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Impact of School Chair on Left-Handed Students

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ABSTRACT

Left-handed students find it challenging to do learning activities at school since the chair are made for those who are right-handed. They must change their posture, bending their neck and lower back, in order to reach the table that is located on the right side of the chair. Consequently, left-handed students may develop musculoskeletal disorders (MSDs) as a result of prolonged awkward posture in the classroom. This study sought to assess the effect of school chairs on the risk of MSDs in left-handed students. The possibility of reducing the discomfort by providing left-handed students with the appropriate chair was also examined. The Nordic Musculoskeletal Questionnaires (NMQ) was administered to a total of 14 left-handed students to identify their discomfort related to the chair they use in the classroom. The potential benefit of the proper chair was evaluated by measuring the deviation of the neck and low back from the upright sitting position. The finding of this study showed that a proper chair for left-handed students helps students sit straight without the need for bending their neck and low back. Modifying the chair to reduce the risk of MSDs is crucial, regardless of students' handedness.

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1. INTRODUCTION

Poor sitting posture could lead to an increased risk of health problems if it is done repeatedly. Various activities, such as the activities we perform at school and the office, require us to stay in a sitting position for a long duration. Awkward posture in a prolonged sitting may lead to musculoskeletal disorders (MSDs) such as low back pain (Allegri et al., 2016). A past study showed that six out of seven left-handed students experienced musculoskeletal pains (Nurwulan & Kristiani, 2020). A good ergonomic chair design may reduce the risk of musculoskeletal disorders that are often faced by left-handed students in the classroom (Kristiani & Nurwulan, 2020).

The fact that they are a minority in the population and public equipment is made for those who are right-handed, left-handed people have to deal with a number of challenges (Albers & Estill, 2007; Dianat et al., 2013; Nurwulan & Kristiani, 2020).

The left-handed population must become accustomed to utilizing numerous tools designed for right-handed from a young age. (Hira, 1980; Nurwulan & Kristiani, 2020). Students need to exert much more effort by shifting their postures even for something as easy as writing in class. The awkward postures caused left-handed students to have MSDs such as neck and back pains (Paul, 1994; Kristiani & Nurwulan, 2020).

The chair's arm table is on the right side of the chair, and it is designed for right-handed students making it a struggle for left-handed kids in school. For the left-handed students to be able to write, they must alter their bodies to reach the arm table on the right side of the chair. A lateral flexion of more than 25 degrees will cause pain in the spine (Todd & Vaccaro, 2016). If students hold this awkward posture for an extended period of time continuously, it will result in discomfort and pain in the afflicted body areas. This study aimed to observe and evaluate any potential impact that a school chair may have on left-handed students. We also considered the advantages of providing left-handed students with a suitable chair. Using proper school furniture may reduce MSD discomfort in left-handed students.

2. RESEARCH METHODOLOGY

A total of 14 left-handed university students with an age of 21.64 ± 1.67 years participated in the experiment. In an experimental study, a small number of subjects is acceptable as long as the effect is significant. Adding more subjects than needed is considered waste (Brysbaert, 2019). Before participating, each subject received a brief explanation and signed an informed consent form. To check for the presence of MSDs in the subjects, the Nordic musculoskeletal questionnaire (NMQ) was given to each subject (Dickinson et al., 1992). The duration of the session, the posture used when sitting in class, and the length of time spent sitting in class were just a few of the brief questionnaires that the students were required to complete.

The subjects were instructed to write for two minutes using a standard chair and a modified ambidextrous chair after completing the surveys. Since they had to perform a total of six writing tasks, we did not ask the subjects to write for a longer duration. It is assumed that the subjects were in their natural writing position within two minutes of duration. Asking the subjects to perform the task longer may increase their MSD discomfort.

