EVALUATION OF EXTENT OF MISMATCH BETWEEN CLASSROOM FURNITURE AND ANTHROPOMETRIC MEASURES OF GIRLS' STUDENTS OF HIGH MADRASAH (SCHOOL)

Benzir Parvin and Prakash C. Dhara*

Ergonomics and Sports Physiology Division

Department of Human Physiology with Community Health

Vidyasagar University

ABSTRACT ■ The present study was aimed to evaluate the extent of mismatch of bench and desk unit of Madrasah with the body dimensions of the girls' students and its comparison with that of general higher secondary girls' schools in West Bengal (India). The study was carried out 703 students, having age range of 10-15 years were selected randomly from different High Madrasah and general high schools, in different districts of West Bengal. The furniture of the school was evaluated class wise (Class V to X). For the evaluation of classroom furniture match criteria equations were defined. The mismatch level was determined for different characteristics of bench and desk unit by considering the furniture dimension and anthropometric measures of the students. After considering the existent classroom furniture dimensions in each match criterion equation, the anthropometric characteristics of the considered students were in order to determine the mismatch between them. The result revealed that there was no significant difference of most of the measures in different classes between Madrasah and general school. Most of the students in class V to X showed higher mismatch in seat height, seat width, seat to desk clearance and seat to desk height both High madrasah and general high schools. Thus, the extent of match percentage was gradually increased with the enhancement of the age of the students. The seat depth of the existent school furniture was lower than the buttock-popliteal length, So there was 100% lower mismatch for the girls of High madrasah and general high schools in class V to X. It may suggested that to take necessary steps to set design criteria of the school furniture for different classes separately considering the change of body dimension of the students due to growth.

Key words: Anthropometric Dimensions, girls' students, school furniture, West Bengal.

INTRODUCTION

School is the second home of the children. Students are required to spend a considerable time of their lives in the school. In the school they use bench and desk unit for about 80% of the school time (Savanur et al., 2007) in the classroom performing various activities like reading, writing, drawing and other related activities, which require them to sit continuously for long hours (Dutta and Dhara, 2012). School children are at special risk of suffering backache due to the prolonged periods spent seated during school and the formation of poor postural habits. Therefore, they feel discomfort/pain in different parts of the body (Zacharkow D, 1988).Therefore, the

* **Corresponding author** : e-mail: prakashdhara@rediffmail.com

school furniture should fulfill the requirements of the children and it should also allow for the changing of postures (Yeats, 1997). A number of researchers reported a mismatch between physical dimensions of school furniture and anthropometric measures of the school students (Gouvali and Boudolos, 2006; Panagiotopoulou et al., 2004; Parcells et al., 1999). This mismatch may cause uncomfortable sitting, awkward body postures and discomfort / pain in different body parts of the children. Under such unsuitable conditions the students may lose their interest in learning (Hira, 1980). Low back pain noticed among taller adolescent students can be attributed to various factors, being perhaps one of the most relevant the mismatch between children's anthropometry and the furniture's dimensions (Grimmer and Williams, 2000, 2004). The said mismatch may be to variation of anthropometric dimensions in different age groups. This differentiated growth may also represent an additional source of anthropometric variability that needs to be considered (Muzzo, 2003) for determining the school furniture dimensions.

Research on classroom furniture has been published worldwide in different journals. As anthropometric measures vary from population to population, the classroom furniture are required to be evaluated for specific population. There is no published data regarding mismatch of furniture of secondary schools for Bengali (Indian) population. Further, no research has been done on girls students of Madrasah (special school for Muslim students) in this regard. The aim of the present study was to evaluate the extent of mismatch of bench and desk unit with the body dimensions of the Madrasah girls students and its comparison with that of general Higher

secondary girls school in West Bengal (India).

2. Methodology:
A. Selections of site and subjects:
The study was conducted on Bengali students of different High Madrasah for girls and general high schools for girls, which were located in different districts in West Bengal. Madrasah is special type school where only the students of Muslim community are admitted. There are two categories of Madrasah education system in West Bengal. One is High Madrasah Education System and other one is Senior Madrasah Education System. In high Madrasah all the students were Muslim whereas in general schools students were from different religions. For the study 703 girls students having age range 10 to 15 years (class V to X) were selected by means of random sampling method. They have no physical disabilities. The study was conducted with proper consent of the school authority. The age of the girl students was authenticated from the schools records provided by the school authorities. All the subjects volunteered for the study.

