ANTHROPOMETRIC MEASUREMENTS OF PRIMARY SCHOOL CHILDREN IN BANGLADESH

By

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This thesis is submitted in total fulfillment of the requirements for the subject RESEARCH 2and 3 and partial fulfillment of the requirements for degree:

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Statement of Authorship

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Abstract

Background: It is very useful to know anthropometric data in order to select the physical dimensions of equipment, furniture, etc. Furniture without having correct anthropometric data can have a negative impact on the people using it. So, correct and specific anthropometric dimensions are necessary for developing furniture for school children. Anthropometrical dimensions are different according to the age, gender, ethnic groups, and differ in different countries. In Bangladesh there were no anthropometric databases available of children to help design suitable furniture for them. Several global studies have shown a mismatch between the physical dimensions of children and class room furniture.

Objective of the study: This study aimed to develop an anthropometric database of the Bangladeshi primary school children aged 6-11 years. This study was designed to understand any significant differences among the Bangladeshi children aged 6-11 years, between their genders and those living in urban or rural areas.

Methodology: This study was conducted using Quantitative cross sectional methodology. By using the convenience random procedure a total of 260 participants aged 6-11 years were selected from two areas (urban and rural) of Bangladesh. Equal percentages were ensured in age ranges, genders and locations during the participant's selection. A total of 22 body dimensions were measured and the data was compared between the boys and girls, rural and urban.

Data analysis: The total analysis process was carried out using the SPSS computer package. Descriptive statistics were used to calculate mean averages, standard deviations and key percentiles. Independent sample T-tests were used to compare the data between the genders and locations (rural and urban).

Result: This study showed the means, medians and standard deviations of 22 anthropometric dimensions in 6-11 years Bangladeshi children. It also shows the key percentiles for product design. The anthropometric dimensions were compared between males and females. Some measurements were significantly different with regard to gender, but most of the measurements were not significantly different with regard to gender. Some measurements were higher in boys and some in girls. In this study, there were significant differences in body dimensions between urban and rural children. Children living in urban areas were higher than children in rural area of Bangladesh.

Key points: Anthropometry, Body dimensions, Rural and Urban areas, Primary school, Children, Bangladesh.

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List of Acronyms

SPSS: Statistical Package for Social Science

Cm: Centimeter

Mm: Millimeter

Kg: Kilogram

BMI: Body Mass Index

SN: Serial Number

GDP: Gross Domestic Product

GNI: Gross National Product

UNICEF: The United Nations Children's Fund

GPS: Government Primary School

RNGPS: Registered Non-Government Primary School

NGO: Non-government organization

BHPI: Bangladesh Health Professions Institute

CRP: Center for the rehabilitation of the paralysed

CHAPTER 1
INTRODUCTION

Ergonomics aims to design safe, effective and easy work and other environment for people. It was a military concern in 1950s, but from the beginning it was widely applied in the industrial, agricultural and service sectors (Mokdad and Al-Ansari, 2009). Ergonomics in work environments has achieved high attention from the researchers, and one main concern is that equipment should be designed according to the principles of anthropometry (Gouvali and Boudolos, 2006). Ergonomics in schools focused on micro-ergonomics issues such as mismatch between student body sizes and their desks and chairs and the prevalence of musculoskeletal disorders amongst school children (Legg and Jacobs, 2008). Anthropometry is the science of human body measurements which provide therapists with a clear understanding about the complexities of the human form and how it interfaces with its environment. It provides the parameters of humane size and shape that allow designers to fulfill the needs of comfort and function. Anthropometric measurements have been established for children and the elderly and for members of a wide variety of ethnic groups(Jacobs, 2008). Based on anthropometric data every country can design fitting furniture for school children (Gouvali and Boudolos, 2006).

Ergonomics is concerned with designing suitable and comfortable work stations that helps increasing efficiency of the work force. School is a working environment where students spend most of their time in class and in a sedentary position. Oyewole, Haight and Freivalds (2010) and Wingrat and Exner (2005) were stated in two different studies that 30% of a student's time student is spent at school. Students spend about 84% to 88% of their time in the sitting position (Baharampour *et al.* 2013). In another study Castellucci, Arezes and Viviani (2010) stated that children spend approximately a quarter of the day at school and 80% of that time sitting down doing their school time. According to Jacobs (2008) children's learning environments are an emerging area in ergonomics, because at school, home, and the library children are usually sitting at a desk or in front of a computer. Many studies showed that anthropometric measurements are an important factor and should be considered in school furniture design (Panagiotopoulou *et al.* 2004). Although the school environment represents the work environment for children, it has not attracted enough attention from ergonomists (Gouvali and Boudolos, 2006). During class time students sit in poor postures with trunk, back and neck flexed. Many studies showed poor anthropometric measurements or an anthropometric mismatch between the anthropometric sizes of students and the dimensions of

the furniture used. The furniture is not designed to promote good sitting posture (Wingrat and Exner, 2005). Moreover studies have shown a positive relationship between back pain and seat height (Baharampour *et al.* 2013). Only 18.9% of American children aged 11-13 years have an appropriate match with anthropometric characteristics (Gouvali and Boudolos, 2006). According to Baharampour *et al.* (2013) the seat height only matched 10.8% of males and 1.6% of females, which is far below the lower limit of acceptance range. According to the field observations made for this study, most of the students were sitting in such a high seat that their legs were not touching the floor. These hanging positions create stress on the popliteal arc, run through the underside of the thigh, and may cause serious discomfort and possibly risk injury. According to a study by Baharampour *et al.* (2013) in Iran, students popliteal buttock length and available seat depth are found to have a 57.8% mismatch. 83.9% of the subject's shoulder height fell below the lower limit of acceptance range, 88.1% had a mismatch between the desk height and their elbow-seat heights, 25.55% had a mismatch between the seat width and buttock width and 30.35% had a mismatch between the armrest distance and the elbow distance. According to a study by Wingrat and Exner (2005) in the Baltimore area Students suffered from different musculoskeletal disorders such as neck pain and back pain, and also repetitive strain injuries such as tendonitis or nerve compression syndromes. In the same study Wingrat and Exner (2005) added that students remained inattentive during their class hours and showed poor hand writing performances due to their uncomfortable sitting posture. The rates of these disorders are gradually increasing. Moreover headache, decreases in concentrations, lack of spirit and tiredness of the eyes are very common complains among the students (Habibi *et al.* 2011; Dhara, Khaspuri and Sau, 2008; Baharampour *et al.* 2013). In the classroom students do much of their work sitting down, such as listening to their teacher, looking at the blackboard, copying from the blackboard, or free writing, completing group works and so on (Jacobs, 2008). Due to the mismatch between the dimensions of the bodies of students and the physical dimensions of furniture, over 50% of the children experienced pains and aches in each of the following major areas, neck area, low back, hips, buttocks, thighs, wrists, knees, hands and the ankles (Oyewole, Haight and Freivalds, 2010)). Ergonomically designed furniture such as chairs with a curved seat, widening the angle between trunk and thigh and enhancing the lordotic curve, has reduced schoolchildren's musculoskeletal symptoms (Saarni *et al.* 2007).

Anthropometric dimensions are important to design school furniture (Hafezi *et al.* 2010; Panagiotopoulou *et al.* 2004). Furniture without having correct anthropometric data has a

negative impact on children's health. Anthropometric data is very useful to select the physical dimensions of equipment and furniture. So, correct and specific anthropometric dimensions are necessary for developing tools and furniture for school children (Hafezi *et al.* 2010). According to Panagiotopoulou *et al.* (2004) in Thessaloniki, Greece, to ensure correct sitting posture some specific measurements such as popliteal height, knee height, buttock popliteal length and elbow height are necessary. There are many studies conducted on children's anthropometry. Almost all the studies found the different anthropometric dimensions in different children but only a few studies have been concerned with the appropriateness of school furniture. (Saarni *et al.* 2007). Studies have also shown different anthropometric data between male and female children. Studies of school children found increasing anthropometric dimensions with age (Mokdad and Al-Ansari, 2009; Panagiotopoulou *et al.* 2004). Studies have shown difference in anthropometric dimensions between different ethnic groups. Results from some studies show differences in anthropometric data from other studies (Hafezi *et al.* 2010; Mirmohammadi *et al.* 2013; Oyewole, Haight and Freivalds, 2010; Torres-Restrepo *et al.* 2014). Habibi, Asaadi and Hosseini (2011) stated that the anthropometric dimensions of students vary by gender, age and growth patterns. Until the age of 9, the mean anthropometric dimensions of boys are greater than those of girls, but at the age of 9-12, girls tend to be bigger than boys. Dhara, Khaspuri and Sau (2008) stated that the mean values of anthropometric dimensions of school children increase gradually with increasing age. According to Panagiotopoulou *et al.* (2004) children's dimensions vary not only within different classes but also within the same class and also vary between different cultures. Anthropometrical data of children in different age, class, gender and environments will help us to develop appropriate furniture and equipment, etc (Mirmohammadi *et al.* 2013; Milanese *et al.* 2013). Recent developments in ergonomics have heightened the need for good chair design. There have been many studies on school children's anthropometry, most of them carried out in the age group 6 to 14 years old (Baharampour *et al.* 2013).