For the writing tasks, the arm table was made moveable as part of the chair alteration so that it could be moved to either the right or left side of the chair. **Figure 1** shows the left-handed subject performing the writing task in both chairs. During the writing task, the behavior of the subjects while seated and writing on the arm table was observed. The neck and lower back deviation degree from the upright was measured using a goniometer.

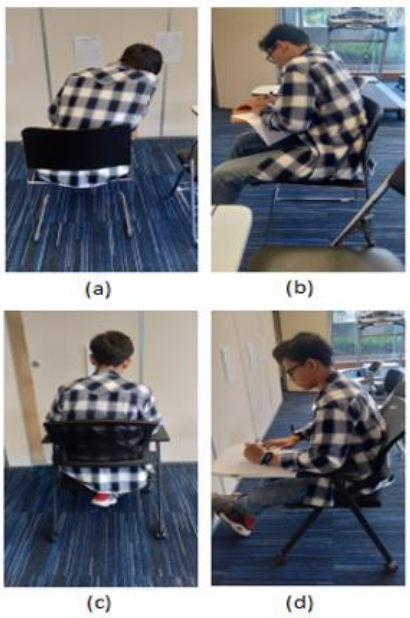

Figure 1. Left-handed students' posture when sitting and writing: (a) back view in a regular chair, (b) side view in a regular chair, (c) back view in a modified chair, (d) side view in a modified chair

Table 1. Nordic Musculoskeletal Questionnaires Summary S1 to S7

		Neck	Shoulders	Upper Back	Elbows	Wrists/hands	Lower back	Hips/thighs	Knees	Ankles/feet
S1	**Q1**	0	0	1	0	0	1	0	0	0
	Q2	0	0	0	0	0	1	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	0	0	1	0	0	0	0	0	0
S2	**Q1**	0	1	1	0	0	1	0	0	0
	Q2	0	0	0	0	0	0	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	1	0	0	0	1	0	0	0
S3	**Q1**	1	1	0	1	1	1	1	1	1
	Q2	1	1	0	0	1	1	1	0	0
	Q3	1	1	0	0	1	1	0	0	0
	Q4	1	1	0	1	1	0	0	0	0
S4	**Q1**	1	0	0	1	1	0	0	0	0
	Q2	0	0	0	0	0	0	0	0	0
	Q3	1	0	0	0	0	0	0	0	0
	Q4	0	0	0	0	0	0	0	0	0
S5	**Q1**	1	1	1	1	1	1	1	1	1
	Q2	0	0	0	0	0	0	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	1	1	1	1	1	1	1	1
S6	**Q1**	1	1	1	1	1	1	1	1	1
	Q2	1	0	1	0	0	0	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	0	1	0	0	1	0	0	0
S7	**Q1**	1	1	0	1	1	1	0	0	0
	Q2	0	0	0	0	0	1	0	0	0
	Q3	1	0	0	0	0	0	0	0	0
	Q4	1	0	1	0	0	1	0	0	0

Table 2. Nordic Musculoskeletal Questionnaires Summary for S8 to S14

		Neck	Shoulders	Upper Back	Elbows	Wrists/hands	Lower back	Hips/thighs	Knees	Ankles/feet
S8	**Q1**	1	1	0	1	1	0	1	0	0
	Q2	1	1	0	1	1	0	1	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	0	0	1	1	0	1	0	0
S9	**Q1**	0	0	0	0	0	1	0	0	0
	Q2	0	0	0	0	0	0	0	0	0
	Q3	0	0	0	0	0	1	0	0	0
	Q4	0	0	0	0	0	1	0	0	0
S10	**Q1**	1	1	1	0	1	1	1	0	0
	Q2	0	0	0	1	1	1	0	0	0
	Q3	1	1	1	1	1	1	1	1	1
	Q4	0	0	0	0	1	1	0	0	0
S11	**Q1**	0	1	1	1	0	0	0	1	0
	Q2	0	1	1	1	0	1	0	1	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	0	0	0	0	0	1	0	1	0
S12	**Q1**	1	1	1	0	1	1	0	0	0
	Q2	1	0	1	0	1	0	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	1	1	0	1	1	0	0	0
S13	**Q1**	1	1	1	1	1	1	1	0	0
	Q2	1	1	1	1	0	1	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	0	0	1	0	1	0	0	0	0
S14	**Q1**	1	0	1	0	0	0	0	0	0
	Q2	0	0	0	0	0	0	0	0	0
	Q3	0	0	0	0	0	0	0	0	0
	Q4	1	1	1	0	1	1	0	0	1

