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Anthropometric Study of the Shantal Community in Rajshahi District

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ANTHROPOMETRIC STUDY OF THE SHANTAL COMMUNITY IN RAJSHAHI DISTRICT

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Philosophy in Statistics of the University of Rajshahi.

BY

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MAY, 2006

Dedicated
To
My Beloved Parents,
Who Have Profoundly
Influenced My Life

Certificate

We are pleased to certify that Md. Rezaul Karim for submission of the M. Phil. thesis entitle " Anthropometric Study of the Shantal Community in Rajshahi District" to the university of Rajshahi, Bangladesh.

We do hereby certify that the works embodied in this dissertation were carried out by the candidate and to the best of our knowledge he used the primary data. His works is original and genuine. No part of this study has been submitted in substance for any higher degree or diploma.

We wish him a colorful future and every success in his life.

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Statement of Originality

This dissertation does not incorporate any part without acknowledgement of any materials previously submitted for a higher degree or diploma in any University / Institute and to the best of my knowledge and belief, does not contain any material previously published or written by another person except where due reference is made in the text.

Md. Rezaul Karim
(Md. Rezaul Karim)

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Author

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Abstract

The aim of the thesis was to study anthropometric variables stature, body weight, body mass index (BMI), sitting height and chest circumference, to find their relationships with some of the demographic and socio-economic variables of Shantal community in Rajshshi District, Bangladesh. The demographic and socio-economic variables were collected through a questionnaire (in Appendix-I). Anthropometric measurements were taken by the author himself. The cluster sampling technique was applied. The sample size were 396 for male and 438 for female.

The present study demonstrated that the average stature, body weight, sitting height and chest circumference of young Shantals were increasing comparatively with those of oldest Shantals. Almost every Shantals were very lean and thin and stature, body weight, sitting height, and chest circumference of Shantals were positively and significantly related to each other.

The present study indicated that the female onset of menarche of Shantals community reached earlier who were heavier and became late menarche who were both taller and thinner. Also lower BMI of female Shantals were reached age at menarche earlier than those of larger BMI. Also, age at menarche was earlier for those whose family income were higher and was late for those whose family

income were lower and the onset of menarche reached earlier than those who have fewer number of sibling.

Through the logistic regression, the present study suggest that the stature of literate male Shantals were shorter than the stature of illiterate Shantals and their differences were significant ($p<0.05$). The body weight and occupation were negatively associated but their differences were insignificant. The stature of literate female Shantals were higher than the stature of illiterate female Shantals and the body weight of female labors were lower than the body weight of non-labor female Shantals with significant differences.

Sexual differences among stature, body weight and BMI of Shantals were found and the male Shantals were taller in stature and heavier in body weight than female Shantals and female Shantals were lean and thin. Government should take favorable view and necessary co-operations for their better health, social and economic management.

Chapter-1

Introduction

Chapter 1

Introduction

1.1 Population and area of Bangladesh

Bangladesh, situated in South East Asia, is the eighth most populous country in the world. She achieved her independence in 1971 from the colonial rule of Pakistan after a tremendous sacrifice. Bangladesh is an irregularly shaped and low-lying country with a total area of 55, 598 square miles or 143,998 square kilometers. It is situated latitudinally between $21^0 5'$ and $26^0 4'$North and longitudinally between $88^0 5'$ and $92^0 5'$ East. The country is an almost surrounded by India except for a short (about 120 miles) South-Eastern frontier with Burma and a southern highly irregular deltaic coastline facing the Bay of Bengal. The boundary with India on the West, North and East is about 1500 miles long. The longest distance from the North-West, extremely on a line South-East to the tip of Chittagong is about 475 miles, the greatest width from East to West is about 290 miles. Except for some mountainous regions in the East and South-East, 90% of the total area of Bangladesh is low land, the alluvial gift of several great river systems that traverse the country to reach the Bay of Bengal (Johnson, 1975).

The physical geography of Bangladesh may be considered in terms of two principal divisions: the flat alluvial plain comprising most of the country and the much smaller area of the Chittagong District and Chittagong Hill tracts in the South-East. The alluvial plain of Bangladesh, which constitutes about 80% of the greater plain of Bengal lies between the India foothills of the Himalayan Mountains on the North and the Bay of Bengal on the South. It is often regarded as deltaic in its entirety, making it the largest delta in the world. The land characteristics of the Bangladesh plain from North to South have sometimes between summed up by geographers as "old mud, new mud and marsh". Most elevations are less than 30 feet about sea level, although altitude up to 350 feet occur in the Northern part of the plain (Richard, et. al, 1975).

During the summer monsoon (mid-May to mid-October) rains dominate the seasons in Bangladesh. The rainfall is high and falls in the range of 140 centimeters to 200 centimeters. The mean maximum temperature is 31^0c (in July) and the mean minimum temperature is 21^0c (in January). These factors make the climate very unpleasant with high relative humidity (86.5% in Chittagong in July) accompanying quite high temperature (Johnson, 1975). Despite the return of sunny skies the uncomfortable hot humid weather persists up to October. Because of rain and flooding there is a super- abundance of standing water and this excess moisture helps to maintain an unpleasant sticky atmosphere. The coastal regions of Bangladesh are subject to damaging cyclones and almost every year.

With a population of about 12.93 crores in 2001, Bangladesh is the most densely populated country in the world. She demonstrates the typically broad-based population age pyramid of an under developed country. About 45% of her population is under 15 years of age which puts a great strain on the economically section (49.5% age 15-60 years) to provide for the children, the aged and the largely unemployed women (BBS, 1994). Ethnically, Bangladesh is homogeneous and 98.8% of the population have Bengali as their mother tongue (BBS, 1977). The economy is significantly dominated by agriculture, which contributes over two-thirds of the gross national product (GDP) and absorbs over three-fourths of the labour force (Chen and Chowdury, 1975).

Rajshahi is a District of Bangladesh. It is situated on the bank of the river Padma and the Narth-West part of the country with a total area 2809 square kilometer (BBS 2001). The average maximum and minimum temperature of this district is 31.16 ^{0}c and 20.98 ^{0}c, respectively. It is surrounded by the districts of Naogaon, Nawabgonj and Natore. The total population of Rajshshi District is about 646716 (BBS 2001). Some ethnic people are living with the normal population in different regions of this district. Shantal is one of the communities of the existing ethnic groups. This communities are living in the different region (ten thana) of Rajshshi. This region is indicated as bold red-circle in the map of Rajshshi District (figure: 1.1). The anthropometric measures of the Shantal community are studied in the thesis.

1.2 Origin of the Shantal

Bangladesh is an independent country born in 1971. Many ethnic people are living here but their lifestyle is remarkably different from normal population. This aboriginal people are mentioned as Tribal, Bonobasy, Pahary, Jongly and Bonotibe to their won culture and anthropology. These populations are recognized as minority communities. According to Qureshi (Qureshi, 1984), there are 31 ethnic groups living in Bangladesh but in census this number is 24 only (BBS, 1991).

Bangladeshi aboriginal have been living in three regions: (i) Hiltax in Chittagong area, (ii) Sylhet and Mymensingh district, and (iii) North-West area (Dinajpur, Rajshahi, Rangpur and Bogra) in Bangladesh (Nee, 1976). Chittagong hill tracts are the most inhabited aboriginal area and Chakma, Marma, Tripura, Kumi, Thangga, Moroo, Uchi, Lushiy, Bom, Chik, Kheing, Koey, Morong, Mong, Bonogogi, Paoun, Shinduj and Reang are the most resident there (Maloney, 1974). Some inhabitants in Mong have been living in Kapupara of Patuakhali district (Satter, 1966). Khasia, Monipori, Pakong are settled in Sylhet. Garo, Hajong, Hodi, Daliye and Paliyabona have been living in Modhupur district of Tangail, Holoaghat, Shabonti and Khalmakanda garo hilly area of Mymensingh. Shantal community have been living discretely with the Orio, Rajbongsi, Hoo, Monda,

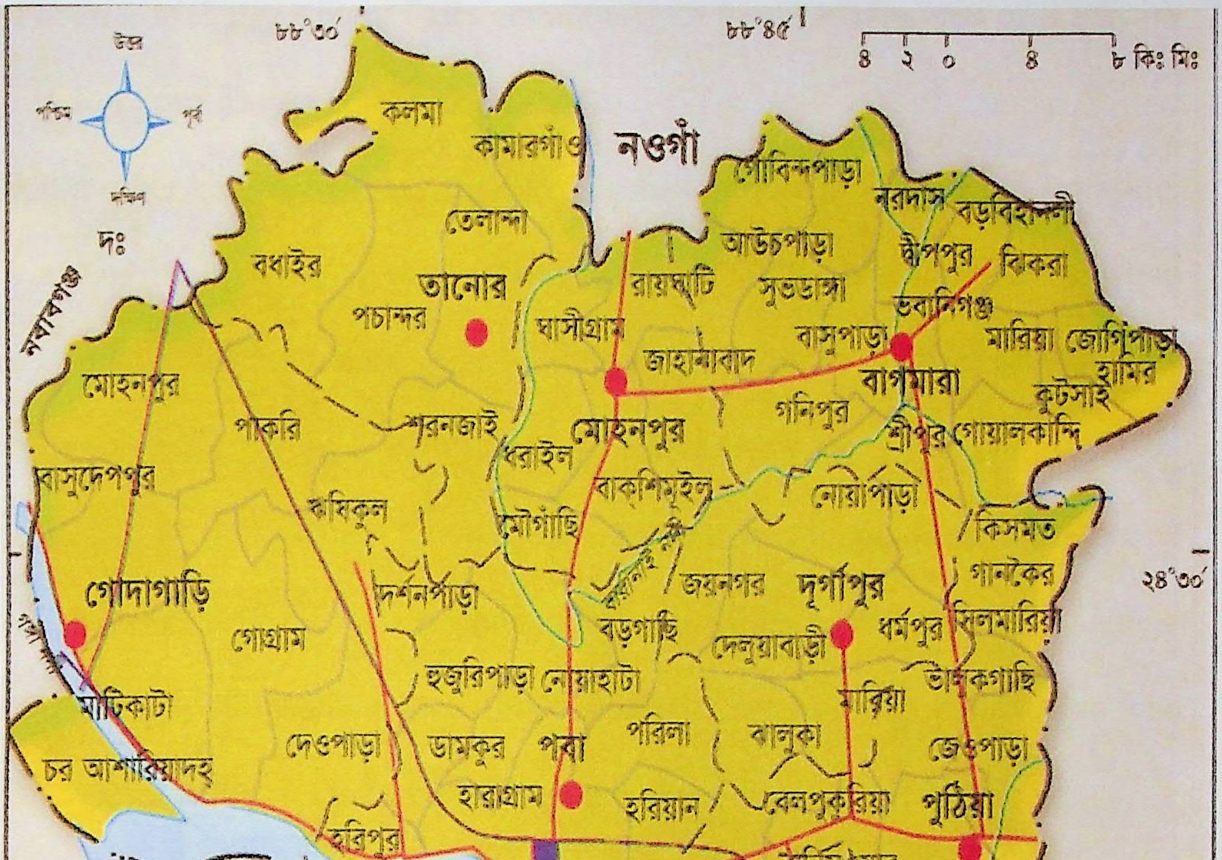

Figure : 1.1-Map of Rajshahi District

Paharia, Mahaly, Kotch, Palia community in the borendro area of Rajshahi, Dinajpur, Rangpur, Bogra and Pabna district.

Like other original tribes, Shantal also has hundreds year of old tradition. Their ways of life is changing under the influence of Hindu, Muslim, and Christian culture as much they have been oppressed by the evil forces of the greater society such as demander, creditor, British rule, political violence etc.

Shantal is one of the ethnic communities in Bangladesh. Their body structure is remarkable for their big bone, flat nose, width lip and short body length (Sultana, 2002). After ancient time, this community are living in their native land and also careful to protect their tradition and culture.

According to Skrefsrud (1968) the word Shantal comes from the word to Shutar. Some say that this community is named by Shantal become they have been living on the plane land (Samotal Bhumi) since long ago. The word 'Shantal' is an English word that have come from the Hindi word "Shaontar"(Mally, 1938). It is very interesting to note that Sir John Shore designated sandals as soontars while Mc.Pherson (1910) mentioned the name as Saungtars.

Despite the various opinions regarding the name of this community most of the anthropologist are agree that Shantal is a name given to this tribe by non-Shantal most probably originating from of Sanskritte.

1.3 Historical Background

Shantal referred to their name `Hor` that mean man and 'Horhopan' mean mankind. According to mythical Cosmology Pulchtu Horrom is the first father and Pulchtu Burhi is the first mother. Other opinion designated them to compare Australian aborigine to their body structure, nature, culture and language. They were residence in Borendro area Vogualour, Porgona, Birevum, Shengvum, Bankura, Hasaribage, Madnipure and Southert part of Balashore area, District of India are foundation of this community. They are found mostly in Borandro and Border area of Rajshahi Dinajpur, Rangpur, Natore, Naogaon, Nawabgonj and Jaypurhat district.

1.4 Religions

It is the habit of Shantal community to live untidily and socially. But at present, the frame of society has been breaking down due to activities of missionaries, changing the environment geo-naturally etc. The religions of village organization has being disappearing day by day and tending mainly to the Christian religion but building up a new church in their locality. Also they have converted in other religions too.

1.5 Customs And Culture

Every nation is known by their own custom and culture. Shantal are remarkable of their gipsy habit in custom. They make a house to the virgin land for the joy of hunt and independent of flout tune. With the time, they have been tending to live as permanent resident. Family (both single and joint), marriage, and kinship are present in their Community. However, after marriage the Shantals become separate from their parents. They generally build their houses by the side of their parent's house but in the same courtyard.

Janamchatiar (birth)

The birth of a child is a great event among Shantals. The birth of a child imposes on the family a new set of rites and duties. The child becomes a fresh client to family property. At the birth of a child, both the village and the family are considered unclean, as a matter of fact, no sacrifice or other religious ceremony is performed. The purification ceremony after child birth are called Janam chatiar. Janam means birth and chatiar a word connected with the Hindi word 'Chut' which means polutting until this ceremony takes place, no one is given allowe to eat or drink with the family and the cleaning ceremony in which the whole village community as well as the relatives and friends of the family participate usually takes place five days after the birth of a child, in the cleaning ceremony, the child is given by a name. The name giving ceremony is the essential part of the Janam chatiar ceremony because in giving the child name the father recognizes the child as his own and the child acquires a definite status in village and among the kinsfolk. In fact, the child is recognized to be a shantals. The name giving also imparts the social obligations of the household to the newly born child. This cleaning ceremony has mainly three-folded function.

1. To purify the house and the village from the defilement caused by the birth of a child.
2. To name the child, thus formally admitting him/her in to the fathers clan and sub-clan and giving the protection of father's spirits.
3. To incorporate the child into the outer fringes of the tribe.

Caco Chatiar (Initiation)

Besides Janam chatiar, there is another most important purificatory ceremony called the Caco Chatiar. Though the world Caco Chatiar literally means "a speaker", this purificatory ceremony is performed anytime before marriage usually between four and twelve years of age. Every Shantal has to undergo an initiation rite through the Caco Chatiar ceremony by which it is believed that a Shantal becomes a number of the Shantal society with rite, duties and privileged. The most important aspect of the ceremony is the recitation of the Myth, which narrates the creation of the world and the wondering of their ancestors till they occupied their present habit.

The Shantal also believe in the next world with its joy and suffering. It is expressed explicitly with a typical mark. In boyhood each man is branch with a Siku (a mark on his left forearm, midway between the wrist and the elbow). The mark is both the sign of being a Shantal and the believe in life and death. The first mark represent life (Jibon) and the second death (moron). Girls are stamped by a tattoo mark on their palms, arms and breast. It is believed that a Shantal society without any mark or with an even mark will be eaten up by on enormous arm Jomraja, and the ruler of hell or norok.

Bapla (Marriage)

The most important stage in life of Shantal community is undoubtedly the marriage. In Bangladesh, the Shantal's process a flexible and intricate tribal marriage system. Marriage is so important among them that they say, " No body but an idiot remains single is at once despised by the sexes, and is classified nest to a thief or a thief they term the unhappy wretch as no 'man' if is a bit suspiring that though marriage is one such importance among the Shantal, child marriage is very rare among them. The general custom prevalent is to contract a monogamous marriage. Polygamy is favored only when a wife barren. According to this community, only a fool can live with more than one wife for as the proverb goes, " A co-wife pricks like spear grass". As a rule, adult marriage is favored by the Shantal. Although the marriage is planned and arranged by the parents, the parties concerned are given freedom of choice. A bride is always expected to be younger than his groom.

In marriage system, it is not only forbid to marriage the same tribe, but also remove out the society. It is permitted to marriage the law of mother's tribe. They cannot utter the name of some relative person after marriage day. They have the believe that they will punished by the natural power if they break this rule. Some traditional peculiarity marriages are shown among this community, summarize as:

- **Kiringe Baho Bapla** : This marriage is occurred choosing by parent is called kiringo baho bapla.

Tonge Chipal Bapla: This marriage occurred according to the rule of poor family that is bridegroom cannot participate to go to the bride's house. Only one or two persons go to bride's house and also come back with her.

Issute Bapla: In this marriage, the oppression of girl are the main factor, the marriage are finished by garady joiay and shong bapla.

Moron (Death)

The Shantal community believes that where a person dies, his social personality is not annihilated but rather transformed. Some of the expression used to denote the death of a person indicates that the soul, after leaving the body, becomes a Bonga (spirit) joining the abode of its deseased ancestors. Thus they have the expression "Nitok Doe Hapramena", means he has became ancestor. The belief in the soul of a person becoming Bonga and the abode of his ancestor is explicitly evident in all the rituals and ceremonies connected with death.