Many studies showed a mismatch between the bodies of the students and the classroom furniture (Panagiotopoulou *et al.* 2004; Gouvali and Boudolos, 2006; Saarni *et al.* 2007; Wingrat and Exner, 2005). In different studies most of the chairs were found to be too high and too deep, and most of the desks were too high (Wingrat and Exner, 2005; Saarni *et al.* 2007). In the same study Wingrat and Exner, (2005) stated that 99% of participants did not fit the seat depth or desk height of their classroom furniture. Saarni *et al.* (2007) found that desks were on average 13 cm above elbow-floor height and chairs 2 cm below popliteal

height. They also found that for 56% of the time participants sat with their backs flexed >20° and/or rotated >45° and for 70% of the time students sat with their necks flexed >20° or rotated >45° . Panagiotopoulou *et al.* (2004) stated that the majority of the students sit on chairs that are too high and too deep and at desks that are too high for them. Hafezi *et al.* (2010) found in a recent study of 6-11 year old students in Iran a mean weight between 21.56±5.33kg and 36.63±9.45 kg in boys and between 20.79±3.48 kg and 35.88±9.40 kg in girls. In the same study the mean height was between 1187/02 ± 53.98 mm and 1420.83±69.39 mm in boys and between 1173.90±51.01 mm and 1421.27±70.82 mm in girls. This study also showed some differences in other anthropometric data between the two genders. Another study of Iranian children showed significant differences in a set of 22 anthropometric dimensions with regard to gender, age and ethnicity (Mirmohammadi *et al.* 2013). A study of students by Panagiotopoulou *et al.* (2004) found the following mean averages for different anthropometric measurements: height was between 129±5.65 mm and 150.02±7.52 mm, buttock-popliteal length was between 32.57±1.79 mm and 38.72±2.81 mm, knee height was between 41.79±2.24 mm and 48.9±2.98 mm, popliteal height between 33.96±2.09 mm and 39.4±2.22 mm, elbow height between 43.92±2.64 mm and 50.8±3.40 mm and shoulder height between 18.22±2.17 mm and 20.9±2.47 mm.

In Bangladesh there are about 16.4 million primary school aged children of 6 to10 years. Among them 9,293,319 students are female. There are more than 82,218 schools and Madrasahs (a different type of school) (Unicef, 2009). There is a lack of children's anthropometric data in Bangladesh, but there are some studies on Bangladeshi children aged 4-10, giving some anthropometric data such as body weight, height, Body Mass Index (BMI), Mid-upper Arm-circumstance and skin fold thickness (Khan *et al.* 2012). Others assessed weight for age, weight for height, height for age, arm circumfarance for age, arm circumfarance for height, weight quotient and height quotient among 2019 children aged 13 to 23 months from a rural area of Bangladesh (Chen, Chowdhury and Huffman, 1980).

The available anthropometric data from different studies on Bangladeshi children are not helpful for designing the work environment such as schools for primary children. There are a few studies available on the anthropometrics of children but they do not cover all the necessary body dimensions for designing school environment according to their needs.

In Bangladesh, most of the furniture manufacturing company may design and produce furniture and equipments for the children according to an average physical dimension. The

anthropometric data may be used in our country in designing various furniture or equipment for the children from other countries which do not represent the average body measurements of Bangladeshi children. Though evidence suggest that students anthropometric dimensions are changed with their age and class but physical dimension of these equipment or furniture do not change anymore (Baharampour *et al.* 2013; Milanese *et al.* 2013).Therefore, this study is designed to measure 22 important anthropometric body dimensions in Bangladeshi primary school going children considering age, gender and rural-urban differences.

1.1 Aim:

To find out 22 anthropometrical body dimensions of Bangladeshi primary school children.

1.2 Objectives:

- To determine anthropometric measurements of Bangladeshi children aged 6-11 years in 22 body dimensions.
- To know the comparison in anthropometric body dimensions between Bangladeshi primary school boys and girls.
- To know the comparison in anthropometric dimensions between urban and rural Bangladeshi primary school children.

1.3 Study significance:

In Bangladesh there is no attention given to designing ergonomic school furniture. The school furniture is far from compatible with the anthropometric measurements of the school children. Legg and Jacobs, (2008) stated that the system within schools contains many different elements, ranging from micro to macro ergonomic in nature including school equipment (e.g. desks, chairs, computers, laptops, books, school bags, uniforms and equipments used for sports. This furniture may be designed by local carpenters without appropriate consideration for body dimensions. Most of the furniture manufactures did not use appropriate anthropometric measurements, or ergonomic considerations to design their products (Oyewole, Haight and Freivalds, 2010). Using ergonomically sound furniture that promotes ergonomic posture in childhood is more important than using it in adulthood. Seating habits are formed at a young age and it is too difficult to change it in adulthood (Baharampour *et al.* 2013). Better matching in the form of adjustable school desks and chairs promote better sitting and standing postures, decreased tension in the upper and lower back muscles, avail pain and improve overall academic grades (Legg and Jacobs, 2008).

Bangladesh is a developing country. In developing countries most classroom furniture has been found to have caused more destruction and injuries to the children. Moreover most classroom furniture in developing countries lacks quality and is often manufactured with wood which offer very rough writing surfaces (Oyewole, Haight and Freivalds, 2010).

This research will provide correct anthropometric data of primary school children in Bangladesh. In Bangladesh, every primary school uses furniture for students which does not have any anthropometric measurements of children. Anthropometric data should play a significant role in designing school furniture for Bangladeshi primary school children. Different furniture designing and manufacturing companies may use an average measurement to design furniture for the children which may not accord with the anthropometric data of the children. But study findings indicate that students would benefit from sitting in smaller furniture that fits their size better (Wingrat and Exner, 2005). This study will help by providing relevant anthropometric data to design furniture such as a reading table, chair, computer table and chair, shelves, desks, drawers, etc for children. Thus it will be possible to design age-appropriate furniture and equipment for both boys and girls as needed. Both rural and urban school children will benefit from this study. The study result may also help by providing data for designing appropriate seats in the school bus, and the home, for the primary school children.

Wingrat and Exner (2005) recommended for occupational therapy practice in their study to promote good sitting postures. They also recommended to instruct the student to sit properly and avoid poor positioning. In the same study they also concluded occupational therapists can provide expertise in assessing elements of the school environment, including the furniture they used. Therefore, this study is significant and will have a positive implications for the learning environments of school children and for Occupational Therapists of Bangladesh in optimizing these environments overall.

CHAPTER 2
LITERATURE REVIEW

2.1 Anthropometry

Anthropometrics refers to the study of human dimensions. Human dimensions include height, limb length and limb girth, as well as the physical capacities such as lifting carrying and grasping. Anthropometrics is fundamental to ergonomics and it applies to the design of different jobs, workplaces, equipment, tools and personal protective equipment (Sanders, 2004). According to Jacobs (2008) ergonomics is concerned with shaping the environment to optimize workers abilities to perform their jobs. An understanding of anthropometry is essential to the application of ergonomics (Jacobs, 2008). Anthropometric data were derived from a sample of military personnel in the 1950s. Gradually data has been gathered from females, individuals of various ages (including children and infants), ethnic groups and wheelchair user groups (Sanders, 2004). Anthropometric charts are used to design the optimal work stations, equipment, furniture and clothing (Tunay and Melemez, 2008). Body measurements gathered for anthropometric charts include static and dynamic dimensions (Sanders, 2004). The fact that people of different occupations have different anthropometric proportions, is poorly understood (Jacobs, 2008).

The design of work furniture should be based on the anthropometry and biomechanics of the human body (Oyewole, Haight and Freivalds, 2010). Anthropometric measurements are a very important factor that should be used to identify the physical dimensions of equipment, furniture, clothing and work stations (Hafezi *et al.* 2010; Oyewole, Haight and Freivalds, 2010). Tunay and Melemez (2008) suggested that specific measurements of popliteal height, knee height, buttock to popliteal length and elbow height are necessary to design the dimensions of school furniture. This will help to attain correct posture of the children (Hafezi *et al.* 2010; Oyewole, Haight and Freivalds, 2010).

2.2 Anthropometric body dimensions

Body measurements gathered for anthropometric charts include static and dynamic dimensions. Static dimensions are measurements of specific anatomic structures (limb length, width and circumferences). Static dimensions are used to design size-specific work station and tools. (Sanders, 2004)

The anthropometric dimensions of children such as stature, weight and body mass index (BMI) have increased over the years and this is due to changes in their standard of living,

eating habits and lack of adequate exercise (Oyewole, Haight and Freivalds, 2010). Anthropometric measures for children vary across different age groups, genders, cultures, races and ethnic backgrounds (Oyewole, Haight and Freivalds, 2010; Gouvali and Boudolos, 2006; Panagiotopoulou *et al.* 2004; Mokdad and Al-Ansari, 2009).

