



# Anthropometric analysis of 15 to 17 years of school students in Charotar region of Gujarat

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**Abstract:** Introduction: Children spend one-quarter of a day in school. However, the anthropometric dimensions of the body of the students were not considered during designing the existing school furniture. It is well known fact that body dimensions of the children varies from age, region etc. Therefore the dimensions of furniture should also be different in different cases. To assess the student ergonomically who are using class-room furniture and to determine the prevalence of musculoskeletal disorder in school student by Nordic questionnaire. Methods: The present investigation was carried out on 95 school students of Charotar region having the age range of 15 to 17 years. Nordic questionnaire was filled by students to determine the prevalence of musculoskeletal problems. Results: The results revealed that all the anthropometric dimensions of the school student's increase with their age. Moreover, there was a little difference between mean values of different anthropometric dimension. These differences become much higher when they were compared between boys and girls. Conclusion: It may be suggested from the present study that the design criteria should be selected based on the anthropometric dimensions of the students. The ill and improper design of benches may create many problems for the students. Through Nordic questionnaire, we concluded that participants who are heighted, having lower back pain comparatively short heighted. Key words: Anthropometric dimensions, classroom furniture, musculoskeletal problems.

## 1. Introduction

Anthropometric data is a collection of the dimension of the human body and useful for apparel sizing, physical anthropology and ergonomics design of the work place. The comfort, physical health, well-being and performance of people can be increased by designing equipment, furniture and other devices according to the needs of human body. (Ibrahim Musa, 2011)<sup>1</sup>. School is a home away for children facilitating their learning activities between 5 to 7 hours per day. Such activities include; reading, writing, drawing and other related activities requiring them to be in session for long hours. The school furniture should suit student's necessity because they mostly consume their time on desk. Therefore the school furniture should be crafted according to anthropometric dimensions for different age groups.(Ibrahim Musa, 2011)<sup>1</sup>

The health, well-being and performance of people depend partly on equipment, furniture, and other devices each person uses. One of the important issues in this regard is designing equipment and furniture according to the anthropometric and characteristics of

the users. Anthropometric data can be used to identify the physical dimensions of equipment, furniture, clothing, and workstations (R. hafezi, H. Akbari, AH.Mehrpavar 2010)<sup>2</sup>. One of the most important factors that influence the students sitting posture is anthropometric measures of the children and the measurements and design features of the school furniture they use. Specific measurements such as popliteal height, knee height, buttock to popliteal length and elbow rest height are necessary in order to determine the dimensions of school furniture that will enable students to maintain the correct sitting posture.(R. hafezi, H. Akbari, AH.Mehrpavar 2010)<sup>2</sup>

The existing school furniture that is benches may not be suitable for children due to they are designed without due considerations according to body features. It has been observed a crash between classroom furniture and anthropometric dimensions for school children. Revealed that school furniture did not balance with anthropometric measures. (Ibrahim Musa, 2011)<sup>1</sup>

School furniture is one of the important physical facilities provided in a classroom environment where the student spends most of their time. The design of workplace for students should ensure body comfort for effective learning process. The functional utility of the student's classroom furniture of its physical structure and biomechanics of human body. (Ibrahim Musa, 2011)<sup>1</sup>

Lack of proper designs, sitting acquires greater muscular force and control to maintain stability with equilibrium, resulting in superior fatigue, irritation and postural habitual complaints. Additionally, school student en-counter with musculoskeletal stress due instability and discomfort sitting arrangement hence it draws the children's attention away from fo-cused teachings. It is difficult to design the seating furniture that matches every student but anthropometry measures increases furniture suitability with vast populations. (Afaf A.M. Shaheen) <sup>3</sup>

## 2. Objectives of The Study

- a) To assess the student ergonomically who are using classroom furniture.
- b) To determine the prevalence of musculoskeletal disorder in school student by Nordic questionnaire.