The critical Junctures in the life cycle of an individual Shantals are replete with danger. Not only the individual is in danger but also he passed this danger on to his family, village and the whole Shantal tribal large. Besides the individual, his family, village and village Bongas are defiled. It obvious that the most important passages in the life cycle of an individual not only concern the relation of mutual harmony and dependence between the individual, his family and society but they also communicated the intimate religious beliefs and practices among Shantal. Thus the rites and ceremonies at the critical junctures in the life cycle predominantly uphold the tribal integrity and solidarity among the Shantal people.

The Kinship of the community: The Kinship of the Shantal community are (i) Sharine (ii)Murmu (iii) Tudu (iv) Harrom (v) Mardy (vi) Basski (vii) Bosra (viii) Poayria (ix) Chara (x) Hasda (xi) Akka (xii) Goashhorane. Shantal community is the hard-working nation. Both the male and female like to work together. It is the peculiarity of their community to finish every act nicely and slowly.

1.6 Social festival

The Shantal community believes in benevolent and malevolent spirits, they offer to these sprits sacrifice and libation to maintain their relationship, thus ensuring the protection and prosperity of the benevolent spirits. The rituals and controlling the malign influence of the malevolent spirits. The rituals are nothing but an external manifestation of the whole way of their life. The (rituals) are observed through some festival performance consisting of sorts of worship or folk cults. From the rites and festival of the people (Shantal), it is quite clear that their economic life, social organization and ritual performances are interwoven mainly around agriculture. In other words, they are closely linked with annual cycle of the Shantal's agricultural operations. Being agriculturists, agriculture keeps Shantal engaged for the greater part of the year. It is important to note that the agriculture to the Shantal was something more than just a means of livelihood. One can say that the agriculture activity permeates the whole of Shantal life. The Shantal conscious that there are a variety of changes in agricultural operations. They are also aware that a drought or any destructive blight on the crops means hunger for all while a good harvest means prosperity. The Shantals are convinced that the aspect of material life must be protected and guarded by appropriate rites and festivals.

The Shantal community celebrates various social festival occasions in annual cycle. Eating, dancing and singing are the main factor of their occasion. They seem the occasion is uncompleted without dancing and singing also with continuous drinking. The peculiarity of their program is not different changing the time of the festival in village. Some of the principal annual rites and festivals are shown in table 1.1

Besides the annual rites and festivals, the Shantal have other rites and festival which are neither associated with agricultural operation and nor performed annually. We may call them occasional rites and festival. The most important of them are Jomsim, Makmore and Karam. The Jomsim is a clan celebration in which a sacrifice is offered in honor of the Sim Bonga (Sun god) at least once in a little time by every household. According to the tradition of the community, Makmore is celebrated at the intervals of five years in which a white goat is sacrificed by the Naek on behalf of the village community to the Mareko Turuko in thanks for having rid in the village of sickness. The Karam is very rarely observed now a day. It is not a communal celebration but on individual one; no sacrifice is offered in this festival but nice beer liberation are poured out the Manjhithan and the Marring Buru Bogas. Tradition tells us that young unmarried people of same sex enter into a life-long friendships alliance during this festival, which has the effect of the rule of clan exogamy. The alliance between boys is called Karmu Dhaemdar between boy is called Karmu Dharum and girls Karamdhar.

The last but the least important thing to be noticed that the secular aspect of the Shantal rites and festival provide the Shantal with entertainment and pleasure. The world "Raska" means pleasure is uttered on the lips of the Shantal and it is not only dear to their hearts but is part and parcel of their life. A Shantal can be characterized by a carefree, uninhibited attitude and a joyous frame of mind. That is why dancing and singing have a very important role at every festival. The Shantal community is a highly ritualistic people and they rarely doubt the efficient of the rituals. They believe that the expected result is not achieved, if it is either due to some holistic force or that the ritual prescriptions were not observed properly. Thus they are very careful about the time, place, and person prescribed from of a ritual. Above all, the religious worship of the Shantal are not only to religious feeling but help him to forget worries and the stress his daily life. At the same time, the collective worship stimulates the community to feel to be in touch with their spirits upon whom they depend. In this way, they regain their confidence, hope and sense of security amid the uncertainties of life. Finally, the feeling of community belonging is reinforced, thus strengthening social solidarity.

Table1.1 Principal annual rites and festivals of Shantal community

Name of the Festival	Month of festival	Agriculture operation
Sohrae	Pous (Dec-Jan)	After the paddy has been harvested. It is called harvest festival.
Baha	Phagun (Feb-Mar)	Offering of the first fruits matkom (Bssia Latifolia) and flowers mainly the sarjom flower.
Krok'Sim	Asharh (June-July)	Sowing of rice seeds in the field.
Haiar Sim	San (July-Agus.)	Sporting of rice seeds
Iri-Gundi Nawi	Bhador (sep-Oct.)	Offer the first fruit of the millet iri (panicum malliaceum) and gundi (panicum frumentaceum)
Janthar	Aghar (Non-Dec.)	Offer the first fruit of the winter rice crop.
Magh Sim	Magh (Jan-Feb)	Cutting of the sari (Thatching grass)

1.7 Political Organization

The frame of the political organization and leadership system are categorized into five stages. They are as follows:

Village organization: Parha Majhi is the leader of the village organization. It has declared that a man will be Parha Majhi who is both wise and aged. There are six assistants to help him. Parha Majhi manages the leadership, administration, the social work with the help of these assistants. Paranik, Jogo Majhi, Jogo Paranik, Godeth Naiki and Kudam Naiki are the title of the assistants, respectively.

(i) **Gram Ponchayet:** Gram Ponchayet are made by a group of Para Majhi. This organization is able to take any joint decision of their festival and internal problems of the village.

(ii) **Baishi Mondol:** Baishi Mondol is a name of leadership among some Gram Ponchayet that he is able to solve the problem, which have no solution from Gram Ponchayet. When the leader of Ponchayet are failure to give solution of any local problem and create a problem to mutual then the problems are submitted to Baesi Mondal. The temporary council of Gram Ponchayet is the subordinate of Baishi Mondal. Baishi Mondal is able to take any essential step under political decision and administrative works.

(iii) **Paragona Majhi:** It is the superior stage among the Baishi Mondal and this stage is formal.

(iv) Desh Majhi: It is the top stage of power to lead among the universal Shantal community. This stage is also formal. Desh Majhi is declared as the superior leader among Shantal-spreaded area.

Moreover, if the Christian Shantal face any problem and now a day accept their decision from their father (Christian father). Presently, they are selecting their leader to participate the local government election both internally and externally.

1.8 Whole diagram of life style

The life style of the Shantal community is comparatives with that of normal population. They have becomes landless after loosing their paternal land. Even, somewhere they have no land to built a hut and as a matter of fact in those places they are becoming converted Christian to have a shelter. Thus, their traditional culture and faith are disappearing gradually. Landless Shantal are generally farmer, labours, rickshaw-puller and small businessman. They have been passing their life by taking food one time or two times in a day. The people of the community are not educated however; very few of them are lower educated (primary level). Recently, their children are getting the opportunity of primary education from the free education program organized by some N.G.O.

Medical facilities are insufficient among the Shantals. *Pani-Pora*, *Kobiraji* are used as medicine for them. Although they have basic knowledge of allopathic, homeopathic treatment but cannot able to take modern treatment due to their economic condition. They have sincerely to build their nation and country although they have not got a right place of shelter, appropriate treatment and good education.

1.9 Objective of the Study

Bangladesh is a country where different ethnic groups of people are living together. Today some of the Shantal and other tribe are abolishing due to their economics problem. Government should take favorable view and necessary cooperation to build them as an active citizen for the agricultural prosperity of the country. Thus, it is essential to study their physical growth first for their better health management and care and to the best of our knowledge the anthropometric study of the Shantal community is still undone in Bangladesh.

The main purpose of this study is to see the physical growth pattern of the Shantal in Rajshahi District.

For this purpose, attempt has been made here in this study to

(i) The location and scale pattern of the anthropometric variable stature, body weight, sitting height, chest circumference,.

(ii) Find the relationship among the anthropometric variables,

(iii) Find the association between age at menarche and socio demographic variables,

(iv) Make a comparative study of age at menarche between the Shantal and other ethnic groups, and

(v) Investigated the sexual difference among the variables.

1.10 Organization of the study

The study is organized in six Chapters as follows:

Chapter 1: The Introduction Chapter that contains a brief description about Bangladesh and it population, Origin, Historical background, Religious, Custom and Culture, The Kinship of this community social festival, political organization, whole diagram of life cycle, the objective and organization of the study.

Chapter 2 contains review of the literature that gives the information on Shantal community and other population.

Chapter 3: Materials of the study, this chapter contains the characteristics of sample, sampling technique and also described the measurement technique for taking the qualitative and the quantitative anthropometric variables.

Chapter 4: Methods of the study, which contains the mathematical model and statistical methods to check the pattern and relationship of the anthropometric variables and also for finding the association age at menarche with, family income, number of sibling and anthropometric variables stature, weight, BMI with education and occupation and also good fitting of the orthogonal polynomial among stature, weight and BMI of Shantal.

Chapter 5: Result and discussion, this chapter contains results and discussion of anthropometric variables and their relationship, association between age at menarche and anthropometric measures and also anthropometric measure with socio-demographic variables. Comparative study of age at menarche and other ethnic people, sexual difference among stature, weight, BMI of Shantal.

Chapter 6: conclusion, which contains summary, the overall findings and specifies direction for possible future extensions of the study.

A selected bibliography is presented next. An appendix contains data used and other relevant information is provided at the end of the thesis.

Chapter-2

Review of the Literature

Chapter 2

Review of Literature

Introduction: Shantal is an important ethnic people of Bangladesh tribal. Many authors have studied them in different ways.

Daltan (1872) discussed broadly the descriptive Ethnology of different tribal population and give many primary information about them

Bodding (1942) investigated the historical background of the social and cultural life of the Shantal. He discussed their different institutions, marriage system, family system, social life system etc. He noticed that the system of the above factor were changing.

.In a changing civilization, the role and life style of the Shantal was discussed by **Mukherjea** (1943). He found that the social structure of life of Shantal was changing due to their acceptance of the Christian religion.

Sengupta, et. al (1963) studied the problem of the education of the Shantal. He examined that conversion to the Christian religion is the main factor to change their tradition and custom.

In a research title, "The Shantal, a tribe in search of a great tradition", **Orans** (1965) discussed about the activities of the Shantal community. This research was descriptive on the education, religion, political awareness etc of the Shantal community.

Bengtolov et al., (1974) studied the secular trend in physical growth of Sweden children aged 10-17 years comparing growth data from three investigation of 1883, 1938-39 and 1965-71. This data included height and weight as well as their velocities. They found that a proportionally larger increase in height than in weight was detected which is more pronounced for girls than for boys between the two later studies. In girls the adolescent growth spurt occurred about six month earlier in the late 60's than the late 30's and the maximum rate of height increase was about 1 cm/yr greater. Boys showed an earlier growth spurt in 1971 than in 1938-39, although the height peak is only slight greater. The weight peaks of boys and girls were of about the same magnitude as in 1938-39.

Lindgren (1976) investigated the height, weight and menarche in Swedish urban school children in relation to socio-economic and regional factors. She collected 740 Swedish urban school children (360 girls and 380 boys) from 40 different urban areas all over the country were followed longitudinally. Height and weight were measured twice a year and age at menarche was recorded. Mean ages at peak height velocity (PHV) and peak weight velocity (PWV) were 11.91±0.95 years and 12.50±1.08 years for girls with average values of 8.30±1.32 cm/year and 7.37±1.94 kg/year. Mean age at menarche was 13.05±1.03 year. The PHV and PWV in boys occurred on average at 14.09±1.11 year and 14.30±1.11years with magnitudes of 9.84±1.40 cm/year and 9.07±2.04 kg/year. No significant differences between socio-economic strata defined by father's occupation and family income were found either for height and weight or for ages at PHV, PWV and menarche.

Ogata (1979) investigated age at menarche and marriage in Bangladesh. A survey was conducted among women in Dhaka City, Bangladesh, to obtain basic data necessary for promoting the maternal/child health and family planning programs in the country. A sample of 775 housewives, born between 1938 and 1957 and having 2 or more children were selected for the random survey. Age at menarche, age at marriage, and age at completion of 1st pregnancy were analyzed. The data are graphed for easy visual communication of results; some data were also tabulated. Age at marriage was found to be very low (mean value was 12.88 years); more than 40% of the women studied were married before the onset of menarche. Women with a history of school attendance showed a delay in the age of 1st marriage of more than 2 years and in the age of 1st pregnancy completion of 1.14 years beyond the average for all the women. Age at menarche was relatively constant over the period studied. The age at 1st marriage has risen almost 1 year, with the average 12.21 years for those born in 1938-42 and the average 13.19 years for those born in 1957. Age at completion of 1st pregnancy actually fell during the same period. Therefore, the period from marriage to the 1st pregnancy completion was shortened.

Liestol (1982) investigated the social condition and menarcheal age: the important of early Year of life. Data on the historical trends for menarcheal age and socio-economic conditions in Norway were used to investigate whether the reproductive system in humans was especially sensitive to environmental stimuli during any particular short age periods. The method that has been used was based on the irregularity in the trend for socio-economic development. These irregularities were reflected in the Gross Domestic Product (GDP), a quantity for which official estimates were available from 1865 onwards. Estimates of menarcheal age for women born in each year from about 1840 have been calculated from information obtained from maternity clinic records. The following conclusion was reached: during the period around or after birth, the processes leading to menarche were clearly more sensitive than at later ages. During adolescence, the maturation process may be influenced somewhat, but probably not much as long as the conditions were not adverse. These observations may be seen as illustrating that phenomena corresponding to the critical or sensitive periods described for animal species, were also observable during the longer-lasting process of human development.

Nutritional status and menarche in a rural community in the Philippines were addressed by **Osteria** (1983). To examine the relationship between nutritional status and onset of menarche, anthropometric measurements and information on age at menarche were obtained from 1844 females aged 6-17 years in a rural community in the Philippines. The mean age at the initiation of the growth spurt in height was 13.5 years, while the spurt in weight occurred at the age of 11.5 years. About 25.2% of respondents had attained menarche by age 11.5 years, 43.6% by age 13.5 years, 88.2% by age 14.5 years, and 96.6% by age 15.5 years. This contrasts with data from Bangladesh, where only 3.5% of girls attain menarche by age 13.5 years and only 35.1% reach this point by age 15.5 years. Further analysis indicated that both age and weight are related to the proportion achieving menarche. The effect of height is not as marked as that of body weight. A minimum level of fatness (about 17% of body weight) is associated with the onset of menstruation and its continued maintenance. Malnutrition results in a shorter reproductive span, later age at menarche, and early menopause.

Ducros and Ducros (1987) studied age at menarche in Tahiti. Data on age at menarche was collected, using the status quo method, among 1246 Tahitian girls attending school. The median age, estimated by probits, was 12.75±1.76 years. The girls of the rural districts had a higher median age (13.08±1.97) years than the girls of Papeete (12.61±1.47) years. The results were compared with data collected among other girls of Maori or European ancestry in France, New Zealand and Easter Island.

Rajangam and Thomas (1988) investigated Menarche and menopause in Tamil Brahmins of India. Age at menarche and menopause among the Tamil Brahmins of Bangalore, India, were analyzed using data on 295 women aged 25-70. He found that the attention was given to the effect of consanguinity, socioeconomic status, family size, and birth order.

Height and weight of Urbans school-going children of Imphal were address (**Yaima and Narendra**, 1989). They collected 726 urban school-going children in the age group 5-16 years were screened during the period from February to May, 1980 at Imphal. The growth rate of girls was apparently faster than that of boys as evidenced from the increment nature of height and weight per annum. Growth spurts were observed during the age group of 6-8 years and 12-13 years for boys, and 5-8 years and 11-12 years for girls. They conclude that height pattern of these children was significantly higher than the Indian standard height. However, weight was more or less similar with the Indian standard.

Height, weight, and body mass index of American Indian school children were addressed by **Jackson (1993).** To describe the current height and weight status of American Indian children who live on or near Indian reservations nationwide. Data for height, weight, and body mass index of the schoolchildren were compared with two national reference data sets, the second National Health and Nutrition Examination Survey (NHANES II) and the Mexican-American population of the Hispanic Health and Nutrition Examination. He found that the three populations were similar in height, but the American Indian children weighed more, although not at a statistically significant level, and had a statistically significant higher body mass index than the NHANES II reference population for nearly every age and sex group.

Age at menarche among the Rajbanshi women of north Bengal were addressed by **Chakravarty** (1994). He observed that age at menarche among the Rajbanshi of northern Bengal is studied using data on 167 women collected in 1991. Results show mean age at menarche was 14.7 years and the trend was declining.

Vasulu (1994) studied genetic structure of a tribal population: anthropometric differences between regions and settlements among the Yanadi. He investigated microevolutionary changes in Morphology in a transient tribal population who are fast changing from a hunting gathering to an agricultural stage. Anthropometric data on 14 measurements collected from the Yanadi, who inhabit different geographical regions and differ in their subsistence and other associated cultural traits, demonstrate high morphological differentiation between two levels of organization: (1) twelve settlements and (2) five regional breeding populations formed by grouping some of the former. The morphologic distances based on Mahalanobis D^2 and the dendrograms show wide differences between sexes, in the case of the breeding populations, which can be associated with patterns of marital migration and of spatial distances. In the case of settlements the pattern shows a poor association with geography. Of three spatial distances viz. map, road and geographical barrier index, road distance produces a larger influence on the morphological differentiation within the tribe.