Mirmohammadi *et al.* (2013) measured 22 body dimensions of Iranian primary school children from different ethnicities. In current study 22 dimensions were selected and their descriptions are given below:-

Table 1: Definitions of anthropometric body dimensions

S.N.	Dimensions	Definitions
1.	Weight	Body weight
2.	Body height	The vertical distance from the floor to the vertex (i.e. the crown of the head)
3.	Eye height, (standing)	The vertical distance from the standing surface to the inner canthus of the eye.
4.	Shoulder height (standing)	Vertical distance from the standing surface to the shoulder
5.	Elbow height (standing)	Vertical distance from the standing surface to the underside of the elbow
6.	Arm length	Difference between shoulder height and elbow height
7.	Forearm length	Distance between acromion and tip of the middle finger
8.	Forearm–forearm distance	Maximum distance between two forearms
9.	Elbow–elbow distance	Distance between two acromions in standard sitting position
10.	Shoulder width	Maximum shoulder width in standing position
11.	Buttock width	Maximum buttock width in sitting position
12.	One-thigh thickness	Maximum thickness of the thigh
13.	Two-thigh thickness	Maximum two thigh thickness when right thigh rests over left thigh
14.	Popliteal height (sitting)	Vertical distance from the floor to the popliteal angle at the underside of the knee where the tendon of the biceps femoris muscle is inserted into the lower leg
15.	Knee height (sitting)	Vertical distance from the floor to the upper surface of the knee in sitting position
16.	Sitting height	Vertical distance from the sitting surface to the vertex
17.	Eye height (sitting)	Vertical distance from the sitting surface to the inner canthus of the eye

18.	Elbow height (sitting)	Vertical distance from the seat surface to the underside of the elbow
19.	Abdominal depth	Maximum horizontal distance from the vertical reference surface to abdominal front in sitting position
20.	Chest depth	Maximum horizontal distance from the vertical reference plane to the front of the chest in men or breast in women
21.	Buttock–knee length	Horizontal distance from the back of the uncompressed buttocks to the front of the kneecap
22.	Buttock-popliteal length	Horizontal distance from the back uncompressed buttocks to the popliteal angle, at the back of the knee, where the back of the lower legs meet the underside of the thigh

(Mirmohammadi *et al.* 2013).

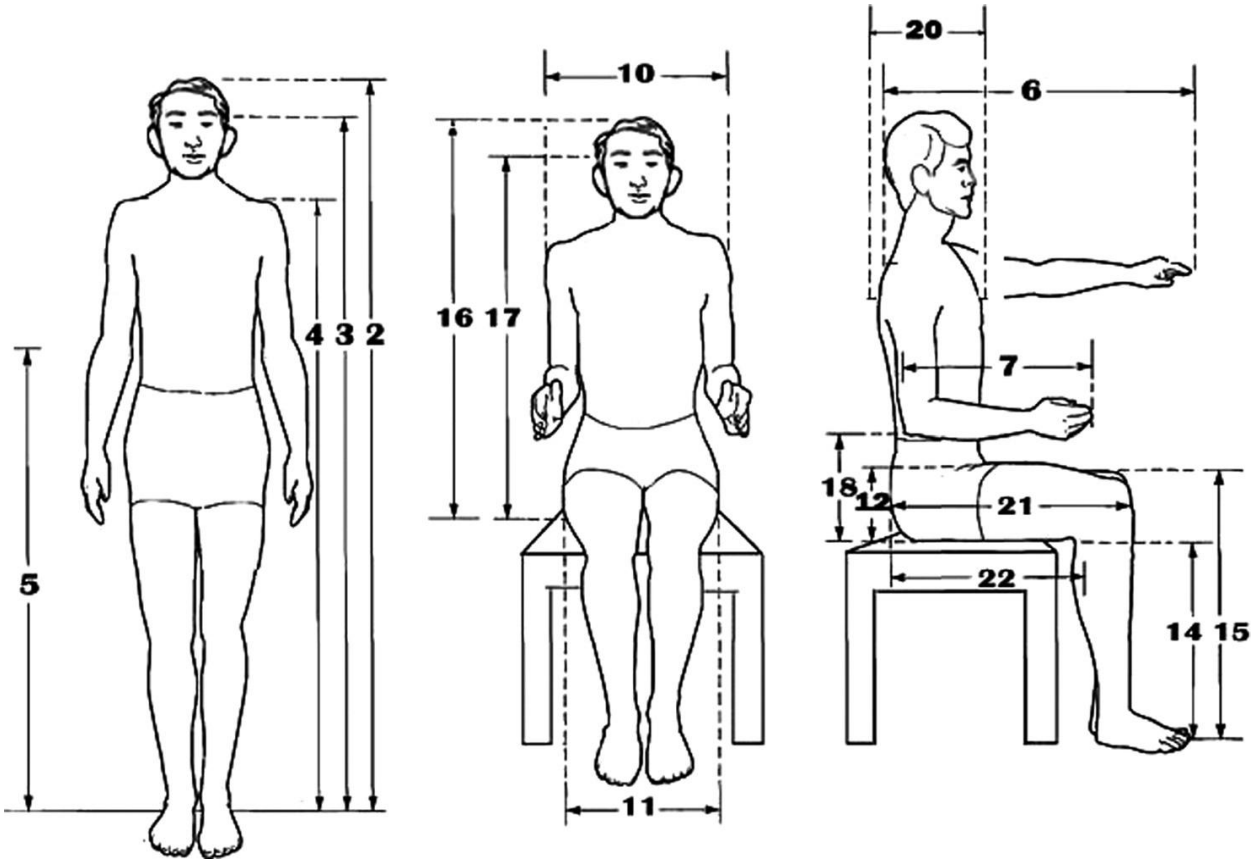

Figure 1: Schematic illustration of the anthropometric dimensions (Mirmohammadi *et al.* 2013).

2.3 Bangladesh

Bangladesh is situated in the northeastern part of South Asia. The area of Bangladesh is about 147,570 square kilometers. It is almost entirely surrounded by India, except for a short southeastern frontier with Myanmar and a southern coastline on the Bay of Bengal. Bangladesh is still struggling to emerge from poverty. Industry has emerged as the largest sector of the economy, contributing about 30 percent to the gross domestic product (GDP). GDP Growth rate of Bangladesh in the year 2013-2014 was 6.02 per capita, and GNI was 1190 Million taka (Bangladesh Bureau of Statistics, 2014). The rate of educated people in Bangladesh is 60%. 33.8% of the total population is in the 0-14 age range, where 23069242 are male and 21995457 are female. 25% of the population lives under the poverty line (Prime Minister's Office, 2014).

2.4 Urban and rural areas

The rural population refers to people living in rural areas (Trading Economics, 2014). In Bangladesh almost three-quarters of the population live in rural areas. Rural people in

Bangladesh rely primarily on agriculture and fishing for their daily income. Poverty is a common feature in this rural life. Over half of these families live below the poverty line. Rural people in Bangladesh face frequent natural disasters and the growing threat of climate changes, so rural livelihoods are now more tenuous than ever (Unicef, 2014).

The definition of an urban area depends on political boundaries, a threshold population size, population density and economic functions. In 2010, 3.5 billion people lived in areas classified as urban (Unicef, 2012). Savar Pourashava was declared an Urban Area by Bangladesh Bureau of Statistic in 2001 (Rajuk). About 28 percent of Bangladesh's total populations (41.7 million) are living in urban areas. Among the top 21 mega cities of the world, Dhaka ranks 9th position with 14.3 million people. Day by day Bangladesh is urbanizing rapidly. The annual population growth rate of approximately 4 per cent in urban areas is more than 2.5 times that in rural areas. The majority of the urban population in Bangladesh is concentrated in a few large cities. Dhaka – with 13 million people - accounts for about 40 percent of the total urban population. It is predicted that by 2030 about 80 million people will be living in Bangladesh's towns and cities. (Bangladesh Urban Forum, 2012)

2.5 Primary school Children

According to the director of Primary Education (2012) Bangladesh has one of the largest primary education systems in the world with an estimated 16.4 million primary school aged children of 6 to 10 years. Among them 9,293,319 students are female. In Bangladesh there are more than 82,218 schools and Madrasahs (a different type of school) (Ministry of Primary and Mass Education, 2014). The Primary Education Compulsory Act passed in 1990 made primary education free and compulsory for all children up to Grade 5. The school environments are very poor and a great challenge for the student (UNICEF, 2009). There are 10 types of schools including Government Primary Schools (GPS), Registered Non-Government Primary Schools (RNGPS), Experimental Schools, community Schools, Non-Registered Non Governmental Primary Schools, Kindergarten, NGO Schools, Primary sections of Secondary Schools, Ebtedayee Madrasahs, Primary sections of Dakhil, Alim, Fazil and Kamil Madrasahs (Director of Primary Education, 2012).

CHAPTER 3
METHODOLOGY

3.1 Study design

This study was conducted using Quantitative cross sectional methodology. According to Baily (1997) quantitative research design is predetermined and structured and not changes during the study. In this study all data was quantifiable and statistical. All variables were defined and data was managed according to the procedures outlined in the project proposal. The study was conducted with a large sample size.

It was stated (Baily, 1997) that cross sectional study is carried out at onetime point or over a short period of time and provides a snapshot of the outcome. This study was conducted in 2014-2015 on Bangladeshi primary school children and gave a snapshot of the current anthropometric data of the children. The result of the study showed the mean average of anthropometric data of Bangladeshi primary school children. So a cross sectional study design was appropriate to conduct this study.

