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COMPATIBILITY OF HIGH SCHOOL DESK DIMENSIONS WITH ANTRHROPOMETRIC MEASUREMENTS

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ABSTRACT

The aim of this study was to examine whether school desk dimensions' match high school students' anthropometry. Anthropometric variables (shoulder, elbow, knee and popliteal height, buttock-popliteal length and hip breadth) were measured from randomly selected 328 students who attend public high schools in Mugla/Turkey and school desk dimensions which are in use in corresponding schools were measured to match with anthropometric data. The age range of the children was from 14 to 18 years. Mean, median, standard deviations, minimum values, maximum values, were analyzed statistically. The measured anthropometric dimensions of the students were also compared with those of the school desks in use. The results of the study showed that most of the anthropometric data of students differ significantly and there exists a high mismatch between anthropometric measurements and the school desk that they use.

Key words: furniture ergonomics, school desk, anthropometry.

INTRODUCTION

The education system in Turkey has been conducted based on 4+4+4 years since 2012. In this curriculum, compulsory education fulfills as 12 years except pre-primary education. The starting age for primary school begins from 60–66 months of age (5–5.5 years of age), and the duration of each tier; primary, secondary; high school is determined as four years (Gursoy et al 2013).

On average, students have spent 30 hours per week at school in Turkey (Cayci, 2018). And they spent considerable amount of those time as seated position on the school desk. Follon and Jameson (1996) reported that being seated for a long period of time on school furniture can be resulted as musculoskeletal discomfort and pain. Correct standing and sitting posture is an important factor for the prevention of musculoskeletal symptoms (Cranz, 2000). Thus, an ergonomic school desk has an important role to provide good sitting posture (Corlett, 2006; Murpy et al., 2004; Saarni et al., 2007)

Anthropometry is the most important factor that should be taken into account in school furniture design. Some of specific anthropometric sizes of students, such as popliteal height, knee height, buttock–popliteal length and elbow height are the basic measurements to determine school furniture dimensions that enable the correct sitting posture (Knight & Noyes, 1999; Parcells et al., 1999; Panagiotopoulou et al., 2004; Gouvali and Boudolos, 2005). Anthropometric measures can be varying between genders, different cultures, different age groups, even in the same age groups (Jeong & Park, 1990). In this manner, student's dimensions vary not only between the different classes, also within the same class. Therefore, the school desk would be able to be compatible with the majority of students. Some authors stated that the adjustability is needed on the school desk to accommodate the variation in anthropometric measures (Evans et al. 1988; Parcells et al., 1999)

There are many studies in the literature that reported mismatch between anthropometric characteristics of students and dimensions of school desk (Castellucci et al 2010; Gouvali and Boudolos, 2005; Molenbroek et al., 2003; Parcells et al., 1999). As a result of the mismatch, some physical and physiological discomfort such as low back pain and neck-shoulder pain (Grimmer & Williams, 2004) may occur and resulted as reduce quality of learning process (Hira, 1980).

The aim of this study was to investigate compatibility between high school students' anthropometry and school desk that currently in use.

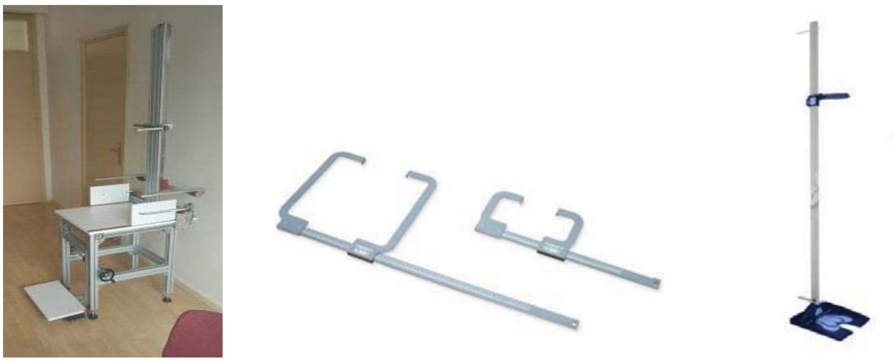
EXPERIMENTAL METHODS

Participants

A total of 328 volunteer students (163 males and 165 females) were selected randomly from two different high schools in province of Mugla/Turkey. The age range of children were between 14–18 years old. Essential permissions were obtained from related institutions. After giving written and verbal information about the study to school administrations and students, written parental permission was obtained from each students' parents who participate to the study.