Henneeberg and louw (1995) studied the average menarcheal age of higher socioeconomic status urban Cape coloured girls assessed by means of status quo and recall methods. Data were collected from 857 girls aged 8 to 20 years attending primary and secondary schools in Cape Town, from 1987 to 1992. The schools were specifically selected for the highest socioeconomic status (SES) of pupils' parents. Girls were interviewed with respect to their menarcheal status and those who were postmenarcheal were also asked to report when they had started to menstruate. They found that the menarcheal age of higher SES Cape Coloured girls is significantly lower than that of white girls in Cape Town (13.30 years) and much lower than that of any group of black South African girls. It falls close to the lower limit of the range reported worldwide. Body heights, weights, and body mass index indicate good growth status of girls studied.

Qaues (1995) have studied the changing of the culture of shantal community in Rajshahi district. She interpreted that the shantal community accept the Christian religion to develop their socio-economic status and security for life.

Gonzales and Viiiena (1996) designed an study to determine the relationship between body mass index and age at menarche in Peruvian children living at high altitude and at sea level. The present study was designed to determine the relationship between body mass index (BMI) and age at menarche in girls (aged 10-19 years) living in Lima (150 m) and in Cerro de Pasco (4340 m above sea level). The purpose of the study was to determine whether the relationships between BMI and both age at menarche and chronological age differ between girls living at low and at high altitude. A later age at menarche was observed at high altitude than at sea level after controlling for socioeconomic status and for the Benn index. The value of the Benn index at the time of menarche, after controlling for chronological age in the analysis, was significantly higher at high altitude than at sea level. It was also observed that the higher the chronological age, the lower the values of the Benn index at the time of menarche. Using the median ages at menarche in Lima and in Cerro de Pasco, they found that a higher Benn index at the time of menarche was still observed at high altitude compared with girls from sea level. In Lima body weight and height were directly related to age at menarche

Sengupta et al. (1996) studied variation in menarcheal age of Assamese girls. This study determined the mean age at menarche among 571 Assamese girls who came from various castes (Brahmin, Kalita, and Kaibarta). The sample population also included Muslims and two Mongoloid populations. Evidence from early research suggested that differences in the mean age at menarche occurred between castes and scheduled tribes in Assam, India. They found the mean age at menarche was 12.23±0.19 years among Brahmin girls, 11.96±0.16 years among kalita, and 11.92±0.08 years among Kaibarta. The decline in age at menarche followed the decline in status among this caste. Among Muslims, the mean age at menarche was 12.10 ±0.10 years. Among the Mongoloid group, the mean age at menarche was 11.83±0.09 years for Ahoms and 11.94±0.12 years for Sonowals. There were no statistically significant differences in menarcheal age between caste and tribal groups.

In Bangladesh many researchers have studied the custom, culture, political organization, regional and social life structure of Shantal community (Satter, 1966; Ahasan, 1989; Jalil, 1991,Karim; 2000 etc).

Secular Growth Changes in the stature and weight of Amerindin Schoolchildren and adults in the Chilean Andes, were studied by **Dittmar** (1998). The study based on two cross-sectional growth surveys carried out in 1972 and 1987. In the survey of 1972, which was undertaken by other authors, a sample of 190 individuals was considered. The 1987 survey performed by the present author comprises a sample of 170 Indians. Both children and adults of each sex, ages 6-29 years, are included. Secular comparisons of age-grouped means indicate a secular increase in stature and weight in Amyrara children, adolescents and adults in the Parinacota province between 1972 and 1987. The Aymara tend to be taller and heavier in 1987. The estimated secular increase for stature is 2.1 cm/decade for males and 1.8 cm/decade for females. For weight, the increase is 2.3 kg/decade for males and 1.5 kg/decade for females. In all cases, growth gain tend to greater in males than the females. The body mass index also increases slightly. The secular changes in stature and weight are statistically significant in both sexes. Form additional nutritional data on the Aymara samples compared, it is concluded that the observed secular increases might primarily reflect improved food supply over the past two decades.

Arantza and Apraiz (1999) investigated the influence of family size and birth order on menarche age of girls from Bilbao city (Biscay, Basque country). They analyzed from a sample of 895 girls of Bilbao 9.5 to 18.5 years of age, the possible influence of family size and birth order on menarche age. The earliest mean ages of menarche occurred in girls from families of one or four or more children, or who occupied the first or last birth order in their families. Later mean ages of menarche occupied in girls belonging to siblings with two or three children or who occupied the second or third birth order in their families, the latest being girls belonging to siblings of three children or of third birth order. This may be due to the variations in the interval of time between births, leading to better care and less stress for the youngest individual of the family and hence may be indicative of psychological as well as biological factors affecting maturation.

Secular trends in stature in Polish children were addressed by **Bielicki and Szklarska** (1999). Mean statures of Polish 19-year-old males, as estimated from large national random samples of conscripts examined at 10-year intervals, increased from 170.5 cm in 1965 to 176.9 cm in 1995. The average statural gain of 2.1 cm/decade is rather high compared to other European countries, although not exceptionally so. In addition, secular trends were analysed separately for each of seven selected social groups, each group comprising subjects equated for three social criteria. Their findings assume special significance in view of: (1) the high ethnic homogeneity of the population of Poland; (2) the absence in that population of any social-class differences in gene frequencies; and (3) certain peculiarities of Poland's post-war economic and political history.

Annette et al. (2000) estimated a continuous decline in menarcheal age in Denmark. They reported a renewed decline in mean menarcheal age in a large Danish sample after a period with a half in the trend towards earlier age at menarche in many North European countries. They studied based on retrospective data from six different samples constituting 42784 women, they found a continuously declining mean menarcheal age in Denmark among women born in the years 1964-1973, in a sample of textile workers born in the year 1939-1968 (n=12605) they also find 1 year higher mean menarcheal age. This indicates that menarcheal age is still delayed in certain groups in Denmark. This leaves the possibility that the meanrcheal age could fall even further in the future.

Chowdhury et al. (2000) analyzed the nutritional status and age at menarche in a rural area of Bangladesh. The age at menarche and its association with nutritional status in a rural area of Bangladesh was determined. A cross-sectional study was conducted in four villages of Rupganj Thana of Narayanganj district. They concluded that the mean weight and BMI were significantly higher among the menstruating girls of 13, 14 and 15 years ($p < 0.01$) than non-menstruating girls. The mean height was found to be significantly higher at 11-14 years among the menstruating girls. They also observed that the age of menarche among this rural Bangladeshi community is not as delayed as expected. Not surprisingly, menarche is associated with better nutritional status.

Kac et al. (2000) investigated the Secular trend in age at menarche for women born between 1920 and 1979 in Rio de Janeiro, Brazil. They found that mean age at menarche decreased from 13.07 to 12.40 years when comparing the group of women born in the 1920s with the 1970s birth cohort, corresponding to a mean rate of –0.0123 years/year ($p<0.001$). The downward trend was –0.0120 year/year ($p>0.05$) for the 1920s, 1930s And 1940s, -0.0093 years/year ($p<0.05$) for the periods from 1920 to 1960, and -0.0224 years/year ($p<0.01$) for the 1960s, 1970s. The results suggest a secular trend in age at menarche.

Age, education and occupation as determinants of trends in body mass index in Finland from 1982 to 1997 were addressed by **Lahti, et al.** (2000). They estimated to investigate trends in body mass index (BMI) and prevalence of obesity among adults in Finland from 1982 to 1997, and to identify population groups with increasing obesity. They found that the mean BMI increased in both genders. In men, the upward trend was greatest (the increase of 1.3 kg/m^2 in 15 years) in the oldest age group (55-64 year), and was found also (the increase of 0.6 kg/m^2) in the youngest age group (25-34 year), whereas in women, the upward trend was most prominent (the increase of 0.9 kg/m^2) in the youngest age group. BMI increased in all educational groups in men, but in women the upward trend seemed to be greatest in the lowest educational group. The upward trends were most prominent among retired and unemployed men, while in women changes in BMI were similar in all occupational groups.

Loesch et al. (2000) designed the secular trend in body height and weight of Australian children and adolescent. To assess the trend in both adults size and tempo of growth they compared the data on stature and body weight obtain in 1992-1993 from 1804 Melbourne school students age 5 to 17 with historical data collected from white Australian during the last 100 years. They illustrate the age dependent trend in stature and body weight by means of regression surfaces. The results have been shown secular increases in adult stature over the last century, with the rate of increase varying between 0.4 and 2.1cm/decade in males and 0.01 cm/decade in females. While secular increase in stature has significantly slowed down during the last two decades, the increase in body weight was still continuing at a high rate and this increase was more pronounced in females. The period of strong secular increase, especially in the tempo of growth, coincide both with the shift toward earlier menarche and the improvement of socioeconomic condition of the Australian people.

Educational level, relative body weight, and changes in their association over 10 years were addressed by **Molarius et al.** (2000). Their study assessed the consistency and magnitude of the association between educational level and relative body weight in populations with widely different prevalences of over-weight and investigated possible changes in the association over 10 years. They found lower education was associated with higher BMI in about half of the male and in almost all of the female populations, and the differences in relative body weight between educational levels increased over the study period.

Musaiger and Al-Mannai (2001) investigated the weight, height, body mass index and the prevalence of obesity among the adult population in Bahrain. To determine anthropometric measurements (weight, height, body mass index), and the prevalence of overweight and obesity based on BMI, a cross-sectional survey of 514 Bahraini native adults aged 30-79 years was selected from households using clustering sampling technique. They indicate that Bahraini adults were shorter but heavier, and have higher mean BMI than their Western counterparts, suggesting a trend to obesity.

Reddy and Rao (2000) studied the growth pattern of the Sugalis--a tribal population of Andhra Pradesh. With a view to assess physical growth, a cross-sectional study was made on 1565 Sugali children (854 boys and 711 girls), anthropometric measurements included height, weight, upper arm circumference, biacromial diameter, biiliocristal diameter, chest circumference, head circumference and skinfold measurements at triceps, subscapular, suprailiac and medial calf. They found that all anthropometric measurements except skinfold measurements exhibit uniform increase with age in both the sexes. They also found that Sugali boys and girls are shorter and lighter than well-to-do Indian standards. The median heights and weights of Sugali boys and girls fall below the 5th percentile of NCHS.

Ulijaszek (2001) studied the socioeconomic status, body size and physical activity of adults on Rarotonga, the Cook Islands. The primary objective of their analysis was to examine the relationships between socioeconomic factors and stature, weight, body mass index and physical activity level of adult Cook Islanders living a largely modernized lifestyle in the pacific region. In a cross-sectional study of physical activity, body size and socioeconomic status, a volunteer sample of 345 Cook Islanders aged 20-65 years was obtained from the total adult population of Rarotonga, and measured at six out-patient clinics. Stature, weight, BMI physical activity level and age were calculated by sex and occupational category, years of education, island of birth and number of years lived on Rarotonga, respectively. Their analyses indicated that the secular trend in stature was a function of the relative level of modernization on Rarotonga relative to other Cook Islands, and with level of education. Those factors associate differently among males and females, the secular trend among males was appearing to be a general phenomenon in response to lifestyle change associated with life on Rarotonga, while among females the trend was a function of lifestyle change associated with education and independent of island of origin. The trend toward increasing body fatness was also different for males and females. Weight declined with age for both men and women, in a linear way for the males, but in a non-linear fashion for the females. Body weight was also greater among those males in more skilled and professional occupations than among those with less-skilled professions. For the women, weight was independent of occupation category. Physical activity patterns of modernizing adult Cook Islanders showed no relationships with socioeconomic variables for the males, but while older women are less active, those born on Rarotonga are less active than those born elsewhere in the Cook Islands. The number of years spent on Rarotonga showed no significant relationships with any of the physical measures, or with physical activity level. That was likely to be as much a function of small sample size as a lack of effect. Although declines in energy expenditure with increasing age have been demonstrated for both males and females in various populations around the world, on Rarotonga this holds true for females and not males, indicating that physical activity declines with increasing age in modernizing societies do not occur in uniform fashion.

Gowth pattern of the Kamars--a primitive tribe of Chhattisgarh was studied by **Mitra et al.** (2002). A cross sectional study of the physical growth status was made on 655 Kamar children (341 boys and 314 girls), aged 5 to 18 years, in the Raipur district of Chhattisgarh. Their study aimed to find out the growth pattern of the Kamar children, which was considered to be a primitive tribe of Chhattisgarh, India and was compared with another Indian tribe and the official data for all India. Anthropometric measurements included height, weight, sitting height, biacromial diameter, biilliocrystal diameter, upper arm circumference, calf circumference and measurements of the triceps and subscapular skinfolds. All anthropometric measurements except skinfold thickness exhibit uniform increase with age in both sexes. However, when height and weight of the Kamar boys and girls were compared with the data for other tribes and for all India, the Kamar children (both boys and girls) indicated lower weight and height and the difference showed to be significant, for almost all ages. Kamar boys showed higher anthropometric values than girls in almost all measurements except in biilliocrystal diameter and in measured skinfolds. Poor socio-economic status of that primitive tribe may be one of the reasons for that poor growth pattern.

Sultana (2002) have studied the impact of Christianity on Shantal culture. She found that shantals are influenced by Christian religion in their socioeconomic status, education, social life, custom and culture.

Fredriks et al. (2003) investigated the height, weight, body mass index and pubertal development reference values for children of Turkish origin in the Netherlands. The aim of their study was to provide growth and sexual maturation reference data for Turkish children living in the Netherlands. They compared these references with the reference data of children of Dutch origin and with Turkish reference data collected in Turkey and elsewhere in Europe. Cross-sectional growth and demographic data were collected from 2904 children of Turkish origin and 14500 children of Dutch origin living in the Netherlands in the age range 0-20 years. Growth references for length, height, weight for height, body mass index (BMI) and head circumference were constructed with the LMS method. A generalized additive model estimated reference curves for sexual maturation and menarche. They found Turkish children were considerably shorter and more overweight than Dutch children. Separate growth charts for Turkish children in the Netherlands were useful for growth monitoring

Maddah et al. (2003) analyzed the association of body mass index with educational level in Iranian men and women.. They estimated the relationship between educational level, BMI, waist-to-hip ratio (WHR), physical activity and parity in a group of Iranian men and women living in Tehran. They found after controlling for age and smoking, women with a higher level of education showed a significantly lower mean BMI than less educated women (24.8±4.2 vs 28.3±4.9, $p<0.01$), while more educated men had a higher mean BMI than less educated men (28.4±4.3 vs 26.7±4.5). In multiple regression analysis, physical activity in leisure time in men and years of education in women were the only determinants of BMI. After controlling for BMI, WHR was not related to the level of education in either men or women. Finally they found data indicated an educational difference in BMI for the study population. In Iranian women, like the women in developed countries, the level of education was negatively related to BMI, while in men the association was positive.

Chapter-3

Materials of the Study

Chapter 3

Materials of the study

Shantals are living in 10 Thanas of Rajshahi District. Considering one Thana as one cluster, 2 clusters were selected at random. All persons of those cluster were considered. From the two-selected cluster, the total number of subjects were 395 for male and 438 for female. The present anthropometric study considered the variables, height (in cm), weight (in kg), sitting height (in cm), chest circumference (in cm), years of schooling (in year), family income (in taka), sleeping time (in hour), age at menarche (in year), religion, occupation, source of water, sanitation, food habits, drug used, relaxation media, health condition, taking of treatment, body colour, housing patterns etc. The qualitative measurement are taken through some questionnaire (in Appendix-I) and the quantitative variables are measured by the author himself as follows:

Stature: The measurement of stature needs a vertical board with an attached metric ruler and a horizontal headboard that can be brought into contact with the most superior point on the head. The combination of these elements is a stadiometer. The subjects were barefooted and little clothed so that the positioning of the body can be seen. They stood in a flat surface that was at a right angle to the vertical board of the stadiometer. The head was positioned in the Frankfort horizontal plane.

The arms hang freely by the sides of the trunk, with the palms facing the thighs. They placed their heels together, with touching the base of the vertical board. The medial borders of the feet are at an angle of about 60^0. If the subject has knock-knees, the feet are separated so that the medial borders of the knees are in contact but not overlapping. The scapulae and buttocks are in contact with the vertical board. The heels, buttocks, scapulae and the posterior aspect of the cranium of some subjects cannot be placed in one vertical plane while maintaining a reasonable natural stance. These subjects are positioned so that only the buttocks and the heels or the cranium are in contact with the vertical board.

The subject is asked to inhale deeply and maintain a fully erect position without altering the load on the heels the movable headboard is brought onto the most superior point on the head with sufficient pressure to compress the hair. The measurement is recorded to the nearest 0.1 cm Recumbent length was measured in place of stature until the age of two years.

Sitting height: The measurement of sitting height requires a table, an anthropometer and a base for the anthropometer. The table should be sufficiently high so that the subject's legs hang freely. The subject sits on the table with legs hanging unsupported over the edge of the table and with the hands resting on the thighs in a cross-handed position. The knees are directed straight ahead. The backs of the knees are near the edge of the table but not in contact with it. The subject sits as erect as possible with the head in the fankfort horizontal plane. In positioning it is useful to approach the subject from the left side and to apply gentle pressure simultaneously with the right hand over the lumbar area and with the left hand on the superior part of the sternum. This reinforces the erect position. Genlte upward traction on the mastoid processes ensures the fully erect seated posture.

The lower half of the anthropometer is set in its base and it is positioned vertically in the midline behind the subject so that it nearly touches the sacral and interscapular regions. When almost ready to make the measurement the measure approaches from the subject's left side. The measurer's left hand is placed under the subject's chin to assist in loding the proper position and the right hand noves the blade of the anthropometer onto

the vertex. When the subject is instructed to take a deep breath and the measurement is made just before the subject exhales. Firm pressure is applied to compress hair. The measurer should observe the level of the anthropometer bland without parallax; hence a small stool may be required. The measurement is recorded to the nearest 0.1 cm.

It is important that the record observe both the position of the subject to avoid slouching and also the position of the subject of the anthropometer to ensure that it is vertical and that the bland is brought down in the midline of the head. If too much pressure is applied to the anthropometer blade it may slide to one side off the vertex. It is important that the subject's arms rest relaxed on the thighs. The subject should not place their hands on the side of the table and push him or herself erect. This procedure may elevate the subjects ever so slightly off the table surface.