3.2 Participants

The study participants were primary school children aged 6-11 years from conveniently selected rural and urban areas in Bangladesh. All participants were conveniently selected from the selected schools. Participants were selected by using their name and roll number available in the school registry books with the help of class teachers. Participants were selected from top to bottom from a class with a verified age range from the list of the students. 130 participants were taken from an urban area and another 130 participants were taken from a rural area. Equal participation of both boys and girls were maintained in both rural and urban area. 13 boys and 13 girls were selected from each class or grade.

3.3 Sample size

All participants of this study were selected using the convenience method. Due to time limitation the sample size was 260.

3.4 Inclusion criteria

- Primary school children aged range 6 to 7 years from class one, 7 to 8 years from class two, 8 to 9 years from class three, 9 to 10 years from class four and 10 to 11 years from class five, were eligible for as participants.
- Both rural and urban children were included in this study.

- Only native children were selected as participants.

3.5 Exclusion criteria

- Children with any physical disability were excluded from the study as they did not meet with the study objectives and they might have deformities of limbs. So, they might change the study results.
- Students younger than 6, or older than 11 were excluded.
- Students who migrated from rural to urban or urban to rural were not allowed to be a participant.
- Children who had no birth certificate were excluded from this study.
- Non native children were also excluded in this study.

3.6 Study settings

Study participants were primary school children from conveniently selected rural and urban areas in Bangladesh. Therefore, data was collected from the following schools: Radio Colony Government Primary Schools in Savar, Dhaka Bangladesh (as an urban school) and from Al-Amin Ideal Academy, Sagoria, Hatia, rural area at Noakhali district in Bangladesh. The Radio Colony Government Primary School is a large school in Savar, Dhaka, with 1500 students in class one to class five. Another selected school Al-Amin Ideal Academy is a rural Bangladeshi school with 1200 students in class one to class five. 22 body dimensions were selected for conducting this study among the 260 students.

3.7 Study period

The proposal for this project was started in June, 2014. This project was completed in February, 2015 by submitting the final thesis. Details of the project time frame are attached in the appendix.

3.8 Data collection procedure

A date was fixed with the conveniently selected school participants in order to take measurements of the participants. Prior to starting data collection the researcher received consent letters signed by the head teacher on behalf of all eligible participants. For collecting data researcher took help from five volunteers. All volunteers were trained on anthropometric measurement and all of them were fourth year students of B.Sc. in Occupational Therapy. Data were collected in two groups with three members for each group. Three female volunteer were worked in a group to collect data from female participants. Three male data collector including two volunteer and researcher were collected data from male children. All

volunteers were instructed about the ethical considerations and definitions of all selected dimensions prior to collecting data. All data were collected in presence of researcher.

Measurements of each child were taken using the same techniques. Data was collected from the children in static standing and sitting positions, as required by the dimensions definitions. All measurements were taken on the right side of the body. Children were asked to wear light/suitable clothes and take off the shoes during data collection. All ethical issues were considered during data collection.

3.9 Data collection instruments

Some data collection instruments were used to collect the data including:

3.9.1 Measuring tape

An appropriate measuring tape was used to measure the body dimensions. The measuring tape was flexible and not harmful for the participants. The measuring tape scale is divided into cm, mm and inch. All dimensions were measured in mm.

3.9.2 Weight scale

A weight scale was used to measure body weight of participant. It was an electronic scale named 'Novenii', made in China, model was NBS 22. The weight machine was used after checking its reliability. The weight was measured in kg.

3.9.3 Demographic questionnaire

Demographic information of the participants was collected by using self-demonstrated demographic questionnaires. Demographic information includes age, gender, living area, name and address of the school, class, monthly family income and parent's occupation. The demographic questionnaire is attached in the appendix.

3.9.4 Anthropometry measurement table

Mirmohammadi *et al.* (2013) used an anthropometry measurement table in his study on Iranian school children to describe the body dimensions and application,. This table has 22 body dimensions. All dimensions are defined. This table was used in the current study. The table is given in detail in the appendix section.

3.10 Data analysis

Data entry and analysis were performed by using the Statistical Package for social science (SPSS), Inc. version 17. This reduces the impact of the missing value and increases the reliability of the analysis. A descriptive statistics was used to calculate the means, standard

deviation and key percentiles (5^{th}, 50^{th}, and 95^{th}) of body dimensions. Descriptive statistics and key percentiles were measured for each dimension. This descriptive statistics showed anthropometric data of total 260 children. The measurements were compared between two genders. A comparison regarding living areas was also performed. Independent sample T-test was used for comparison of means between two gender and also for between two living areas, urban and rural.

3.11 Ethical considerations

- Researcher took permission from the authority of BHPI.
- Permission was taken from Upozila (sub-district) Education Officer for visiting schools and collecting dada.
- Informed consent was given to the two participant schools prior to collect data.
- Researcher ensured that the confidentiality is maintained about the participants.
- Participant did not be individually identified.
- All participant schools authority was informed about the purposes of the study.
- Researcher ensured the participant safety when take measurement.
- Other ethical issues including plagiarism, misconduct, data fabrication and/or falsification etc were observed by researcher and project supervisor.

CHAPTER 4
RESULT

In this study, 260 children (130 boys and 130 girls) ages 6 to 11 years in five classes of primary schools and two living areas (urban and rural) were assessed. An equal participation of the children was ensured for every age range, class, living area and gender. From every class and age range only 13 children were assessed, which is 20 percent of total participants. Among the total 260 children, 130 children were selected from rural area and another 130 from urban area, which is 50 percent of total participants. Similarly 50 percent boys and 50 percent girls were selected from two schools.

4.1 Anthropometric data among children

Table 2: Anthropometric data among children (n= 260: age range= 6-11, boys = 130, girls =130)

				Percentiles		
SL. No.	Dimensions	Mean	± SD	5^{th}	50^{th}	95^{th}
1.	Weight (kg)	23.45	6.08	16.00	22.4	30.38
2.	Body height (mm)	1260.52	107.48	1110	1257.5	1444.75
3.	Eye height, (standing) (mm)	1140.06	135.73	980.25	1140	1329.75
4.	Shoulder height (standing) (mm)	1017.36	99.54	860.5	1010	1194.75
5.	Elbow height (standing) (mm)	767.05	74.19	641	760	899.75
6.	Arm length (mm)	250.46	35.19	200	250	314.75
7.	Forearm length (mm)	350.29	48.99	285.25	340	430.00
8.	Forearm–forearm distance (mm)	276.02	26.99	240	270	320.00
9.	Elbow–elbow distance (mm)	284.59	31.01	240	280	345.00
10.	Shoulder width (mm)	297.75	28.17	255	297.5	350.00
11.	Buttock width (mm)	243.06	30.83	210	240	294.75
12.	One-thigh thickness (mm)	81.38	40.92	60	79	100.00
13.	Two-thigh thickness (mm)	138.41	24.77	100.5	135	184.75
14.	Popliteal height (sitting) (mm)	330.27	36.08	270	330	390.00
15.	Knee height (sitting) (mm)	393.04	43.26	320.5	395	467.85
16.	Sitting height (mm)	653.38	51.04	560.5	650	739.75
17.	Eye height (sitting) (mm)	537.12	49.22	460	540	620.00
18.	Elbow height (sitting) (mm)	161.92	24.22	120	160	200.00
19.	Abdominal depth (mm)	154.04	31.95	120	150	190.00
20.	Chest depth (mm)	155.42	29.87	125	150	189.75
21.	Buttock–knee length (mm)	406.21	48.24	340	400	485.00
22.	Buttock- popliteal length (mm)	336.93	40.60	280.25	335	400.00

Result showed mean weight of the selected children's 23.45 kg, body height 1260.52 mm, standing eye height 1140.06 mm, arm length 250.46 mm, elbow-elbow distance 284.59 mm, poplitial height 330.27 mm, knee height 393.04 mm, sitting height 653.38 mm and buttock poplitial length 336.93 mm. Percentiles (5^{th}, 50^{th} and $95^{th)}$ for body height respectively 1110 mm, 1257 mm and 1444.75 mm; for standing eye height respectively 980.25 mm, 1140 mm and 1329.75 mm; for arm length respectively 200 mm, 250 mm and 314.75 mm; for poplitial height respectively 270 mm, 330 mm and 390 mm; for buttock poplitial length respectively 280.25 mm, 335 mm and 400 mm. Table 2 shows the means, median and standard deviation of 22 anthropometric dimensions in 6 to 11 years old children. It also shows the key percentiles (i.e. 5^{th}, 50^{th} and 95^{th}), used for product design.

