

Ergonomics Analysis of Computer Use in Distance Learning during the Pandemic of COVID-19

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ABSTRACT

One impact of the COVID-19 pandemic on education is the mandated learning from home or distance learning (DL) in both state and private education institutions to prevent the transmission of COVID-19. DL may require long periods of time in front of a computer screen, which can create ergonomic issues such as eye, shoulder or neck problems, low back pain, and fatigue or stress. This study was structured to look at the ergonomic behavior of students in the statistics department at Padjadjaran University. The data were gathered using questionnaire, and there were 146 respondents who were willing to answer and send back the questionnaire. The results of the analysis show that the majority of students do not have knowledge about ergonomics when using computers. However, students agree that wrong posture can affect health conditions, especially those related to musculoskeletal disorders. The real impact felt by students is the health condition around their neck, shoulders, waist, bottoms, and wrists.

Keywords: *Ergonomic, Computer used, Distance Learning, Musculoskeletal disorders.*

1. INTRODUCTION

The COVID-19 pandemic has had an influence on education, with all government and private educational institutions deciding to conduct learning and work activities from home, often known as the "distance learning" (DL) system, in order to prevent the transmission of the virus (**Herliandry & Suban, 2020**). When the government enacted a large-scale social limitation, the Ministry of Education and Culture (**Kemendikbud**) adopted the DL system. According to government statistics, the total number of students enrolled in public and private universities is more than 8 million (**Kemenristekdikti, 2019**). This number is also an estimation how many students participate in DL .

Since March 2020, students at Universitas Padjadjaran have been required to do DL as part of the government's strategy. Supporting facilities in the form of laptops, computers, tablets, or other gadgets that will boost performance during PJJ are required for preparation. Implementing DL with these facilities will necessitate a study area or a workplace with varied ergonomics for each individual. The difference in ergonomics level can be evident in the

body posture when using the computer **(Widianawati, Khorioni, Nugroho, & Wulan, 2020)**.

Ergonomics by definition from the Indonesian Language Dictionary (KBBI) is a harmony between workers, types of work, and the environment of the work being carried out **(KBBI, 2021)**. Ergonomic workplaces require ergonomic seats to work effectively and comfortably. According to studies conducted in Indonesia, people who work in a sitting position for more than 4 hours each day have a two-fold increased risk of back discomfort compared to those who work for less than 4 hours **(Wulandari & Zaidah, 2019)**. In order to be comfortable when working, especially during DL, an ergonomic seating position is necessary to reduce the risk of back injury. Moreover in general, the purpose of implementing ergonomics is to improve safety, job satisfaction, and a person's quality of life **(Mayasari & Saftarina, 2016)**.

Musculoskeletal diseases (MSDs) are problems with the human body's musculoskeletal system. Interactions in the workplace can produce distractions. Since the burden of work is becoming greater, the frequency and duration of work is increasing, and the individual is being exposed to vibrations more frequently. Therefore, the individual's chance of acquiring MSDs is increasing. Knowledge of ergonomics and MSDs is closely related to working behavior when doing the DL and body posture when using a computer **(McCauley, 2012)**. Knowledge of ergonomics will change behavior of seating position in front of computer so that it can avoid or minimize the risk of musculoskeletal injury, since it can be prepared in advance to prevent the disease.

A study states that complaints of pain in the neck and itchy or sore eyes are caused by patients looking at the screen too low, which can be avoided if the screen is positioned slightly below eye level. Another study found that wrist pain in the form of carpal tunnel syndrome could be associated with prolonged mouse use. All these complaints can be avoided if working in an ideal position **(Wu, et al., 2020)**.

To account for these effects, many ergonomic guidelines have been developed. However, it is important to remember that students' views and circumstances differ when completing the DL. For example, the majority of the devices utilized and students' positions during online lectures are either sitting or lying on the couch. As a result, it's critical to understand students' behavior and circumstances ahead of time so that suitable suggestions can be made to reduce negative effects.

