and sex were also recorded of each measured child.

An additional 17 non-participant families with similar income, education levels and those who had children under the age of six years old were selected randomly. All non-participants owned dairy cattle and dairy farming was the main source of income for the majority. All 26 children under age six in these families were measured for their weight and height. Date of birth and sex were also recorded. The majority of those living in Santo Domingo live in adobe made homes.

Conclusion

Even though Peru over the past several decades has had an improvement in child health, there is still a high incidence of stunting. Peru's wasting and underweight indicators are low

even when compared to other Latin American countries. However, Peru's stunting indicator is high therefore my study assumed a high incidence in the children of Santo Domingo.

Santo Domingo has a population that has limited access to basic necessities such as electricity and water. It is a population where the majority of the families depend on dairy farming as their main source of income. The Gomez project implemented a dairy project to involve eligible dairy farmers to participate in this project and provide services. My study was conducted based on the Gomez project and involved a small sample of the children and families of this area.

CHAPTER 3
METHODS

Data Collection and Design

The study involved: (1) measuring the height and weight of children under six, whose parents are participants of a dairy project compared to parents who are not participants in the dairy project and (2) conducting a survey of development and wealth indicators at the household (HH) level.

Anthropometric and vaccine data for the children in Santo Domingo was collected from the *la posta* (basic clinic facility administered by the Ministry of Health which is located in Herby Alto). All communication was conducted in Spanish.

I introduced myself as a graduate student from the University of Florida and explained what I was researching and read them their rights if they chose to participate in my study (through the informed consent form). I then obtained a signature from the parent who was present. Formal compensation was not specified in the informed consent process or proposal, but customary gifts included photos, candy and clothes for the children, fruit, bread and clothing detergent.

Indicators of Development

The survey administered for this study was for wealth indicators (Indicator 2006). The survey asked about household capital, including the availability of water, electricity and sewage in the home. The health impacts of having these utilities in the home were hypothesized to be very important. Water and sanitation improve child's health and nutrition by decreasing exposure to pathogens, thereby reducing diarrhea and improvements in anthropometric indices in children and reductions in total mortality (Pinstrup-Andersen 1995). Key criteria included in the survey included:

Household capital ownership

- TV
- Iron
- Number of beds
- Stove
- Vehicle (car/truck)
- Refrigerator
- Sewing machine
- Radio
- Bicycle
- Tractor

Amenity Ownership

- Electricity
- Water in house
- Outhouse

Income

- Income from farm
- Income off farm – from source other than farm

The other method used was a survey on the indicators of development. This allows collecting both social and agro-economic data. This survey asked about key indicators of development which are used as a way to measure the effects of project intervention, such as the dairy project (Spring 1995).

Mother and father's age, education and occupation were obtained. Mother's age and education are important to know. Women are the main providers of nutrients and informal health care to their children and other members of their household (Pinstrup-Andersen 1995).

Mother's education has a substantial effect on the child's health and mortality rate even after controlling for major lifetime events and economic status. Previous studies have shown the effect mother's education has on child health. A study done in Uganda on 720 children showed a higher prevalence of stunting among children of non-educated mothers. When all socio-

economic indicators were simultaneously adjusted for in conditional regression analysis, it left mothers' education the only independent predictor of stunting. Children of non-educated mothers are significantly more likely to be stunted compared to those of mothers educated above primary school (Wamani 2004).

A study done in Peru equated improving women's education to improving a community's healthcare facility, water supply and sewage system. The study found that over 25 % of children were stunted and chronically malnourished. These children were from rural community homes where the average schooling for mothers is four years compared to urban mothers with nine years of schooling. This implies that a mother's educational level directly affects a child's nutritional status. In areas with many educated mothers, the entire community's health improves because the mothers share health advice and information (Escobal 2005).

In the present works, the diet of the children was also investigated to see if animal-source foods are consumed in the home. Nutritional status of children may be easily improved from dairy animals if all the milk produced is not sold. Although height is not as responsive as weight to nutritional interventions, there is evidence of rapid response of linear growth during a short period of treatment of malnourished children. Restoration of normal height is possible, up to the age of about 10. It was found that the majority of the cases that have reported gains in height have been based on the use of milk or soya-based supplements. For example, children in boarding schools in Papua New Guinea, their growth response was proportional to the amount of milk in their supplement (Tangka 2000).

Limitations of the Research

It is important to mention the possible caveats of this research project. No geographic region is identical throughout. However, in this community, the households were almost identical. Higher nutritional status or food consumption may be a reflection of preexisting social

economic status (SES) or independent (or actual proceeding) participation. Conversely a decrease in nutritional status and food consumption can reflect the result of the project. The research was conducted during the cold climate time for the coast. Anthropometric data could be somehow affected but it should not be a significant factor.