4.2 Comparison between male and female children

Table 3: Comparison of anthropometric data between male and female children

SL. No.	Dimensions	Sex	Mean	± SD	t	p	95% CI of the difference	
							Lower	Upper
2.	Weight (kg)	Male	23.46	5.52	.025	.98	-1.47	1.51
		Female	23.44	6.615				
3.	Body height (mm)	Male	1253.96	103.39	-.98	.33	-39.37	13.14
		Female	1267.08	111.44				
4.	Eye height (standing) (mm)	Male	1143.38	101.71	.395	.69	-26.55	39.86
		Female	1136.73	163.15				
5.	Shoulder height (standing) (mm)	Male	1012.18	95.59	-.84	.40	-34.68	13.97
		Female	1022.54	103.45				
6.	Elbow height (standing) (mm)	Male	760.78	71.98	-1.37	.17	-30.63	5.55
		Female	773.32	76.09				
7.	Arm length (mm)	Male	252.70	32.76	1.03	.31	-4.11	13.08
		Female	248.22	37.47				
8.	Forearm length (mm)	Male	338.96	34.40	-3.83	.00	-34.32	- 10.99
		Female	361.62	58.11				
9.	Forearm -forearm distance (mm)	Male	272.42	25.18	-2.16	.03	-13.74	-.65
		Female	279.62	28.34				
10.	Elbow –elbow distance (mm)	Male	282.14	26.98	-1.28	.20	-12.46	2.66
		Female	287.04	34.49				
11.	Shoulder width (mm)	Male	297.85	24.95	.055	.96	-6.70	7.09
		Female	297.65	31.15				
12..	Buttock width (mm)	Male	240.64	32.28	-1.27	.21	-12.37	2.68
		Female	245.48	29.24				
13.	One thigh thickness (mm)	Male	82.33	56.20	.38	.71	-8.10	11.92
		Female	80.42	14.18				
14.	Two thigh thickness (mm)	Male	144.44	26.41	4.04	.00	6.17	17.93
		Female	132.38	21.47				
15.	Poplitial height (mm)	Male	332.62	35.66	1.05	.295	-4.12	13.50
		Female	327.92	36.48				
16.	Knee height (mm)	Male	393.28	42.21	.09	.93	-10.12	11.06
		Female	392.81	44.45				
17.	Sitting height (mm)	Male	655.50	53.61	.67	.51	-8.25	16.71
		Female	651.27	48.45				
18.	Eye height sitting (mm)	Male	542.31	52.73	1.71	.09	-1.59	22.36
		Female	531.92	45.04				
19.	Elbow height sitting (mm)	Male	163.54	24.04	1.08	.28	-2.68	9.14
		Female	160.31	24.38				
20.	Abdominal depth (mm)	Male	155.04	39.97	.50	.62	-5.81	9.81
		Female	153.04	21.21				
21.	Chest depth (mm)	Male	156.62	37.23	.64	.52	-4.92	9.69
		Female	154.23	20.05				
22.	Buttock knee length (mm)	Male	401.58	40.57	-1.55	.12	-21.02	2.48
		Female	410.85	54.62				
23.	Buttock poplitial length (mm)	Male	338.85	38.83	.76	.45	-6.10	13.75
		Female	335.02	42.36				

t = t-value, p = p-value, CI = confidence interval

The anthropometric dimensions were compared between males and females. Some measures were significantly different with regard to gender. The mean forearm length 338.96±34.40 mm in boys and 361.62±58.11 mm in girls (t=-3.83; p=0.00), forearm-forearm distance 272.42±25.18 mm in boys and 279.62±28.34 mm in girls (t=-.16; p=0.03) and two thigh thicknesses respectively 144.44±26.41 mm in boys and 132.38±21.47 mm (t= 4.04; p=0.00). Most of the measurements were not significantly different with regard to gender. Some measurements were higher in boys and some in girls. Body height, shoulder height, elbow height, forearm length, forearm-forearm distance, elbow-elbow distance, buttock width and buttock knee length were higher in girls. Boys were higher in weight, eye height, arm length, shoulder width, one thigh thickness, political height, knee height, sitting height, sitting eye height, sitting elbow height, abdominal depth, chest depth and buttock poplitial length. Table 3 shows the comparison of dimension of male and female children.

4.3 Comparison between urban and rural children

Table 4: Comparison of anthropometric data among the rural and urban children of Bangladesh

SL. No.	Dimensions	Living area	Mean	± SD	t	p	95% CI of the difference	
							Lower	Upper
1.	Weight (kg)	Urban	24.48	6.95	2.78	.01	.60	3.53
		Rural	22.41	4.87				
2.	Body height (mm)	Urban	1276.69	111.46	2.45	.02	6.34	58.35
		Rural	1244.35	101.22				
3.	Eye height standing (mm)	Urban	1161.58	105.18	2.58	.01	10.24	75.83
		Rural	1118.54	158.09				
4.	Shoulder height standing (mm)	Urban	1033.22	102.42	2.598	.01	7.68	55.77
		Rural	1001.50	94.32				
5.	Elbow height standing (mm)	Urban	779.34	75.83	2.70	.01	6.66	42.47
		Rural	754.77	70.69				
6.	Arm length (mm)	Urban	254.73	36.40	1.968	.05	-.006	17.096
		Rural	246.18	33.55				
7.	Forearm length (mm)	Urban	355.81	39.01	1.83	.07	-.87	22.95
		Rural	344.77	56.89				
8.	Forearm-forearm distance (mm)	Urban	283.08	27.95	4.36	.00	7.74	20.49
		Rural	268.96	24.11				
9.	Elbow-elbow distance (mm)	Urban	293.33	34.86	4.73	.00	10.21	24.76
		Rural	275.85	23.68				
10.	Shoulder width (mm)	Urban	303.92	28.56	3.62	.00	5.62	19.07
		Rural	291.58	26.47				
11.	Buttock width (mm)	Urban	243.66	37.24	.31	.75	-6.34	8.74
		Rural	242.46	22.83				
12.	One thigh thickness (mm)	Urban	80.68	13.35	-.28	.78	-11.41	8.61
		Rural	82.08	56.41				
13.	Two thigh thickness (mm)	Urban	145.25	24.00	4.62	.00	7.84	19.495
		Rural	131.58	23.699				
14.	Poplitial height sitting (mm)	Urban	337.32	36.49	3.20	.00	5.42	22.74
		Rural	323.23	34.38				
15.	Knee height (mm)	Urban	399.28	44.17	2.34	.02	1.99	22.95
		Rural	386.81	41.57				
16.	Sitting height (mm)	Urban	660.62	54.00	2.30	.02	2.098	26.83
		Rural	646.15	46.98				
17.	Eye height (sitting) (mm)	Urban	544.15	48.80	2.34	.02	2.16	25.997
		Rural	530.08	48.81				
18.	Elbow height (sitting) (mm)	Urban	165.04	25.54	2.09	.04	.35	12.11
		Rural	158.81	22.49				
19.	Abdominal depth (mm)	Urban	154.58	40.04	.27	.79	-6.74	8.89
		Rural	153.50	21.10				
20.	Chest depth (mm)	Urban	159.88	38.92	2.43	.02	1.696	16.15
		Rural	150.96	15.38				
21.	Buttock knee length (mm)	Urban	409.31	51.67	1.04	.30	-5.59	17.97
		Rural	403.12	44.54				
22.	Buttock poplitial length (mm)	Urban	337.52	42.597	.23	.82	-8.76	11.11
		Rural	336.35	38.66				

t = t-value, p = p-value, CI = confidence interval

Averages of different dimensions were compared between rural and urban. There was a significant difference in body dimensions between the urban and rural children. The means for body weight 24.48±6.95 mm in urban children 22.41±4.87 mm in rural children (t=2.78; p = 0.01); body height 1276.69±111.46 mm in urban children and 1244.35±101.22 mm in rural children (t=2.45; p= .02); eye height standing 1161.58±105.18 mm in urban children and 1118.54±158.09 mm in rural children (t=2.58; p=0.01); shoulder height 1033.22±102.42 mm in urban children and 1001.50±94.32 mm in rural children (t= 2.59; p = 0.01); elbow height standing 779.34±75.83 mm in urban children and 754.77±70.69 mm in rural children (t=2.70; p=0.01); arm length 254.73±36.40 mm in urban children and 246.18±33.55 mm in rural children (t=1.97; p= 0.05); forearm-forearm distance 283.08±27.95 mm in urban children and 268.96±24.11 mm in rural children (t=4.36; p=0.00); elbow-elbow distance 293.33±34.86 mm in urban children and 275.85±23.68 mm in rural children (t=4.73; p=0.00); shoulder width 303.92±28.56 mm in urban children and 291.58±26.47 mm in rural children (t=3.62; p=0.00); two thigh thickness 145.25±24 mm in urban and 131.58±23.69 mm in rural children (t=4.62; p=0.00); poplitial height 337.32±36.49 mm in urban and 323.23±34.38 mm in rural children (t=3.20; p=0.00); knee height 399.28±44.17 mm in urban and 386.81±41.57 mm in rural children (t=2.34; p=0.02); sitting height 660.62±54.00 mm in urban and 646.15±46.98 mm in rural children (t=2.30; p=0.02); eye height sitting 544.15±48.80 mm in urban and 530.08±48.81 mm in rural children (t=2.34; p=0.02); elbow height sitting 165.04±25.54 mm in urban and 158.81±2249 mm in rural children (t=2.34; p=0.04); chest depth (t=2.43; p=0.02). Most of the measures were higher in urban children except one thigh thickness. One thigh thickness was higher in rural children and it was 82.08 mm where urban children had 80.68 mm. But there was no significant difference (t=-.28; P=0.78). Table 4 shows the comparison of anthropometric data among the urban and rural children.