Antropometric measurements

A special anthropometric chair (Fig. 1a) was developed to gather sitting anthropometric measurements. A group of 8 anthropometric variables were defined and measured according to ISO 7250-1 (2008) with using a specially designed anthropometric chair (Fig. 1a), anthropometer (Fig. 1b), and a stadiometer (Fig. 1c).



(a) (b) (c)

Figure 1: Instruments of anthropometric measurements

All measurements were done by two staff who are a male and a female. Male students were measured by male staff and female students were measured by female staff. Anthropometric measures were taken with thin clothes such as t-shirt and shorts, and without shoes. Data were recorded in centimeters. The anthropometric variables that gathered from the students were given following:

Stature (S): determined as the vertical distance between the floor and the top of the head, and measured with the subject erect and looking straight ahead.

Popliteal Height (PH): measured with 90° knee flexion, as the vertical distance from the floor or footrest and the posterior surface of the knee (popliteal surface).

Buttock-Popliteal Length (BPL): taken with a 90° angle knee flexion as the horizontal distance from the posterior surface of the buttock to the popliteal surface.

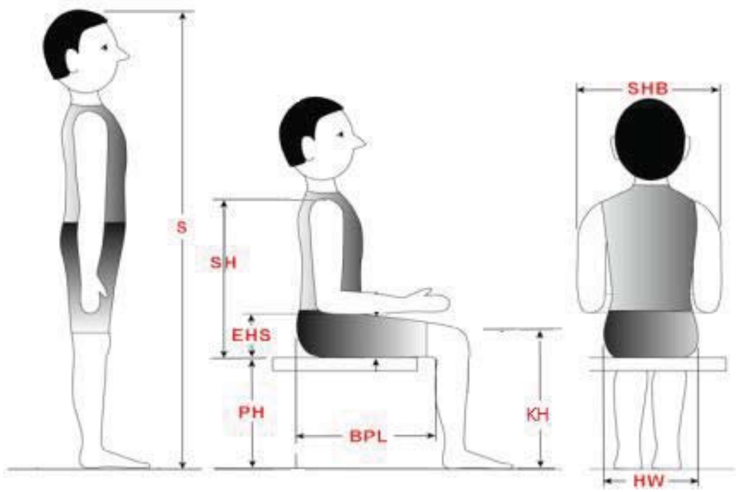
Hip Width (HW): the horizontal distance measured in the widest point of the hips in the sitting position.

Elbow Height Sitting (EHS): taken with a 90° angle elbow flexion, as the vertical distance from the bottom of the tip of the elbow (olecranon) to the subject's seated surface.

Shoulder Breadth (SHB): Maximum horizontal breadth across the shoulders, measured to the protrusions of the deltoid muscles.

Shoulder Height Sitting (SH): Vertical distance from the seat surface to the acromion.

Knee Height (KH): measured with 90° knee flexion, as the vertical distance from the floor or footrest and highest point of the superior border of patella.



(Source: Castelluci et. al., 2010)

Figure 2: Anthropometric variables

Furniture measurements

For the school desk measurements, one chair and desk style was identified as the dominant model in the classrooms (Fig. 3). Determined chair and desk dimensions were measured with a standard metal tape measure. All measured chairs and desks were multiuser type (Fig. 3). The following dimensions were gathered from the school desks:

Seat height (SH): was measured as the distance from the highest point on the front of the seat to the floor.