B. Anthropometric Measurements:
Different anthropometric measures of the school children were taken by adopting proper landmark definition and standard measuring techniques (Khaspuri et al., 2007; Hafezi et al., 2010; Dutta et al., 2012; Qutubuddin et at., 2013). All the body dimensions of the girls were taken only from the right side of their body.

The equipment used for that purpose was an anthropometer (Holtain). Accuracy and repeatability of measurement was achieved by practice prior to the data collection session. The data recorded for a subject was the mean of three trials. All subjects were wearing light cloths during measurements.

During measuring body dimensions under sitting condition, the subjects were asked to sit in such a way that the upper leg and lower leg remained at right angle to each other. Following anthropometric body dimensions were taken during sitting position on the bench as shown in Fig. 1).

C. Measurement of physical dimension of the furniture

The following measures of the furniture (unit of bench and desk) used in the school were taken

(i) **Bench Height:** Vertical distance from the floor to the highest point on the front of seat was measured.

Table-1. Definition of measured anthropometric dimensions.

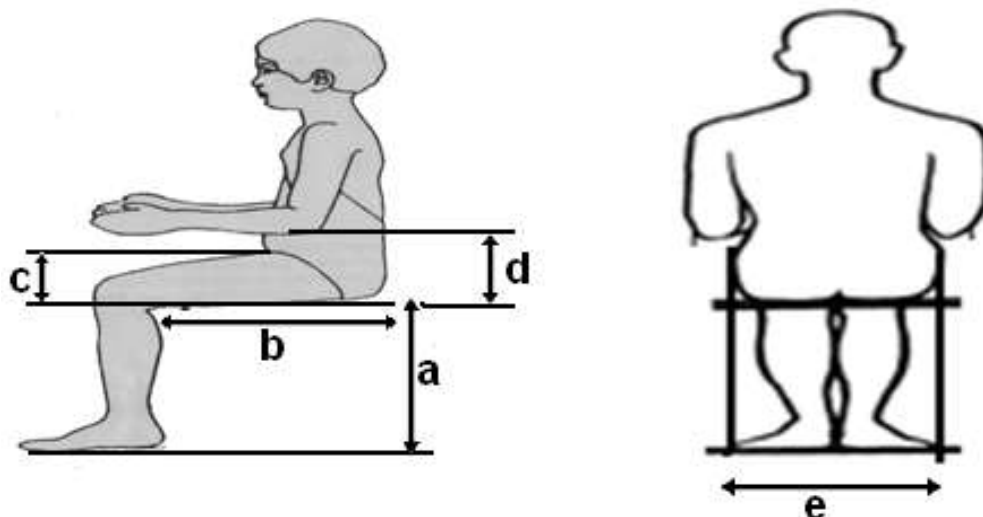| Anthropometric dimensions	Definition
Stature	It is the vertical distance from the floor to the vertex.
Elbow height, Sitting	Measured with the elbow flexed at 90°, as the vertical distance from the seat surface to the bottom of the tip of the elbow.
Popliteal height, sitting	Distance taken vertically with 90° knee flexion, from the floor to the popliteal space, which is the posterior surface of the knee or popliteal space.
Buttock-popliteal length, sitting	With 90° knee flexion, distance was measured horizontally from the posterior surface of the buttock to the posterior surface of the knee or popliteal space.
Hip breadth, sitting	Maximum horizontal distance across the hips in the sitting position.
Thigh thickness, sitting	Distance measured vertically from the seat surface to the highest point on the top of the right thigh.

Fig. 1: Different anthropometric dimensions of girls' students during sitting position on the bench.
[(a) Popliteal height, sitting, (b) Buttock-popliteal length, sitting, (c) Thigh clearance height from seat,(d) Elbow height from the seat, sitting, (e) Hip breadth, sitting]

(ii) Bench Depth: Horizontal distance of the sitting surface from the back of the seat to the front of the seat was measured.