## 3. Materials and Methods

Design: Correlational study

Settings: Schools of Charotar region of Gujarat

Sampling method: Convenient sampling

Sample size: 100

Inclusion criteria: 15 to 17 years of age group, BMI with 15 to 25 kg/m<sup>2</sup>, Healthy individuals, willing to participate

Exclusion criteria: Recent orthopaedics conditions, Children with audi-tory impairment,



Children who are not able to understand simple in-structions, Amputated student, Limb length discrepancy

Data collection tools: Consent form, Demographic details, Measure tape, Nordic questionnairePen/ Pencil

Procedure:

- Subjects were selected on the bases of inclusion and exclusion criteria.
- They were explained about the purpose and procedure of the research.
- Inform consent about the study was signed by the subjects.
- Different anthropometric measures(Fig. 1,2) and classroom furni-ture dimensions(Fig. 3,4) were taken by the use of measure tape.
- Subject was instructed to seat straight and to remove the foot-wear

#### 4. Results

The descriptive statics including minimum, maximum, mean and standard deviation of the 95 student’s (64 boys and 31 girls) anthropometric meas-ures are presented in table. (Table 1)

Table1: Furniture Dimension Measurement

Parameters (cm)	Min	Max	Mean	SD
Height	130	182	153.5052632	12.49074013
Sitting height	114.3	136.6	123.7989474	4.375305332
Popliteal height	40.3	52	46.59052632	2.339215803
Knee height	42.6	62.6	51.08105263	3.142647439
Hip breadth	20	36.6	28.81578947	3.408416235
Elbow rest height	56	71.3	64.43157895	2.840110245
Buttock popliteal length	35	51	42.71684211	3.376031052
Buttock knee length	40.3	59	50.04105263	3.605329823

Table-2: Posture analysis of the respondents with REBA using hand tools

Models	Bench height(cm)	Bench width(cm)	Bench length(cm)	Foot rest(cm)
1.	48	22	94	10
2.	46	24	92	5
3.	48	23	100	8
4.	49	26	97	8
5.	48	25	98	8

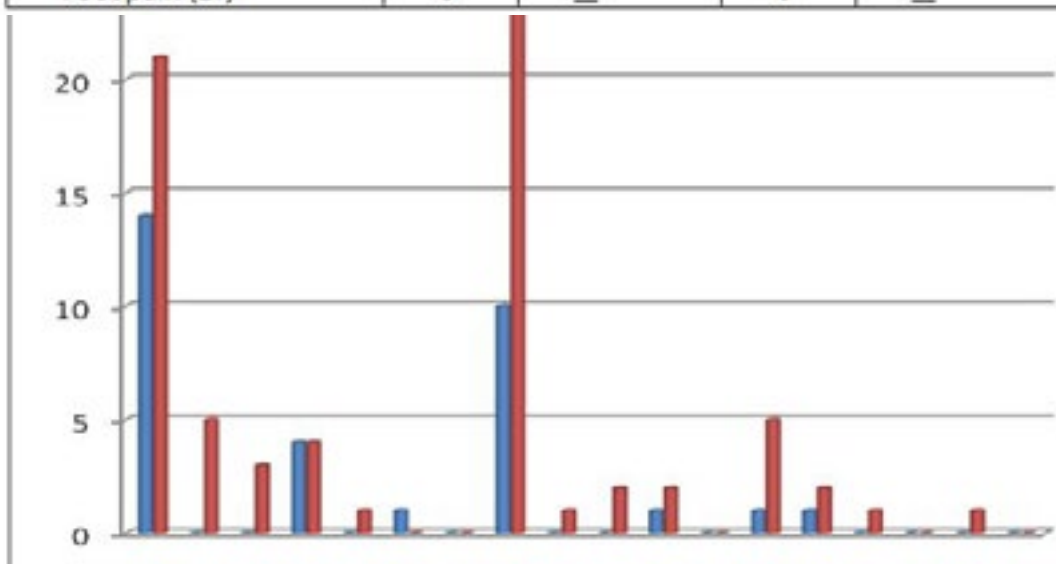
For the furniture dimension we measured bench height, bench length, bench width, foot rest. Table 2:

(Table 2) This result indicates that there is mismatch between anthropo-metric data of students and furniture dimension. So it creates musculoskeletal problem.