Seat depth (SD): was measured from the back of the sitting surface of the seat to its front.

Seat width (SW): was measured as horizontal distance between lateral edge of the seats.

Backrest height (BH): was measured from the floor to upper edge of backrest.

Desk height DH): was measured from the floor to the top of the front edge of the desk.

Desk clearance (DC): was measured from the floor to the bottom of the front edge of the shelf under the desk surface.

Figure 3: Multiuser type school desk

DATA ANALYSIS

All data were analyzed by using SPSS (v22.0), descriptive statistics (mean, median, standard deviation, minimum value and maximum value) were determined to describe the physical characteristics of the subjects.

Equations relating anthropometric dimensions and furniture dimensions

The match or mismatch levels between student's anthropometric measures and the furniture dimensions were calculated based on the equations adapted from Parcells et al. (1999) and Gouvali and Boudolos (2005). In order to identify relevance between body size and furniture dimension, anthropometric measurements of each student were compared to the school desk that he/she use. The equations that used in the study were given following:

Popliteal height and seat height mismatch:

A mismatch was defined by following equation (1). The equation define that seat height should be lower than popliteal height so that the lower leg constitutes a 5–30^0 angle relative to the vertical and the shin-thigh angle is between 95 and 120^0. A 2.5 cm correction for shoe height was added to popliteal height (EN 1729-1, 2015).

$$(P + 2{,}5) \cos 30^0 \leq SH \leq (P + 2{,}5) \cos 5^0 \quad \textbf{(1)}$$

Buttock–popliteal length and seat depth mismatch:

Parcells et al. (1999) and defined as mismatch the case when depth was ≤ 80% or ≥ 95% of popliteal-buttock length. Gouvali & Boudolos (2006) suggested a slightly laxer relation by the equation 2. The following equation (2) was used to define match level of buttock-popliteal length and seat depth compatibility.

$$0{:}80PB \leq SD \leq 0{:}99PB \quad \textbf{(2)}$$

Hip width and seat width mismatch:

Seat width should be enough to support ischial tuberosity in order to achieve stability and allow space for lateral movements, thus, it should be large enough to accommodate the users with the largest hip breadth. The following equation (3) proposes that seat width should be at least 10% and at the most 30% larger than hip breadth (for space economy):

$$1{:}1HW \leq SW \leq 1{:}3HW \quad \textbf{(3)}$$

Shoulder height and backrest height mismatch:

Backrest height should be below scapula to facilitate mobility of the trunk and arms. The equation (4) recommends keeping the backrest lower than the scapula, or at most on the upper edge of the scapula (60–80% of shoulder height):

$$((P + 2{,}5) \cos 30^0) + 0{:}6SH \leq B \leq ((P + 2{,}5) \cos 5^0) + 0{:}8SH \quad \textbf{(4)}$$

Sitting elbow height and desk height mismatch:

Desk height relatively consider with elbow rest height as the major design criterion. Parcells et al. (1999) suggested that desk height should be adjusted to elbow floor height, so that it would be minimum when shoulders are not flexed or abducted, and maximal when shoulders are at 25^0 flexion and 20^0 abductions (elbow rest height

0.8517+shoulder height 0.1483). The equation modified based on the fact that elbow-floor height is the sum of elbow rest height and seat height;

$$E + [(P + 2,5) \cos 30^0] \leq SH \leq ((P + 2,5) \cos 5^0] + (E0:8517) + (S0:1483) \quad \textbf{(5)}$$

Knee height and desk clearance mismatch:

Underneath desk height should be enough to allow free space between the knees and the underneath surface of the desk. The equation below (6) considered as appropriate the case that underneath desk height was at least 2 cm higher than knee height (but not higher than desk height plus its thickness 4 cm);

$$(K + 2) + 2 \leq UD \leq ((P + 2) \cos 5^0) + (E0:852) + (S0:148) - 4 \quad \textbf{(6)}$$

RESULT AND DISCUSSION

School furniture dimensions

The school desks used in this study are the standard multiusers type school furniture which provided to public high schools. The obtained dimensions of school chairs and desks from each classroom were given in Table 1.