(iii) Bench width: Horizontal distance from left hand side of the seat and the right-hand side or vice versa was measured.

(iv) Bench to Desk Height: Vertical distance from the highest point on the front of seat to the top of the front edge of the desk was measured.

(v) Bench to desk clearance: Horizontal distance from the highest point on the front of seat to the back at the top of the front edge of the desk under the writing surface was measured.

D. Assessment of mismatch of the furniture: The mismatch between the school furniture and the body dimensions of the users was assessed by comparing the furniture dimension with relevant body dimension of the students. The degree of mismatch was determined quantitatively, as mentioned below.

(I) Seat height Vs. Popliteal height:
Seat height should be matched with the popliteal height of user population. According to many investigators seat height should be lower than the popliteal height (Molenbroek and Ramaekers, 1996; Parcells et al., 1999) but seat height does not have to be higher than 4 cm (Gutierrez and Morgado, 2001) or 88% of the popliteal height (Parcells et al., 1999; Hafezi et al., 2010 and Ismaila et al., 2010) in order to avoid compression in the underside of the thigh (Garcia Molina et al., 1992). This match criterion was determined using the criteria described by Gouvali and Boudolus (2006), but popliteal height was modified according to a shoe height of 3 cm (castellucci et al., 2010) as par the results of a national consumers' survey (SERNAC, 2005); the two way match criterion was determined by the application of following equation

(Castellucci et al, 2010):
(Popliteal height+3) cos30° $\leq$ seat height $\leq$ (popliteal height+3) cos5°

(II) Seat depth Vs. Buttock-popliteal length:
The seat depth should be matched with the buttock-popliteal length of the user population. It should be lesser than the buttock-popliteal length of the subjects for the clearance of calf muscle. But if it is too less, the thigh would not be supported enough. The following equation was used to determine the match criterion (Castellucci et al, 2010,Parcells et al., 1999; Hafezi et al., 2010; Ismaila et al., 2010 and Gouvali and Boudolos, 2006):

0.80*buttock-popliteal length $\leq$ seat depth $\leq$ 0.95*buttock-popliteal length

(III) Seat width Vs. Hip breadth:
The seat width should be matched with the hip breadth of the subjects. It should be higher than the hip breadth to avoid the compression of the buttocks and to relieve discomfort and mobility restrictions, (Gutierrez and Morgado, 2001; Mondelo et al., 2000; Oyewole et al., 2010; Sanders and McCormick, 1993 and Parcells et al., 1999). The seat width should be at least 10% but not more than 30%, larger than the hip breadth in order to provide proper seating while making economic use of space (Gouvali and Boudolus (2006). The following equation was used to determine the level of mismatch (Gouvali and Boudolus 2006; Dianat et al., 2013; Van Niekerk et al., 2013):
1.10*Hip width $\leq$ seat width $\leq$ 1.30*Hip width

(IV) Seat to desk clearance Vs. thigh thickness:
Seat to desk clearance should be matched with thigh thickness of the subjects. It is considered appropriate when the clearance is higher than thigh thickness in order to permit free leg movement (Garcia-Acosta and Lange-Morales, 2007; Molenbroek et al., 2003). The desk clearance should be 2 cm higher than knee height (Parcells et al. 1999

and Gouvali and Boudolos, 2006). The following equation was used to find the match criterion (Castellucci et al, 2010):

Thigh thickness + 2 < seat to desk clearance

(V) Seat to desk height Vs. elbow height, sitting:

The desk height is an important criterion for designing the school furniture. It should be matched with the sitting elbow height (Parcells et al. 1999; Garcia-Acosta and Lange-Morales, 2007; Milanese and Grimmer, 2004; Molenbroek et al., 2003; Sanders and McCormick, 1993). It was also suggested that the desk should be 3–5 cm higher than the sitting elbow height (Pheasant, 1991; Poulakakis and Marmaras, 1998). The sitting elbow height was taken as the minimum height of seat to desk height in order to provide a significant reduction on spinal loading (Occhipinti et al., 1985) and the maximum height of seat to desk should not be higher than 5 cm above the sitting elbow height. With these considerations the following equation was used to define the match criteria (Castellucci et al, 2010):