Weight: The measurement of weight requires a moveable weighted scale. The scale marked the value between 0 to 120 kg. The scale with wheels to facilitate movement from one location to another. The subjects stand still over the center of the scale. Light indoor, clothing can be worn, excluding shoes. The weight of this clothing was subtracted. The measurement was recorded to the nearest 100g.

Chest circumference: The measurement of chest circumference requires a highly flexible inelastic tape measure that is no more than 0.7 cm wide. During the measurement, the subjects stand erect, in a natural manner, with the feet at shoulder width. The arms are abducted slightly to permit passage of the tape around the chest. When the tape is snugly in place, the arms are lowered to their natural position at the sides of the trunk. The chest should be bare except that women may wear a strapless bra. Chest circumference is measured at the level of the fourth costo-sternal joints. Laterally, this corresponds to the levels of the sixth ribs. The measurement is made in a horizontal plane at the end of a normal expiration. The fourth costo-sternal joints are located by a two-handed palpation method whereby the measurement places both index fingers on the superior surfaces of the clavicles. While the thumbs locate the first intercostals spaces. The index fingers then replaces the thumbs, which are lowered to the second intercostals spaces. This procedure is repeated until the fourth ribs are located. The fourth ribs and their costal cartilages are followed medially to their articulations with the sternum. The level of the fourth costo-sternal joints is marked. An alternative procedure is to locate the manubrio-sternal joint, which projects markedly and is at the level of the second costal cartilages. The third and fourth costo-sternal junctions can then be located sequentially.

The measurer stands in front of the subject but slightly to one side. The tape housing is held in the right hand while the free end of the tape is passed in front of the subject and retrieved by the measurer's left hand as it passes around the subject's back. The free end of the tape is then positioned between the right axilla and the sternum. At the time the measurer ensures that the tape is at the correct horizontal position first at the back and then at the front. The reserve end of the tape is then placed near the zero ends.

The tape should be in light contact with the skin without indenting it but the tape may be away from the skin near the vertebral column. The skin should be free of perspiration because this may increase friction between the skin and the tape.

Chapter-4

Methods of the Study

Chapter 4

Methods of the study

To find the average pattern of anthropometric variables, mean and standard deviation were considered. Among the variables there may exist the interrelationship that was checked by correlation matrix. The variables those were significantly interrelated with each other were considered for further analysis to check their degrees of dependency. The pattern of dependency whether it was linear or nonlinear were checked by graphical representation first. It was considered the method of multiple linear regression in case of linear relationship and nonlinear regression in case of non-linear relationship. In the present study, in case of nonlinearity, orthogonal polynomial regression of higher order was taken into account.

Consider the polynomial model (Montgomery and Peck, 992) as:

$$Y_i = \beta_0 + \beta_1 X_i^1 + \beta_2 X_i^2 + \beta_3 X_i^3 + \cdots + \beta_k X_i^k + \varepsilon_i, \quad i = 1, 2, \cdots, n \qquad (4.1)$$

Generally the columns of the X matrix will not orthogonal. Furthermore if we increase the order of the polynomial by adding a term $\beta_{k+1} X^{k+1}$ we must recomputed $(X'X)^{-1}$ and the estimates of the lower-order parameters $\hat{\beta}_0, \hat{\beta}_1, \ldots, \hat{\beta}_k$, will change

Now suppose that we fit the model

$$y_i = \alpha_0 p_0(x_i) + \alpha_1 p_1(x_i) + \alpha_2 p_2(x_i) + \dots\dots + \alpha_u p_u(x_i) + e_i, \quad i = 1, 2, \dots, n \qquad (4.2)$$

where $\alpha_u p_u(x_i)$ is a uth order orthogonal polynomial defined such that

$$\sum_{i=1}^{n} p_r(x_i) p_s(x_i) = 0, \quad r \neq s, \; r, s = 0, 1, \dots, k$$
$$p_0(x_i) = 1 \qquad (4.3)$$

Then the model becomes Y=Xα+ε, where the X matrix is

$$X = \begin{vmatrix} p_0(x_1) & p_1(x_1) & \dots & p_k(x_1) \\ p_0(x_2) & p_1(x_2) & \dots & p_k(x_2) \\ \vdots & \vdots & & \vdots \\ p_0(x_n) & p_1(x_n) & \dots & p_k(x_n) \end{vmatrix}$$

Since this matrix has orthogonal columns, the $X'X$ matrix is

$$X'X = \begin{vmatrix} \sum_{i=1}^{n} P_0^2(x_i) & 0 & \dots & 0 \\ 0 & \sum_{i=1}^{n} P_1^2(x_i) & \dots & 0 \\ \vdots & \vdots & & \vdots \\ 0 & 0 & \dots & \sum_{i=1}^{n} P_k^2(x_i) \end{vmatrix}$$

The least squares estimator of the α are found from $(X'X)^{-1} X'Y$ as

$$\hat{\alpha}_j = \frac{\sum_{i=1}^{n} P_j(x_i) y_i}{\sum_{i=1}^{n} P_j^2(x_i)}; \quad j = 0, 1, \dots, k \tag{4.4}$$

Since $P_0(x_i)$ is a polynomial of degree zero, we can set $P_0(x_i) = 1$, and consequently

$$\hat{\alpha}_0 = \bar{y}$$

The residual sum of squares is

$$SS_E(k) = S_{yy} - \sum_{j=1}^{k} \hat{\alpha}_j \left[\sum_{i=1}^{n} P_j(x_i) y_i \right] \tag{4.5}$$

The regression sum of squares for any model parameter does not depend on the other parameter in the model. This regression sum of squares is

$$SS_R(\hat{\alpha}_j) = \hat{\alpha}_j \sum_{i=1}^{n} p_j(x_i) y_i$$

If we wish to assess the significance of the highest-order term, we should test $H_0 : \alpha_k = 0$. We would use

$$F_0 = \frac{SS_R(\alpha_k)}{SS_E(k)/(n-k-1)} = \frac{\hat{\alpha}_k \sum_{i=1}^{n} p_k(x_i) y_i}{SS_E(k)/(n-k-1)} \tag{4.6}$$

as the F-statistic. Furthermore if the order of the model is changed to k+r, only the r new coefficient must be computed. The coefficients $\hat{\alpha}_0, \hat{\alpha}_1, \dots, \hat{\alpha}_k$ do not change due to the orthogonal property of the polynomial. Thus sequential fitting of the model is computationally easy.

The orthogonal polynomials $P_j(x_i)$ are easily constructed for the case where the levels of x are equally spaced. The first five orthogonal polynomials are

$$
\left.\begin{aligned}
&P_0(x_i)=1\\
&P_1(x_i)=\lambda_1\left[\frac{x_i-\bar{x}}{d}\right]\\
&P_2(x_i)=\lambda_{12}\left[\left(\frac{x_i-\bar{x}}{d}\right)^2-\left(\frac{n^2-1}{12}\right)\right]\\
&P_3(x_i)=\lambda_{13}\left[\left(\frac{x_i-\bar{x}}{d}\right)^3-\left(\frac{x_i-\bar{x}}{d}\right)\left(\frac{3n^2-7}{20}\right)\right]\\
&P_4(x_i)=\lambda_4\left[\left(\frac{x_i-\bar{x}}{d}\right)^4-\left(\frac{x_i-\bar{x}}{d}\right)^2\left(\frac{3n^2-13}{14}\right)+\frac{3(n^2-1)(n^2-9)}{560}\right]
\end{aligned}\right] \quad (4.7)
$$

Where d is the spacing between the levels of x and the $\{\lambda_j\}$ are constants chosen so that the polynomial will have integer values.

To estimate the association between two groups of variables height, weight, BMI and social status, education level of the Shantal, the samples were arranged into coding variables according to age. The logistic regression was applied for finding the appropriate relationship between anthropometrics measurement, social status and education level.

Assuming that we have a single regressor, let's try to write the model as

$$Y_i=\beta_0+\beta_1X_i+\varepsilon_i,\quad i=1,2,\cdots,n \quad (4.8)$$

We would logically let $Y_i = 0$ if the ith unit does not have the characteristic that Y represents, and $Y_i = 1$ if the unit does possess that characteristic.

It thus follows that ε_i can also take on only two values: $1 - \beta_0 - \beta_1 X_i$ if $Y_i = 1$ and $-\beta_0 - \beta_1 X_i$ and if $Y_i = 0$. Therefore ε_i cannot be even approximately normally distributed. Consequently, the model given by Eq. (4.8) is inapplicable for a binary dependent variable.

In simple linear regression the starting point in determining a model is a scatter plot of Y versus X, but this is of limited value when there are only two possible values of Y. Consequently, it is necessary to consider other plots. One such plot results from smoothing the Y values, and then plotting the smoothed values against X. We might also consider a plot of $E(Y|X)$ against X. But now we must postulate a relation between the two, rather than plotting points, since the ordinate of the plot is not related to data.

It is customary to let $E(Y_i|X_i = \pi_i)$ which is here π_i represents the probability of successes, for example, someone dying within a stated time period who has a cholesterol level given by X.

We certainly wouldn't expect the relationship to be linear over a wide range of X_i as we would expect π_i to be almost 1.0 for any extremely large value of X_i (assuming that the time interval is not short and there are no other risk factors), and to be very close to zero for any low values of X_i that is within the normal range.

What about the relationship between π_i and X_i intermediate value of X_i? Since we would expect to observe an asymptotic-type graph segment at very large and very small values of X_i, we would expect some what of a curvilinear relationship in the neighborhood of the extreme values, whereas the rest of the graph might be closer to linear. Thus, the graph might resemble Figure 4.1. This S curve configuration has been found to be appropriate in many applications for which Y is a binary random variable.

The function

$$\pi_i = \frac{\exp(\beta_o + \beta_1 X)}{1 + \exp(\beta_o + \beta_1 X)} \qquad (4.9)$$

will produce a graph similar to Figure 9.1 when $\beta_o < 0$ and $\beta_1 < 0$. (Here exp denotes exponentiation.) The model given by Eq. (4.2) satisfies the important requirement that $0 \le \pi_i \le 1$ and will be a satisfactory model in many applications. The model in terms of Y would be written as $Y = \pi(X) + \varepsilon$.

The value of X at which $P(Y=1) = 0.5$, which is given by $-\beta_O / \beta_1$, provides useful information.

It follows from Eq. (4.9) that $\pi/(1-\pi) = \exp(\beta_o + \beta_1 X)$, so

$$\log\left(\frac{\pi}{1-\pi}\right) = \beta_o + \beta_1 X \qquad (4.10)$$

The interpretation of β_1 is naturally somewhat different from the interpretation in linear regression. In Eq. (4.3), β_1 obviously represents the amount by which log odds change per unit change in X. It is somewhat more meaningful, however, to state that a one- unit increase in X increases the odds by the multiplicative factor e^{β_1}. This is apparent if we exponentiate both sides of Eq. (4. 10).

Even in simple logistic regression, we would not expect to have large n_i very often, and in multiple logistic regression it is extremely improbable that we would have each combination of regressor values repeated a large number of times. Therefore, the method of (non interval) weight least squares will not be illustrated for logistic regression.

Method of maximum likelihood

The most commonly used method of estimating the parameters of a logistic regression model is the method of maximum likelihood. The (simple) likelihood function is, in general, defined as the joint probability function of the random variables whose realization constitute the sample. Specifically, for a sample size n whose observation are $(y_1, y_2, \ldots, y_n)$, corresponding random variables are $(Y_1, Y_2, \ldots, Y_n)$.

Since the Y_i are assumed to be independent, the joint probability density function is

$$g(Y_1, Y_2, \ldots, Y_n) = \prod_{i=1}^{n} f_i(Y_i)$$

$$= \prod_{i=1}^{n} \pi_i^{Y_i} (1-\pi_i)^{1-Y_i} \qquad (4.11)$$

Since $f_i(Y_i) = \pi_i^{Y_i}(1-\pi_i)^{1-Y_i}$, $Y_i = 0, 1$; $i = 1, 2, \ldots, n$. (The latter is simply the probability that y_i equals 0 or 1 and is thus a Bernoulli random variable relative to π_i). In words, Eq (4.11) gives the probability of a particular sequence of 0's and 1's.

It should be noted that the assumption of independent Bernoulli random variables may not always be plausible (see Mc.Cullagh and Nelder.1989, p.124). Nevertheless, we will assume that the assumption holds.

Maximum likelihood estimators are generally obtain by maximizing the logarithm of the likelihood function, as this is easier to solve than the likelihood function and is a suitable substitute since the logarithm is a monotonic function). Taking the logarithm of each of Eq. (4.11) produces

$$\log(g(Y_1,\ldots,Y_n)) = \log\left[\prod_{i=1}^{n} \pi^{Y_i}(1-\pi_i)^{1-Y_i}\right]$$

$$= \sum_{i=1}^{n} Y_i \log(\pi_i) + \sum_{i=1}^{n} (1-Y_i)\log(1-\pi_i) \qquad (4.12)$$

$$= \sum_{i=1}^{n} Y_i \log\left(\frac{\pi_i}{1-\pi^i}\right) + \sum_{i=1}^{n} \log(1-\pi_i)$$

Using the Eq. (4.9) and Eq. (4.10) we get,

$$\log(g(Y_1, Y_{2,\ldots,} Y_n)) = \sum_{i=1}^{n} Y_i + (\beta_0 + \beta_1) - \sum_{i=1}^{n} \log[1+\exp(\beta_0 + \beta_1 X_i)] \qquad (4.13)$$

The logarithm of the likelihood function (i.e the log likelihood) is thus given by Eq. (4.13) and differentiating Eq. (4.13) with respect to β_0 and with respect to β_1 produces the two likelihood equations. Specifically, letting log (L (β_0, β_1)) denote the logarithm of the likelihood function, we obtain

$$\frac{\partial \log(L(\beta_{0,}\beta_1)}{\partial \beta_0} = \sum Y_i - \sum \frac{\exp(\beta_0 + \beta_1 X_i)}{1+\exp(\beta_0 + \beta_1 X_i)} \qquad (4.14)$$

$$\frac{\partial \log(L(\beta_{0,}\beta_1)}{\partial \beta_1} = \sum X_i Y_i - \sum \frac{\exp(\beta_0 + \beta_1 X_i)}{1+\exp(\beta_0 + \beta_1 X_i)} \qquad (4.15)$$

The maximum likelihood estimators of β_0 and β_1 are obtain by setting the right side of each of these equations equal to zero, and then solving the equations simultaneously (and iteratively) so as to produce β_0 and β_1. Iteration would continue until certain convergence criteria are met. But with the help of package program SPSS version 10.0 the results can be easily obtain.

The performance of our fitted model has examined using the restricted cross validity predictive power (Khan and Ali, 2003) of the form

$$\rho_{rcv}^{2}=1\text{-w }(1\text{-R}^2),\ R^2>1-w^{-1},\ w=\frac{(n+1)(n-1)(n-2)}{n(n-k-1)(n-k-2)},\ n>k+2 \qquad (4.16)$$

Further, the stability of the model was examined using the shrinkage in R^2, i.e. $\tilde{\eta}^2=\left|\rho_{rcv}^2-R^2\right|$. If $\tilde{\eta}^2\leq\alpha$ then over the population the fitted model is said to be stable at $100\alpha\%$ level of significance (Stevens, 1996).

Data screening:

As usual with data sets of this type, a few outliers (abnormal data points) were found. These were identified using the informal techniques suggested by Dunn and Clark (1974). After detecting of presence of outlier, they were removed. The presence of such abnormal point in data sets can affect the interpretation of results (Stevens, 1996).

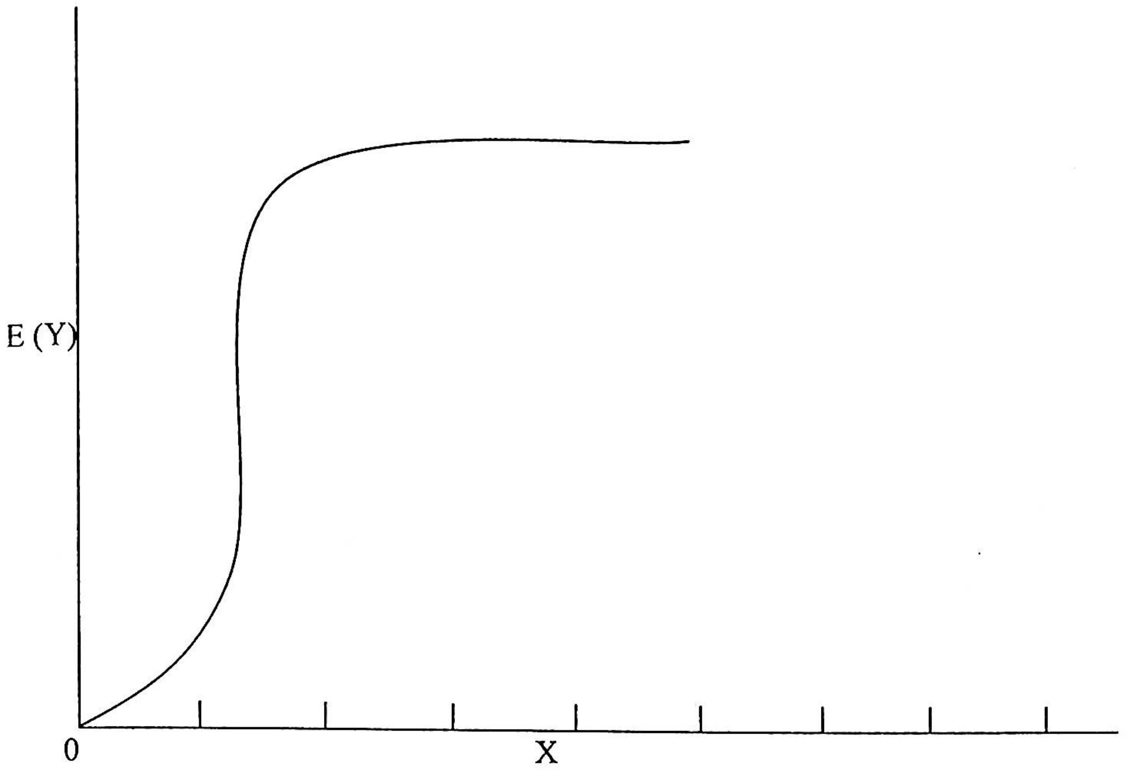

Figure: 4.1 Typical function graph for logistic regression

Chapter-5

Results and Discussion

Chapter 5

Results and Discussion

5.1 The location and scale pattern of the anthropometric variables

To see the location and scale pattern of the anthropometric variables of the Shantals, mean and standard deviation are computed and shown in table 5.1. From this table it is found that the average heights of Shantals are increasing comparatively with those of oldest Shantals. Almost every Shantals were very lean and thin because the maximum average weight were about 46 kg for male and 41 kg for female, and also the maximum average BMI were about 19 kg/m^2 for both male and female. This may happen due to the poor economic condition of the Shantals. The average sitting height and chest circumference of Shantals are also increasing comparatively with those of oldest Shantals, however, the results may slightly affected with the fluctuation of the sample size.

