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MISMATCH BETWEEN CLASSROOM FURNITURE AND STUDENT BODY DIMENSIONS: CASE OF IZMIR

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Keywords

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Anthropometry
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Mismatch

Abstract

The aim of the research is to determine the anthropometric measures of school children aged 12-13, who live in Izmir, Turkey, in order to propose anthropometrically appropriate school furniture (desk and chair), and to compare findings with the available classroom furniture produced according to Standards of Classroom Furniture, published by Republic of Turkey General Directorate of Primary Education to determine potential mismatches. A total twelve anthropometric data were collected by convenience sampling from 393 (207 male and 186 female) students. The data was analysed with the aid of the SPSS v13 software on a desktop computer. Descriptive statistics for each anthropometric dimension are given as mean, standard deviation and 5th and 95th percentile values for male and female in mm. The obtained anthropometric data used for calculating classroom furniture dimensions, sitting height, seat depth, seat width, backrest height and desk height. Mismatches were found when the findings were compared with the Standards of Classroom Furniture, published by Republic of Turkey General Directorate of Primary Education and the dimensions of primary school classroom furniture supplied by DMO.

SINIF MOBİLYALARI VE ÖĞRENCİ VÜCUT ÖLÇÜLERİ ARASINDAKİ UYUMUN ARAŞTIRILMASI: İZMİR ÖRNEĞİ

Anahtar Kelimeler

Ergonomi
Antropometri
Sınıf mobilyası
Endüstriyel tasarım
Uyum

Öz

Bu çalışmanın amacı İzmir ilinde okuyan 12-13 yaş arası öğrencilerin antropometrik verilerinin belirlenerek onlar için ergonomik uygunlukta okul sırası ve masası ölçülerinin saptanması ve standartları T.C. Milli Eğitim Bakanlığı'nca belirlenerek okulların kullanımına tahsis edilmiş olan sınıf mobilyalarının öğrenciler için uygun olup olmadığının tespit edilmesidir. Bu kapsamda 393 (207 erkek ve 186 kadın) öğrenciden 12 farklı antropometrik ölçü toplanmıştır. Toplanan ölçüler SPSS v13 yazılımı yardımıyla analiz edilmiş, her ölçü için ortalama, 5. ve 95. yüzdelikler olmak üzere betimsel istatistiki değerler elde edilmiştir. Elde edilen antropometrik veriler uygun oturma yüksekliği, oturma genişliği, oturma derinliği, sırtlık yüksekliği ve masa yüksekliği ölçülerinin hesaplanmasında kullanılmış ve mevcut sıra ve masa ölçüleriyle karşılaştırılmıştır. Karşılaştırma sonucu, T.C. Milli Eğitim Bakanlığı'nca belirlenmiş sınıf mobilyası ölçülerinin ve DMO tarafından tedarik edilen sınıf mobilyalarının İzmir ilinde okuyan öğrenciler için uygunluğunun tartışmalı olduğu sonucuna varılmıştır.

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1. Introduction

In 2019, according to Turkish Address Based Population Registration System, there are 12.699.343 primary schools children aged 5-14 (6 340 423 aged 10-14) in the country, which represent around 15.48% (7.73% for 10-14) of the whole population (82 003 882). This means, in every work day, 12.699.343 primary school students whose physical development is still ongoing, use school furniture and spend more than 5 hours of the school day in a sitting posture. In the light of these data, it can be inferred that school furniture's effects on posture cannot be underestimated.

According to several research, school-aged children have been suffering musculoskeletal pain, back pain, neck pain, leg pain, and shoulder pain because of bad sitting posture during school days (Babayiğit, 2017; Gierlach, 2002; Jayaratne, 2012; Koskelo et al., 2007; Murphy & Buckle, 2003; Parcells et al., 1999). Therefore, sitting in a correct posture is an important element of a healthy working practice as the correct posture helps to maintain the natural lumbar curve and correct position of the pelvis to keep the vertebrae in alignment and the overrated forces acting on the body, thence sitting in a correct position preclude pains and increase work performance. Despite all these research findings and a large number of users, there is still little interest in the appropriateness of school furniture. Especially in Turkey, there is a lack of research. Moreover, state schools in Turkey are forced to be furnished with the products of State Supply Office (DMO) and also, all schools are forced to be furnished according to Standards of Classroom Furniture, published by Republic Of Turkey General Directorate of Primary Education (2014), which may not appropriate for all students when the lack of research in Turkey would be taken into account.