In addition, there was only one project in progress in this community at the time of this study. Santo Domingo is a small community and in a remote location that there has been little study done on this community. The sample taken for this research was a small sample and a limited amount of data was collected.

The variables analyzed were household nutrition (foods such as milk, animal-sources, vegetables, etc.) and growth indices of children. Independent variables were project participation or not, parent's education and income. Child health under five is a sensitive marker of household and community health, a goal of the project; however due to the limited number of children under five years of age children under six years of age were also included.

Conclusion

Anthropometric data and household indictor data was obtained from 27 families and 41 children in Santo Domingo. Anthropometric data was conducted on children less than six years of age. Development and wealth indicators were used to analyze the households of the children studied. Indicators collected included household and farm wealth capital. Based on the small sample obtained there are limitations to my study. All data contained was utilized to analyze the health situation of the children of Santo Domingo.

CHAPTER 4
RESEARCH DATA

Underweight Indicator: Moderate and Severe

Table 4-1 provides a comparison between Peru, Latin America (LA), Santo Domingo Participants, and Santo Domingo Non-Participants for the underweight indicator: moderate and severe. As mentioned in Chapter 2, a child is considered a moderate and severe case when below -2 standard deviations from median weight for age of the reference population. As the table displays, the Santo Domingo study groups had zero percent of under-fives suffering from moderate and severe underweight compared to the rest of Latin America and Peru who each are at seven percent for this category (UNICEF Peru 2006).

Underweight Indicator: Severe

A child suffering under the underweight category is below -3 standard deviations for their median weight for age of reference population (UNICEF Peru 2006) (Table 4-1).

Table 4-1 Underweight Indicators

	Percentage of under-fives suffering from: Underweight	
	Moderate and severe	Severe
*Peru (1996-2004)	7%	1%
*LA and Caribbean (1996-2004)	7%	1%
**Santo Doming Participants (2007)	0%	0%
**Santo Domingo Non-Participants (2007)	0%	4%

Source: *UNICEF State of the World's Children 2006
**Author 2005

Wasting: Moderate and Severe

The prevalence of wasting is much lower than that of stunting or underweight. The expected prevalence in developing countries is two-three percent. The highest prevalence in the world is South Central Asia (15.4%) and West Africa (15.6%). A child is considered a moderate and severe case when they are below -2 standard deviations for median height for age of reference population (UNICEF Peru 2006). Peru as a whole was at one percent and Latin America at two percent compared to Santo Domingo Participants and Santo Domingo Non-Participants who were both at zero percent (Table 4-2).

Table 4-2 Wasting Indicators

	Percentage of under-fives suffering from: Wasting
	Moderate and severe
*Peru (1996-2004)	1%
*LA and Caribbean (1996-2004)	2%
**Santo Domingo Participants (2007)	0%
**Santo Domingo Non Participants (2007)	0%

Source: *UNICEF State of the World's Children 2006
**Author 2005

Stunting: Moderate and Severe

Stunting that is classified as moderate and severe is below -2 standard deviations from median height for age of reference population. For children less than five years old, a low prevalence of stunting is <20% and 20-29% is a medium prevalence. Latin America is

considered as low prevalence but Peru is considered as medium prevalence region. Peru is still not as high as East Africa which is at 48% for stunting of children under five years old and the highest incidence of stunting worldwide.

As for Santo Domingo, participants and non-participants are considered as low prevalence; however it is substantially lower for the children of those families who participated in the dairy project. (Table 4-3).

Table 4-3 Stunting Indicators

	Percentage of under-fives suffering from: Stunting
	Moderate and Severe
*Peru (1996-2004)	25%
*LA and Caribbean (1996-2004)	16%
**Santo Domingo Participants (2007)	7%
**Santo Domingo Non-Participants (2007)	19%

Source: *UNICEF State of the World's Children 2006
**Author 2005

Feeding of Animal-based Foods

Eighty-five percent of Santo Domingo families feed their children animal products based on the sample diet provided by all those questioned. These animal products include milk, eggs, goat, turkey, chicken, lamb and beef. For families that retain milk produced for family consumption, there is no refrigeration therefore what is retained is consumed daily. Of non-

participating families, 70% give their children milk on a daily basis. Of participating families, 90% give their children milk on a daily basis and 60% give eggs as part of their diet.

All families (participants and non-participants) boiled the water they obtain from the *puqio* when used for drinking and when given to the children. In addition, despite the limited income obtained by these families, 81% take their children to the *posta* (clinic in Herby Alto), doctor or hospital when their children are sick. Children are fed on average three full meals per day. All of the children are taken care of by their mother and in some occasions by their mother and mother's sister.

Some households retain more milk for household use and others sell more. This conduct has an effect on the income from milk sold (Table 4-4) (Table 4-5).