Table1: Dimensions of the school furniture (dimensions in cm)

School	Grade	Dimension variables					
		Seat height	Seat depth	Seat width	Backrest height	Desk height	Desk clearance (shelf height)
School A	9th grade	47	29,5	110	76	76	60
	10th grade	47	29,5	110	76	76	60
	11th grade	47	29	110	76	76	58
	12th grade	47	29	110	76	76	58
School B	9th grade	46,5	30	120	78,5	76	63
	10th grade	47	30	120	77,5	76	63
	11th grade	47	30	120	77	76	63
	12th grade	47	30	120	75	76	63

The table shows that for each grade, almost similar dimensioned furniture was used in all classrooms within the same school.

Antropometric data of students

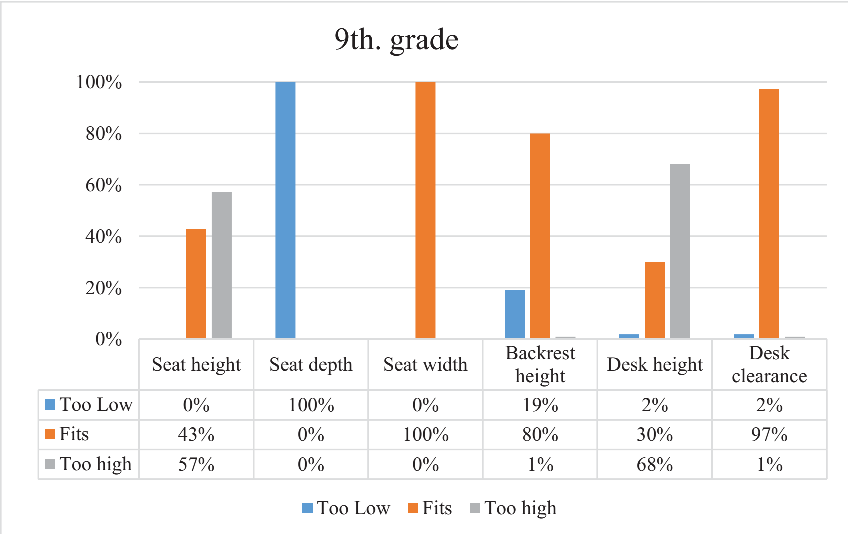
A summary of descriptive statistics of students' anthropometric data that obtained from two different school is presented in Table 2.

Table 2: Summary of student's anthropometric data (dimensions in cm)

Anthropometric variables	N	Minimum	Maximum	Median	Mean	Std. Deviation (±)
Height	328	147	192,5	166	166	9,02
Popliteal height	328	32,5	53,5	43,5	43,7	3,18
Buttock-Popliteal length	328	38	57,3	49,2	19,1	3,34
Hip width	328	30,5	55	37,7	38	3,52
Elbow height sitting	328	17,5	29,5	23,5	23,4	2,18
Shoulder breadth	328	32,7	50	41	41,1	2,86
Shoulder height sitting	328	24,5	69,5	56,7	56,6	3,94
Knee height sitting	328	42	62	51,3	51,5	2,98