Because the physical health of the students and correct sitting posture, which may affect the adulthood sitting habits, can be achieved through anthropometrically appropriate school furniture, the purpose of this research is to compare Izmir living primary school students' anthropometric measures with school furniture dimensions, that are available for them, in order to observe a potential mismatch, and propose anthropometrically appropriate school furniture (desk and chair) dimensions, targeting school children, for obtaining a correct, painless sitting posture.

2. Literature Review

However, the research of anthropometrics and the design of school furniture is crucial, there is a few research conducted on school furniture in Turkey. We can group those research according to their purposes;

- Forming anthropometric data on Turkey living children
- Determining Turkey living children's growth standards
- Obtaining Turkey living children's anthropometric data for school furniture design usage
- Analysing appropriateness of school furniture to students
- Or a mix of these purposes

Example research of analysing appropriateness of school furniture to students are conducted by Erdogan, Erkoc & Sakar (2007), Uluuysal & Kurt (2011), Açık et al. (2014), In 2007, Erdogan and his colleagues investigated 24 primary school's computer laboratories located at Kadıköy/İstanbul, according to appropriateness of the ergonomic criteria in the schools by using US-OSHA Ergonomic Evaluation Checklist which is adapted to Turkish by the researchers. With the same purpose, in 2011, Uluuysal & Kurt evaluated the computer laboratories according to appropriateness of the ergonomic principles in the primary schools. US-OSHA Ergonomic Evaluation Checklist was used and 30 different elementary schools' computer laboratories were evaluated in Eskisehir. In 2014, Açık and his colleagues collected data from 140 primary school students, aged 8-14, in Ankara and found that the classroom furniture in use are not suitable for the majority of the students.

Although, all of the researches' aim is to form anthropometric data on Turkey living children; some of them have only this purpose, such as Kayış's research (1986). She took 15 measurements on 3584 pupils aged 6-13 who live in Ankara, to determine the anthropometric data. This research was later revised and turned into a database for designing classroom furniture by Kayış (1987) and Kayış and Özok (1991). They did not propose an example design nor design guidelines but, they conclude that different sized school furniture should be designed and used for each grade. Besides Kayış and Özok's research, there are only a few research on primary schools furniture in Turkey. One of them is Akın and Sağır's (1998) investigation on the anthropometric characteristics of 245 Van living primary schoolgirls aged between 9-10 years by taking measurements in 14 dimensions for designing school furniture. But they did not apply those anthropometric data to a design. In 2006, Burdurlu and his colleagues examined the anthropometric characteristics of a total of 668 Turkish students between 12-15 years attending primary schools in Ankara/Turkey. In 2010, Usan investigated primary schools desks and chairs according to the appropriateness of the ergonomic criterions in the primary schools. In this

research, anthropometric measurements of 1079 primary schools students in Çukurova region were collected and school furniture was designed according to these measurements.