Table 5.1: Mean and standard deviation of height, weight, sitting height, chest circumference and BMI for Shantals. The values without parenthesis are for male and those in the parenthesis, for female

Age interval	Mid age (x)	n	Height (cm) Mean±S.d	Weight (kg) Mean±S.d	Sitting height (cm) Mean±S.d	Chest circumference (cm) Mean±S.d	BMI Mean±S.d
0-4	2	23 (25)	92.90±12.16 (88.69±12.76)	10.57±2.57 (8.96±2.21)	48.50±6.64 (48.23±10.82	49.61±5.37 (48.15±4.62)	12.30±2.38 (11.53±2.33)
5-9	7	34 (34)	119.77±11.77 (117.76±20.08)	18.88±4.38 (19.35±7.67)	62.22±6.67 (62.57±10.11)	56.05±8.02 (56.79± 6.26	12.90±1.59 (14.87±9.02)
10-14	12	48 (51)	140.08±13.10 (142.36±8.96)	29.88±11.37 (31.50±8.18)	70.08±7.56 (71.79±6.0)	64.39±7.02 (66.66±7.48)	14.62±2.41 (15.27±2.88)
15-19	17	45 (44)	156.07±9.12 (149.28±7.31)	40.40±8.58 (38.45±5.79)	79.73±5.06 (75.16±5.2)	73.28±4.98 (66.66±7.48)	16.61±1.66 (17.31±2.65)
20-24	22	30 (43)	158.39±7.77 (151.65±4.41)	46.87±6.21 (41.23±5.63)	80.25±3.88 (75.26±3.5)	78.20±5.47 (74.81±6.64	18.76±1.75 (18.51±2.28)
25-29	27	53 (68)	157.07±4.91 (150.99±6.13)	46.21±6.62 (41.13±6.65)	78.89±6.32 (75.88±3.1)	78.01±5.61 (74.16±5.93)	18.64±1.96 (18.35±2.39)
30-34	32	43 (55)	157.04±5.47 (149.77±6.91)	46.12±6.35 (41.00±7.53)	80.57±3.62 (75.70±4.3)	78.61±5.07 (76.05±7.49)	18.60±2.15 (18.30±3.18)
35-39	37	33 (40)	157.03±7.04 (149.74±6.79)	46.10±6.27 (41.00±7.53)	78.92±7.64 (75.94±3.4)	81.39±5.84 (76.81±8.23)	18.58±2.70 (18.21±2.23)
40-44	42	20 (30)	156.97±7.20 (149.68± 4.46)	45.60±7.98 (40.96±6.48)	78.43±4.31 (76.95±4.38)	77.70±5.46 (74.64±6.91)	18.52±2.45 (18.13±2.95)
45-49	47	25 (11)	156.78±4.61 (149.55± 5.08)	45.16±4.47 (39.09±5.26)	79.85±3.70 (75.38±3.52)	78.12±8.20 (74.64±6.91)	18.38±1.95 (17.42±1.60)
50-54	52	41 (37)	156.32±7.76 (149.49±5.20)	43.20±10.59 (38.54±8.07)	78.41±2.37 (76.03±3.70)	79.62±7.49 (73.33±4.83)	17.76±2.43 (17.22±3.21)

5.2 The relationship among the anthropometric variables

To check the relationship among the anthropometric variables, correlation matrix are prepared and shown in table 5.2. This table shows that stature, weight, sitting height, and chest circumference of Shantals are positively and significantly related to each other. This implies that the morphological growths regarding size and shape of the Shantal community are strongly related to each other. However, it is not clear here that how much growth about shape causes how much growth about size of the Shantal community. For this, we have to check dependency pattern among the anthropometric variables.

Table 5.2: Correlations coefficient between the pair of anthropometric measurement of the Shantals. The values above the diagonal are for male and those below, for female

	Height (cm)	Weight (kg)	Sitting height (cm)	Chest circumference (kg)
Height (cm)		0.98*	0.99*	0.96*
Weight (kg)	0.98*		0.97*	0.99*
Sitting height (cm)	0.99*	0.98*		0.97*
Chest circumference (kg)	0.95*	0.97*	0.95*	

*The correlation is significant at 5% level.

5.3 The pattern of dependence whether it was linear or non-linear

To check the pattern of dependence whether it was linear or non-linear among the variables stature, weight, BMI, age at menarche, family income, number of sibling, education and occupation, the graphical representations among the variables were considered and it was found that the relationship between weight and BMI were linearly related to each other. The same pattern was also found between heights, weight, sitting height, chest circumference and years of schooling for female. For male, the pattern of linear relationship was found for the variables height, weight, sitting height, chest circumference, family income, number of sibling and age at menarche with year of schooling (figures 5.1, 5.2, 5.3, 5.4 and 5.5).

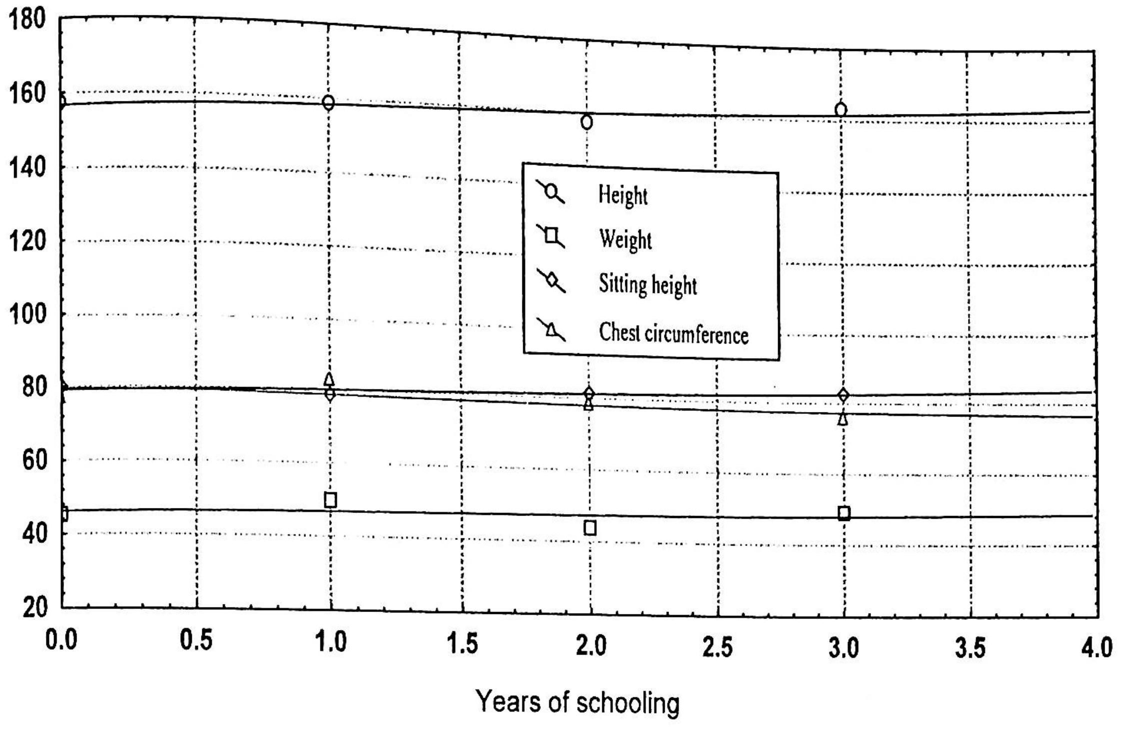

Figure: 5.1 Stature (cm), weight (kg), sitting height (cm), chest circumference (cm
by years of schooling for male aged 20-25.

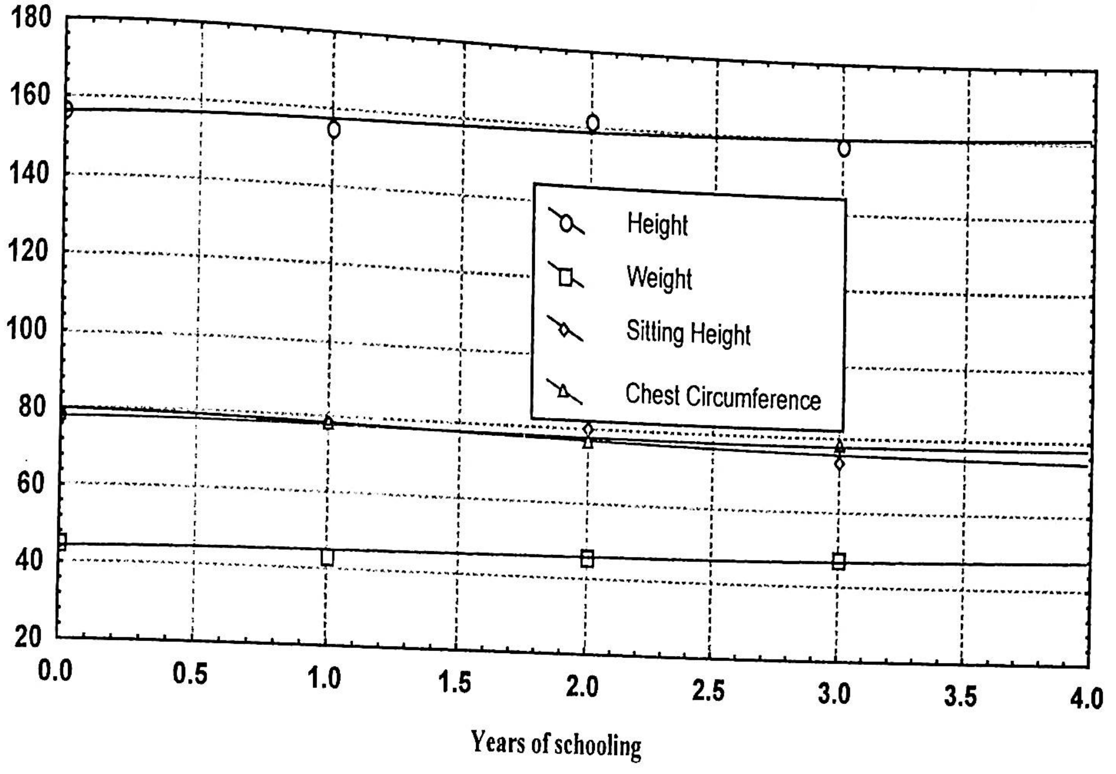

Figure 5.2 Stature (cm), weight (kg), sitting height (cm), chest circumference (cm) by years of schooling for male aged 25-30

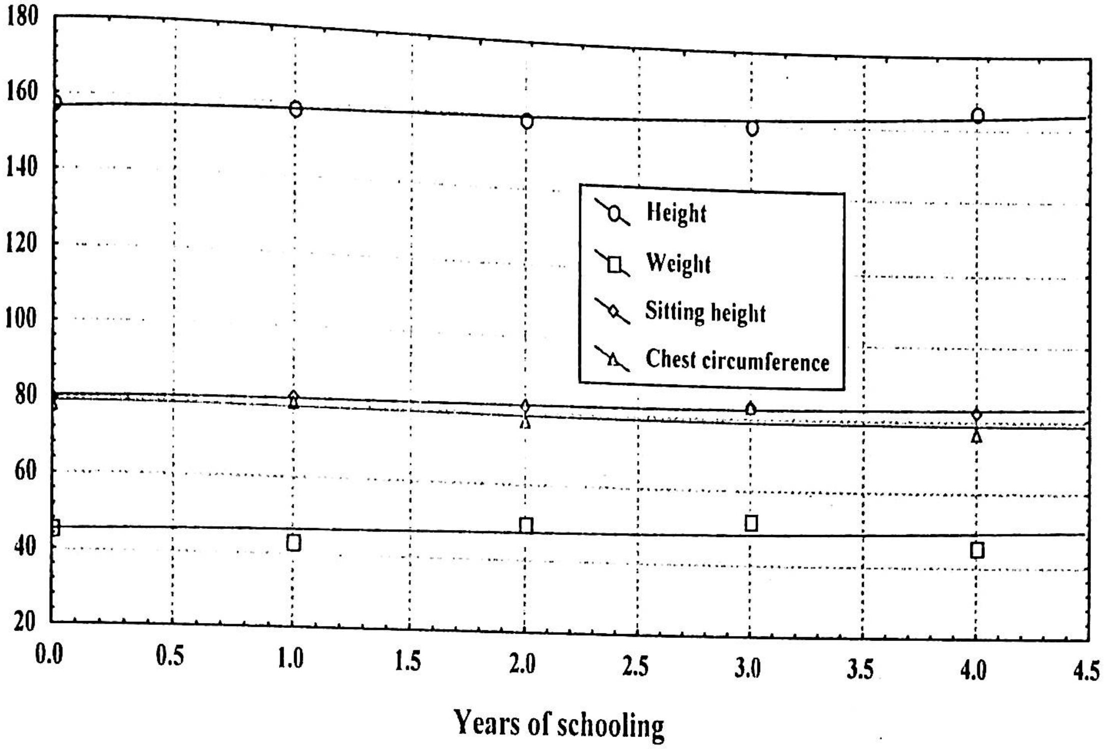

Figure: 5.3 Stature (cm), weight (kg), sitting height (cm), chest circumference (cm) by years of schooling for male aged 30-35

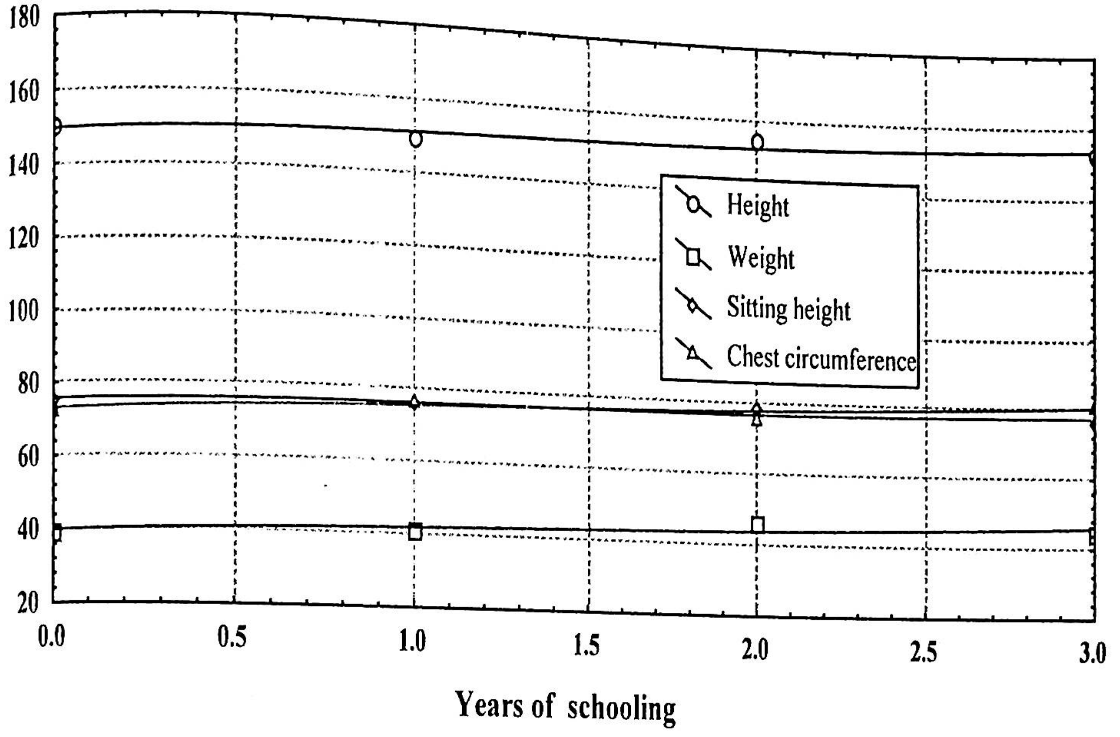

Figure 5.4 Stature (cm), weight (kg), sitting height (cm), chest circumference (cm) by years of schooling for female aged 25-30