4.4 Discussion

This study showed 22 anthropometric dimensions of Bangladeshi primary school children aged 6-11 years for class one to class five and two different living areas (rural and urban) of Bangladesh. This study was aimed to investigate the anthropometric dimensions of primary school children in Bangladesh, which is not representative of children in other Bangladeshi ethnic groups. This was the only and first study on body dimensions measurements of Bangladeshi primary school children. This study shows average value of 22 body dimensions with key percentiles for Bangladeshi primary school children aged 6-11 years. Boys had the higher weight than girls. In some measures such as body height, shoulder height, elbow

height, forearm length, forearm-forearm distance, elbow-elbow distance, buttock width, and buttock knee length, girls were higher than boys. Most of the measures were higher among the urban children then rural children. These differences are probably due to geographic, climate and economic differences in different part of Bangladesh.

Anthropometric dimensions in primary school children of Bangladesh found in this study were different from other countries. Anthropometric dimensions of Bangladeshi children were lower than Hong Kong, Bahrain, Iranian, Finland and Chilean children (Mirmohammadi *et al.* 2013; Hafezi *et al.* 2010; Chung and Wong, 2007; Sarni *et al*. 2007; Castellucci, Arezes and Viviani, 2009). The mean sitting height of the children in this study was 653.38 mm but Panagiotopoulou *et al.* (2003) found mean height for 2^{nd}, 4^{th}, and 3^{rd} grad students from three primary schools in Thessaloniki, Greece respectively 129 cm, 140 cm and 150 cm. In the same study they found buttock-poplitial length respectively 32.57 cm, 35.52 cm and 38.72 cm for 2^{nd}, 4^{th} and 6^{th} grade school children but current study found 336.93 mm for Bangladeshi children. For knee height they found 41.79 cm, 46.15 cm and 48.9 cm but current study found 393.04 mm; for poplitial height they found 33.96 cm, 36.89 cm and 39.4 cm but in current study showed 330.27 mm; for sitting elbow height they found 43.92 cm, 47.81 cm and 50.8 cm but current study showed 161.92 mm. All measurements they found are higher than the measurements of the current study.

The current study found a significant difference for some dimensions between two genders and also between two different living areas. There are many studies in different populations on measurements of body dimensions of children. Mirmohammadi *et al.* (2013) compared the anthropometric dimensions between male and female in 7-11 years age range and six ethnic groups and found a significant difference in all dimensions regarding genders and age. P value for difference between ethnicities were less than 0.001 for all dimensions except for body height in 7 years girls (P=0.001), body height in 11-year girls (P=0.001) and sitting eye height in 11 year girls (P=0.004). They measured 22 dimensions and found some measures higher in boys and some in girls from different age and ethnic groups, which is in agreement with current study.

Hafezi *et al.* (2010) found different dimensions among boys and girls in different age and grade of Iranian children. Average value of dimensions in their study was different from current study. In their study the mean weight was between 21.56±5.33 kg and 36.63±9.45 kg in boys and between 20.79±3.48 kg and 35.88±9.40 kg in girls. Mean height was between

1187.02±53.98 mm and 1420.83±69.39 mm in boys and between 1173.90±51.01 mm and 1421.27±70.82 mm in girls. In this current study mean weight was 23.46±5.52 kg in boys and 23.44±6.62 kg in girls. Mean height was 1253.96±103.39 mm in boys and 1267.08±111.44 mm in girls. They also found some dimensions higher in boys and some in girls, which is similar with current study result.

Oyewole, Haight and Freivalds (2010) measured ten body dimensions of first graders (age 6 and 7 years) in the elementary school in the United States which were different from the dimensions of the children of current study. In their study 5^{th} percentile of stature was between 1050.41 mm and 1130.03 mm in boys, between 1060.68 mm and 1130.03 mm in girls. They also found a mismatch between student's body dimensions and class room furniture. Saarni *et al.* (2007) conducted a study on the 6^{th} and 8^{th} (12 and14 years old) school children from two comprehensive schools in Finland and found the boys were 5.7 cm taller than girls, 167.2±11.2 cm and 161.5±8.7 cm respectively. The mean height of the participants was 164.0±10.2 cm. Boys were heavier than girls, 59.9±13.3 kg and 53.4±8.8 kg respectively. The mean weight was 56.2±11.4 kg. They also found less difference in sitting height between genders than height and weight. The mean sitting height was 85.2±5.2 cm; 86.5±6.2 cm in boys and 84.1±4.2 cm in girls. In current study showed the mean sitting height of the children 653.38±51.04 mm; 655.50±53.61 mm in boys and 651.27±48.45 mm in girls. Current study also showed boys are taller than girls, 1253.96±103.39 mm for boys and 1267.08±111.44 mm for girls but less difference in weight, 23.46±5.52 mm for boys and 23.44±6.62 mm for girls.

Chung and Wong (2007) assessed 10 to 13years school children in Hong Kong and found significant differences in body dimensions, body height ($t=2.21$, $p=0.03$), hip breadth in standing ($t=4.73$, $p<0.00$), hip to knee in standing ($t=12.56$, $p<0.00$) and lateral ankle to floor in standing ($t=3.60$, $p<0.00$). There were also significant differences in shoulder to hip in standing ($t=-77.00$, $p<0.00$), shoulder to elbow in sitting ($t=-72.28$, $p<0.03$), thigh thickness in sitting ($t=-74.34$, $p<0.00$) and knee to floor in sitting ($t=-72.30$, $p<0.02$). They also found some measures higher in girls and some higher in boys, which were in agreement with the current study.

Diep (2003) conducted a study on eight anthropometric dimensions among Vietnamese urban and suburban children. He found a gradual increase of student anthropometric dimensions with age. He did not found any significant difference between gender and locations (urban

and suburban). In current study there is very few dimensions show significant difference between genders, is in agreement with this study. But in current study result shows very significant difference between locations (urban and rural). This may cause for difference of anthropometric dimensions among the populations of different locations. There are many important contributing factors to this difference is race, ethnicity, and climate, nutritional and economical factors in Bangladesh are different from other countries which can influence the anthropometric dimensions.

Mokdad and Al-Ansari (2009) conducted an anthropometric survey on Bahraini School children aged six to twelve years and found an increasing body dimensions with the age as the children are in a period of development. Habibi, Asaadi and Hosseini (2011) also found different growth paterns by age and sex. Their findings indicated that until the age of 9, mean anthropometric dimensions of boys are greater than those of girls but at the age of 9 to 12 girls tends to be bigger than boys. They also found some measures higher in girls and some in boys, which is in argument with current study.

Dhara, Khaspuri and Sau (2008) were found a mismatch between body dimensions of school children furniture of rural secondary school in the state of west Bengal, India. They also found an increase body dimensions gradually with the age. Panagiotopoulou *et al.* (2004) found a consistent increase in mean by age group and standard deviations also increase with age. This study showed mismatch between school furniture and students body dimensions.

Lin *et al.* (2004) found a significant difference between the dimensions among Chinese, Japanese, Korean, and Taiwanese population in East Asia which was in agreement with current study in finding difference between urban and rural populations. In another study Castellucci, Arezes and Viviani (2010) found a significant differences in body dimensions mesurements among different schools. They considered different socioeconomic levels and found differences between stutures. Tunay, and Melemez, (2008) found significant differences between the anthropometric measures of Turkish students and other nations compared.

It is well known that there is a mismatch between school furniture and body dimensions of the school children all over the world (Diep, 2003; Panagiotopoulou *et al.* 2004; Gouvali and Boudolos, 2006; Saarni *et al.* 2007, Wingrat and Exner, 2005). Baharampour *et al.* assessed student body dimensions from Tabriz University of Medical Science community and found mismatch between student's bodily dimensions and furniture available to them. In our

country there is also observed anthropometrical mismatch between student body dimensions and dimensions of furniture available for them. This mismatch can be attributed many musculoskeletal disorders among the children (Hafezi *et al.* 2010). The anthropometric database of current study can be used to design appropriate furniture and equipments for the school children. It also can be used to design clothing.

CHAPTER 5
RECOMMENDATIONS AND LIMITATIONS

5.1 Study limitations

This study had some limitations. It was tried to select native children as a sample, but there may be some non native children which was not informed by their parents or school teachers. Age range was tried to maintain during sample selection, but there may had some children who did not meet age range for being a sample which was not informed by their parents. Data was collected in a short duration of time. For conducting such kind of studies more long duration of time are needed. Most of the similar published studies took more long time. There are some similar published studies with larger sample size. But this study had 260 sample sizes and probably did not represent the total population of Bangladesh.

Volunteers were collected data and there were two teams of data collectors. This might influence the study result. It was not possible to recheck all measurements due to short duration of time. This is another limitation of this study. But confusing data was rechecked during the data collection. Children body dimensions gradually increase with their age. This study did not show any result for every age or grade. In different studies researcher used anthopometer, digital 75 cm caliper, etc. modern tools and equipments. But in this study tape measurements, digital weight scale was used for collecting data. This might influence study result.

This study result showed the body dimensions of selected two schools of two different areas of Bangladesh. So, this study result is not applicable for the other part of Bangladesh and also on the ethnic groups of Bangladesh.