Comparison of students' anthropometric data and school desk

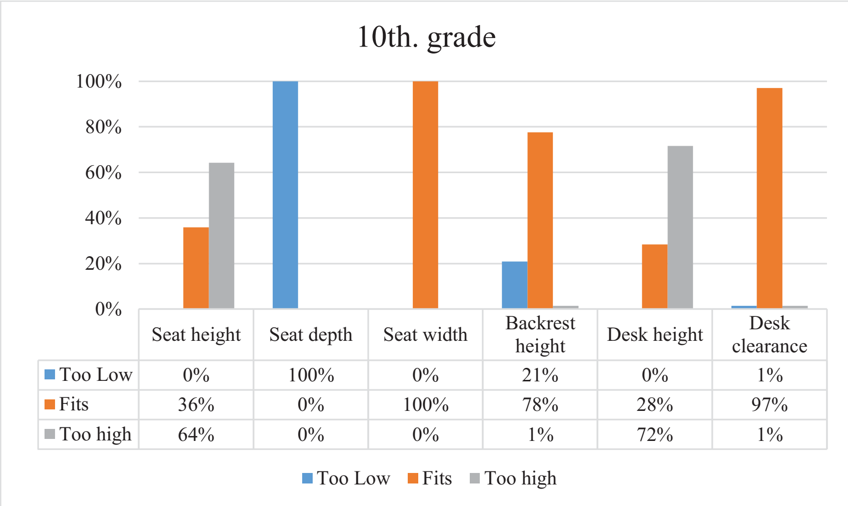
In each match criterion equation, minimum and maximum accepted limits were determined for each student according to their anthropometric measurements and the limits were compared with the school desk that he/she uses. Three categories were defined in case of two-way equations: "Fits" (match) level when the furniture dimension is between the accepted limits of the student, a "Too high" (high mismatch) level when the furniture dimension is higher than maximum accepted limit and a "Too low" (low mismatch) level when the furniture dimension is lower than minimum accepted limit. Match level of each criterion for 9th grade students were given in Fig. 4.



	Seat height	Seat depth	Seat width	Backrest height	Desk height	Desk clearance
Too Low	0%	100%	0%	19%	2%	2%
Fits	43%	0%	100%	80%	30%	97%
Too high	57%	0%	0%	1%	68%	1%

Figure 4: Result of match level for 9th grade

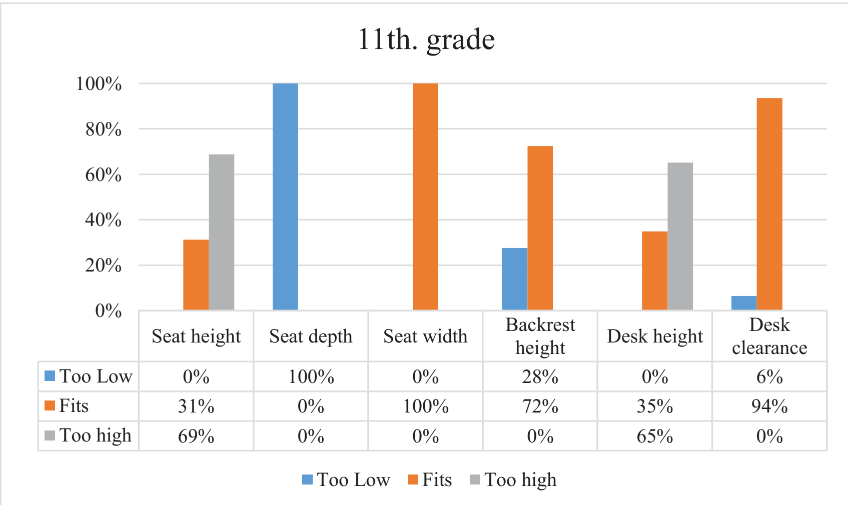
Fig. 4 shows that seat height and desk height are too high for the majority of the 9th grade students. Seat depth was mismatch for all students as too low. Seat width excepted fit for all students because of the measured chairs was multiusers type and was not possible to evaluate for independent use. Backrest height was evaluated as fit for 78% of the students while it was too low for 21%. Desk clearance was fit for almost all students. The results for 10th grade students were given in Fig. 5.