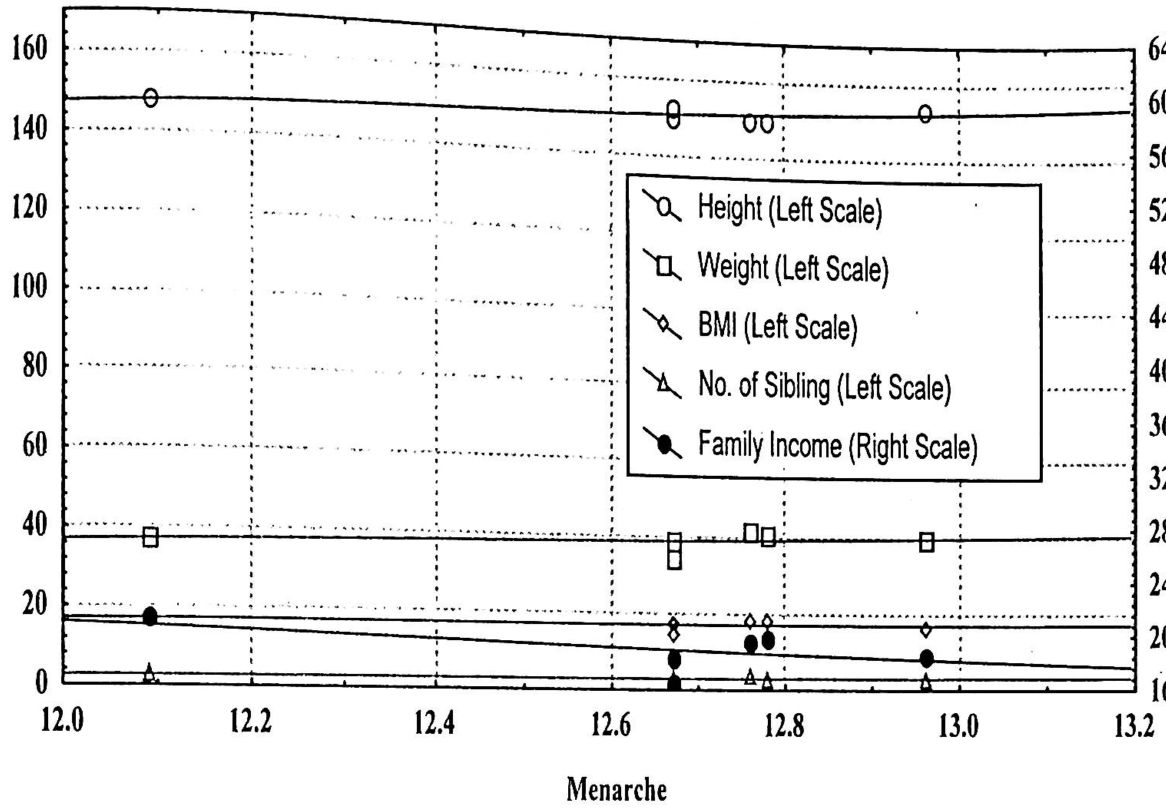

Figure: 5.5 Stature (cm), Weight (kg), BMI, No. of Sibling and Family Income by Menarche

5.4 The association among the age at menarche, height, weight, BMI, family income and number of sibling

Association between age at menarche and other variables was shown in table 5.3. The table 5.3 indicates that the female onset of menarche was earlier for those who were shorter and became late menarche who were taller. The female onset of menarche was earlier for those who were heavier in weight, and became late menarche for those who were thinner. The female Shantal were reached menarche at earlier for those who have the lower BMI and at the late menarche for those who were higher in BMI. The female Shantal were reached at earlier menarche for those whose family income were higher and at late menarche whose family income were lower. The female Shantal were also reached at earlier than those who had fewer numbers of sibling and at late menarche who had more number of siblings.

Also, the association between numbers of sibling and family income was shown in table 5.4. This table highlighted that whose family income were higher they had more number of sibling and whose family income were lower they had fewer numbers of sibling ($p<0.01$).

Table 5.3: Estimated mean values of age at menarche, height, weight, BMI, Family income and number of sibling with their S.D by current age of Shantals.

Birth year	Current age	N	Age at menarche		Height (cm)		Weight (kg)		BMI		Family income		Number of sibling	
			Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
1980-1989	14-24	96	12.09	1.40	147.94	6.67	37.83	6.66	17.26	2.74	2089.58	1383.38	2.61	1.55
1970-1979	25-34	126	12.78	1.07	150.04	6.77	41.19	7.44	18.29	2.97	1982.14	1123.57	2.90	1.62
1960-1969	35-44	80	12.76	1.07	150.32	7.54	41.97	8.87	18.54	3.44	1965.00	814.13	3.24	1.68
1950-1959	45-54	24	12.96	0.86	153.59	9.95	39.92	6.85	16.76	2.34	1870.83	867.52	2.91	1.74
1940-1949	55-64	15	12.67	1.05	149.83	5.45	39.47	7.59	17.55	3.11	1826.67	606.47	2.93	1.28
1930-1939	65-74	9	12.67	1.00	152.79	7.84	34.33	8.29	14.52	2.43	1655.56	1023.61	2.63	2.06

Table 5.4 linear regression results

Dependent Variable	Independent variable	Regression coefficient (B)	St. Error (B)	R^2	P-value
No. Of Sibling	Family income (0.989)	0.00278	.000526	0.7488	0.01

5.5 Comparative study of age at menarche between the Shantals and other ethnic groups

Comparative study of age at menarche between the Shantals and other ethnic groups is shown in table 5.5. This table shows that the Shantal women attained average age at menarche approximately 3.5 years earlier than Philippine girls (Osteria, 1979), 2.5 years earlier than Indian Rajbanshi girls (Chakvarty, 1994), one year earlier than Tahiti urban (Ducros and Ducros, 1987), Swedish (Lindgren, 1976), and Cape Towns girls (Heeeebarg and Iouw, 1995). About the same average age at menarche was found for other of Assamese aboriginals (Sengupta et al., 1996).

Table 5.5. Average age at menarche (in years) of Shantals and of some other ethnic groups.

Authors	Ethnic group	Age at menarche
Lindgren (1976)	Swedish	13.05
Osteria (1979)	Philippines	15.5
Ducros and Ducros (1987)	Tahiti rural	12.75
	Tahiti urban	13.08
Chakravarty (994)	Indian (Rajbanshi)	14.7
Henneeberg and louw (1995)	Cape Towns Girl	13.3
Sengupta et a (1996)	Assamese:	
	Brahmin	12.30
	Kalita	11.96
	Kaibarta	11.92
	Muslims,	12.10
	Ahoms Mongoloid	11.83
	Sonowals Mongoloid	11.94
Kac et al. (2000)	Riode Janeiro	12.40
Present Study	Shantal	12.09

5.6 Fitting of orthogonal polynomial of stature, weight and BMI on age

The relationship between age and each of stature, weight, and BMI are non-linear (figures are not shown here), polynomial of higher order was applied.

For male Shantals, the well fitting of third degree orthogonal polynomial of stature, weight and BMI on age are presented in figure 5.6, 5.7, and 5.8 and the detailed results are shown in table 5.6. These figures show that the fitting of the orthogonal polynomial looks good. The stature of male Shantal is significantly increasing until age 22 and after 22 ages the increasing has been ceased up to 37 and again slightly increasing up to age 50 (fig: 5.6). The weight is increasing until age 27 and after age 27 the increasing has been ceased up to age 50 (fig: 5.7). The growth pattern of BMI exhibits the same fashion as that of body weight.

For female Shantals, fitting of orthogonal polynomial of stature, weight and BMI on age are presented in figure 5.9, 5.10, and 5.11. These figures highlight that the fitting of the orthogonal polynomial also looks good. The stature of female Shantal is significantly increasing until age 22 and after 22 ages the increasing has been gone away up to 37 and again slightly increasing up to age 50 (fig: 5.9). The growth pattern of weight exhibits the same fashion as body weight of male Shantal (fig: 5.10). The BMI is increase until age 22 and after age 22 the increasing has been ceased up to age 50 (fig: 5.11).

Table 5.6 divulge that more than 96% variation in stature is explained by the orthogonal polynomial regression for both malt and female Shantal. Also, all the polynomial regression coefficients are highly significant ($p<0.05$) except the cubic coefficient for the dependent variable BMI.

These overall finding suggest that the pattern of stature, weight, BMI of the Shantal are increasing at some common ages and this tendency is slightly decreasing with corresponding to increasing their age. The physically growth of Shantal community are comparatively lower than those of normal Bangladesh (ref). These may happen due to the lack of proper nutrition, poverty, illiteracy etc. Using the estimated coefficient from Table 5.6 we may obtain the fitted equation in terms of the original repressors as:

For male:

$$Height = 160.55 + 0.036[X_l - 27] - 0.055[X_l - 27]^2 + 0.002[X_l - 27]^3$$
$$= 160.55 + 0.036A - 0.055A^2 + 0.002A^3, \quad A = X_l - 27 \quad (5.8)$$
$$Weight = 46.28 + 0.3475A - 0.03227A^2 - 0.00055A^3 \quad (5.9)$$
$$BMI = 18.372 + 0.1162A - 0.00597A^2 + 0.0000022A^3 \quad (5.10)$$

For female:

$$Height = 154.006 - 0.2069A - 0.0527A^2 + 0.0023A^3 \quad (5.11)$$
$$Weight = 42.117 + 0.123A - 0.0298A^2 + 0.00079A^3 \quad (5.12)$$
$$BMI = 18.417 + 0.0282A - 0.0063A^2 + 0.000136A^3 \quad (5.13)$$

Table 5.6: Study of 3rd degree orthogonal polynomial regression model for anthropometric variables on age

Sex	Dependent variable	Source of variation	Estimated coefficient of the polynomial	Sum of Square	Degrees of Freedom	Mean Square	F_0	R^2
Male	Height	Regression		4465.183	3	1488.39	255.386	
		Linear, α_1	4.694182	397.59	1	397.59	68.220	
		Quadratic, α_2	-1.3841	2423.90	1	2423.90	415.905	0.99
		Cubic, α_3	0.304431	1643.71	1	1643.71	282.036	
		Residual		40.79409	7	5.828		
		Total		4505.977	10			
	Weight	Regression		1571.469	3	523.823	115.277	
		Linear, α_1	2.964364	966.6197	1	966.6197	212.724	
		Quadratic, α_2	-0.819	575.5097	1	575.5097	126.652	0.98
		Cubic, α_3	0.082699	29.34006	1	29.34006	6.457	
		Residual		31.80619	7	4.544		
		Total		1603.276	10			
	BMI	Regression		57.23821	3	19.08	45.755	
		Linear, α_1	0.588273	38.06713	1	38.06713	91.288	
		Quadratic, α_2	-0.14948	19.17024	1	19.17024	45.971	0.95
		Cubic, α_3	0.000445	0.00085	1	0.00085	0.002	
		Residual		2.915949	7	0.417		
		Total		60.15416	10			
Female	Height	Regression		3868.954	3	1289.65	873.155	
		Linear, α_1	4.110545	1858.624	1	1858.624	201.542	
		Quadratic, α_2	-1.31967	1494.24	1	1494.24	162.029	0.98
		Cubic, α_3	0.346844	516.0897	1	516.089	55.962	
		Residual		64.55741	7	9.222		
		Total		3933.511	10			
	Weight	Regression		1163.452	3	387.820	262.573	
		Linear, α_1	2.380455	623.322	1	623.322	422.019	
		Quadratic, α_2	-0.74745	479.345	1	479.3455	324.540	0.99
		Cubic, α_3	0.119033	60.784	1	60.784015	41.154	
		Residual		10.341	7	1.477		
		Total		1173.793	10			
	BMI	Regression		44.627	3	387.82	1999.07	
		Linear, α_1	0.443818	21.667	1	21.6672	111.686	
		Quadratic, α_2	-0.15888	21.658	1	21.65867	111.643	0.97
		Cubic, α_3	0.017417	1.301	1	1.301417	6.708	
		Residual		1. 356	7	0.194		
		Total		45.98389	10			