Table 4-4 Participant Families: Milk Sold, Income Obtained and Number of Producing Cows

Participants
Range: $1.02-$15.32
Average: $5.07

HH #	Liters/day of milk sold	Amount sold
100	14	3.58
101	10	2.55
102	20	5.11
103	8	2.04
104	30	7.66
105	25	6.38
106	5	1.28
107	18	5.79
108	60	15.32
109	4	1.02

Source: Author 2005

Table 4-5 Non-Participant Families: Milk Sold, Income Obtain and Number of Producing Cows

Non-Participants
Range: $2.55-$15.32
Average: $5.62

HH #	Liters/day of milk sold	Amount sold
500	none-cheese only	n/a
501	10	2.55
502	n/a	n/a
503	32	8.17
504	11	2.81
505	18	4.60
506	25	4.85
507	20	5.11
508	50	12.77
509	60	15.32
510	28	7.15
511	7	1.79
512	n/a	n/a
513	20	5.11
514	50	12.77
515	34	8.68
516	15	3.83

Source: Author 2005

Milk Production and Needs

Dairy cattle require several components in order for them to produce milk. One dairy cattle can produce 6-7 gallons (23-27 liters) per day of milk. Dairy cattle consume about 100 pounds of feed per day and 25-50 gallons of water per day. They require a balanced diet that consists of hay, grains, protein sources and other vitamins and minerals. In addition, shade and protection from the elements with bedding that is made of wood chips and sand also are required for the caring of and optimum production of milk. In areas where it is hot, sprays misters are used to fan water out to keep the cattle cool (Dairy Farming Today 2007).

The requirements for optimum dairy cattle production are limited to the farmers of Santo Domingo and their dairy cattle. Therefore, the amount of milk produced by the dairy cattle in Santo Domingo is lower due to several reasons. The majority of dairy cattle here are not

provided shade or given protection from the elements. In addition, they are not provided with the usual 25-50 gallons of water needed per cow per day for optimum milk production. Homes in Santo Domingo do not have water and must obtain it from an outside source twice per week. The amount of water obtained and reserved is not sufficient for each cow. The feed given to the cattle is not a mix of a balanced diet but mostly cane shavings, sweet potatoes foliage and corn cobs. This feed is obtained in exchange for labor in agricultural fields. In addition, the cattle are not provided with proper bedding other than sand or cane shavings. Therefore, these dairy producing households could produce more milk if provided with the means to obtain the above necessary tools to achieve optimum milk production. Education and payment alone will not result in optimum milk production.

Santo Domingo Households

Participant Families

The composition of each household was not obtained. However, data collected does show that for participant households, there is a range of 4-10 members in each, with an average of six family members per household. The mothers of the children studied range in age from 18-41 years of age and father's age between 27-46 years of age. All of mothers label their occupation as housewife and farmer. Eighty percent of fathers label themselves as farmers. The range of number of rooms is one to four rooms, with an average of two rooms per household.

Non-Participant Families

The composition of each non-participant household was also not obtained. However, data collected does show that for non-participant households, there is a range of 2-14 members in each, with an average of six family members per household. The mothers of the children studied range in age from 19-37 years of age and father's age between 24-40 years of age. All of mothers label their occupation as housewife and farmer. Eighty-eight percent of fathers label themselves

as farmers. The range of number of rooms is one to four rooms, with an average of two rooms per household. Comparing participant and non-participant households, they very similar in all comparisons.

Participant and Non-Participant Families: Compared Case Studies

Height-for-Age and Weight-for-Age

In each group of participant and non-participant households, there were children who surpassed the healthy range in height for age and weight for age. As previously discussed, the ranges for height-for-age is +2 or greater SD which is classified as tall, normal range is from -2 to +2 SD and stunted is under -2 SD. The ranges for weight-for-age is +2 or greater SD is classified as overweight, normal range is from -2 to +2 SD and undernourished is under -2 SD (Reyes 2005).

The majority of the children in this community are within normal ranges of health for height-for-age and weight-for-age. However, there were children who resulted in figures greater than -2SD or +2 SD. Two families, one from participant and one from non-participant families, had children at extreme levels of health and were thus chosen as case studies. Table 4.6 displays the similarities and differences between these families.

Participant Household Case Study "A"

Participant "A" is a household typical of Santo Domingo. The residents obtain their water from the water reserve as the rest of the community. They obtain water once a week and boil the water before it is given to the children of the household. Income of this household is obtained from the sale of milk and there is no off-farm income. There are no major or minor crops grown. Child care and food preparation is performed by the mother.

Household "A" has limited resources. They do not own a battery operated TV or radio. There are two beds in the home and two rooms. This home is made of straw panels and does not

have a roof. There is no water, electricity or outhouse access. In addition to owing dairy cattle, other livestock owned are six meat cattle, two goats, and four calves. This household's normal residence is in the upper region of Santo Domingo. The environment is harsher in the upper region therefore current residence was with the wife's father at the time of this study. The youngest child had a respiratory infection due to the colder climate compared to their usual residence.