5.1 Recommendations

It is recommended to repeat these types of studies to know the secular trends among Bangladeshi children. In current study only 22 body dimensions were analyzed. More dimensions can be recommended to develop a strong anthropometric database. Large sample size can give more significant results for developing anthropometric database. It is needed to conduct studies with larger sample size.

There are many ethnic groups in Bangladesh. Present study does not represent those ethnic groups. So, it can be recommended to conduct new studies to understand the anthropometric dimensions of different ethnic group. This study result only showed the primary school children of Bangladesh. It is needed to understand anthropometric dimensions of the children

in every age and grade. Because anthropometric measurements are vary with the age and grade.

It is recommended to repeat these kinds of studies to understand anthropometric dimensions of Bangladeshi high school students and college students. It is also recommended to use anthropmeter, digital 75 cm caliper.

CHAPTER 6
CONCLUSION

Anthropometry is a science of human body measurement. Anthropometric data varies between age, gender, and ethnicity. Anthropometric data also vary among county to countries. Anthropometric difference of age, gender must be needed to design suitable furniture for the primary school children. Furniture or equipment which is not appropriate with our body dimensions is responsible for developing musculoskeletal disorders. Different studies have showed the high prevalence of musculoskeletal disorders among the primary school children due to lack of anthropometric data in their classroom furniture. Many studies have shown an association between musculoskeletal disorders and classroom furniture.

This study result provided average values of body dimensions of the Bangladeshi primary school children aged 6 to 11 years old. Among the Bangladeshi children there were some dimensions higher in boys and some in girls. But measurements of urban children are higher than girls. Result also showed a significant difference between the rural and urban children. This study result provides an anthropometric database for the Bangladeshi primary school children. It is believed that, today measurement of anthropometric dimensions is one of the key steps for product design. Age, gender are major contributors to these dimensions, ethnicity and geographical locations are also influence to these dimensions, for the preparations of anthropometric databases it is important to consider these variables. There were significance differences in different anthropometric dimensions between ages, genders, ethnic groups and locations. Considering these differences are important for designing products such as furniture, clothes etc.

There are many studies show anthropometric data of different age, group, ethnicity and countries. All data show different result from each others. Child anthropometric data is necessary to design correct working posture for the children. Previously in Bangladesh there were no available anthropometric data of children to design furniture. This study result will help us to design furniture by using appropriate anthropometric data. It is recommended to furniture designers and manufacturers for using the data obtained in this study to make adjustable furniture according to the anthropometric dimensions of Bangladeshi children.

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APPENDIX

Appendix 1

1.1 Proposal approval and permission from BHPI

Date: 23 July 2014

To
The Head of the Department
Department of Occupational Therapy
Bangladesh Health Professions institute (BHPI)
Center for the Rehabilitation of the Paralysed (CRP)

Sub: Prayer for the approval of undergraduate academic thesis proposal.

Sir,
With due respect, I beg most respectfully to state that I am a student of 4th year, B.Sc in Occupational Therapy, Department of Occupational Therapy, BHPI, the academic institute of CRP. As a partial fulfillment of my Bachelor of Science degree in Occupational Therapy Course, under the medicine Faculty University of Dhaka, I will have to conduct a research project in this academic year which is a part of my academic curriculum. I have chosen a title related with anthropometry and the study title is "Anthropometric measurement of primary school going children in Bangladesh." I can make sure you that this study will not do any harm of any one. The details of my study are attached with the proposal approval letter.

I therefore pray and hope that you would be kind enough to give me permission to conducte this study and oblige thereby.

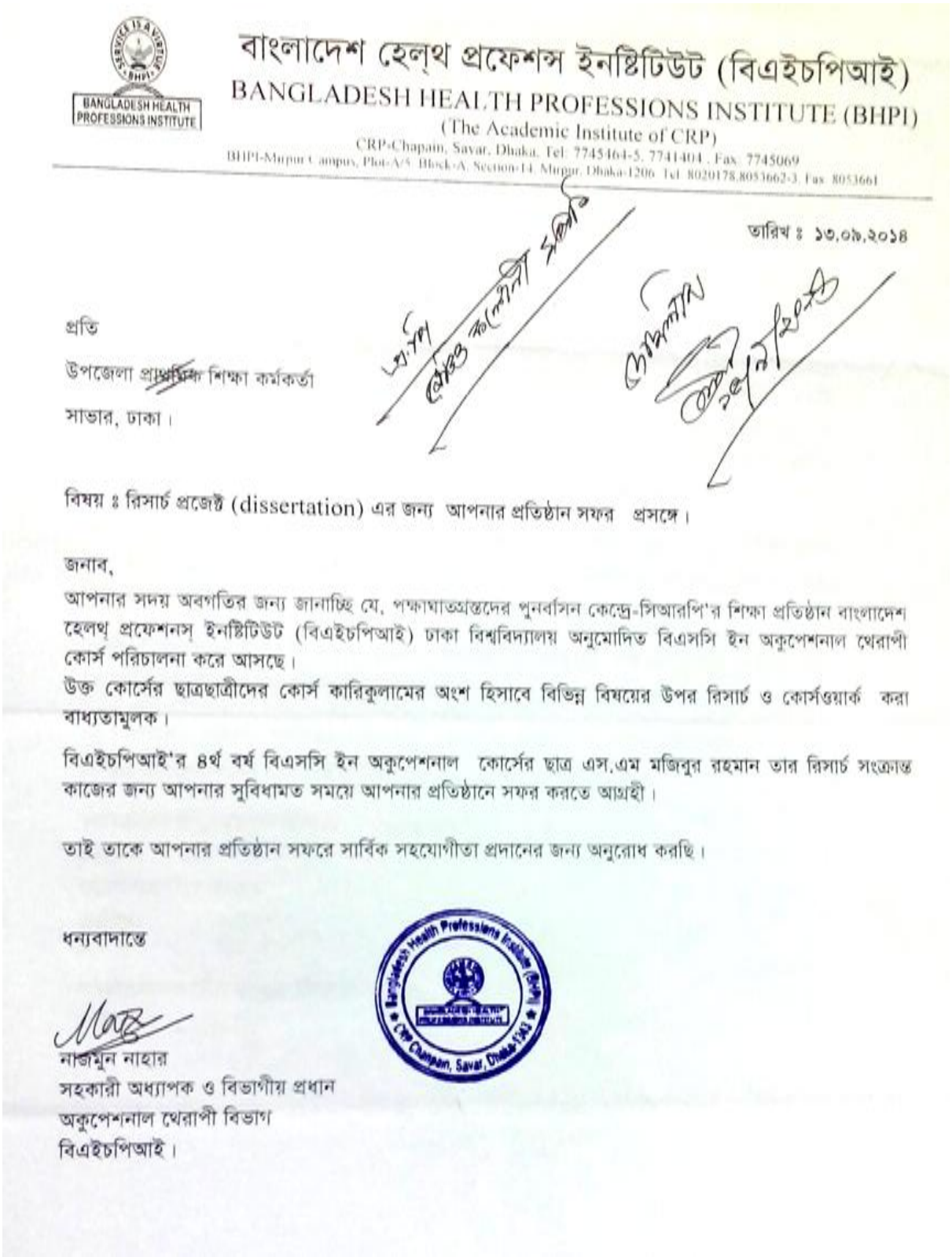
Your most obidient,
Mazib

S. M. Mazibur Rahman
Roll: 13, B.Sc in Occupational Therapy, 4th year, Session:- 2010-2011.
Attachment: The proposal of the reaearch project

Name	Comments & signatures
Nazmun Nahar Assisstent Professor & Head of the Department, Department of Occupational Therapy, BHPI,CRP,Chapain,Savar Dhaka-1343.	As per supervisor's recommend it may allow her to conduct this study.
Md. Monjurul Habib Lecturer, Department of Occupational Therapy, BHPI,CRP,Chapain,Savar Dhaka-1343.	This phoposal can be approved for further proceeding.