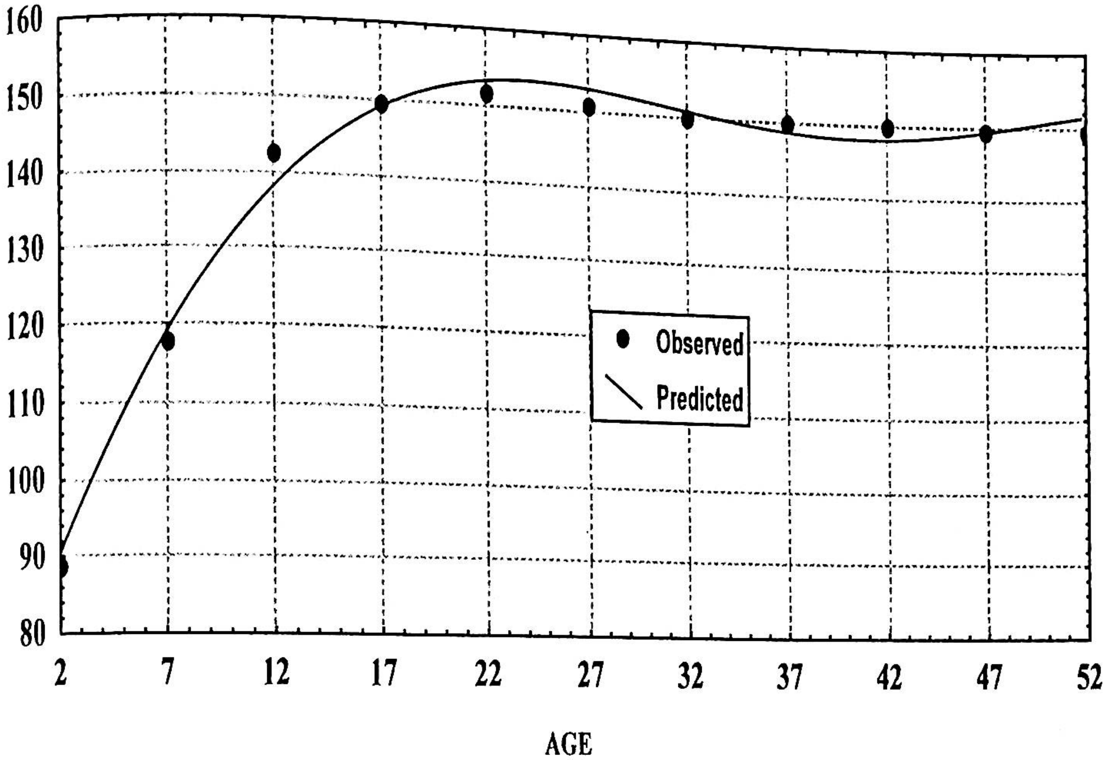

Figure: 5.6 Fitting of orthogonal polynomial of Stature (cm) for male

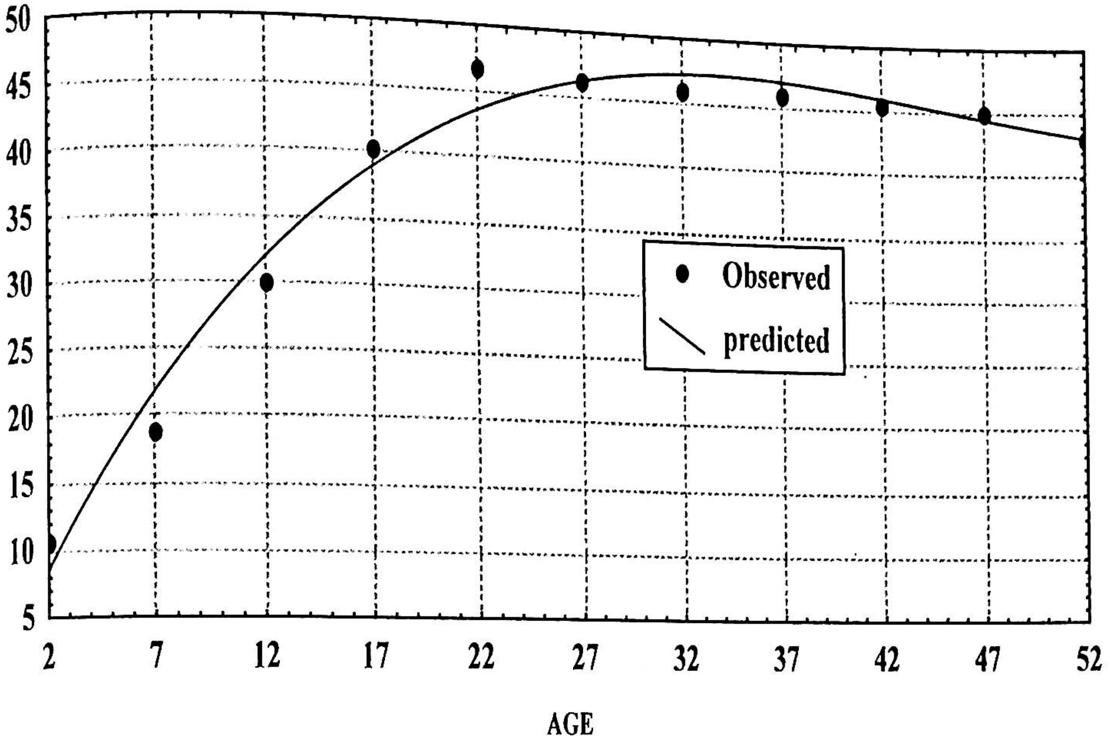

Figure: 5.7 Fitting of orthogonal polynomial of weight (kg) for male

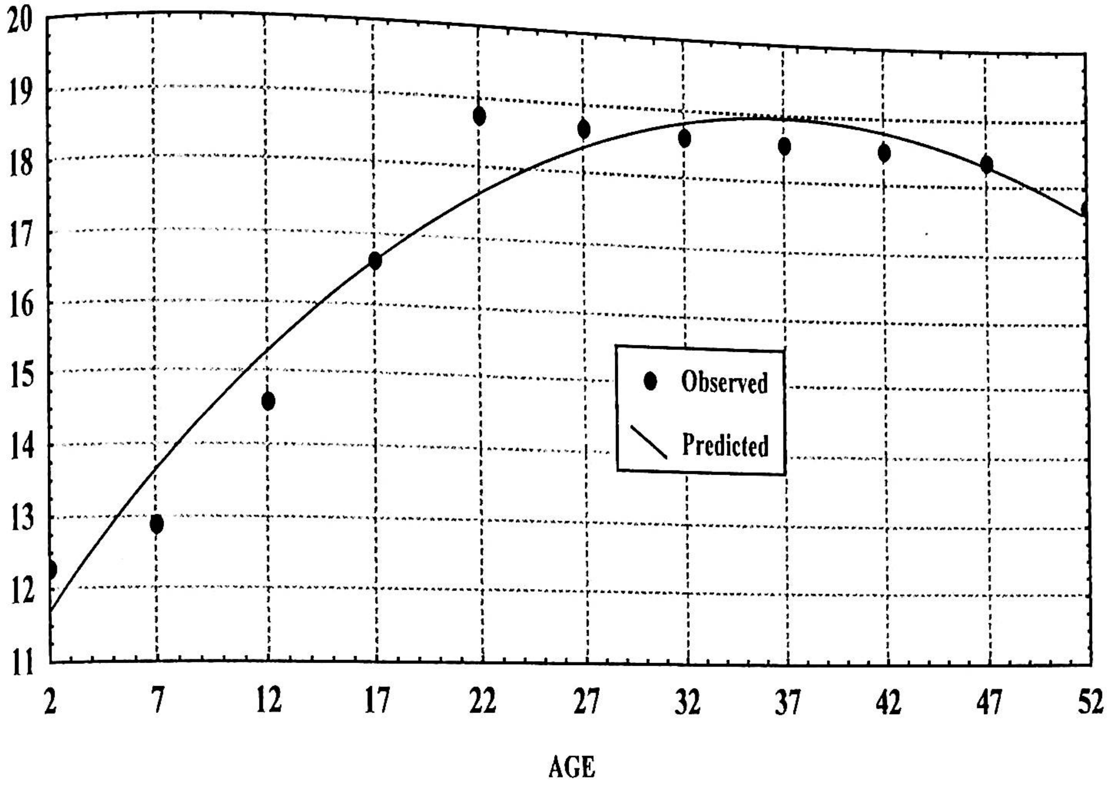

Figure: 5.8 Fitting of orthogonal polynomial of BMI for male

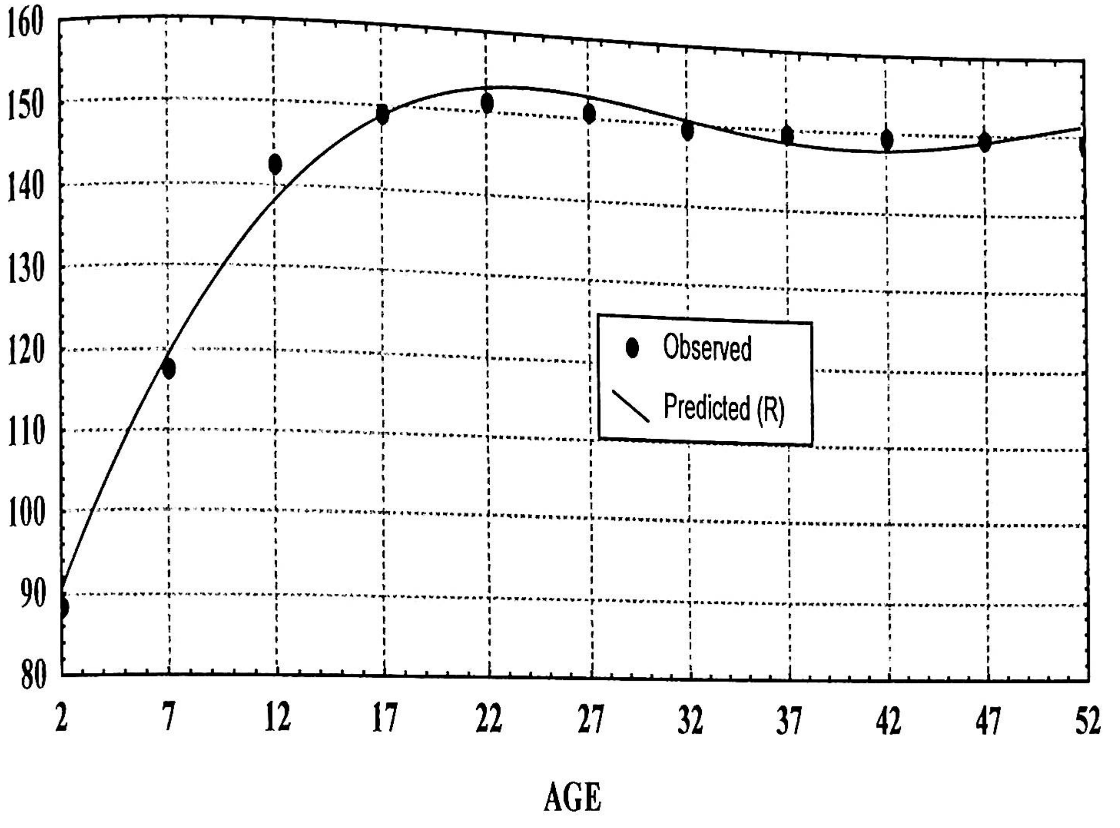

Figure: 5.9 Fitting of orthogonal polynomial of Stature (cm) for female

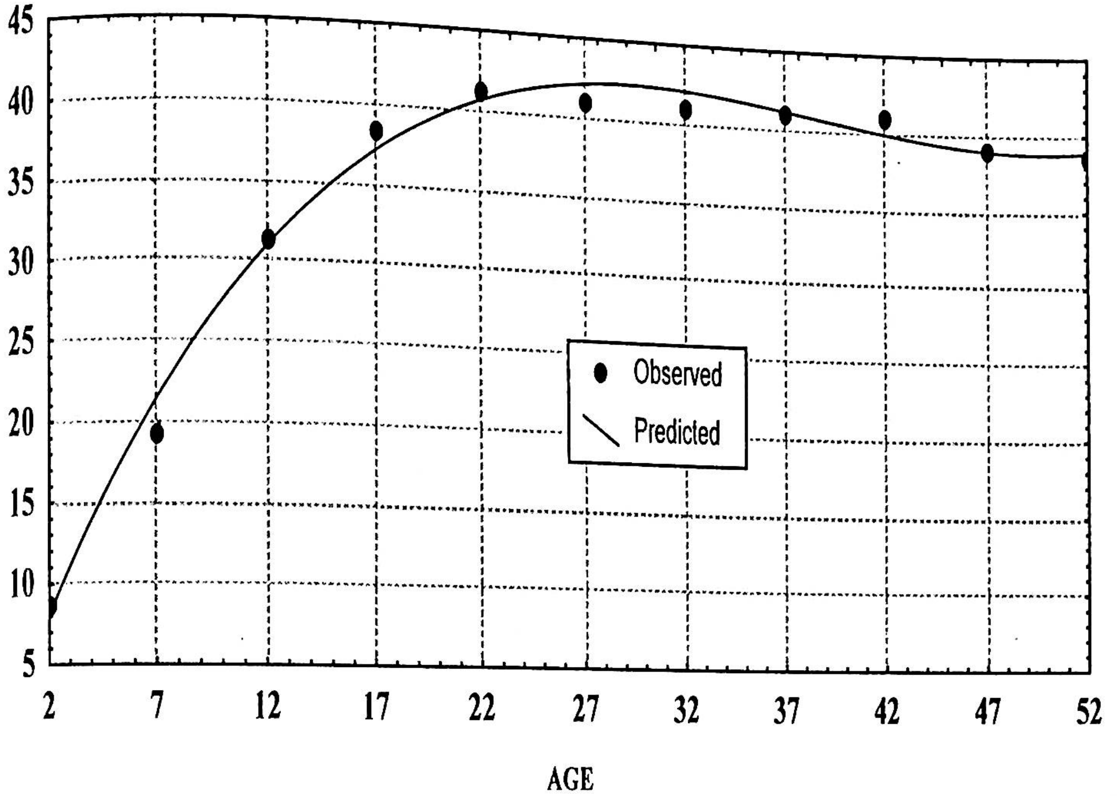

Figure: 5.10 Fitting of orthogonal polynomial of Weight (kg) for female

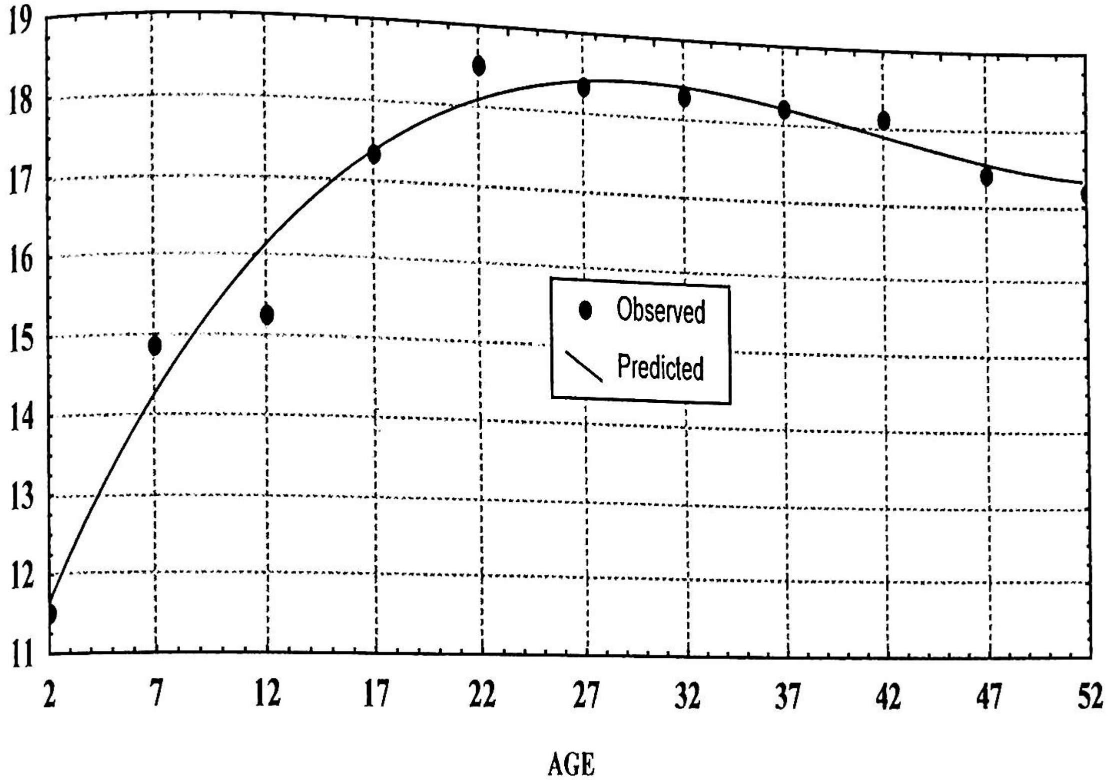

Figure: 5.11 Fitting of orthogonial polynomial of BMI for female

5.7 Cross-validity predictive power:

To check the validity of the above fitted models, cross-validity predictive power, was applied and the results are shown in table 5.7. This table shown that comparing the value of R^2 and ρ^2_{crv} for taking different degrees of fitted orthogonal polynomial models found that 3rd degree polynomial regression model fitted well in height, weight, and BMI for both sexes. Also this fitted model was highly stable for the patterns of the growth.

Table 5.7 Estimated cross validity predictive power, ρ^2_{cv}, of the Predicted polynomial models of Shantals

Sex	Equation	n	k	R^2 3rd order	ρ^2_{cv}
Male	(5.8)	395	3	0.991	0.979
	(5.9)	395	3	0.980	0.953
	(5.10)	395	3	0.951	0.956
Female	(5.11)	438	3	0.984	0.963
	(5.12)	438	3	0.991	0.979
	(5.13)	438	3	0.970	0.929

5.8 Sexual difference among stature, weight and BMI of Shantals

Sexual difference among stature, weight and BMI are shown in figures 5.12, 5.13 and 5.14. Figure 5.12 show that the female Shantal are shorter than male Shantal. Male Shantal are heavier than female (figure 5.13) and female Shantal are also lean and thin than male Shantal (figure 5.14).