Sitting elbow height < seat to desk height < Sitting elbow height + 5

3. RESULT AND DISCUSSION

3.1 Dimensions of School Furniture

The dimensions of the classroom furniture (n=261) of the four different institutions, taking two each from Madrasah and general school, were measured by the same measurer with a metal tape. The mean values of different measures of bench and desk have been presented in Table 1. The measurements were taken by selecting benches and desks randomly from each class starting from Class-V to Class-X. During the evaluation of the furniture of Class-V to Class-X of Madrasah and general schools, it was observed that only a single variety of desk and bench unit was used in each school/Madrasah. The presented data showed that the furniture dimensions, viz., bench height, bench depth, bench width, desk height, etc were almost the same in each of the classes. Although it has been found that there was a significant difference ($p<0.001$) in desk height, desk length, bench to desk height and bench to desk clearance of the classroom furniture between Madrash and general school, but their percentage difference was very less (0.2% to 5.1 %).

Table-1. Different measures of the school furniture -Bench and Desk

Furniture Dimensions	Madrasah	General School	Percentage Difference
	n=113	n=148	
Desk Height(cm)	72.53±3.08**	73.52±2.48	1.4
Desk Depth(cm)	26.43±2.02	26.07±2.27	1.4
Desk length(cm)	177.37±20.53**	182.00±1.88	2.6
Bench Height(cm)	45.86±1.74	45.99±1.49	0.3
Bench Depth(cm)	23.89±1.48	23.81±1.31	0.3
Bench width(cm)	36.43±0.68	36.36±0.61	0.2
Bench to desk height(cm)	24.48±2.78*	25.72±2.90	5.0
Bench to desk clearance (cm)	16.98±2.55*	17.85±2.42	5.1

*$p<0.001$, **$p<0.01$ 'n' represents the number of furniture (Bench and Desk) investigated

Table-2: Mean± SD of anthropometric measures (cm) of the girl students

Class	School type	Stature	Sitting elbow height	Popliteal Height	Hip breadth	Buttock-popliteal length	Thigh thickness height
V	Madrasah (n=54)	132.74± 6.69	16.86± 2.27	34.89± 2.05	22.49± 1.65	39.83± 5.64	10.01± 1.85
	General school (n=81)	133.47± 7.75	16.15± 2.16	35.11± 2.13	21.94± 2.05	39.37± 4.82	10.19± 1.69
VI	Madrasah (n=56)	140.87± 7.48	15.87± 2.60	35.50± 2.61	22.93± 2.63	43.36± 3.24	9.23± 1.62
	General school (n=85)	139.21± 6.64	16.91± 2.66	36.44± 1.83	23.26± 2.48	42.04± 4.93	10.41± 1.35*
VII	Madrasah (n=50)	142.07± 5.97	17.04± 2.19	37.05± 2.84	24.86± 2.66	44.58± 5.28	11.30± 1.37
	General school (n=85)	142.85± 6.37	17.80± 2.17	37.40± 2.75	24.39± 2.79	45.44± 3.21	11.14± 1.43
VIII	Madrasah (n=52)	146.03± 5.88	19.30± 2.55	38.47± 2.05	24.21± 1.93	47.48± 2.84	11.37± 1.31
	General school (n=65)	148.32± 5.78***	19.53± 2.35	38.43± 2.67	25.15± 2.12***	48.99± 2.75**	11.53± 1.14
IX	Madrasah (n=50)	149.08± 4.97	18.39± 2.56	39.42± 2.73	26.00± 2.45	46.79± 4.02	11.02± 1.57
	General school (n=52)	150.24± 4.76	18.64± 2.50	39.89± 2.53	26.04± 1.92	49.53± 3.09*	11.14± 1.34
X	Madrasah (n=38)	149.32± 4.35	19.05± 2.34	39.47± 2.73	26.82± 3.72	47.88± 4.74	11.24± 1.28
	General school (n=35)	152.04± 4.35	19.51± 1.82	39.99± 2.60	26.60± 2.45	46.11± 4.63	11.04± 1.16