	Seat height	Seat depth	Seat width	Backrest height	Desk height	Desk clearance
Too Low	0%	100%	0%	21%	0%	1%
Fits	36%	0%	100%	78%	28%	97%
Too high	64%	0%	0%	1%	72%	1%

Figure 5: Result of match level for 10th grade

Seat height and desk height were too high for majority of 10th grade students. Seat depth was found too low for all the 10th grade students. Seat width excepted fit for all students because of the measured chairs was multiusers type and was not possible to evaluate for independent use. Backrest height was fit for 72%, too low for 28%. Desk clearance was also fit for almost all the students except it was too low for 6%. The results of match levels for 11th grade students were given in Fig. 6.



	Seat height	Seat depth	Seat width	Backrest height	Desk height	Desk clearance
Too Low	0%	100%	0%	28%	0%	6%
Fits	31%	0%	100%	72%	35%	94%
Too high	69%	0%	0%	0%	65%	0%

Figure 6: Result of match level for 11th grade

As it can be seen from the Fig. 6, seat height was fit for only 33% while it was too high for 64%. Seat depth was too low for 100% of the students. Seat width excepted fit for all students because of the measured chairs was multiusers type and was not possible to evaluate for independent use. Backrest height was found as fit for 60%, too low for 40%. Desk height was too high for 57% while fit for 43%. And desk clearance was fit for 90%, too low for 10%. The results of match levels for 12th grade students were given in Fig. 7.

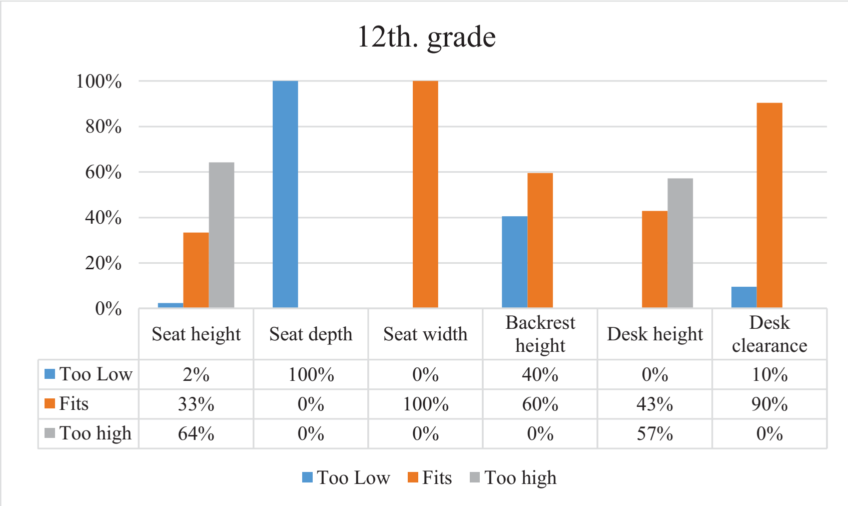


Figure 7: Result of match level for 12th grade

Fig. 7 shows that seat height was fit for only 33% of the students while it was too height for 64% and too low for 2%. Seat depth was too low all the students. Seat width excepted fit for all students because of the measured chairs was multiusers type and was not possible to evaluate for independent use. Backrest height was fit for 60% while too low for 40%. Desk height was satisfied only 43% of the 12th while it was too high for the remain. Desk clearance was fit for 10% and too low for 10%. A summary of the match level results of all grades together were given in Fig. 8.