This research will be conducted with student respondents at the Department of Statistics, Universitas Padjadjaran, for the academic year 2019 to 2021. The choice of respondents is because Universitas Padjadjaran applies DL to all students from the beginning of college to the present. Furthermore, because the Statistics Department's theoretical and practical learning is primarily done on computers, students must be aware of ergonomic posture during DL in order to maximize comfort and avoid musculoskeletal problems (MSDs) such as muscle, bone, and joint disorders.

2. METHODOLOGY

A survey on body posture in using a computer during DL was carried out for one week online with the target of students of the Statistics Department academic year of 2019 to 2021. The questionnaire has measured the level of reliability and validity. The survey includes the characteristics of research subjects, characteristics in doing DL, knowledge of ergonomic body posture, ergonomic behavior applied by students so far, and complaints of MSDs pain

in the past year. All questions is available in Bahasa. The dummy table for this questionnaire design is given by Table 1. to Table 5. (has been translate in English), while the sample of the online questionnaire is provide in Figure 1.

Table 1. Characteristics of Research Subjects

Question Item	Response
Gender	M/F
NPM (determine the academic year)	Short answer
Age (Age calculated until 1 st November 2021)	
Height (in cm)	
Weight (in kg)	

Table 2. Characteristics in doing DL

Question Item	Response
1. Were you in a sitting position during college?	Yes/No
2. Duration of PJJ in a sitting position for 1 day (in hours)	Option 1-10
3. Frequency or Number of PJJs in days for 1 week (in days)	Option 1-7
4. Do you study using a desk?	Yes/No
5. Which type of device do you use in college?	More than one option (Laptop, Computer, Tablet, Device)
6. Besides the sitting position, which position did you apply when studying PJJ?	More than one option (Lay down, Stand up, Squat position, Sit on the ground, others)
7. Which type of seat do you use during PJJ?	Seat choice (with picture)
8. Do you have a history of musculoskeletal disorders?	Yes/No

Table 3. Musculoskeletal Disorders on one Last Year

The body part condition in the last 12 months at some time:	Response (in scale of 1 to 10)
Neck, Shoulder, Upper arm, Waist, Butt, Elbow, Forearm, Wrist, Palm, Thigh, Knee, Calf, Ankle, Sole,	<p style="text-align: center;">0 1 2 3 4 5 6 7 8 9 10</p> <p style="text-align: center;">Tidak Nyeri Sangat Nyeri</p>

The questionnaire was adapted to various literature studies. For musculoskeletal disorders, the question items were adjusted to the Nordic Body Map questionnaire but focused on posture while using the computer. The Nordic Body Map is a method that has been widely used by ergonomics experts to assess the severity of musculoskeletal disorders (MSD) and has high validity and reliability (Tarwaka, 2014). This method was first introduced by Kuorinka et al. (1987), which was later validated by Dickinson et al. (1992) and Chaffin and Anderson (1991) as written in Helander (Helander, 1995). Questionnaire The Nordic Body Map contains 28 items of human body segments to assess the level of physical complaints. However, since this research focused on the ergonomic in computer used, we reduce the question from 28 items to 14 items.

Table 4. Knowledge of Ergonomic Body Posture

Question Item	Response
1. Do you know the definition of ergonomics?	Yes/No
2. Do you know the purpose of ergonomics?	
3. Do you know how to apply ergonomics in the workplace?	
4. Do you agree that there will be risk factors for musculoskeletal disorders due to learning positions during Distance Learning (PJJ)?	
5. Do you know, what is the correct sitting position during PJJ?	
6. Do you know the proper position of the head, neck and back when sitting?	
7. Do you know how to properly position your arms and elbows when the PJJ is in a sitting position?	
8. Do you know how to properly position your hands and wrists when the PJJ is in a sitting position?	
9. Do you know how to properly position your knees and feet when the PJJ is in a sitting position?	
10. Do you know the position of your eyes on your computer/laptop during PJJ?	