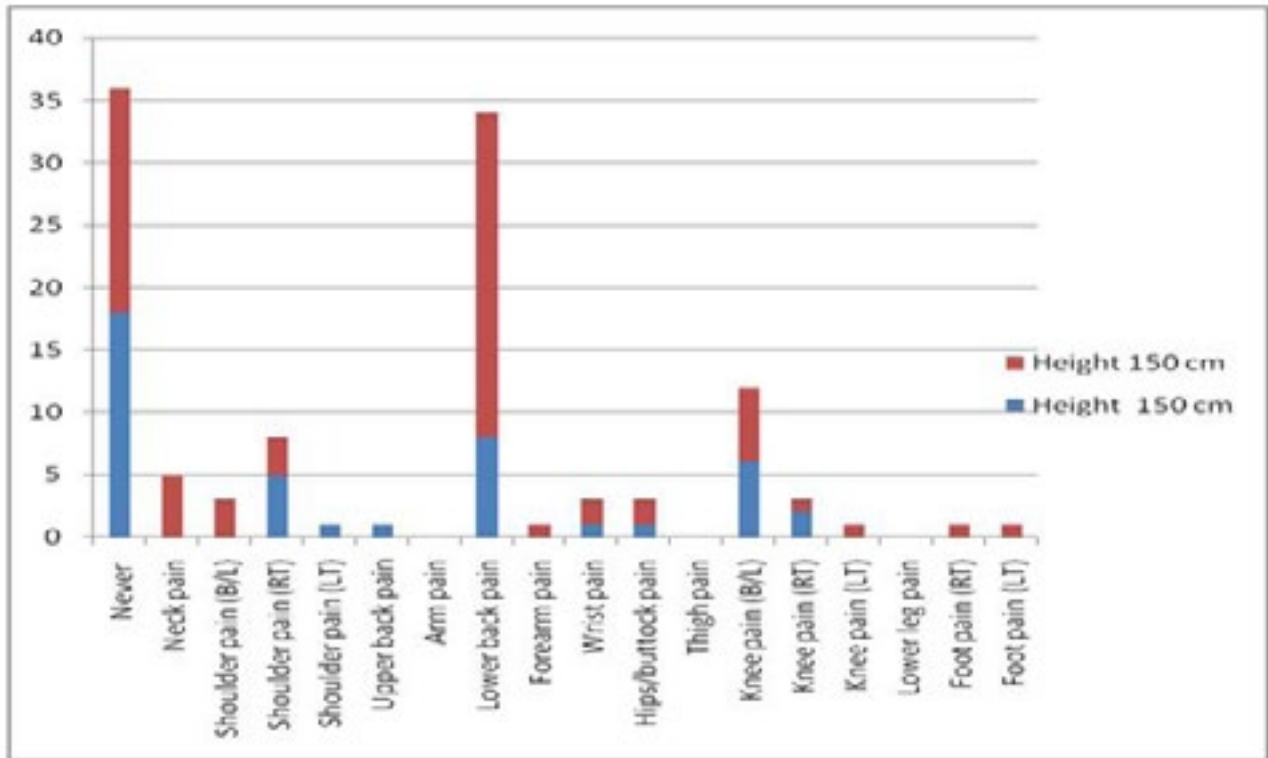
Nordic Questionnaire: Then we used Nordic questionnaire to determine the prevalence of problem in musculoskeletal system because of mismatch between furniture dimensions and students anthropometry. The musculoskeletal problem faced by the students is presented in the table.

Table-3

Musculoskeletal problem	Girls	Percentage (%)	Boys	Percentage (%)
Never	14	14.73	21	22.1
Neck pain	0	—	5	5.26
Shoulder pain (B/L)	0	—	3	3.15
Shoulder pain (RT)	4	4.21	4	4.21
Shoulder pain (LT)	0	—	1	1.05
Upper back pain	1	1.05	0	—
Lower back pain	10	10.52	23	24.2
Forearm pain	0	—	1	1.05
Wrist pain	0	—	2	2.10
Hips/buttock pain	1	1.05	2	2.10
Thigh pain	0	—	0	—
Knee pain (B/L)	1	1.05	5	5.26
Knee pain (RT)	1	1.05	2	2.10
Knee pain (LT)	0	—	1	1.05
Foot pain (RT)	0	—	1	1.05
Foot pain (LT)	0	—	0	—