Appendix 2

2.1 Permission from Upazila (sub-district) Educational Officer



বাংলাদেশ হেল্‌থ প্রফেশন্স ইনষ্টিটিউট (বিএইচপিআই)
BANGLADESH HEALTH PROFESSIONS INSTITUTE (BHPI)
(The Academic Institute of CRP)
CRP-Chapain, Savar, Dhaka. Tel: 7745464-5, 7741404 , Fax: 7745069
BHPI-Mirpur Campus, Plot-A/5, Block-A, Section-14, Mirpur, Dhaka-1206. Tel: 8020178,8053662-3, Fax: 8053661

তারিখ ঃ ১৩.০৯.২০১৪

প্রতি

উপজেলা প্রাথমিক শিক্ষা কর্মকর্তা

সাভার, ঢাকা।

বিষয় ঃ রিসার্চ প্রজেক্ট (dissertation) এর জন্য আপনার প্রতিষ্ঠান সফর প্রসঙ্গে।

জনাব,

আপনার সদয় অবগতির জন্য জানাচ্ছি যে, পক্ষাঘাতগ্রস্তদের পুনর্বাসন কেন্দ্রে-সিআরপি'র শিক্ষা প্রতিষ্ঠান বাংলাদেশ হেলথ্ প্রফেশনস্ ইনষ্টিটিউট (বিএইচপিআই) ঢাকা বিশ্ববিদ্যালয় অনুমোদিত বিএসসি ইন অকুপেশনাল থেরাপী কোর্স পরিচালনা করে আসছে।

উক্ত কোর্সের ছাত্রছাত্রীদের কোর্স কারিকুলামের অংশ হিসাবে বিভিন্ন বিষয়ের উপর রিসার্চ ও কোর্সওয়ার্ক করা বাধ্যতামুলক।

বিএইচপিআই'র ৪র্থ বর্ষ বিএসসি ইন অকুপেশনাল কোর্সের ছাত্র এস,এম মজিবুর রহমান তার রিসার্চ সংক্রান্ত কাজের জন্য আপনার সুবিধামত সময়ে আপনার প্রতিষ্ঠানে সফর করতে আগ্রহী।

তাই তাকে আপনার প্রতিষ্ঠান সফরে সার্বিক সহযোগীতা প্রদানের জন্য অনুরোধ করছি।

ধন্যবাদান্তে

নাজমুন নাহার
সহকারী অধ্যাপক ও বিভাগীয় প্রধান
অকুপেশনাল থেরাপী বিভাগ
বিএইচপিআই।

Appendix 3

3.1 Permission from author

Home | Account Info

Logged in as:
Mazibur Rayhan
LOGOUT

Title: An epidemiologic study on anthropometric dimensions of 7–11-year-old Iranian children: considering ethnic differences

Author: SeyyedJalilMirmohammadi, RahmatollahHafezi, Amir HoushangMehrparvar, et al

Publication: Ergonomics

Publisher: Taylor and Francis

Date: Jan 1, 2013

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Appendix 4

4.1 Consent form (English)

Consent form

Assalamu-alaikum/ Namasker. My name is S. M. Mazibur Rahman Student of B.Sc. in Occupational therapy at Bangladesh Health Professions Institute (BHPI), CRP, Savar Dhaka, Bangladesh. I am conducting a study for partial fulfillment of Bachelor of Science in Occupational Therapy degree. The titled of the study is "**Anthropometric measurement of primary school children in Bangladesh**". This study will help us to design different school furniture appropriately for the school going children.

The purpose of this study is to know 22 important anthropometric body dimensions of the children. For this reason, I would need to collect data from the Bangladeshi primary school going children. According to my inclusion criteria which I include in my research project proposal, your students/ child have met all the inclusion criteria and I would like to invite your child/student as a subject of my study willingly. If they participate in this study, I will measure their body dimensions. To measure their body dimension I will use safe instruments, so that they will not cause any harm. I would like to meet with them in a session during their free time. Your & your child's voluntary participation will help me to complete my research project. You have the right to withdraw consent and discontinue participation at any time. Information from this study will be anonymously coded to ensure confidentiality.

If you have any query about the study or right as a participant, please feel free to contact with S. M. Mazibur Rahman (student) or Md. Monjurul Habib lecturer in Department of Occupational Therapy, BHPI, CRP, Savar, Dhaka-1343.

Do you have any questions before I start?

So may I have your consent to proceed with the participation?

Yes: ☑ No: ☐

Signature of the Researcher Mazib

I ....MAHMUDL.....HOQUE.....have read and understand the consents of the form. I agree to participant in the research without any force.

Signature of the participant

06.12.14

4.2 Consent form (Bangla)

CONSENT FORM (Bangla)

এই গবেষণাকারী এস এম মজিবুর রহমান বাংলাদেশ হেলথ প্রফেশন ইনিস্টিটিউট, সিআরপিতে বিএসসি ইন অকুপেশনাল থেরাপি কোর্সে অধ্যয়নরত। এই গবেষণাটিতে গবেষণাকারী বাংলাদেশি প্রাইমারি স্কুলগামী শিশুদের এলথ্রপমেট্রিকাল পরিমাপ নেবে। যার সাহায্যে প্রাইমারি স্কুল গামী শিশুদের জন্য সঠিক এলথ্রপমেট্রিকাল মাপের স্কুল চেয়ার, টেবিল অথবা বেঞ্চ তৈরি করা সম্ভব হবে।

এই গবেষণাতে আমার ছেলেমেয়ে/ ছাত্রছাত্রী একজন অংশগ্রহনকারী এবং আমি পরিস্কার ভাবে এই গবেষণার উদ্দেশ্য সম্পর্কে অবগত। আমার যে কোন সময় এই গবেষণা থেকে আমার ছেলেমেয়ে/ ছাত্রছাত্রীকে সরিয়ে আনার অধিকার আছে। এজন্য আমি প্রশ্নের উত্তর প্রদান করার জন্য কারো কাছে দায়বদ্ধ না। এই গবেষনাটির সাথে আমার এবং আমার ছেলেমেয়ে/ ছাত্রছাত্রীর কোন সম্পৃক্ততা নেই এবং আমার এবং আমার ছেলেমেয়ে/ ছাত্রছাত্রীর চিকিৎসার সাথে বর্তমানে এবং ভবিষ্যতে কোনভাবে সম্পৃক্ত না।

আমি অবগত যে, আমার এবং আমার ছেলেমেয়ে/ ছাত্রছাত্রীর সকল তথ্য সহ নাম ঠিকানা কোথাও প্রকাশ করা হবেনা। শুধুমাত্র গবেষণাকারী এবং তার সমন্বয়কারী এই তথ্যাবলী দেখার এবং গবেষণার কাজে ব্যবহারের ক্ষমতা রাখেন।

আমি এই গবেষণাকারীর এবং তার গবেষনার সমন্বয়কারীর সাথে এই গবেষনার পদ্ধতি সম্পর্কে অথবা যেকোন প্রশ্নের উত্তর জানার জন্য কথা বলতে পারব।

আমি আমার ছেলেমেয়ে/ ছাত্রছাত্রীকে উপরোক্ত তথ্য গুলো ভালো ভাবে জেনে নিজ ইচ্ছায় এই গবেষণায় স্বেচ্ছাই অংশগ্রহণ করতে উৎসাহিত করছি।

অংশগ্রহনকারীর স্বাক্ষর/ টিপসই
তারিখ: ০৬/১২/১৪
গবেষণাকারীর স্বাক্ষর
তারিখ: Mazib 06.12.14

সাক্ষ্যপ্রদানকারীর স্বাক্ষর/ টিপসই
তারিখ: 06.12.14

Appendix 5

5.1 Questioner

Serial No: … … … … … … … … … … Date: … … … … … … … … … …

Name and address of the school:

Name of the student:

Age: **Roll No:** **Class:** **Sex:**

Living area: | Rural | Urban |

Parents Occupation: Public service/Private service/House wife/ Unemployed/ others … … …

Anthropometric dimensions estimation

Sl. no.	Dimensions	Description	Acquired measurement
1.	Weight	Body weight	
2.	Body height	The vertical distance from the floor to the vertex (i.e. the crown of the head)	
3.	Eye height, (standing)	The vertical distance from the standing surface to the inner canthus of the eye.	
4.	Shoulder height (standing)	Vertical distance from the standing surface to the shoulder	
5.	Elbow height (standing)	Vertical distance from the standing surface to the underside of the elbow	
6.	Arm length	Difference between shoulder height and elbow height	
7.	Forearm length	Distance between acromion and tip of the middle finger	
8.	Forearm–forearm distance	Maximum distance between two forearms	
9.	Elbow–elbow distance	Distance between two acromions in standard sitting position	
10.	Shoulder width	Maximum shoulder width in standing position	
11.	Buttock width	Maximum buttock width in sitting position	
12.	One-thigh thickness	Maximum thickness of the thigh	
13.	Two-thigh thickness	Maximum two thigh thickness when right thigh rests over left thigh	
14.	Popliteal height (sitting)	Vertical distance from the floor to the popliteal angle at the underside of the knee where the tendon of the biceps femoris muscle is inserted into the lower leg	

15.	Knee height (sitting)	Vertical distance from the floor to the upper surface of the knee in sitting position	
16.	Sitting height	Vertical distance from the sitting surface to the vertex	
17.	Eye height (sitting)	Vertical distance from the sitting surface to the inner canthus of the eye	
18.	Elbow height (sitting)	Vertical distance from the seat surface to the underside of the elbow	
19.	Abdominal depth	Maximum horizontal distance from the vertical reference surface to abdominal front in sitting position	
20.	Chest depth	Maximum horizontal distance from the vertical reference plane to the front of the chest in men or breast in women	
21.	Buttock–knee length	Horizontal distance from the back of the uncompressed buttocks to the front of the kneecap	
22.	Buttock-popliteal length	Horizontal distance from the back uncompressed buttocks to the popliteal angle, at the back of the knee, where the back of the lower legs meet the underside of the thigh	

(Mirmohammadi et al, 2013)

Appendix 6

6.1 Study time frame

	June,14	July,14	Aug,14	Sep,14	Oct,14	Nov,14	Dec,14	Jan,14	Feb,14
Proposal writing									
Literature review									
Methodology									
Data collection									
Data analysis									
Result writing									
Discussion									
1st draft									
2nd draft									
Final submission									