Internationally, mismatch research is predominant in the context of school furniture and anthropometrics. Parcells et al. (1999) showed that fewer than 20% of students can find bodily appropriate school furniture and girls are less likely to use fitting chairs. Panagiotopoulou et al. (2003) concluded that "the chairs are too high and too deep and desks are also too high for the pupils. This situation has negative effects on the sitting posture of the children especially when reading and writing. Gouvali and Boudolos (2006) found that desks were mismatched 81.8% and seat height was mismatched 71.5% of children, while seat depth was appropriate for only 38.7% of children. In 2010, Catellucci and his colleagues carried a research on appropriateness of classroom furniture to the students in three schools and found that there were mismatches between student's bodily dimensions and seat height (86% for school A, 72% for school B and 85% for School C), and seat depth (30% for school A, 24% for school B and 39% for School C). Agha (2010) indicated that seat height, seat depth and desk height mismatches occurred for 99% of the students. Ramadan (2011) checked the anthropometric match for four adjustable desk-chair sets' combinations, and found that there were mismatches between students and seat heights and desk heights. Afzan et al. (2012) showed that the school furniture in Mersing, Johor, Malaysia do not match with students. The mismatches for aged 8 were 100% for seat height and seat depth, 44% for desk and backrest height; for aged 11 were 79% for seat height, 100% for seat depth and desk height, and 91% for backrest height. Dianat et al. (2013) found that body dimensions of the students do not match with school furniture; 60.9% for seat height, 54.7% for seat width, and 51.7% desktop height. In 2014, Rosyidi and his colleagues analysed the match between school furniture and the students' anthropometric data by sampling from six regions in Indonesia. They found there were mismatches with seat height (94,64%), seat depth (63,17%), backrest height (37,76%) and desk height (95, 57%). Macedo et al. (2015) compared the anthropometric data of 7th through 12th grades students live in Portugal with the school furniture available to them, and found that only 24% to 44% of the students match with the available tables and 4% to 9% of the students match with the available seats. In the research Castellucci and his colleagues carried in 2015, it is found that seat height was not appropriate for 18% of the students, seat depth was not appropriate for 43,2% of the students, and desk height was not appropriate for 83% of the students. Parvez et al. (2018) showed that seat height, seat depth, seat width, and desk height do not fit to the almost all of the Bangladeshi students. Wutthisrisatienkul and Puttapanom assessed mismatches between northern Thailand living students and school furniture, and showed that TISI Size 6 type of furniture's seat height is too high for all students.

This research is differentiate from these previous works by two main reasons, first and foremost this research was conducted in Izmir and fill the gap in the anthropometric data of 12-13 years school children, where the gap between sitting height difference at its higher in adolescence since "the rapid growth of the lower extremities is characteristic of the early part of the adolescent spurt" (Malina et al., 2004, pp.67-68), who live in Izmir; secondly the results compared with forced classroom dimensions by Republic Of Turkey General Directorate of Primary Education to determine compatibility.

3. Methodology

Anthropometric measurements were collected by convenience sampling from 393 (207 male and 186 female) students, aged from 12 to 13 years old, are going to three different primary schools; Cemil Midilli İÖO, Rıza Özmenoğlu İÖO and Ali Erentürk İÖO in Izmir, Turkey; in 2011-2012 academic year. After ethical permissions were granted from Republic of Turkey Governorship of Izmir and Republic Of Turkey Ministry Of National Education's Izmir Headquarter, 700 receipts of permission were sent to student's parents randomly. 393 positive, 106 negative answers were received. 201 receipts of permission were never returned back.

Sample size was determined according to principles of sample statistics (Fisher and Yates, 1974; Altman et al., 1991) and calculated by an online program, Raosoft®. According to the 2011 results of Republic of Turkey Ministry of National Education's Izmir Headquarter, total number of 12-13 years primary school student population was 105,253; with 95% confidence interval and 5% error, the research's sample size is sufficed.

An adequate description of the human body may require over 300 dimensions (Pheasant, 1986), but the scope of this research is limited on sitting, thus, twelve body dimensions (see Figure 1.) was collected by the first author with the help of one assigned student. The assigned student noted the collected measurements on a sheet designed for the research. Once the particular dimension was measured, the assigned student presented it to the first author for inspection. During the measurement, subjects were

required to wear only shorts and a t-shirt. Thus, the data were collected during gym classes. All anthropometric measurements were taken three times in order to achieve accuracy while the student was sitting on a straight surfaced adjustable stool with knees bent at 90-degree angle and erect position, by Holtain Anthropometer.