*$p<0.001$, **$p<0.01$, ***$p<0.05$

3.2 Anthropometric measures of the school students.

The descriptive statistics of the six anthropometric dimensions of the students, which were related to the school furniture design, of the four different schools are presented in Table 2. An independent t-test was performed to examine the differences in measurements between the Madrasah and general schools. It was observed that there were significant differences between Madrasah and general school only in a few cases, e.g., thigh thickness height ($p<0.001$) in class VI, stature ($p<0.05$), Hip breadth ($p<0.05$), Buttock-Popliteal length ($p<0.01$) in class VIII, and also Buttock-Popliteal length ($p<0.001$) in Class IX. However, the percentages of differences of those measures

were very less varying from 1.6% to 5.9% only. Further, there was no significant difference of most of the measures in different classes between Madrasah and general school.

The body dimensions of the school children and the furniture dimensions should match for a comfortable sitting in the class. The relevant body dimensions for a particular furniture dimension have been shown in Table 3. For determining the proper dimensions of the school furniture, the corresponding anthropometric measures should be considered. The degree of mismatch between furniture dimensions and anthropometric measures of the users should be quantified.

dimensions determined a minimum (min) and a maximum (max) acceptable limit for each dimension, individually for each student (Gouvali and Boudolus, 2006). After assessing the existent classroom furniture measure in each match criterion equation, the established limits and the body dimensions of the students were compared and 3 categories were defined in the case of the two-way equations: "Match" level when the existent dimension was between the limits, "High mismatch" level when the minimum limit of the criterion equation was higher than the existent dimension and a "Low mismatch" level when the maximum limit of the criterion

Table 3: The furniture dimension and the corresponding anthropometric measures

Sl. No.	Furniture dimension	Body dimension
1.	Seat height	Popliteal height
2.	Seat depth	Buttock- Popliteal length
3.	Seat Width	Hip breadth
4.	Bench to desk height	Thigh thickness height
5.	Desk Height	Sitting Elbow Height and Popliteal height

3.3 Mismatch between anthropometric measures and classroom furniture:

For the evaluation and design of classroom furniture the applied anthropometry and ergonomics principles should be considered and to determine the values of each furniture dimension, the extent of mismatch could be evaluated by some match criteria equation (Gutierrez and Morgado, 2001). In the case of desk width and depth, no criteria were defined to compare with the anthropometric measure. In fact, those furniture dimensions were related with functional criteria, such as the need for available desk surface, and not with any particular anthropometric measure (Gutierrez and Morgado, 2001). Equations relating body dimensions to school furniture

equation was lower than the existent dimension. School-aged children are constantly changing in size, resulting in high variability in body dimensions (Feldman, 2002). Thus, there was high probability of a mismatch between students and one-size fits all furniture. In the studied Madrasah and high schools the furniture dimensions were more or less the same in different classes. This might be one of the reasons of misfit between the users and the furniture.

Table 4 shows the mismatch percentage between the anthropometric measures of girls' students and the existing classroom furniture dimensions on the basis of seat height, seat depth, seat width, seat to desk clearance and seat to desk height by class wise.

Table 4: Match and Mismatch between the Dimensions of Existing Classroom Furniture and body dimensions of the children