Table 5. Ergonomic Behavior Applied So Far

Question Item	Response
1. I position my head and neck upright facing straight ahead and perpendicular to the floor.	Never/ Rarely/ Sometimes/ Often/ Always
2. I position my shoulders and upper arms perpendicular to the floor and relax.	
3. I use my fingers relaxed when typing.	
4. I position my hands and wrists straight and parallel to the floor at an angle of 0 degrees.	
5. I position my thighs parallel to the floor and supported by a chair.	
6. I position my knees at the same level as my hips and slightly forward legs.	
7. I position my lower leg perpendicular to the floor and rest flat on the floor or supported by a stable footrest.	
8. I use a chair with an adjustable height and back.	
9. I use a chair with a backrest that can support the lower body.	
10. I use a chair that has a cushion in the front and does not put pressure on the back of the knee and lower leg.	
11. The height of the keyboard that I use is stable and in line with my elbows and wrists.	
12. The keyboard that I use is placed in front of me at a distance that is neither too far nor too close so that the elbows remain close to the body.	
13. On my desk there is sufficient space for other devices such as a mouse.	
14. I do other activities on the sidelines of using computers/laptops/tablets/devices.	
15. During lectures I take a break once every 30-40 minutes (micro breaks).	
16. When I study using a computer/laptop/tablet/device, I take a break once every 1-2 hours (mini breaks).	
17. I stretch regularly when using a computer/laptop/tablet/device.	

Kuesioner Penelitian: Sikap Tubuh Ergonomis dalam Pembelajaran Jarak Jauh (PJJ)

Kuesioner Sikap Tubuh Ergonomis dalam Pembelajaran Jarak Jauh (PJJ)

anindya.apriliyanti@unpad.ac.id Switch account Draft saved

Kondisi Dasar PJJ

Mohon dijawab dengan data yang sebenar-benarnya

1. Apakah Anda saat kuliah berada dalam posisi duduk? *

Ya

Tidak

2. Durasi PJJ dalam posisi duduk selama 1 hari (dalam jam) *

1 2 3 4 5 6 7 8 9 10

7. Jenis kursi manakah yang Anda gunakan saat PJJ? *

Pilihlah jenis kursi paling mendekati yang digunakan Anda dalam PJJ.

A B C D E

Kondisi bagian tubuh saya dalam waktu 12 bulan terakhir pada sebagian waktu: *

Pengisian menggunakan skala nyeri 0 - 10. 0 = Tidak nyeri dan 10 = Sangat nyeri.

	0	1	2	3	4	5	6	7	8	9	10
Leher	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bahu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lengan Atas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Pinggang	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pantat	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Siku	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lengan Bawah	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pergelangan Tangan	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Telapak Tangan	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Paha	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lutut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Betis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1. Sample of The Online Questionnaire

In general, the flow of this research is described in Figure 2. A literature review on ergonomics attitudes is obtained from the ergonomics guide by the Indonesian Ergonomics Association (PEI). One of the authors in this study is a doctor who studies ergonomics, so that medical validity can be justified.

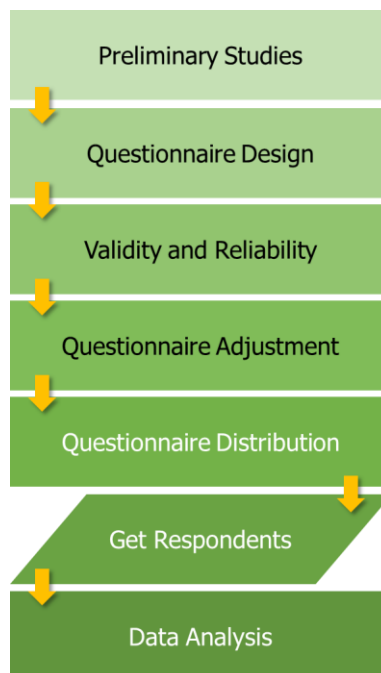


Figure 2. General Flow of the Research

3. RESULTS AND DISCUSSION

From the distribution of questionnaires obtained as many as 146 respondents. Discussion and analysis results from all respondents will be given according to the characteristics

measured in the questionnaire. The descriptive analysis is performed for describing the conditions of the respondents' answers.