Graph 1

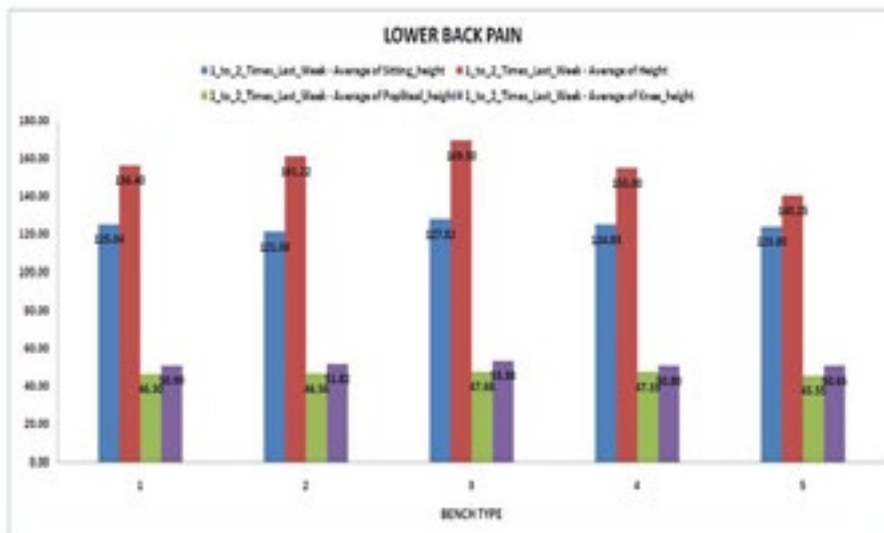


Graph 2

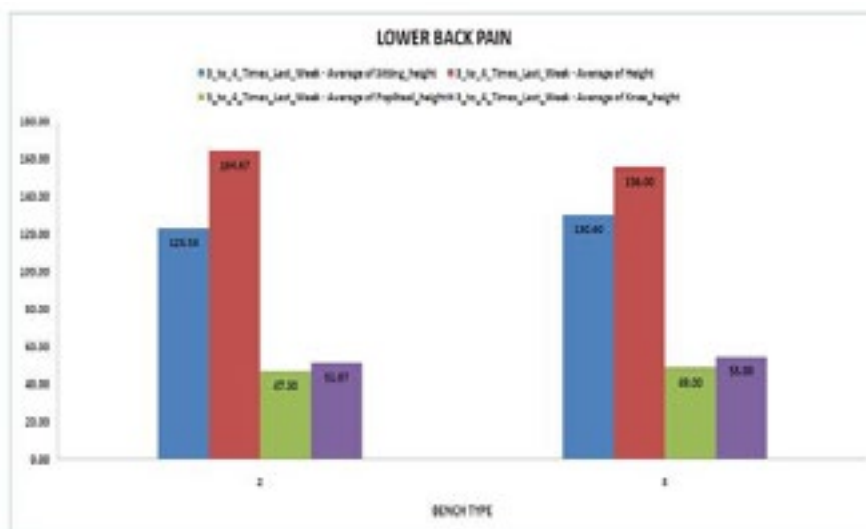
From the result of Nordic questionnaire, it shows that long heighted boys have more problem than girls that to in lower back area. The graph shows that the heighted students having more musculoskeletal problem especially in lower back (27.36 %).

Table 4:

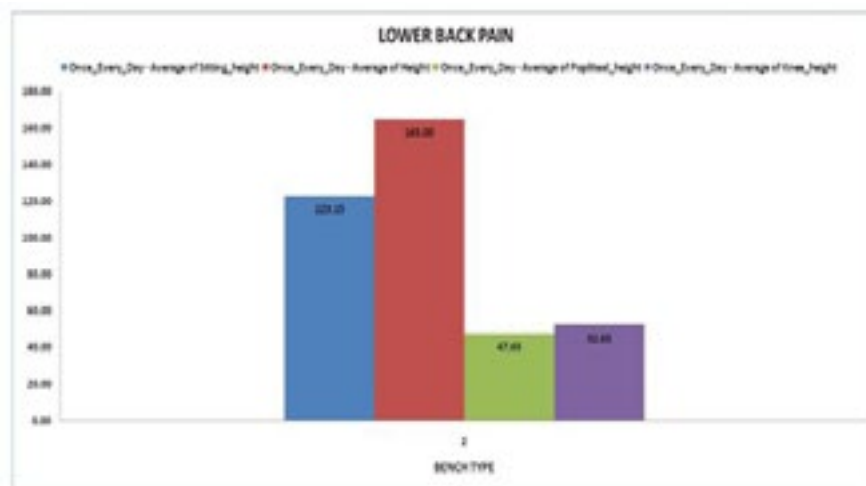
Musculoskeletal problem	Height 150 cm	Percentage (%)	Height 150 cm	Percentage (%)
Never	18	18.95	18	18.95
Neck pain	0	—	5	5.26
Shoulder pain (B/L)	0	—	3	3.15
Shoulder pain (RT)	5	5.26	3	3.15
Shoulder pain (LT)	1	1.05	0	—
Upper back pain	1	1.05	0	—
Lower back pain	8	8.42	26	27.36
Forearm pain	0	—	1	1.05
Wrist pain	1	1.05	2	2.10
Hips/buttock pain	1	1.05	2	2.10
Thigh pain	0	—	0	—
Knee pain (B/L)	6	6.315	6	6.315
Knee pain (RT)	2	2.10	1	1.05
Knee pain (LT)	0	—	1	1.05
Foot pain (RT)	0	—	1	1.05
Foot pain (LT)	0	—	1	1.05