S: Subject

Q1: Have you at any time during the last 12 months has trouble (pain, discomfort, etc) in:

Q2: During the last 12 months have you been prevented from carrying out normal activities (job, housework, etc) because of this trouble in:

Q3: During the last 12 months have you seen a physician for this condition:

Q4: During the last 7 days have you had trouble in:

0: No

1: Yes

Table 3. Pearson's Correlation Results

Condition 1	Condition 2	Correlation	p-value
Knee pain in last 7 days	Prolonged sitting	-0.679	0.008
Neck pain in last 7 days	Poor sitting posture	0.603	0.022
Problem in performing daily activities due to neck pain	Class duration	0.664	0.01
Wrist pain in last 12 months	Class duration	0.592	0.026
Low back pain in last 12 months	Class duration	0.609	0.021
Wrist pain in last 7 days	Neck pain in last 12 months	0.632	0.015
Shoulder pain in last 7 days	Neck pain in last 7 days	0.645	0.013
Elbow pain in last 12 months	Problem in performing daily activities due to shoulder pain	0.548	0.043
Problem in performing daily activities due to elbow pain	Problem in performing daily activities due to shoulder pain	0.65	0.012
Problem in performing daily activities due to waist pain	Problem in performing daily activities due to shoulder pain	0.645	0.013
Problem in performing daily activities due waist pain	Seeing physician due to shoulder pain in last 12 months	0.679	0.008
Low back pain in last 7 days	Back pain in last 12 months	0.559	0.038
Wrist pain in last 12 months	Elbow pain in last 12 months	0.559	0.038
Problem in performing daily activities due waist pain	Elbow pain in last 7 days	0.782	0.001
Waist pain in last 7 days	Elbow pain in last 7 days	0.782	0.001
Wrist pain in last 7 days	Problem in performing daily activities due to wrist pain	0.632	0.015
Problem in performing daily activities due waist pain	Problem in performing daily activities due to wrist pain	0.645	0.013
Problem in performing daily activities due waist pain	Seeing physician due to wrist pain in last 12 months	0.679	0.008
Problem in performing daily activities due waist pain	Seeing physician due to low back pain in last 12 months	0.679	0.008

3. RESULT AND DISCUSSION

Because most of the everyday tools are made for the right-handed population, life is more challenging for the left-handed population. The school chair made for right-handed students must also be adjusted to fit left-handed students. The arm table's awkward location in the classroom, next to the chair, is one of the difficulties. When performing the writing assignment in class, the left-handed students are compelled to slant their bodies to the right in order to reach the table. From the start of class until the end, the left-handed students maintain this unnatural position. Their awkward seating position could lead to spinal disorders like kyphosis and scoliosis (Hosea et al., 1986; Nissenen et al., 1995; Milenkovic et al., 2004; Kristiani & Nurwulan, 2020).

Students who are left-handed also have the risk of MSDs in addition to spinal disorders (Whittfield et al., 2001; Murphy et al., 2003). The evaluation results of the prevalence of MSDs using the NMQ showed that the left-handed students reported aches in the neck, shoulder, wrist, low back, waist, knees, and ankles in the last seven days from the day of the participation. The summary of the NMQ is presented in **Table 1** and **Table 2**. The noteworthy findings from Pearson's correlation of the NMQ and habit in the classroom are displayed in **Table 3**. The table makes it clear that the left-handed student's classroom habits caused them to develop MSD symptoms. Longer class

sessions and hunched-over posture caused pain in the neck, wrists, and low back in some students. The knee problems were nonetheless alleviated by prolonged sitting. The results of the correlation analysis also revealed relationships between the various types of pain, such as the correlation between neck pain and shoulder and wrist pain.