Non-Participant Household Case Study "B"

Non-participant "B" is also typical of families in Santo Domingo. Water is obtained from the water reserve as the rest of the community. The residents obtain water twice a week and boil the water before it is given to the children of the household. Income of this household is obtained from the sale of milk and there is no off-farm income. There are no major or minor crops grown. The mother of this household is responsible for food preparation and child care.

Household "B" owns a battery-operated TV and radio. There are four beds and two rooms. This home is made of straw and cane panels. There is no water, electricity or outhouse access. In addition to owing dairy cattle, other livestock owned are two donkeys, 10 chickens, and four ducks (Table 4-6).

Table 4-6 Case Studies

	# in HH	Material of home	Lactating cows	Milk sold (liters / day)	Surplus milk	# Times child fed/ day	Child's diet	H/A	W/A	W/H	# Under 5 children
Participan A	4	Straw, No Roof	6	8	Family	3	Eggs, Milk	0.37	2.23	2.26	2
Non Participan B	8	Cane, Wheat Panels	5	20	Family	3	Oatmeal, Milk, Bread, Rice, Soup, Eggs	-2.54	-1.62	-0.02	4

Source: Author 2005

Impact of Dairy Project Participation

So what impact did the Dr. Gomez project provide from the participants perspective? The dairy project provided animal care education, concentrated feed at a lower price, and faster payment of milk sold (Table 4-7). Eight of the 10 participants perceived some type of change from participating in this project. The majority of participants' perceived changes associated with knowledge and education on how to better care for their livestock. Not one of the participants commented that the education received or purchase of feed increased their milk production.

In addition, some participants commented that they receive faster payment of the milk they sell. Previously, payment did not come or took up to four months; however at the time of this study, payment was coming in every week. Information was obtained from an employee of Fongal which was the previous dairy *COLLECTIVO* that was collecting and distributing the milk obtained from the Santo Domingo dairy farmers. Fongal was closed at the time when it visited. However, the informant did comment that the administrator of Fongal was stealing money from the company therefore utilities were not being paid and were shut off. Therefore, Santo Domingo dairy farmers were not getting paid for months.

Table 4-7 Dairy Project Impact

Participant's Comments on Dairy Project Impact		
HH #	What Does the Project Provide?	Perceived Changes from the Project
100	Concentrated feed at a lower cost than local sellers	Little change
101	Faster payment, dairy cattle management and education	Faster payment, dairy cattle management and education
102	Animal care education	Animal care education
103	Animal care education	Animal care education
104	Guidance, education and concentrated feed	Better cared of animals
105	Orientation on the care of animals	Orientation on the care of animals
106	Orientation on the care of animals	Better care of animals
107	Animal care education	None
108	Concentrated feed, animal care education	Concentrated feed, animal care education
109	Animal care education	Better understanding of how to raise cattle

Source: Author 2005

In addition, participants of the dairy project were asked what items they possessed before and after the project. All of the participant households had the same items before and after the project. The items that were questioned were the ownership of the following: battery operated TV, iron, number of beds, stove, vehicle, refrigerator, sewing machine, battery operated radio, bicycle and tractor. The project had no effect on the purchasing of household capital.

Relation Between Milk Sold and Child Health Status

Gender Division of Labor

No formal data were obtained on the gender division of labor in Santo Domingo. However, when conducting the questionnaire and obtaining the anthropometric data on the children, activities were observed. In addition, those being questioned would provide information on the gender division of labor (Table 4-8).

Elder males or females were not observed often in this community. When elders were present, the assistance each provided was observed through childcare, obtaining water or obtaining forage for the cattle. Children, male or female, were only observed accompanying their parents to obtain water from the *PUQIO* or if they were very young, they would accompany their mothers to obtain forage and water. Other than obtaining water, children were solely observed attending school and playing with other children. Adult females were those observed the most during the time of this study.

Off-farm work performed was also discussed. This category does not include labor such as weeding, the preparation of farm land, planting or harvesting because none of the families in Santo Domingo are able to produce any crops. The environment is too dry to support any crop life.

Table 4-8 Gender Division of Labor

	Male adult	Female adult	Male child	Female child	Male elder	Female elder
Agricultural Labor	√				√	
Milking		√				
Cleaning		√				
Cooking		√				
Child Care		√				√
Obtaining Forage for Cattle	√	√			√	√
Feed Cattle	√	√				
Obtaining Water from Outside Source	√	√	√	√	√	√

Source: Author 2005

Household and Farm Capital Ownership

When comparing participant and non-participant families to household capital ownership, similarities and some differences are found (Table 4.9).