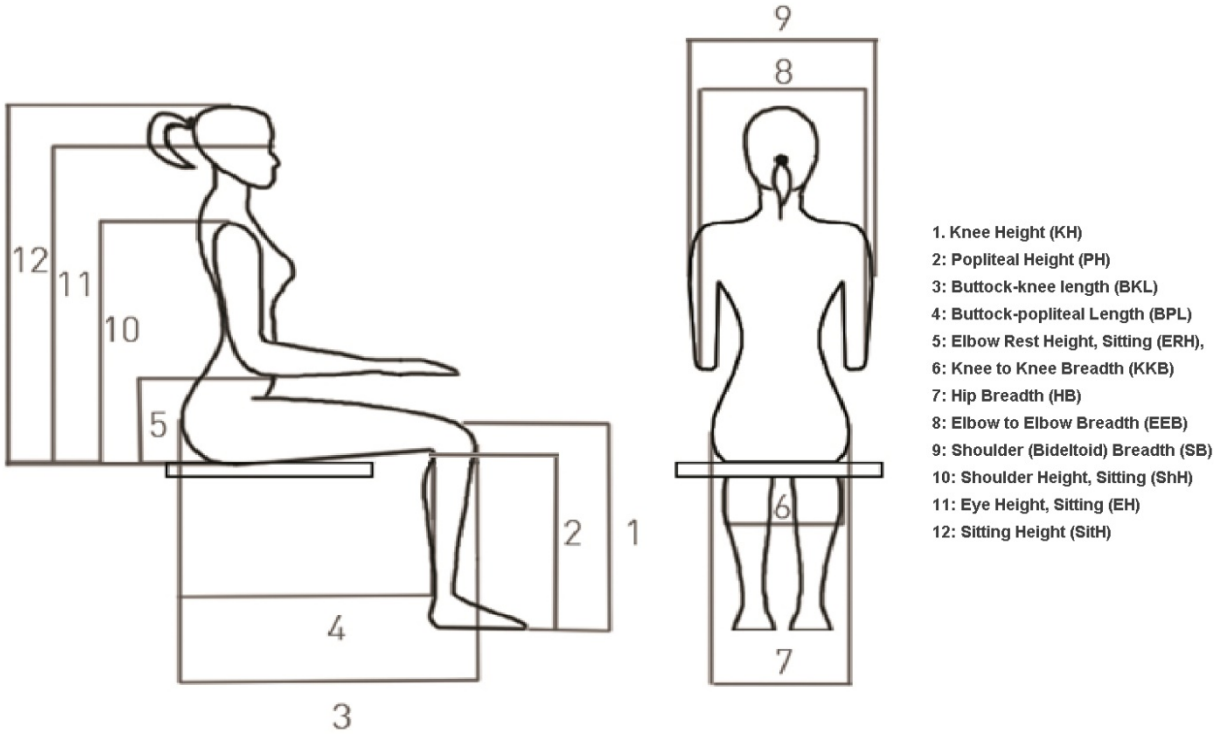

Figure 1. Anthropometric Dimensions

Measurements of the classroom furniture, supplied by DMO, were obtained from the technical sheets which were published at DMO's official webpage. Standards of classroom furniture dimensions, published by Republic of Turkey General Directorate of Primary Education, were also obtained from the official webpage.

The anthropometric data was analysed and summarized with the aid of the SPSS v13 software on a desktop computer. Descriptive statistics for each anthropometric dimension were given as mean, standard deviation and 5th and 95th percentile values for male and female in mm. According to those values, seat height (SH), Seat depth (SD), Seat width (SW), Backrest height (BH) and Desk height (D) were calculated.

3.1. Application and Interpretation of Data

After the anthropometric data was analysed and summarized (Table 1), obtained anthropometric dimensions applied to formulas in order to calculate anthropometrically appropriate classroom furniture dimensions for 12 and 13 years Izmir living students. Calculated classroom furniture dimensions, later, were compared with the measurements of the classroom furniture, supplied by DMO and Standards of Classroom Furniture Dimensions, published by Republic of Turkey General Directorate of Primary Education in order to determine whether there is a mismatch or not.