An awkward sitting position in the classroom is strongly connected with neck pains. In addition, students reported low back and wrist pain in the past year, which is related to the number of hours spent in class each day. According to earlier research, prolonged awkward posture increases the risk of MSD symptoms. (Winkel et al., 1986; Naqvi, 1994; Sondergaard et al., 2010). Prolonged awkward body posture that is done continuously enhances the pain in the affected body parts (Trevelyan & Legg, 2006; Lis et al., 2007; O'Sullivan et al., 2012). When left untreated, the MSDs may result in unbalanced walking that could cause serious issues such as falls and accidents (Selamaj, 2020). The prevention of MSDs in left-handed students could be accomplished by altering posture while seated during writing chores by shifting the arm table to the left side of the chair (Kristiani & Nurwulan, 2020).

The arm table was made portable as part of the chair modification. The arm table can be positioned on either the right or left side of the chair. Both right-handed and left-handed students can use the chair. The consideration of this portable arm table is due to the few numbers of left-handed students. Thus, it will be more economic for the school because a specific chair for left-handed students will not need to be made.

The improper chair, which was made for right-handed students, caused left-handed students to have MSDs, according to Pearson's correlation results. The paired t-test calculation was used to determine the extent of the impact of the appropriate chair. The paired t-test compares the differences in the subjects' neck and low back deviations from an upright sitting position between regular and modified chairs. This is to figure out which kind of chair is safest for left-handed students in terms of reducing the likelihood of MSDs occurring. The modified chair significantly reduced the neck deviation degree from 28.52±10.71 to 2.79±3.13 ($p<0.001$). Similarly, the low back deviation degree was also decreased from 38.55±8.91 to 7.33±4.87 ($p<0.001$). It is clear from the comparative analysis that utilizing a suitable chair might significantly lower the degrees of neck and low back deviation. Because they do not have to slant their bodies to the right in order to reach the arm table, students can sit in the classroom in comfort. A comparative analysis using the NMQ questionnaire between existing and modified chairs is not possible since it would need a longitudinal study of at least one year. In addition, the universities where left-handed students do their studies do not provide a chair to accommodate left-handedness.

4. CONCLUSION

It is possible to modify the chairs in the classroom to encourage students to write while seated properly. The symptoms of musculoskeletal disorders (MSDs), such as pain in the neck, shoulder, and low back, may be lessened by adopting the proper sitting posture. The study's findings strongly recommended the school upgrade the chairs in the classroom to lower the incidence of MSDs in left-handed students. This is critical since students' discomfort may affect both their academic performance and attendance at school. Making the arm table portable would be a straightforward adjustment to the chair that would make it possible for the chair to

be used by students regardless of their handedness.

In this study, we assessed how left-handed students were affected by inappropriate classroom chairs. However, we only examined how bad posture in the classroom affected MSD symptoms. We did not take into account additional MSD symptoms brought on by activities outside of the classroom. Although students spend most of their time in the classroom during the weekdays, they may have activities outside of the classroom that could negatively impact their posture and may cause MSD pains such as sports or bad posture at home due to sitting habits. Further studies should take into account the activities outside of the classroom to objectively analyze the impact of school furniture on students' health and wellness.

REFERENCES

Albers, J.T., & Estill, C.F. (2007). Simple solutions: ergonomics for construction workers. U.S. Department of Health and Human Services. DHHS (NIOSH) Publication No. 2007-122.

Allegri, M., Montella, S., Salici, F., Valente, A., Marchesini, M., Compagnone, C., et al. (2016). Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Res, 5*, F1000 Faculty Rev-1530.