Furniture Dimension	Class	Madrasah			Total Mismatch		General school			Total Mismatch	
		PH	SH	Match	LM	HM	PH	SH	Match	LM	HM
Seat Height	V	34.89	46.66	-	-	100%	35.11	46.36	-	-	100%
	VI	35.50	45.10	-	-	100%	36.44	45.94	-	-	100%
	VII	37.05	46.23	2%	-	98%	37.40	46.91	-	-	100%
	VIII	38.47	46.41	-	-	100%	38.43	44.80	3.08%	-	96.92%
	IX	39.42	46.66	4%	-	96%	39.89	45.21	7.69%	-	92.30%
	X	39.46	46.24	10.53%	-	89.47%	39.99	45.80	11.90%	-	88.01%
	Class	BPL	SD	Match	LM	HM	BPL	SD	Match	LM	HM
Seat Depth	V	39.83	22.94	-	100%	-	39.37	23.18	-	100%	-
	VI	43.36	22.76	-	100%	-	42.04	23.52	-	100%	-
	VII	44.58	24.58	-	100%	-	45.44	23.99	-	100%	-
	VIII	47.48	24.64	-	100%	-	48.99	24.28	-	100%	-
	IX	46.79	24.26	-	100%	-	49.53	23.67	-	100%	-
	X	47.88	24.17	-	100%	-	46.11	23.91	-	100%	-
	Class	HB	SW	Match	LM	HM	HB	SW	Match	LM	HM
Seat Width	V	22.49	36.41	1.85%	-	98.14%	21.94	36.32	1.23%	-	98.76%
	VI	22.93	36.23	1.78%	-	98.21%	23.26	36.12	2.35%	-	97.64%
	VII	24.86	36.39	14%	-	86%	24.39	36.51	12.94%	-	87.05-%
	VIII	24.21	36.47	3.84%	-	96.15%	25.15	36.22	10.76%	-	89.23%
	IX	26	36.06	16%	-	84%	26.04	36.35	9.61%	-	90.38%
	X	26.82	36.65	23.68%	-	76.31%	26.60	36.46	37.14%	-	62.85%
	Class	TTH	SDC	Match	LM	HM	TTH	SDC	Match	LM	HM
Seat to desk clearance	V	10.01	16.11	87.04%	-	12.96%	10.19	14.83	91.36%	-	8.64%
	VI	9.23	16.95	100%	-	-	10.41	18.32	98.82%	-	1.18%
	VII	11.30	16.84	96%	-	4%	11.14	18.06	98.82%	-	1.18%
	VIII	11.37	17.29	90.38%	-	9.62%	11.53	18.84	95.38%	-	4.62%
	IX	11.02	16.04	86%		14%	11.14	18.78	100%	-	-
	X	11.24	18.75	100%	-	-	11.4	18.06	100%	-	-
	Class	SEH	SDH	Match	LM	HM	SEH	SDH	Match	LM	HM
Seat to desk height	V	16.86	23.08	22.22%	-	77.78%	16.15	24.20	23.46%	-	76.54%
	VI	15.87	24.78	10.71%	-	89.29%	16.91	27.23	1.18%	-	98.82%
	VII	17.04	22.42	52%	-	48%	17.80	26.58	14.12%	-	85.88%
	VIII	19.30	24.56	55.77%	-	44.23%	19.53	23.28	67.74%	-	37.10%
	IX	18.39	24.40	36%	-	64%	18.64	25.11	23.08%	-	76.92%
	X	19.05	26.16	13.16%		86.84%	19.51	22.22	71.43%	-	28.57%

PH=Popliteal Height, BPL=Buttock-Popliteal Length, HB=Hip Breadth, TTC=Thigh Thickness Height, SEH=Sitting Elbow Height.
SH=Seat Height, SD=Seat Depth, SW=Seat Width, SDC=Seat to Desk Clearance, SDH=Seat to Desk Height, LM=Lower Mismatch, HM=Higher Mismatch

Most of the students in class V showed 100% higher mismatch in Madrasah and general schools because the seat height was too high (high mismatch). In class VI there was also 100% higher mismatch in both Madrasah and general schools. In class VII, the seat height was appropriate for popliteal height in case of only 2% of the girl students of Madrasah and remaining 98% of the students had higher mismatch and there was 100% higher mismatch in case of general school. In class VIII the levels of mismatch (higher) were 100% and 96.92% in Madrasah and in general school respectively. In case of Class X the match percentage was 10.53% and 11.90% in Madrasah and in general school respectively.

Thus the results indicated that the extent of match percentage was increased gradually with the enhancement of the age of the students. It appeared that the growth of the student reduced the extent of mismatch between furniture dimension and the body measure, as the seat height was constant.

Seat Height, which is the starting point for the design of classroom furniture and also the measure used for prescription of a set size (Garcia-Acosta and Lange-Morales, 2007; Molenbroek et al., 2003). In the case of the high mismatch most of the students will not be able to support their feet on the floor, generating increase tissue pressure on the posterior surface of the knee (Garcia-Molina et al., 1992; Gutierrez and Morgado, 2001; Milanese and Grimmer, 2004).