Table 1. Anthropometric Data of Students (all dimensions are in mm)

		12 years		13 years		12 and 13 years	
		Girls	Boys	Girls	Boys	Girls	Boys
Popliteal Height	Mean	406.45	418.26	416.84	430.75 mm	412.25	425.26

	SD		2.73	1.77	1.69	2.33	1.67	1.67
	Minimum		368.00	371.00	388.00	377.00	368.00	371.00
	Maximum		464.00	458.00	502.00	487.00	502.00	487.00
	Percentile	5	370.00	390.50	391.85	394.35	379.85	392.90
		95	443.65	449.00	445.30	474.55	444.15	461.30
Buttock-popliteal Length	Mean		439.43	434.72	458.77	455.22	450.24	446.21
	SD		3.35	3.63	3.13	3.50	2.43	2.65
	Minimum		378.00	378.00	407.00	396.00	378.00	378.00
	Maximum		501.00	510.00	573.00	580.00	573.00	580.00
	Percentile	5	402.15	388.50	419.00	407.25	408.70	396.00
		95	487.85	490.00	492.45	517.05	492.00	504.20
Hip Breadth	Mean		335.06	336.27	353.18	340.90	345.19	338.87
	SD		4.64	5.67	3.18	3.77	2.81	3.26
	Minimum		265.00	227.00	301.00	268.00	265.00	227.00
	Maximum		460.00	559.00	433.00	440.00	460.00	559.00
	Percentile	5	289.05	275.50	310.40	290.90	294.85	279.90
		95	410.35	400.50	403.00	410.75	403.00	407.10
Shoulder Height	Mean		326.90	327.68	339.31	343.79	333.83	336.71
	SD		2.17	2.56	1.84	2.46	1.50	1.88
	Minimum		291.00	278.00	296.00	300.00	291.00	278.00
	Maximum		360.00	386.00	383.00	418.00	383.00	418.00
	Percentile	5	297.10	295.00	308.85	308.00	302.85	300.90
		95	356.85	360.50	363.00	381.00	359.00	374.70
Elbow-rest Height	Mean		185.50	172.56	203.78	182.38	196.75	178.07
	SD		3.67	3.44	3.12	2.90	2.84	2.24
	Minimum		132.00	114.00	143.00	125.00	132.00	114.00
	Maximum		255.00	328.00	273.00	262.00	389.00	328.00
	Percentile	5	135.45	137.50	162.35	134.25	146.70	136.80
		95	242.25	209.50	248.15	224.60	248.00	214.40

3.1.1. Seat Height (SH)

Seat height (SH) is directly related to Popliteal Height (PH). Research showed that SH must be lowest than PH (Molenbroek et al., 1996; Parcells et al., 1999). In order to calculate correct seat height, lowest 5th percentile of PH value should be considered as delimiter and shoe height should be added to PH for correction. The equation (1) was used by Gouvali & Boudolos (2006) for calculating the SH value ranges which was defined by researchers (Evans et al., 1988; Occhipinti et al., 1993; Sanders and McCormick, 1993):

$$(PH + Shoe\ Height)\cos 30° \leq SH \leq (PH + Shoe\ Height)\cos 5° \quad (1)$$

3.1.2. Seat Depth (SD)

According to researchers, in order to achieve reaching backrest without lumbar spine discomfort or popliteal surface compression, 5th percentile of Buttockpopliteal Length (BPL) should be accepted as maximum value for SD (Phesant, 1991; Helander,