Table 4-9 Household and Farm Capital Percentage

Percentage of Households with Capital Ownership	TV (battery)	Iron	Stove	Vehicle	Fridge	Sewing Machine	Stereo (battery)	Bicycle	Tractor
Participant	60	0	20	0	0	0	70	0	0
Non Participant	52	5	5	0	0	5	65	11	0

Source: Author 2005

The table displays household capital and the percentage of ownership. No one owns a refrigerator or vehicle. There is low ownership of irons, sewing machines and bicycles. Over than half of households, have battery operated TV and radios. One main difference is stove ownership. There are a greater number of participant families who own charcoal or wood stoves.

As for farm capital, the table shows that no one owns tractors and other farm equipment. The only farm capital documented and visually evident was that of livestock and other small animals for Santo Domingo participants and non-participants (Table 4-10) (Table 4-11).

Horses and burros are used for transportation of people, water, food shavings and other goods. Non-participant households have a greater variety of livestock, as well as higher numbers of ownership.

Table 4-10 Participant Livestock Capital

	Cows Lactating	Cows Pregnant	Meat Cattle	Lamb	Horses	Burros	Chickens	Turkeys	Goats	Calves	Doves
100	2	3	0	3	0	2	0	0	0	0	0
101	4	0	0	5	1	3	7	0	0	0	0
102	4	0	6	0	0	2	0	2	0	0	0
103	6	0	6	0	0	0	0	0	2	4	0
104	6	1	0	0	0	4	6	0	0	0	20
105	3	3	0	7	2	2	10	0	0	9	0
106	2	0	0	2	0	2	0	0	0	2	0
107	6	0	0	7	0	0	0	0	0	3	0
108	3	3	0	0	0	0	0	0	0	8	0
109	1	2	0	0	0	0	0	0	0	6	0

Source: Author 2005

Table 4-11 Non-Participant Livestock Capital

	Cows Lactating	Cows Pregnant	Meat Cattle	Lamb	Burros	Chickens	Ducks	Goats	Calves	Doves	Pigs	Parakeets	Geese
500	3	0	6	6	2	12	0	45	0	0	0	0	0
501	10	0	0	1	2	0	0	2	0	0	0	0	0
502	0	0	0	0	0	0	0	0	1	0	0	0	0
503	3	0	0	0	1	0	0	0	4	0	0	0	0
504	3	3	0	0	3	0	0	0	4	0	0	0	0
505	2	0	5	0	3	2	0	0	0	0	0	0	0
506	1	4	0	0	0	4	27	0	1	0	0	0	0
507	5	3	0	0	2	10	4	0	0	0	0	0	0
508	4	0	0	2	2	5	0	0	2	0	6	0	0
509	6	0	4	2	2	0	0	0	10	0	0	0	0
510	3	5	1	0	2	8	0	0	1	0	0	0	0
511	1	0	0	0	0	4	0	1	0	0	0	0	0
512	1	0	5	0	2	4	0	0	0	0	0	0	0
513	2	0	0	0	2	1	0	1	0	0	1	0	0
514	4	0	1	0	2	0	0	0	0	0	0	0	0
515	4	0	1	0	0	0	9	0	7	3	0	2	3
516	2	2	0	0	2	0	0	0	5	0	0	0	0

Source: Author 2005

Diet

This research study did not investigate in depth the daily diet of this community. However, selected items were mentioned during the part of the questionnaire when asked what the children were fed during the day. Some households mentioned what they fed their children by the meal of the day (Table 4-12).

Table 4-12 Sample Diet of Santo Domingo Children

	Breakfast	Lunch	Dinner	Average # Times Fed/Day
Participants	Breast milk, oatmeal, milk, eggs, potato	Breast milk, beans, rice, salad, eggs, bread	Breast milk, eggs, rice, soup, lentils, meat	3
Non Participants	Oatmeal, milk, eggs, bread	Beans, meat, rice, soup, potato	Rice, fried foods, potato, milk, soup,	3

Source: Author 2005

Conclusion

The data obtained from my study was compared to different factors that could affect the health of children. Data was analyzed for gender division of labor, income received per family, the impact of the Gomez project, farm capital ownership and the diet of the children. All of these factors were analyzed and presented in detail.

CHAPTER 5
RESULTS, CONCLUSIONS AND RECOMMENDATIONS

Results and Conclusions

Although child nutrition and its effects have been thoroughly studied, the inter-relating factors of why some children grow healthier than others are still studied throughout the world. A principal objective of this study was to find a link between feeding animal products and the growth of children whose parents were part of the Gomez Dairy Project in Santo Domingo, Peru. It was assumed that participants of the dairy project would be nutritionally healthier than non-participants. However, the findings did not support the original hypothesis of this study and the reasons why will be discussed in this chapter.