This result, regarding too high of a seat height or a high mismatch, is very similar to the studies with Hong Kong school children, aged 10-13, in which too high chairs were found, with a mismatch ranging from 93 to 100%, depending on the different analyzed chairs (Chung and Wong, 2007). Similar studies were also carried out with Dutch students between 4 and 12 years of age, with 60% of the students using seats that were too high (Molenbroek et al., 2003), with Greek students, aged 6 to 18 years old, with 71.5% of high mismatch. On the other hand, low mismatch or a low seat showed the same result as the study of Gouvali and Boudolos (2006), with 1%. American children aged 6 to 12, with 81 to 91% in the same situation (Parcells et al., 1999).

The seat depth of the existed classroom furniture was lower than that of the buttock-popliteal length. So there was 100% lower mismatch for the girls of Madrasah and general schools in class V to X. Therefore, their thighs would not be supported enough and would generate discomfort (Pheasant, 2003).

In this case, and to avoid the compression on the posterior surface of the knee, the students will place their buttocks forward on the edge of the seat (Panagiotopoulou et al., 2004).

Regarding the width of the seat the results showed that there was 98.14% higher mismatch of the furniture in Madrasah and it was 98.76% in general school. It was noted that for only 1.85% of students in Madrasah and 1.23% students in general school the seat width was found to be matched with hip breadth of the subjects in class V. The match percentage was increased in higher classes (class IX and X). This might be due to growth of the hip with the advancement of the age of the children. The most of the girls of both type of schools showed higher mismatch between the furniture dimension and Hip breadth in all the classes. However, such higher mismatch would be beneficial for the students during sitting on the bench because they would get enough clearance while sitting. Accordingly, the schoolchildren were able to dissipate the pressure at the buttock (Gutierrez and Morgado, 2001) causing no mobility restrictions (Evans et al., 1988; Helander, 1997; Occhipinti et al., 1993; Orborne, 1996; Sanders and McCormick, 1993).

Seat to Desk Clearance (SDC) showed higher mismatch of 12.96% and 8.64% of the students of Madrasah and general schools respectively in class V. Such higher mismatch was also noted other classes. However, in all the classes higher percentage (86% to 100%) of match was observed in both Madrasah and general schools. Underneath should be enough so that there is space between the knees and the underneath surface of the desk (Dul and Weerdmeester, 1998; Helander, 1997; Sanders and McCormick, 1993). Parcells et al (1999) proposed that the desk clearance should be at least 2 cm, while other researchers have

proposed at least 5 cm of clearance. In the present study more than 5 cm clearances were found.

Seat to Desk Height were too high and showed higher mismatch (64% to 89% in Madrasah and 76.5% to 98.8% in general school) in most of the classes. However, the match percentage was very high in class VIII in both type of schools and also in class X in case of general school. Long distance between low benches and high benches might hamper the elbow rest. Many researchers have considered elbow rest height as the major criterion for desk height (Dul and Weerdmeester, 1998; Sanders and McCormick, 1993) based on the fact that there was a significant reduction in the load on the spine when arms can be supported on the desk. As a result of this, children were required to work with shoulder flexion and abduction or scapular elevation, causing more muscle work load, discomfort and pain in the shoulder region (Garcia- Molina et al., 1992; Szeto et al., 2002). The frequency of higher desks was, for Hong Kong school children aged 10–13, 61.2% of the students using large chairs and 99.1% for those using small chairs (Chung and Wong, 2007). Similarly, Gouvali and Boudolus (2006) have found that 78.8% of Greek students, aged 6 to 18, face the same problem. In the present study the problem of higher desk was prevalent in most of the classes. The students had to raise their shoulder during using the desk as elbow rest.

IV. CONCLUTION

The present study was focused on the evaluation of the school furniture of high Madrasah with a comparison to general high school. The furniture of the school was evaluated class wise (Class V to X). It was clear that mismatch level was notably high between existing school furniture and the anthropometric measures the girls' students in high Madrasah as well as in general school. It was revealed that the there were not much difference in the dimensions of school furniture between Madrasah and general high school. The mismatch pattern in different furniture dimensions was more or less the same in Madrasah and general girls' school. It can be concluded that class-rooms furniture was not appropriate for the studied student population. It may suggested that to take necessary steps to set design criteria of the school furniture for different classes separately considering the change of body dimension of the students due to growth.

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