3.1 Characteristics of Research Subjects

Table 6 show the demographics and student behavior of the Department of Statistics at the University of Padjadjaran while attending DL. From Table 3, it can be seen that the majority of respondents are female, which is 66.4%. This is rational because in the Department of Statistics, the majority of students are female. The proportions for each academic year can be said to be balanced, namely 32.87% for the 2021 batch, 38.35% for 2020, and 28.76% for 2019. The most respondents are 20 years old, but the distribution is normal from 17–21 years old. The minimum height is 142 cm and the maximum is 182 cm, with the majority being around 165 cm. The minimum student body weight is 37, and the maximum is 92, with the majority of body weight being around 50 kg. The height and weight conditions of students are quite diverse, but in general have ideal conditions.

Table 6. Descriptive of Respondents Characteristics

Variabel	Value		Variable	Atribut	Value	
Gender			Academic Year	2019	42	28.76%
Male	49	33.60%		2020	56	38.35%
Female	97	66.40%		2021	48	32.87%
Age			Height	min	142	
16	1	0.68%		max	182	
17	5	3.42%		median	160	
18	31	21.23%		mode	165	
19	20	13.70%	Weight	min	37	
20	49	33.56%		max	92	
21	39	26.03%		median	50	
22	2	1.37%		mode	53	

3.2 Characteristics in doing DL

The behavior of respondents when DL shows that 97.3% of respondents use a desk when studying. The majority of the devices used are laptops (145 respondents) and gadgets (84 respondents). 100 respondents chose to sit on a ground (lesehan) other than sitting on a chair, while the rest attended lectures by lying down as an alternative to sitting on a chair. This needs attention from teachers and students, considering that the lying position is not recommended when working on a laptop or device. The summary of this characteristic is shown in Table 7. The duration of DL is visualized in Figure 3. It is shown that students spend 5-6 hours to do online learning/ DL for about 5 days a week.

Table 7. Summary Characteristics of DL Behavior

Variable	Value		Variable	Value
Use Desk?			DL position beside sitting position	
Yes	142	97.30%	Lay down	53
No	4	2.70%	Stand Up	9
Device (in combination)			Squat	7
Laptop	145		Sit on a ground	100
Computer	11		Other	10
Tablet	8			
Devices	84			

The selection of seats in the DL activity is given in Table 8. The majority of seats used were type C seats (43.8%), followed by type D seats (32.2%). Almost half of the students use standard chairs that cannot be adjusted according to their height. However, 32.2%, or about 47 respondents, already have an ergonomic chair. Overall, the type of chair used already has lower and upper back cushions that can reduce back injuries.