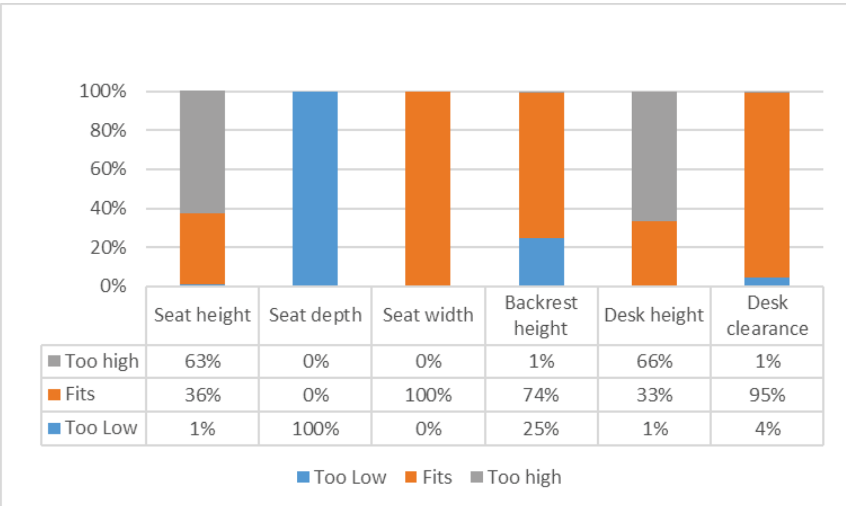


Figure 8: Result of match level for all grades

As it can be seen from the Fig. 8, seat height was fit for only 36% of the students while it was too high for 63% and too low for 1%. This result means that majority of the students use higher seat in comparison with their body sizes. Seat height is accepted as starting point for design of classroom furniture (Garcia-Acosta & Lange-Morales, 2007; Molenbroek et al., 2003). In "Too high" case, students will not be able to support their feet from the floor and an increasing tissue pressure may occur on the posterior surface of the knee (Milanese & Grimmer, 2004). In this situation, vascular and neural structures will be effected negatively (Milanese and Grimmer, 2004).

Seat depth was too low for all the students in the four grade. In the case of too low, children's thighs would not be supported enough and would generate discomfort (Pheasant, 2003) and also blood circulation may be prohibited (Milanese and Grimmer, 2004). Seat width was acceptable for all students because the measured chairs were multiusers type and chairs dimension were enough for two persons. Thus, there was no possibility to evaluate for independent use. Backrest height was fit for 74% of students and too low for 25% and too high for 1%. In the case of too high, a compression would generate in the scapula and limited the arm mobility (Gutierrez & Morgado, 2001).

Desk height was too high for 66% of students, and fit for only 33%. The use of a higher desk would require to flex shoulders more than 25^0 and abduct more than 20^0 to be able to support elbows on the desk. This may cause more muscle work load, discomfort and pain in shoulder and scapula region (Garcia- Molina et al 1992; Szeto et al 2002). Desk clearance was acceptable for 95% of the students while it was too low for 4% and too high for 1%. The situation of mismatch is cause mobility constraint because of contact thigh with the desk or the shelf under the desk (Parcells et al 1999; Sanders & McCormick, 1993).

CONCLUSION

This study aimed to compare relation between anthropometric sizes of high school students in Mugla/Turkey and school desk dimensions which are in use. As a result of the study, it was expected to focus on the suitability of school furniture to the anthropometric characteristics of students using equations modified in accordance with principles proposed by the literature.

It can be concluded that seat depth, seat height and desk height of school desk have high mismatch levels which may result discomfort and pain on posterior surface of the knee and shoulder region. To design a school desk, it is need to have potential target population and utilize reliable equations that originate from experimental research. Thus, national anthropometric data is the most important factor for the design criterion to fulfill bodily expectations of students, comfort and consequently health and wellbeing.

As a result of this study, highlight the fact that classroom furniture should be acquired and selected with ergonomics concerns.

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REFERENCES

Castellucci, H. I., Arezes, P. M., Viviani, C. A. 2010. Mismatch between classroom furniture and anthropometric measures in Chilean schools. Applied Ergonomics, 41: 563–568.

Cayci, B. 2018. İlkokullardaki Ders Süresi ve Ders Saatlerinin Sınıf Öğretmeni Görüşlerine Göre Değerlendirilmesi, International Journal of Eurasian Education and Culture, 5, 117–131.

Chaffin, D., Anderson, G. 1991. Occupational Biomechanics. Wiley, New York.