When this study began, it was hypothesized that because animal products were a daily part of the children's diet (especially for the children of the participant families) and that the children appeared physical healthy, the incidence of underweight and wasted children would be low but stunted children would be high. The hypothesis that the number of stunted children would be high is because of the high incidence of stunted children in Peru. It was also assumed that there would be a difference between participant and non-participant children because participant children were part of the dairy project and receiving monetary and educational benefits. As discussed in Chapter 1, the literature supports the notion that there is a positive effect from milk and other animal products on the health of children worldwide. However, no differences were found between participant and non-participant families in terms of child nutrition. Family and physical environment was similar throughout the whole community including the ownership of livestock and especially dairy cattle. The only difference initially found for the participants of the project was weekly payment of milk sold (faster payment of what was previously received). However, faster payments were due to the Gomez researched project and this affected all of

Santo Domingo dairy farmers, and therefore, all farmers received timely weekly payment for milk sold.

It was believed that there would be a high number of stunted children because as discussed in Chapter 2 there is a high prevalence of stunting, especially in the rural areas of Peru. Peru is affected by poor socioeconomic conditions and exposure to adverse conditions such as illness and/or inappropriate feeding practices. Peruvian children are often faced with chronic but moderate deficiencies of nutrients therefore they tend to be "short for their age." It was assumed that the children of Santo Domingo were part of this country-wide health problem. This study shows a low prevalence of stunted children for participant *and* non-participant children. Even with the limited sample of this study and small variation throughout the community, the children of this community were found not to be malnourished. Anthropometric findings show that none of the children, participant or non-participant, were found to be *underweight - moderate and severe* or under the *wasting* category. Ninety-six percent of the non-participant children were found to be healthy under the category of *severe underweight*, and the entire group of participant children was found healthy under this same category. Of the participant children, 97% were non-stunted and 81% of non-participant children were non-stunted.

What was different for the children who were not healthy? As discussed in Chapter 4, several case studies were presented of the children in the undernourished category. These cases showed several factors coming into play. These children were found in households with low and with no daily milk production. There is little income to purchase items for the household. In addition, these households are larger in size and often have more than one child under the age of five. Two families have limited amounts of milk so little is retained for family consumption; one

family produced no milk at all. Also, one family only obtained water once a week compared to twice a week compared to the other households that obtained water.

Therefore, it is conjectured that low milk or animal food consumption may be a factor in the undernourishment of these children; however, it is not the sole cause of why they are unhealthy. It is evident that there are other factors to consider in addition to the intake of animal products. These factors are clean water availability, the number of people in a household, the amount of milk reserved for the household, and for specific family members the amount of other animal and vegetable protein products consumed on a daily basis, the location of residence, the number of young children in a household, and proper mothering skills. Families with healthy children most likely had a combination of the se factors.

The many factors have an effect on child health and development. Water availability can affect the amount of daily clean and fresh water a child is receiving and can prevent dehydration. The environment of Santo Domingo is dry and there is unlimited sun exposure. The children of this community perform the majority of their daily activities outside (e.g., as walking to and from school, assisting in household or farm duties, and playing). The number of residents in a household reduces the amount of food available for each individual of the household especially vital foods such as oatmeal, eggs, milk, legumes, and rice. Any food products, including animal products that contain proteins, carbohydrates, vitamins, etc, affect the growth of children. The closer the residence is to the Cañete River, the closer it is to the water supply which affects feeding livestock. The further away a residence is from the river the drier and colder is the environment and limits the number of times water is obtained, as well as other activities such as washing clothes. Proper mothering skills are one more factor affecting child growth. One of the

households discussed in Chapter 4 where the mother did not properly care for her children well in terms of appearance and hygiene compared with the other mothers interviewed.

What are some reasons why the majority of the children studied are healthier than children in the rest of Peru? Several factors could be involved. Santo Domingo households own a variety of livestock such as cattle and chickens. This allows for a variety in the children's diet that can include eggs, meat and milk. The water given to the children is boiled before consumption to kill bacteria and pathogens. Children are also exposed to sun exposure and therefore get Vitamin D. The diet fed to the children, even though limited, includes foods that provide carbohydrates, fat, and protein.

Future Research

Feeding practices during the first years of life have an important influence on the nutritional status, growth and function in young children (Allen 2001). Hence future studies of Santo Domingo should have additional types of data collected and use some additional methodology compared to this study.

Further investigation would be to obtain a larger sample of Santo Domingo children and household members. A more detailed account of the food bought and food fed to the children would be recorded. Food fed to children should be broken down into categories such as carbohydrates, fats and proteins. In addition, the amount of water or other liquids given to children on a daily basis should be measured or counted. Medical techniques could be incorporated to analyze if any of the children are dehydrated. A food intake survey could be given to each household member.

Other areas of Peru without livestock could be analyzed and compared to Santo Domingo to see if the difference in health is the presence of animal products in the diet. The La Molina dairy unit discussed in Chapter 2 would be a good comparison area to live at because it is located

in Santo Domingo and allow for direct observation of the households. A further study could include interviewing the elders of the community and questioning changes they have observed over time in the community. In addition, research should include fertility and natality histories of women.