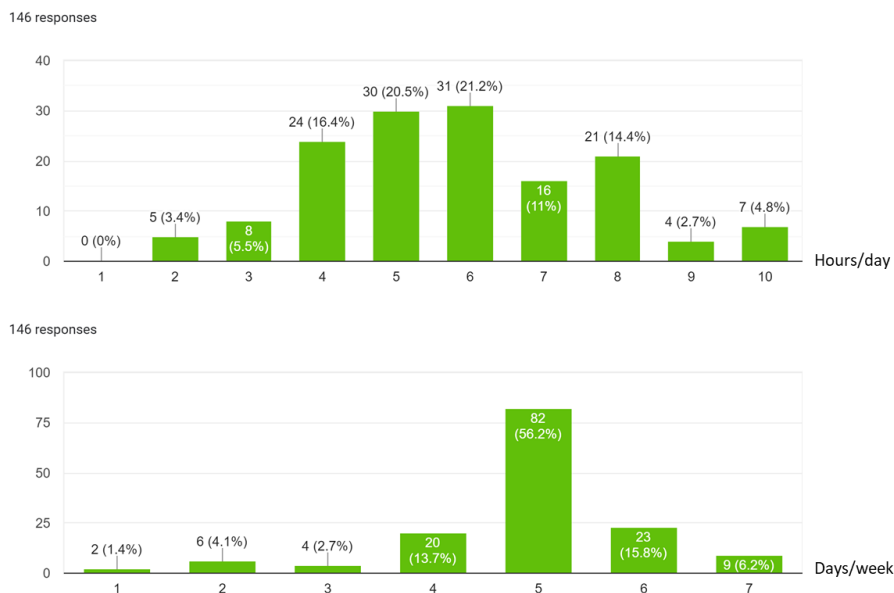


Figure 3. The Duration of Distance Learning

Table 8. The Selection of Seats in the DL Activity

				
11.6%	11%	43.8%	32.2%	1.4%

3.3 Musculoskeletal Disorders from one Last Year

For the majority of students who claim to have no history of MSDs, this DL activity greatly affects their health condition. From all affected body parts, it can be seen that non-ergonomic DL activities have a lot of influence on the condition of the neck, shoulders, waist, bottom, and wrists. For other parts of the body, the distribution of pain levels is skewed to the right, so that other parts of the body are less affected by the DL activity. Figure 4 shows the summary of musculoskeletal disorders.

3.4 Knowledge of Ergonomic Body Posture

Knowledge of ergonomic posture is shown in Table 9. From the Table 9, most of the respondents do not know the definition and purpose of ergonomic attitude. In addition, 111 out of 146 respondents also did not know about a workplace that supports an ergonomic attitude. However, respondents agree that the wrong posture during DL will trigger MSDs disorders. Although the majority of respondents do not know about ergonomics, they claim

to know how to sit and have good eyesight when using a computer. While the position of the head, neck, back, arms, elbows, and hands is obvious, the majority of respondents do not know it yet.

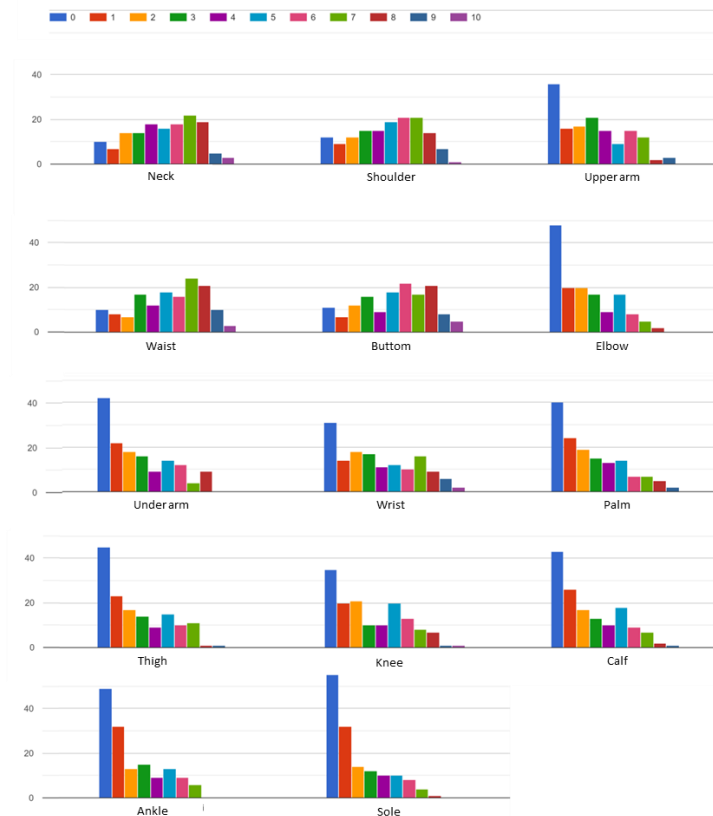


Figure 4. The Summary of Musculoskeletal Disorders

Table 9. The Selection of Seats in the DL Activity

Question Item	Answers	
	Yes	No
1. Do you know the definition of ergonomics?	63	83
2. Do you know the purpose of ergonomics?	54	92
3. Do you know how to apply ergonomics in the workplace?	35	111
4. Do you agree that there will be risk factors for musculoskeletal disorders due to learning positions during Distance Learning (PJJ)?	144	2
5. Do you know, what is the correct sitting position during PJJ?	106	40
6. Do you know the proper position of the head, neck and back when sitting?	93	53
7. Do you know how to properly position your arms and elbows when the PJJ is in a sitting position?	54	92
8. Do you know how to properly position your hands and wrists when the PJJ is in a sitting position?	56	90
9. Do you know how to properly position your knees and feet when the PJJ is in a sitting position?	60	86
10. Do you know the position of your eyes on your computer/laptop during PJJ?	109	37