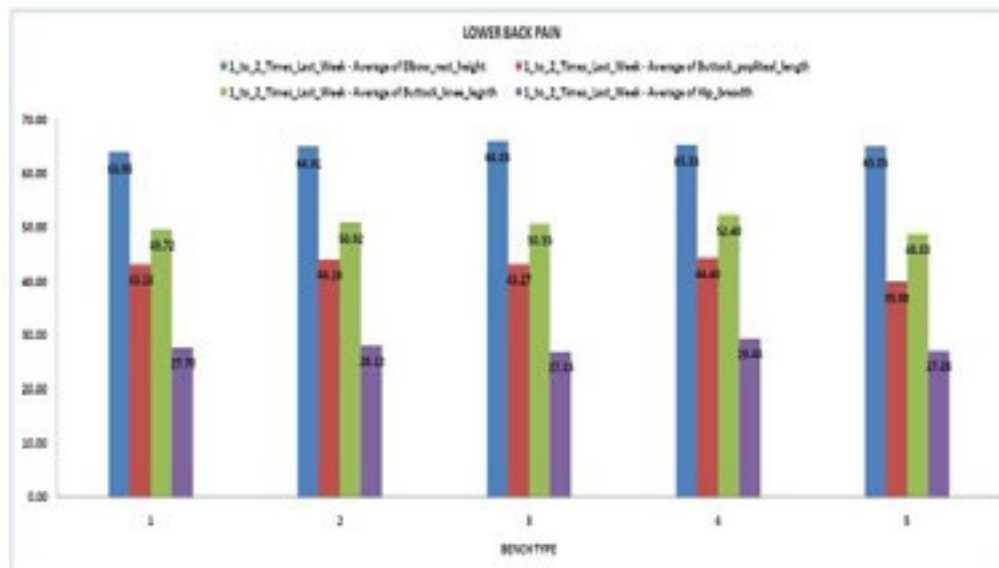
Graph 3



Graph 4



Graph 5



Graph 6

## 5. Discussion

There are enormous variations in body size among individuals. On the other hand, any mismatch in the work environment leads to users discomfort, low productivity, work hazards and accidents. The body dimensions of children are important for the design of schools furniture. These problems because children of different body sizes may be combined in the same classroom. Thus, benches of very different sizes should be made available to fit different children.

Provision of adjustable benches might appear suitable solution, but especially young children might have great difficulties in adjusting that furniture to their size and liking. Moreover, adjustable seats and desks are costlier are unable to provide such furniture because of financial reasons. Adekunle Ibrahim Musa (2012)<sup>1</sup> had done study on "Anthropometric evaluations and assessment of school furniture design in Nigeria: A case study of secondary schools in rural area of Odeda, Nigeria." That study was carried out on 621 schoolboys with age range of 12-17 years in junior and senior secondary schools. He concluded that the ill and improper designs of desks may create many problems for the students such as fatigue muscular stress and discomfort or pain in different body parts. Savanur et al. (2007)<sup>10</sup> measured the dimensions of 104 items of furniture (chairs and desks) and 42 anthropometric dimensions of 225 students from grade six to grade nine (age: 10-14 years) in five schools at Mumbai, India. They reported that the seat and desk heights were higher than the comparable students' anthropometric dimensions. The depth of the seats and the desks were less than comparable students' anthropometric dimensions. Moreover, the students reported discomfort in shoulder, wrist, knee and ankle regions. This study was limited by being applied only on boys in only two schools in Egypt. On the result of that we concluded that long heighted students (27.36%) having more problems in lower back compare to short heighted students.

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## 6. Conclusion

It may be suggested from the present study that the design criteria should be selected based on the anthropometric dimensions of the students. There are chances of mismatch between the student's dimensions and available furniture. The ill and improper design of benches may create many problems for the students such as fatigue, muscular stress and dis-comfort/pain in different body parts. Through Nordic questionnaire, we concluded that the participants who are heighted, having lower back pain comparatively short heighted.

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