1997, Sanders & McCormick, 1993; Molenbroek & Kroon-Ramaekers, 1996; Khalil et al, 1993). In the light of this information, the equation (Catellucci et al., 2014; 2016) (2):

$$0{,}80PL \leq SD \leq 0{,}95BPL \quad (2)$$

3.1.3. Seat Width (SW)

Seat width (SW) is directly related to hip breadth (HB). In order to secure of right sitting position, there should be enough space for hip, so, seat width should be at least equal to maximum value of HB. In order to ensure enough range for motions in addition securing right sitting position, SW value should be increased. According to Gouvali & Boudolos (2006), optimum SW should be between 10% and 30% larger than HP. So, the equation (3):

$$1.1HB \leq SW \leq 1.3HB \quad (3)$$

3.1.4. Backrest Height (BH)

According to researchers, in order to prevent movement restrictions of upper body and arms, backrest height should be lower than scapula (Oborne, 1996; Khalil et al., 1993). This means also, lowest 5th percentile of shoulder height (ShH) data should be targeted. If, BH will be calculated from shoulder height (ShH) data, according to Gouvali & Boudolos (2006) and Agha (2010) equation (5) should be:

$$0{,}6\ ShH \leq BH \leq 0{,}8\ ShH \quad (4)$$

3.1.5. Desk Height (DH)

The equation of desk height (DH) calculation is developed by Parcells et al. (1999), according to information about angles and positions of arms on table-top during work, which is provided by Chaffin and Anderson (1991). On the basis of this calculation method, elbow rest height (ERH) is not the only determiner of the desk height, but the flexion (θ = 25 °) and abduction (β = 20 °) of the shoulders, shoulder height (ShH), and the length of the upper arm (UA = ShH-ERH) should be also taken into consideration. To find desk height, seat height should be added to dimension between seat surface (also refers as seat height – SH) and table-top (SsTt):

$$DH = SH + SsTt \quad (5)$$
$$= SH + ERH + UA[(1 - cos\ \theta) + cos\ \theta\ (1 - cos\ \beta)]$$
$$= SH + ERH + (ShH - ERH)[(1 - 0{,}9063) + 0{,}9063(1 - 0{,}9397)]$$
$$= SH + 0{,}8517ERH + 0{,}1483\ ShH$$

Minimum DH is accepted equal to ERH (Parcells et al, 1999). In the light of this information, the equation (6):

$$SH + ERH \leq DH \leq SH + 0{,}8517ERH + 0{,}1483\ ShH \quad (6)$$

4. Results

4.1. Anthropometric Measures of the Students

In this research, with the intention of proposing an example design for anthropometrically appropriate classroom furniture, obtained body measures were applied to calculations. The results were given in Table 2:

Table 2. Calculated Dimensions of Anthropometrically Appropriate Classroom Furniture

	12 years	13 years	Adjustable furniture dimensions for 12 to 13 years
Seat Height	338 to 389 mm	356 to 392 mm	338 to 392 mm
Seat Depth	310 to 369 mm	325 to 387 mm	310 to 387 mm
Seat Width	615 to 726 mm	484 to 572 mm	615 to 726 mm
Backrest Height	177 to 236 mm	184 to 246 mm	236 to 246 mm
Desk Height	543 to 564 mm	552 to 576 mm	543 to 576 mm

When the results of Seat Height (SH) values are compared, it can be seen that the maximum SH value for 12 years, 370 mm and for 13 years 392 mm. Thus, for an adjustable furniture for 12 to 13 years, the minimum and maximum values should be between 352 mm to 392 mm.

For Seat Depth (SD), the maximum SD value for 12 years 369 mm and for 13 years 387 mm. Thus, for an adjustable furniture for 12 to 13 years, the minimum and maximum values should be between 369 mm to 387 mm.

Since the Seat Width (SW) does not adjustable in production manner, in this research SW value is accepted as 726 mm.

For Backrest Height (BH), it can be seen that the maximum BH value for 12 years is 236 mm; maximum BH value for 13 years is 246 mm; and maximum BH value for both 12 and 13 years is 240,72 mm. Since backrest height should be lower than scapula, for designing shared classroom furniture for 12 and 13 years, BH should be designated as the lowest maximum value among results for 12 years, 13 years; and 12 and 13 years. When the results compared, it can be seen that the lowest maximum value of BH is 236 mm. Thus, for an adjustable furniture for 12 to 13 years, the minimum and maximum values should be between 236 mm to 246 mm.