3.5 Ergonomic Behavior Applied in DL

The summary of ergonomic behavior is shown in Table 10. Ergonomic behavior applied by the majority of students is appropriate. Namely, especially regarding the use of the keyboard, relaxed fingers when typing, and the presence of loose space to place other items on the table. In addition, many short breaks are carried out on a mini-break scale, followed by micro-breaks. Students have also been doing stretches regularly on the sidelines using a computer, laptop, tablet, or other device. Almost 50% of students sometimes place their heads, necks, shoulders, upper arms, hands, wrists, thighs, knees, and hips in the correct position. What needs attention is the use of chairs. Students generally use chairs that are less ergonomic. This can be a concern in terms of improving health conditions in DL, specifically replacing chairs that are more supportive of body shape and can be adapted to body conditions.

Table 10. Summary of Ergonomic Behavior Applied So Far

Question Item	Never	Rarely	Sometimes	Often	Always
1. I position my head and neck upright facing straight ahead and perpendicular to the floor.	4	28	67	42	5
2. I position my shoulders and upper arms perpendicular to the floor and relax.	8	39	53	39	7
3. I use my fingers relaxed when typing.	0	10	29	69	38
4. I position my hands and wrists straight and parallel to the floor at an angle of 0 degrees.	11	46	60	23	6
5. I position my thighs parallel to the floor and supported by a chair.	9	39	53	36	9
6. I position my knees at the same level as my hips and slightly forward legs.	9	35	69	28	5
7. I position my lower leg perpendicular to the floor and rest flat on the floor or supported by a stable footrest.	12	50	48	27	9
8. I use a chair with an adjustable height and back.	68	35	12	10	21
9. I use a chair with a backrest that can support the lower body.	44	26	20	25	31
10. I use a chair that has a cushion in the front and does not put pressure on the back of the knee and lower leg.	38	23	27	27	31
11. The height of the keyboard that I use is stable and in line with my elbows and wrists.	30	46	34	22	14
12. The keyboard that I use is placed in front of me at a distance that is neither too far nor too close so that the elbows remain close to the body.	9	28	31	57	21
13. On my desk there is sufficient space for other devices such as a mouse.	23	13	25	33	52
14. I do other activities on the sidelines of using computers/laptops/tablets/devices.	0	14	59	52	21
15. During lectures I take a break once every 30-40 minutes (micro breaks).	4	33	60	34	15
16. When I study using a computer/laptop/tablet/device, I take a break once every 1-2 hours (mini breaks).	3	34	47	49	13
17. I stretch regularly when using a computer/laptop/tablet/device.	11	43	52	25	15

4. CONCLUSION AND RECOMMENDATION

According to the findings of this survey, the majority of students from Universitas Padjadjaran's Department of Statistics utilize laptops and other devices in online lectures by sitting in a chair and setting the device on a table. DL takes roughly 5–6 hours each day, 5 days a week to complete. After a year of practicing DL, the body's condition has health consequences, particularly in the neck, shoulders, waist, bottom, and wrists. Despite their lack of ergonomics understanding, students believe that improper posture in DL can be harmful to one's health. The usage of chairs is a situation that requires care during DL because the majority of students utilize chairs that are less ergonomic.

Applying the rest guidelines on a scale of micro-breaks or mini-breaks, then exchanging positions alternately between sitting and standing, are some suggestions that can be made. If students are using a device, use the other hand to support the arm carrying the device, hold them higher to keep the neck straight, or use a holder to boost the height to eye level. Collaboration between teachers, students, and parents is also crucial for this online course to run well and without causing body discomfort.

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