This study could have also analyzed different hypotheses. Other hypothesis that could have been researched is, does a greater number of livestock household make a household better off? Are children in larger household sizes worse off nutritionally? Did participants of the dairy project negatively affected by the project?

Applied Recommendations to Increase Child Nutrition

Given the poor economic situation of the Santo Domingo families and their children, is it reasonable to recommend that their children continue to consume animal products? The answer is that this will continue for these families because dairying is their source of income and food.

Strategies to improve and continue the consumption of animal products in Santo Domingo include:

- Educating the mother to target small amounts of animal products (such as liver and meat) to her young children
- Encouraging consumption of cheaper animal products (e.g., eggs, fish, dried milk)
- Supporting home production of small animals such as fish and birds
- Giving fermented rather than fresh milk because refrigeration is not needed (Allen 2001)

It is further recommended that a community-wide dairy program/project be implemented to provide animal care education. Provide nutrition workshops to the families on the importance of feeding animal products, legumes and oatmeal. Provide hygiene workshops to teach the need of a daily and clean water supply.

The children and the families of Santo Domingo even with their limited amount of resources have been able to provide a basic nutritional environment for their children. The

recommendation of a community well or water supply in close proximity and a safe source of water for cooking and drinking purposes should be implemented. There should be some type of sewage system for the proper management of human waste. There would even be a recommendation for the neutering/spaying of the dog population presently in Santo Domingo to reduce the risk to livestock and spread of dog waste and diseases.

Conclusion

The findings of my study did not support the original hypothesis proposed. There was low incidence of stunted children and the children were found not to be malnourished. Animal-based foods was not the only factor affecting the health of the children of Santo Domingo; other factors were found to have an effect such as household size, mother's care, location of residence and water availability. Therefore my study gives indication that further research is needed in the community of Santo Domingo and that not only diet but environment affects the health of children. The proper interventions and programs can support the health of all children around the world including those of Santo Domingo.

APPENDIX A
ANTHROPOMETRIC DATA SHEET

Anthropometry
Study of Nutrition and Health -- 2005
Cañete, Peru
University of Florida – English Translation Code: __ __ __

Date: _____

Hour: _____

Measurement by: _____

Name of the objective child: _____

Name of the mother: _____

Name of the father: _____

Sex: ____ 1. Male ____ 2. Female

Date of Birth: _____ / _____ / _____ Age: _____ in months

Height and Weight of the Child:

Size (cm): ____ ____ ____. ____

Weight (kg): ____ ____ ____. ____

Recumbent measurement _____
(Check if YES)

APPENDIX B
DEVELOPMENT INDICATOR SURVEY

Study of Nutrition and Health – 2005
Cañete, Peru
Date: _____
Code: __ __ __
University of Florida
Survey of Development Indicators (English Translation):

A. HH SIZE AND COMPOSITION

- # in HH: _____

- Relationship Age Gender Yrs Schooling Occupation

*1.
2.
3.
4.
5.
6.
7.
8.

B. HH CAPITAL

-Do you own the following?

	Before Project	Now
1. TV		
2. Iron		
3. Bed (s)		
4. Stove		
5. Car		
6. Truck		
7. Refrigerator		
8. Sewing Machine		
9. Stereo		
10. Bicycle		
11. Tractor		

- # of rooms in the home? _____
- Material home is made out of? _____

- Do you have in your home…?

___ Electricity
___ Water (If answer is NO then ask next question)

___ Toilet (sewage system)

- If *NO WATER* is in the home…

From where is it obtained?_____
How often is it obtained? _____

Do you boil the water to drink? ___ Yes ___ No
Is it boiled for when given to the children? ___ Yes ___ No

C. INCOME

Sources of income:

- On farm income: _____

_____

- Off farm income: _____

_____

Amount of milk sold _____

Current price of milk sold_____ per _____

Surplus of milk what is done with it? _____

D. PROJECT SERVICES

What does the project provide to you?

_____

_____

Perceived changes as a result of the project?

_____

_____

E. LAND AND CROP INFORMATION

- Land size: _____

- Ownership of Land Status: _____

-Major Crops Grown: _____

_____

-Minor Crops Grown: _____

_____

F. FARM CAPITAL

- Types of animals owned	# Owned	Purpose
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

G. DIET OF CHILDREN

-Basic diet of child (ren) for breakfast, lunch and dinner? (B)_____ (L)

_____ (D) _____

-Basic diet of child (ren) when sick?

_____

- How often child (ren) are fed?

_____

- What is done with child (ren) is sick?

_____

- Who is main caregiver to the child (ren)?

_____

- Who prepares their food?