When the Desk Height (DH) results compared, it can be seen that maximum DH value for 12 years is 564 mm, and for 13 years, it is 576 mm. The minimum DH value has found as 543 mm. So, for an adjustable furniture for 12 to 13 years, the minimum and maximum values should be between 543 mm to 576 mm. Yet, when the 95%ile of KH data for 12 years, 13 years; and 12 and 13 years are taken into consider, it can be seen that 576mm clearance is not high enough for setting storage of students' belongings under the desk. So, storage can be settled on the side surfaces of the desk.

4.2. Comparison of Proposed Adjustable School Furniture Dimensions with In-Use School Furniture Dimensions and the Mismatches

Republic of Turkey General Directorate of Primary Education's School Furniture Standards (2014) were given in Table 3 and Dimensions of Primary School classroom furniture supplied by DMO were given in Table 4.

Table 3. General Directorate of Primary Education Standards of Classroom Furniture Dimensions (in mm)

	For Primary School Usage
Seat Height	380 to 410
Seat Depth	340 to 370
Seat Width	330 to 360
	250
Backrest Height	
Desk Height	630 to 660

Table 4. Dimensions of Primary School Classroom Furniture Supplied by DMO (in mm)

For Primary School Usage	Type I (Conforming to General Directorate of Primary Education Standards)	Type II
Seat Height	380	420
Seat Depth	360	380
Seat Width	350	550
Backrest Height	250	280
Desk Height	630	700

Figure 2 and Figure 3 presents the percentage of students who fit or did not fit to the available classroom furniture to them supplied by DMO. Because of the Republic of Turkey General Directorate of Primary Education's School Furniture Standards are given in ranges, and remain in between the DMO's Type I and Type II classroom furniture, relatively, their mismatch percentages weren't given separately.

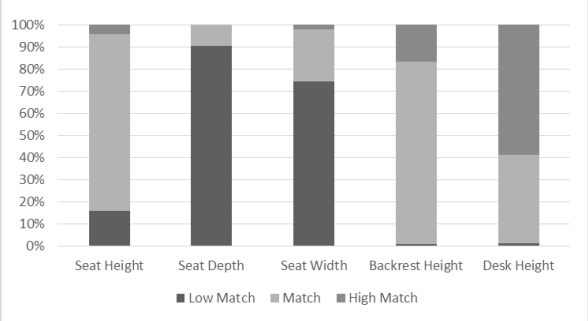

Figure 2. Mismatch Percentages for Type I Classroom Furniture

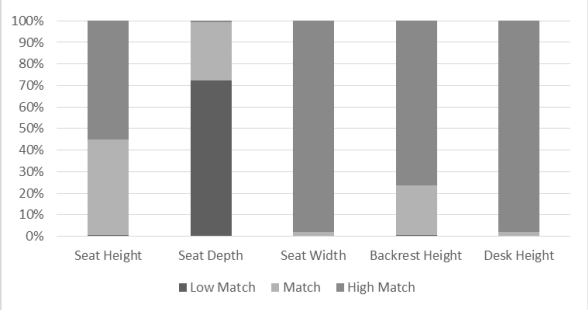

Figure 3. Mismatch Percentages for Type II Classroom Furniture

As presented in the Figure 2, seat height of Type I is too low for 16% and too high for %4 of the students. Seat depth is too deep for 91% of the students, and seat width is too narrow for 75% of the students. Backrest height is too low for 1% and too high for 17% of the students. It is found that Type I desk is too low for 1% of the students, and too high for 59% of the students.

As presented in the Figure 3, seat height of Type II is too low for 1% and too high for 55% of the students. Seat depth is too deep for 72% of the students. Backrest height is too low for 1% and too high for 76% of the students. It is found that Type II desk is too high for 98% of the students.

When the calculated dimensions of anthropometrically appropriate classroom furniture for Izmir living students were compared with the General Directorate of Primary Education Standards of classroom furniture dimensions and the classroom furniture can be supplied by the State Supply Office (DMO), it can be seen that only Seat Depth value is matching with General Directorate of Primary Education Standards and DMO's Type I classroom furniture. Rest of the values is either lower or higher for Izmir living primary school students which will cause bad sitting posture and consequently pain.