Brysbaert, M. (2019). How many participants do we have to include in properly powered experiments? A tutorial of power analysis with reference tables. *Journal of Cognition, 2*(1), 16.

Dianat, I., Karimi, M.A., Hashemi, A.A., Bahrampour, S. (2013). Classroom chair and anthropometric characteristics of Iranian high school students: proposed dimensions based on anthropometric data. *Applied Ergonomics, 44*(1), 101-108.

Dickinson, C.E., Campion, K., Foster, A.F., Newman, S.J., O'Rourke, A.M., Tomas, P.G. (1992). Questionnaire development: an examination of the Nordic Musculoskeletal questionnaire. *Applied Ergonomics, 23*(3), 197-201.

Hira, D. S. (1980). An ergonomic appraisal of educational desks. *Ergonomics, 23*(3), 213–221.

Hosea, T.M., Simon, S.R., Delatizky, J., Wong, M.A., Hsieh, C.C. 1986. Myoelectric analysis of the paraspinal musculature in relation to automobile driving. *Spine (Phila Pa 1976), 11*, 928e36.

Kristiani, A.B., & Nurwulan, N.R. (2020). Furnitur sekolah dan kelainan muskuloskeletal pada siswa kidal. *KESMAS UWIGAMA, 6*(2), 128-134.

Lis, A., Black, K., Korn, H., Nordin, M. (2007). Association between sitting and occupational LBP. *European Spine Journal, 16*, 283e98.

Milenkovic, S.M., Kocijancic, R.I., Belojevic, G.A. 2004. Left handedness and spine deformities in early adolescence. *European Journal of Epidemiology, 19*, 969–972.

Murphy, S.D, Peter, B., David, S. (2003). Classroom posture and self-reported back and neck pain in schoolchildren. *Journal Applied Ergonomics, 35*(2), 113-120.

Naqvi, S.A. (1994). Study of forward sloping seats for VDT workstations. *Journal of Human Ergology, 23*, 41e49.

Nissinen, M., Heliovaara, M., Seitsamo, J., Poussa, M. (1995). Left handedness and risk of thoracic hyperkyphosis in prepubertal schoolchildren. *International Journal of Epidemiology, 24*, 1178–1181.

Nurwulan, N.R., & Kristiani, A.B. (2020). Potensi kelainan muskuloskeletal pada siswa kidal. *Jurnal Kesehatan Masyarakat Indonesia, 15*(2), 9-12.

O'Sullivan, K., O'Keeffe, M., O'Sullivan, L., O'Sullivan, P., Dankaerts, W. (2012). The effect of dynamic sitting on the prevention and management of low back pain and low back discomfort: a systematic review. *Ergonomics, 55*, 898e908.

Paul, D. Left-handed helpline. (1994). Manchester: Dextral Books.

Selamaj, G. (2020). Impacts of mobile phone distractions on walking performance. *Indonesian Journal of Computing, Engineering, and Design, 2*(1), 32-37.

Sondergaard, K.H., Olesen, C.G., Sondergaard, E.K., de Zee, M., Madeleine, P. (2010). The variability and complexity of sitting postural control are associated with discomfort. *Journal of Biomechanics, 43*, 1997e2001.

Todd, A. J., & Vaccaro, A.R. (2016). *Physical examination of the spine. Second Edition*. New York: Thieme Medical Publishers, Inc.

Trevelyan, & F. C., Legg, S.J. (2006). Back pain in school children—where to from here? *Applied Ergonomics, 37*(1), 45-54.

Whittfield J., Legg, S.J. Hedderley, D.I. (2001). The weight and use of schoolbags in New Zealand secondary schools. *Ergonomics, 44*(9), 819–824.

Winkel, J., Jorgensen, K. (1986). Evaluation of foot swelling and lower-limb temperatures in relation to leg activity during long-term seated office work. *Ergonomics, 29*, 313e328.