CORLETT, E. N. 2006. Background to sitting at work: Researchbased requirements for the design of work seats. Ergonomics, 49, 1538–1546.

CRANZ, G. 2000. The Alexander Technique in the world of design: posture and the common chair. J. Bodywork Movement Ther. 4 (2), 90–98.

EVANS, W. A., COURTNEY, A. J., FOK, K. F. 1988. The design of school furniture of Hong Kong school children an anthropometric case study. Appl. Ergon. 19 (2), 122–134.

FALLON, E., AND JAMESON, C. 1996. An ergonomic assessment of the appropriateness of primary school furniture in Ireland. Advances in Applied Ergonomics. pp. 770–773. West Lafayette, USA.

GARCIA-ACOSTA, G., LANGE-MORALES, K. 2007. Definition of sizes for the design of school furniture for Bogota´ schools based on anthropometric criteria. Ergonomics 50, 1626–1642.

GOUVALI, M. K., AND BOUDOLOS, K. 2005. Match between school furniture dimensions and children's anthropometry. Applied Ergonomics, 37, 765–773.

GRIMMER, K., AND WILLIAMS, M. 2004. School furniture and the user population: an anthropometric perspective. Ergonomics, 47, 416–426.

GÜRSOY, E., KORKMAZ, S. Ç., DAMAR, A. E. 2013. Foreign language teaching within 4+4+4 education system in Turkey: Language teachers' voice. Egitim Arastirmalari-Eurasian, Journal of Educational Research, 53(A), 59–74.

GUTIERREZ, M., MORGADO, P. 2001. Guia de recomendaciones para el disen o del mobiliario escolar Chile. Ministerio de Educacio´n and UNESCO, Santiago de Chile.

HIRA, D. S. 1980. An ergonomic appraisal of educational desks. Ergonomics, 23, 213–221.

ISO 7250-1, 2008. Basic Human Body Measurements for Technological Design. International Organization for Standardization, Geneva, Switzerland.

JEONG, B. Y., PARK, K. S. 1990. Sex differences in anthropometry for school furniture design. Ergonomics 33, 1511–1521.

KNIGHT, G., NOYES, J. 1999. Children's behaviour and the design of school furniture. Ergonomics 42 (5), 747–760.

MILANESE, S., GRIMMER, K. 2004. School furniture and the user population: an anthropometric perspective. Ergonomics 47, 416–426.

MOLENBROEK, J. F. M., KROON-RAMAEKERS, Y. M. T., SNIJDERS, C. J. 2003. Revision of the design of a standard for the dimensions of school furniture. Ergonomics, 46, 681–694.

MURPHY, S., BUCKLE, P., STUBBS, D. 2004. Classroom posture and self-reported back and neck pain in school children. Applied Ergonomics, 35, 113–120.

PANAGIOTOPOULOU, G., CHRISTOULAS, K., PAPANICKOLAOU, A., AND MANDROUKAS, K. 2004. Classroom furniture dimensions and anthropometric measures in primary school. Applied Ergonomics, 35, 121–128.

PARCELLS, C., STOMMEL, M., AND HUBBARD, R. P. 1999. Mismatch of classroom furniture and student body dimensions: empirical findings and health implications. J. Adolesc. Health, 24(4), 265–273.

PHEASANT, S. 1991. Ergonomics, Work and Health. Macmillan, Hong Kong.

SAARNI, L., NYGARD, C., KAUKIAINEN, A., AND RIMPELA, A. 2007. Are the desks and chairs at school appropriate? Ergonomics, 50(10), 1561–1570.

SANDERS, M. S., MCCORMICK, E. J. 1993. Applied anthropometry, work-space design and seating. In: Human Factors in Engineering and Design, seventh ed. McGraw-Hill, Singapore.

SZETO, G., STRAKER, L., RAINE, S. 2002. A field comparison of neck and shoulder postures in symptomatic and asymptomatic office workers. Applied Ergonomics 33, 75–84.

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