_____

APPENDIX C
ANTHROPOMETRIC DATA

Table C-1. Participant Child Anthropometric Data

ID #	Gender	HT/AGE	WT/AGE	WT/HT
100	F	0.29	0.70	0.78
101	M	0.49	1.81	1.93
102	F	-0.53	0.47	0.93
103	M	0.04	1.48	1.79
104	M	-0.20	0.24	0.46
105	F	-1.27	-0.88	-0.28
106	M	-2.46	-1.07	0.61
107	F	-0.58	-0.58	-0.10
108	M	-0.76	-0.32	0.26
109	F	-0.45	-1.92	-1.99
110	M	0.14	1.28	1.60
111	M	0.37	2.23	2.26
112	M	0.70	1.02	0.71
113	M	-1.69	-1.27	-0.01
114	F	0.29	-0.42	-0.51

Table C-2. Non-Participant Child Anthropometric Data

ID #	Gender	HT/AGE	WT/AGE	WT/HT
500	M	1.63	2.21	1.2O
501	M	-1.00	0.26	1.07
502	M	-1.49	-1.76	-0.90
503	F	-2.17	-0.81	0.67
504	M	-1.84	-0.70	0.64
505	F	-1.03	-0.50	0.15
506	F	-0.32	-1.17	-1.22
507	F	-2.48	-1.10	0.52
508	F	0.27	1.05	1.23
509	M	-1.43	-0.60	0.36
510	F	-1.63	-0.31	0.78
511	M	1.55	1.59	1.09
512	F	-2.30	-3.29	-2.89
513	F	-1.90	0.35	1.97
514	F	-0.66	0.21	0.70
515	F	-0.46	0.29	0.71
516	M	-1.90	-0.08	1.10
517	F	0.70	2.98	3.19
518	M	-1.85	-0.23	1.35
519	M	-2.04	-0.31	1.04
520	F	-2.54	-1.62	-0.02
521	F	-1.61	-0.71	0.29
522	F	-1.76	-0.67	1.05
523	M	-1.59	0.06	1.51
524	M	-1.38	-0.53	0.53
525	F	-1.69	-1.20	-0.20

APPENDIX D
VITAMINS IMPORTANT FOR THE GROWTH OF CHILDREN OBTAINED FROM ANIMAL PRODUCTS

Calcium

In the case for children, calcium is an important nutrient for growth. It is difficult for a child to even approach the average calcium requirements (around 345 mg/d) on a cereal-based diet (Neumann 1999). Milk is the major dietary source of calcium for bone growth. Calcium not only builds bones and teeth, it is utilized in essential functions all over the body. Infants undergo growth and development for many years. Disposition of calcium into bones continues until the third year of life (Patton 2004).

Vitamin D

Vitamin D is also an important nutrient for children. It is a requirement for the digestive absorption of calcium. Proper development and mineralization of the human skeleton requires this vitamin. The human body requires exposure to sunlight to generate vitamin D from 7-dehydrocholetrol, a precursor in the skin. It is the ultraviolet component of sunlight that accomplishes this reaction. Vitamin D produced by this means is effective in meeting the body's needs for the vitamin. (Patton 2004).

Vitamin A

Vitamin A deficiency leads to high cases of blindness and high infant and child mortality. Around 40 million children suffer from vitamin A deficiency and about 35,000 infants and young children are blinded annually. It is important for maintaining the structure and function of the cornea and lens and produces necessary components for night vision. Vitamin A also plays a role in resistance to infection through multiple functions; mechanical barriers against invasion of pathogens and maintain a role in immunity. Animal-source foods, especially milk, are an excellent source of pre-formed vitamin A (retinol) (Neumann 1999).

Vitamin B12

Animal-source foods are nearly the sole source of vitamin B12 for humans. In developing countries, mal-absorption of this vitamin is present because due to a wide variety of infections and intestinal parasites in all ages. Vitamin B12 deficiency affects the hemalogic system, the nervous system and immune function. Vitamin B12 is found in eggs and dairy products among other animal food sources. The prevalence of B12 deficiencies in developing countries is not well documented, but is probably widespread where consumption of animal products is low or absent. There is a need for the study of the prevalence of vitamin B12 deficiency in developing nations because of the serious health and neurological consequences for women, infants and young children (Neumann 1999).

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BIOGRAPHICAL SKETCH

Priscilla M. Medina was born in Columbus, Indiana on March 22. She grew up in the small and beautiful beach town of Mexico Beach, Florida. She received her bachelor's degree in animal science from the University of Florida, Gainesville, Florida, in 2002. She will graduate with her master's degree in Latin American Studies with a specialization in anthropology from the University of Florida, Gainesville, Florida, in 2007.

Priscilla M. Medina plans after graduation to work helping families and children from Latin America. She currently resides in Gainesville, Florida with her boyfriend Andres Vargas and German Shepard mix rescue Lima.