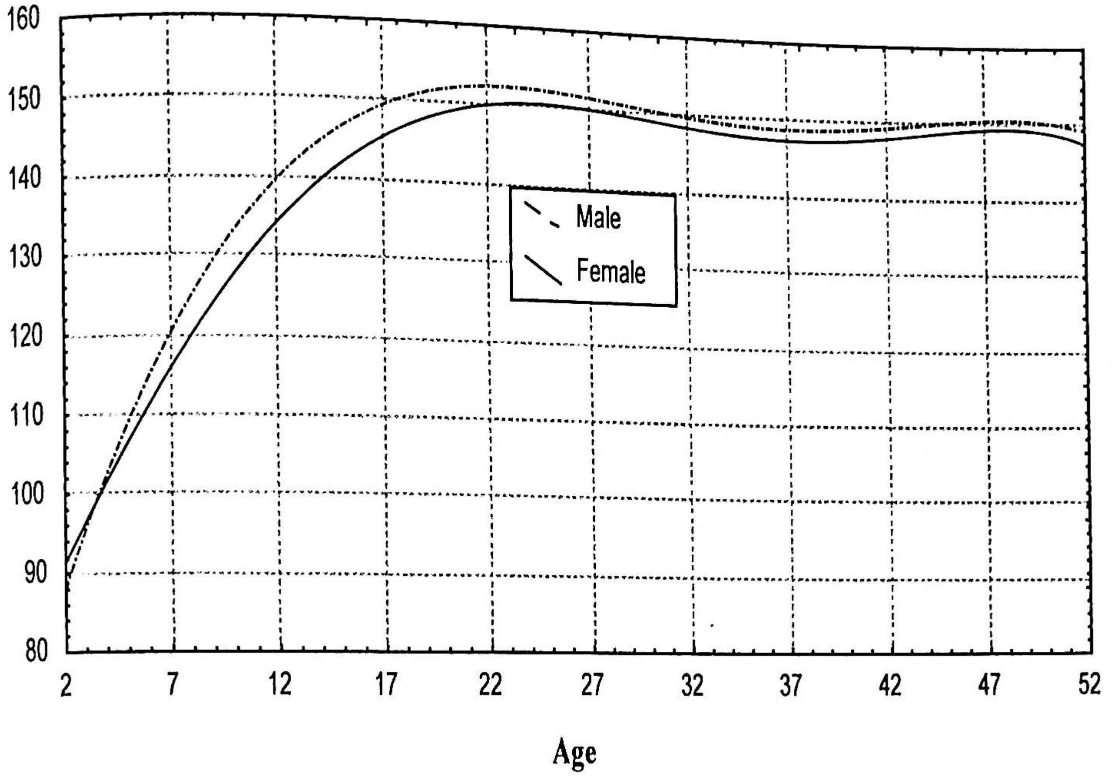

Figure: 5.12 Fitting the stature (cm) for male and female

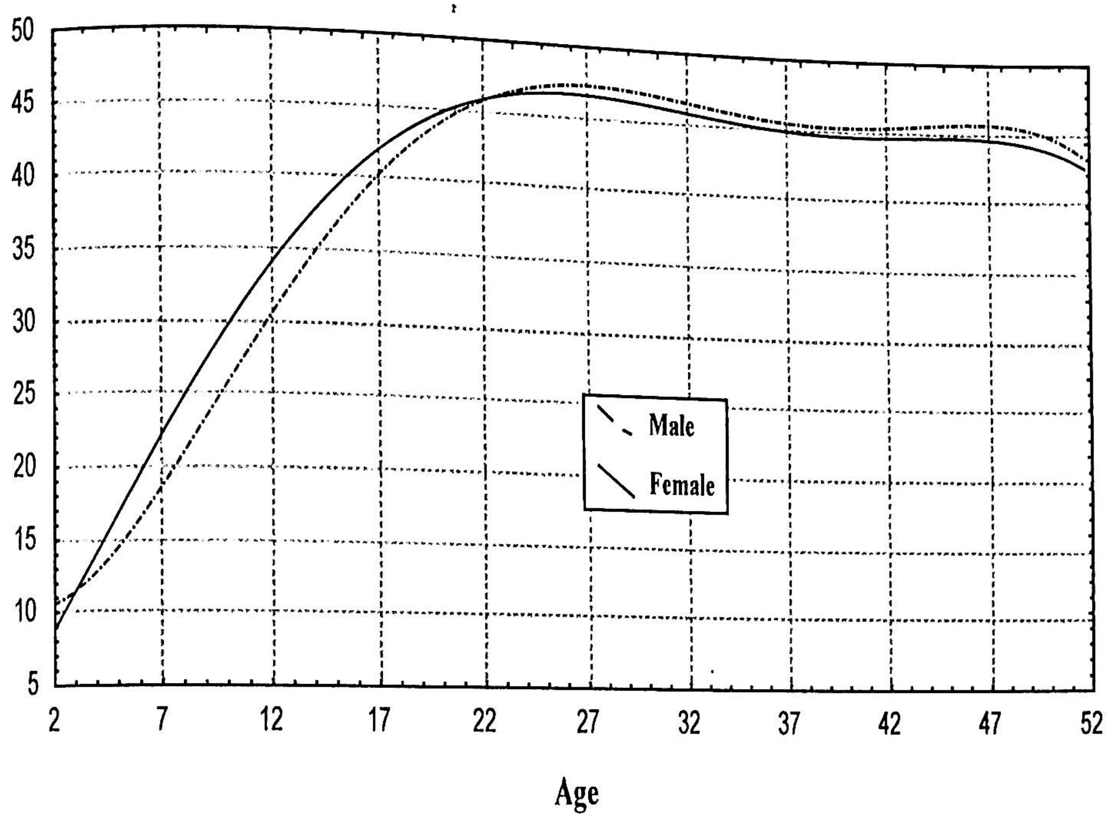

Figure: 5.13 Fitting the weight (kg) for male and female

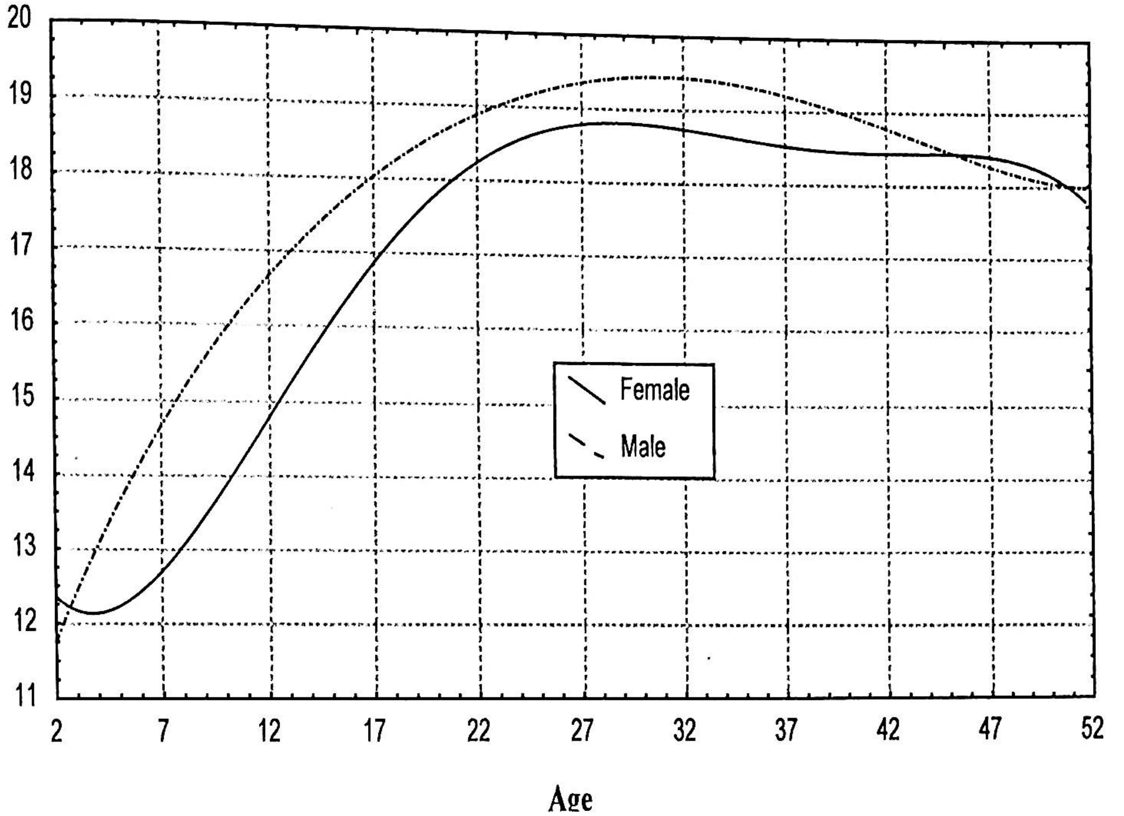

Figure: 5.14 Fitting the BMI for male and female

5.9 The pattern of dependency of the anthropometric variables on education and occupation

To find out the pattern of dependency of anthropometric variables on occupation and education, logistic regression were applied and the estimated coefficients are shown in table 5.4 for male and table 5.5 for female. For male Shantals, the stature of literate Shantals were shorter than the stature of illiterate Shantals and which is significant $(p < 0.05)$. i.e. there are (1-0.61)*100=39% literate Shantals whose height are normally shorter to the illiterate Shantals. Although this results are not adjusted. This may happens due to poverty, ignorance of balance diet, proper nutrition, taking good food and also lack of education. The association between weight and occupation are negatively associated but insignificant. i.e. there is no association between weight and occupation of male Shantals community.

The weights of literate male Shantals are lower than those of illiterate male and which is significant $(p < 0.05)$ i.e. (1-.53)*100=47% literate Shantals whose weight are normally lower than that of the illiterate Shantals. Although this result are not adjusted. Again this may happen due to poverty, ignorance of balance diet, proper nutrition, taking good health care and also lack of education. The weight and occupation are negatively associated but insignificant. i.e. there is no significant association between weight and occupation of male Shantals community.

The BMI of literate are lower than those of illiterate Shantals but statistically insignificant. This implies that there is no association between BMI and education of male Shantals community. The BMI and occupation are positively associated but also statistically insignificant. Implying no association between weight and occupation of male Shantals community.

For female Shantals, stature and education are positively significantly $(p < 0.05)$ associated, the stature of literate female Shantals are higher than that of illiterate female Shantals. The weights of working female are lower than the weight of non-working female and it is statistically significant $(p < 0.05)$ i.e. (1-0.67)*100=33% female Shantals whose weight are normally lower than the non working female. Although this result are not adjusted. This happens due to emitting their calories or lack of proper nutrition.

The weights of literate female Shantals are heavier than that of illiterate female and it is significant $(p < 0.05)$. The association between weight and occupation of female are positively associated. This implies that weight of working female are heavier than the weight of non- working female Shantals.

Table 5.8: Regression coefficient and the corresponding odds ratio obtain from logistic regression model for the selected variables of male Shantal

Dependent Variable	Explanatory variable	Estimated parameter (β)	Wald ratio value	Significant value	Exp (β)
Height	Education	-0.486	3.56	0.050	0.615
Height	Occupation	-4.932	0.13	0.715	0.007
Weight	Education	-0.644	6.20	0.013	0.525
Weight	Occupation	5.533	0.17	0.682	252.84
BMI	Education	-0.213	0.69	0.405	0.808
BMI	Occupation	5.306	0.154	0.694	201.55

$$\text{Variable} = \begin{bmatrix} 1, & \textit{if Variable} \geq \textit{it's Median} \\ 0, & \textit{if Variable} < \textit{it's Median} \end{bmatrix}$$

The BMI of literate female are higher than that of illiterate female and it is insignificant. This implies that here is no association between BMI and education of female Shantals. The BMI and occupation of female are positively associated but also statistically results are insignificant. i.e. there is no association between BMI and occupation of female Shantals community. This happens due to poverty, ignorance of balance diet, proper nutrition, taking good health care and also lack of education.

Table 5.9: Regression coefficient and the corresponding odds ratio obtain from logistic regression model for the selected variables of female Shantal

Dependent Variable	Explanatory variable	Estimated parameter (β)	Wald ratio value	Significant value	Exp (β)
Height	Education	0.54	3.97	0.05	1.72
Height	Occupation	-0.41	2.89	0.09	0.67
Weight	Education	0.70	6.68	0.01	2.01
Weight	Occupation	0.53	0.05	0.83	1.05
BMI	Education	0.35	1.65	0.20	1.41
BMI	Occupation	0.09	0.14	0.71	1.09

$$\text{Variable} = \begin{bmatrix} 1, & \textit{if Variable} \geq \textit{it's Median} \\ 0, & \textit{if Variable} < \textit{it's Median} \end{bmatrix}$$

Chapter-6

Conclusion

Chapter 6

Conclusion

6.1 Summary and overall findings

The location and scale pattern of the anthropometric variables imply that stature, sitting height and chest circumference of Shantals are increasing comparatively with those of oldest Shantals and almost every Shantals are very lean and thin.

The relationship among the anthropometric variables tells that the stature, weight, sitting height, and chest circumference of Shantals are positively and significantly related to each other.

Sexual differences among stature, weight and BMI of Shantals highlight that male Shantals are higher and heavier than female Shantals and also female are lean and thin than male Shantals.

The associations among the age at menarche, stature, weight, BMI, family income and number of sibling suggest that female onsets of menarche reached earlier than those who are shorter, and become late menarche who are taller. The onsets of menarche are earlier than those who are heavier in weight, and become late menarche who are thinner. The onset of menarche reach earlier than those whose family income are higher, and become late menarche whose family income are lower and also the onset of menarche reach earlier than those who have fewer number of sibling, and become late menarche who have more number of sibling.

Comparative study of age at menarche between the Shantals and other ethnic groups implies that the Shantal women attained average age at menarche approximately 3.5 years earlier than Philippine girls, 2.5 years earlier than Indian Rajbanshi girls, one year earlier than Tahiti urban, Swedish and Cape Towns girls. About the same average age at menarche was found for other of Assamese aboriginals.

It is found that number of sibling has the significantly ($p<0.05$) positive impact on the family income.

Logistic regression divulges that the stature of literate male Shantals are shorter than the stature of illiterate Shantal and the difference is significant ($p<0.05$). There are (1-0.61)*100=39% literate Shantal whose stature are normally shorter to the illiterate Shantals. The association between weight and occupation are negatively associated but it is insignificant. i.e statistically, there is no association between weight and occupation of male Shantals community.

The stature of literate female Shantals are higher than the stature of illiterate female. The weights of working female are lower than the weight of non-working female and it is significant ($p<0.05$).

There are (1-0.67)*100=33% female whose weight are normally lower to the non- working female. The weight of working female is higher than the weight of non-working female.

Bangladesh is a country where different ethnic groups of people are living together. Shantal, is one of the communities, are abolishing due to economic and social conditions. They have no land and property to live as a good citizen. Also, education and knowledge in balanced diet are absence to take their better health management and care. As a results, their physical structure are very lean and thin. Government should take favorable view and necessary co-operations to build them as an active citizen for the development of the country.

6.2 Possibly extension

Again, regional comparison could have been done if time and scope were available. These extensions would be done in the future study in this area. Also the bigger sample size would be useful for the better results. A detail investigation on the health, disease, nutrition etc would be taken into account for the better performance of the Shantal community in the society. Comparative study between Shantal and normal population might be interesting. Although, we have already collected some other variables (please see questionnaire in Appendix-I).

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APPENDIX

পরিসংখ্যান বিভাগ, রাজশাহী বিশ্ববিদ্যালয়

গবেষণা প্রশ্নপত্র এম.ফিল/পি.এইচ.ডি-২০০২

Topics : A Statistical analysis on Human Growth and Development.

গবেষণার বিষয় ঃ মানুষের শারিরীক বৃদ্ধি ও উন্নয়নের উপর পরিসংখ্যানীয় বিশ্লেষণ।

গবেষক ঃ মোঃ রেজাউল করিম

তত্ত্বাবধায়ক শিক্ষক ঃ ডঃ মোঃ নূরুল ইসলাম এবং ডঃ মোঃ আইয়ুব আলী

(সংগৃহিত তথ্যাদি শুধুমাত্র গবেষণার কর্মে ব্যবহৃত হবে)

১। উত্তর দাতার/দাত্রীর পরিচিতি ঃ

নামঃ কাশু   পিতার নামঃ সূর্য্য

ঠিকানাঃ

গ্রাম/শহরের নামঃ [illegible]   উপজেলা/থানাঃ [illegible]   জেলাঃ রাজশাহী

২। জন্ম তারিখ ঃ ১০-৮-৭৮   জন্মস্থান ঃ [illegible]

৩। বৈবাহিক অবস্থাঃ ক) অবিবাহিত/বিবাহিত/বিপত্নিক/বিধবা/তালাকপ্রাপ্ত/আলাদাবাস, খ) বিবাহিত তারিখ ঃ ১০-৭-৯৮

৪। সারণীতে উল্লেখিত তথ্যগুলো দিন ঃ

বয়স	উচ্চতা	ওজন	বসে উচ্চতা	বুকের পরিধি	শিক্ষাগত যোগ্যতা	ধর্ম	পেশা	পেশার বয়স	কাজের ধরণ	কাজের সময় কাল
বছর-মাস	cm	kg	cm	cm						ঘন্টা
৩১-২	১৭১.২	৪৭	৮৫.২	৭৭	অশিক্ষিত	ইসলাম	চাকুরীজীবি			
					I—V	হিন্দু	ব্যবসায়ী			
জন্মকালে					VI— X	খৃষ্টান	ছাত্র/ছাত্রী			
					S.S.C	অন্যান্য	গৃহিনী			
পরিবারের মাঃ আয়			পঃ সদস্য সংখ্যা	সন্তান সংখ্যা	H.S.C		শ্রমজীবি	২০	[illegible]	৮
১৮০০/-			৬	১	Graduate					
					P.Graduate					

৫। আপনি কি ধরণের উৎস থেকে পানি পান করেন ?

টিউবওয়েলের পানি [✓]   ট্যাপের পানি [ ]   কুয়ার পানি [ ]

পুকুরের পানি [ ]   বিশুদ্ধকৃত পানি [ ]   অন্যান্য [ ]

৬। আপনার বাড়িতে কি ধরনের পায়খানা আছে ?

সংযুক্ত বাড়ি [ ]   কাঁচা [✓]   ঘরের সাথে যুক্ত [ ]   অন্যান্য [ ]

৭। আপনি কি ধরনের খাবার গ্রহন করেন ?

(মাসে দিনের সংখ্যানুযায়ী খাবার গ্রহন)- বক্সের পাশে পরিমান লিখুন।

ভাত [৬০]   মাছ [৩]   ডাল [৪০]   মাংস [৩]   অন্যান্য [২০]

মিষ্টি [১]   রুটি [৬৫]   ফলমূল [X]   ডিম [৬]

ঘি [X]   পোলাও [X]   দুধ [X]   সবজি/তরকারী [৬০]

৮। আপনি নিম্নোক্ত বিষয়ে অভ্যস্থ কিনা ?   না [ ]

যদি হ্যাঁ হয় তবে-চা [✓]   কফি [ ]   ধুমপান [✓]   মদ (ভারী) [ ]

গাঁজা [ ]   ফেনসিডিল [ ]   মদ(হালকা) [ ]   অন্যান্য [ ]

১। আপনার রাতে ঘুম কেমন হয় ?

ভাল [✓] মোটামুটি [ ] খারাপ [ ]

১০। আপনি রাতে কখন ঘুমাতে যান ? [১০]

এবং সকালে কখন ঘুম থেকে ওঠেন ? [৬]

১১। আপনি কি কি খেলাধুলা করেন ? ফুটবল/ক্রিকেট/হা-ডু-ডু/ব্যাডমিন্টন/দৌড়াদৌড়ি/অন্যান্য, মোট সময়ঃ [ ] ঘন্টা

১২। আপনি কি কি ব্যায়াম করেন ? মোট সময়ঃ [ ] ঘন্টা

১৩। আপনার বিনোদনের মাধ্যম কি কি ঃ টিভি/রেডিও/সিনেমা হল/অন্যান্য। দৈনিক কত সময় ব্যয় করেন ? [২] ঘন্টা

১৪। আপনি কি সম্পূর্ণ সুস্থ ? হ্যাঁ [✓]

যদি না হয় তবে নিম্নের কোন ধরনের সমস্যা জনিত অসুস্থ ? পূর্বপুরুষদের ঐ রোগ থাকলে বক্সে F. M. GF. GM লিখুন

দৃষ্টিশক্তি সমস্যা [ ] হৃদরোগ [ ] শ্রবণ শক্তি সমস্যা [ ] ডায়েবেটিস [ ]

পেটেরপীড়া [ ] অঙ্গ-প্রত্যঙ্গ সম্পর্কিত সমস্যা [ ] বাতের ব্যাথা [ ]

ঠাণ্ডালাগা জনিত সমস্যা [ ] হাঁপানি [ ] রক্তচাপ [ ] অন্যান্য [ ]

১৫। আপনি কি প্রতিদিন সময় মত খাদ্য গ্রহণ করেন ?

হ্যাঁ [✓] না [ ]

১৬। আপনি দুপুরে খাওয়ার পর কি ঘুমান? ঘুমালে গড়ে কত ঘন্টা লিখুন।

প্রায় প্রতিদিন [ ] খুব কম [ ]

মাঝে মাঝে [ ] না [✓]

আপনি কোন ধরনের চিকিৎসা গ্রহন করেন ?

অ্যালোপ্যাথিক [✓] হোমিওপ্যাথিক [ ] কবিরাজি [ ]

আপনার পিতা-মাতার শারীরিক নিম্নোক্ত বিবরণ দিন ঃ ১৮

পিতার বয়স ঃ [ ] বছর, মাতার বয়সঃ [ ] বছর।

পিতার উচ্চতাঃ [ ] cm মাতার উচ্চতাঃ [ ] cm

পিতার ওজনঃ [ ] kg মাতার ওজনঃ [ ] kg

১৯। আপনার কত বয়সে প্রথম ঋতুস্রাব শুরু হয়েছে (দিন/মাস/বছর) ঃ

২০। ক) মানসিক অবস্থা ঃ ভাল/মোটামুটি/মন্দ খ) আর্থিক অবস্থাঃ স্বচ্ছল/মোটামুটি/অস্বচ্ছল

২১। ক) গায়ের রং ঃ ফর্সা/শ্যামলা/কালো খ) দৃষ্টিশক্তি ঃ ভাল/মোটামুটি/খারাপ গ) শ্রবনশক্তিঃ ভাল/মোটামুটি/খারাপ

২২। আপনার চারিত্রিক বৈশিষ্ট্য কি রকম? শান্ত-শিষ্ট প্রকৃতির/ শান্ত-চঞ্চল মধ্যম প্রকৃতির/ শান্ত-গম্ভীর প্রকৃতির/ চঞ্চল প্রকৃতির

২৩। বাড়ীর সার্বিক পরিবেশ ঃ ক) কাচা/পাকা/টিন/খড় খ) স্বাস্থ্যকর/মোটামুটি স্বাস্থ্যকর/অস্বাস্থ্যকর

তথ্য প্রদানের জন্য আপনাকে আন্তরিকভাবে ধন্যবাদ।

.... তথ্য প্রদানকারীর স্বাক্ষর

তারিখঃ ২৮/৭/০৫

.... তথ্য গ্রহনকারীর স্বাক্ষর

Photograph of Author with Shantal of Horipur Village

Photograph of Author with Shantal of Adharcota Village