According to results, seat heights of available classroom furniture are higher than the proposed seat height of anthropometrically appropriate classroom furniture for Izmir living students. Parcells and her colleagues (1999) and Pheasant (1986) clearly indicate that when the seat is much higher, feet will not reach the floor and the front edge of the seat will press into the area just behind the knees, because of taking excessive weight on thighs, cutting off circulation to the legs and feet and it causes pain. To avoid this pain, students mostly shift forward and lose their contact with the backrest which gives lumbar support to them (Knight and Noyes, 1999) and face with back pain instead of leg pain.

The comparison clearly shows that available classroom furniture's seat widths are too narrow for Izmir living students. Narrower seats cause pain due to not allowing the user to perform lateral movements freely and not providing enough space to achieve postural stability (Dianet et al., 2013; Gouvali and Boudolos, 2006; Khalil et al., 1993; Sanders and McCormick, 1993)

According to researchers, to prevent movement restrictions of the upper body and arms, backrest height should be lower than scapula (Oborne, 1996; Khalil et al., 1993). When the results and available furniture's backrest values are compared, it can be seen that the values are higher than the proposed backrest height of anthropometrically appropriate classroom furniture for Izmir living students. Izmir living students may get hurt and have back pain while using the supplied furniture by DMO and furniture designed according to dimensions which are obligated by General Directorate of Primary Education.

When the proposed dimensions of anthropometrically appropriate classroom furniture for Izmir living students were compared with the General Directorate of Primary Education Standards and the classroom furniture can be supplied by the State Supply Office (DMO), it can be seen that there are mismatches between desk heights. According to results, Izmir living students' elbow-rest heights are much lower than the available desk heights. In such a case, students must raise their arms to proceed with their tasks and to achieve this posture shoulders must be raised or abducted that will cause overstressing the deeper posterior neck muscles, which will cause shoulder and neck pain eventually (Occhipinti et al, 1993; Parcells et al, 1999; Szeto et al., 2002).

5. Conclusion

Most of the readers of this article experienced the use of classroom furniture for several years and may remember how uncomfortable that furniture was, and unfortunately, most of the classroom furniture still is. As most of the researchers determined that the main reason for comfort lack is due to a mismatch between classroom furniture dimensions and students' anthropometry. Over and above, those mismatches cause several types of pains and unwanted permanent poor sitting posture habits. It is well known that anthropometrically appropriate classroom furniture could be designed by the help of collecting data from the actual users and applying findings to design. And also, by designing anthropometrically appropriate classroom furniture could prevent the pains and poor sitting habits. By using the recommended dimensions, to design anthropometrically appropriate and relatively comfortable classroom furniture for 12 and 13 years old Izmir living students is achievable.

Yet, the comparisons of the proposed dimensions calculated according to anthropometric data obtained in this research with General Directorate of Primary Education Standards of Classroom Furniture and classroom furniture are supplied by a governmental institution, the State Supply Office, showed that there is a substantial mismatched which may cause poor posture and pain on Izmir living students. Although the standardization of classroom furniture is a necessity for enabling a consistent base to reach safety and quality, when the nationwide variability of students' bodily dimensions is considered, setting sizes without proper research, could cause harmful outcomes. To avoid such an outcome, conducting nationwide anthropometric researches on classroom furniture to maintain children's bodily health is an eminent need. By this way, General Directorate of Primary Education could establish more reliable standards and State Supply Office could produce anthropometrically appropriate classroom furniture.

Although the sample size of this research is statistically generalizable, it should be noted that the obtained data is specifically pertaining to İzmir, Turkey, and should be used for designing classroom furniture that is only aimed for the regional market. Indeed, to propose a widely covered classroom furniture design guideline, further research should be conducted which incorporate anthropometric data from other age groups and different parts of Turkey.

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Conflict of Interest

No conflict of interest was declared by the authors.

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