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CORRELATION BETWEEN DURATION OF SCREEN TIME AND METHOD OF HANDLING SMARTPHONE TOWARDS THE INCIDENCE OF DE QUERVAIN'S SYNDROME AMONG THE MEDICAL STUDENTS OF DIPONEGORO UNIVERSITY

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ABSTRACT

Background: Smartphone with all of its benefits make the majority of its users become too attached with the device that can fulfil their various needs. Due to its accessibility, an increase of daily screen time has also been observed which may have negative impacts on health, one of them being De Quervain's Syndrome. De Quervain's Syndrome is a type of Repetitive Strain Injury, affecting the thumb and wrist caused by a repetitious activity that puts burden or trauma to the aforementioned body parts. **Objective:** To assess the correlation between duration of screen time and method of handling smartphone towards the incidence of De Quervain's Syndrome among the medical students of Diponegoro University. **Methods:** This research used an analytical-observational approach with a cross-sectional design. The subjects were 113 students from the Faculty of Medicine, Diponegoro University that were obtained using consecutive sampling method. The correlation between duration of screen time and method of handling smartphone with the incidence of De Quervain's Syndrome were performed using Spearman's test. **Results:** A weak significant correlation was observed between the average duration of screen time towards the incidence of DQS pain on the right hand based on the DQST results ($p=0.11$), but no significant correlation was found between the same variables on the left hand ($p=0.082$). There is no significant correlation between the method of handling smartphones with the incidence DQS pain based on the DQST results, both on the right ($p=0.93$) and left ($p=0.167$) hands. **Conclusion:** Average duration of screen time was weakly correlated with the incidence DQS pain in the right hand, but no correlation was found in the left hand, based on DQST results, among the students from the Faculty of Medicine, Diponegoro University. No correlation was observed between the method of handling smartphones and the incidence of DQS among the students from the Faculty of Medicine, Diponegoro University. **Keywords:** *De Quervain's Syndrome, Duration of Screen Time, Method of Handling Smartphone, Pain, Smartphone, Thumb*

INTRODUCTION

The present technology development is developing rapidly and spreading to various sectors, one of which is the communication sector. Gadgets or mobile phones that were once used only for communicating are now transformed into all-round devices that we usually know as smartphones. Smartphones with their various advantages cause the majority of people ranging from children, teenagers, adults, to the elderly to be unable to extricate themselves from devices that can adapt to all their needs ranging from the phone, typing short messages, playing online games, browsing, listening to music, watching videos, or simply looking for the latest news information. With various conveniences and access to smartphones, causing the duration of daily smartphone use also increases which is not realized to have a bad effect on health.^{1,2}

The duration of prolonged smartphone use can cause Repetitive Strain Injury which can affect the hands and wrists.³ De Quervain's Syndrome is one of

the Repetitive Strain Injuries that occur in the thumb and wrist due to repetitive activity. The presence of this repetitive activity results in loading or trauma to the thumb and wrist which results in inflammation of the tendon musculus extensor pollicis brevis and tendon abductor pollicis longus which is in the synovial scabbard.^{1,3,4}

The prevalence of the occurrence of De Quervain's Syndrome in the United States there are 11,332 cases in the at-risk population of 12,117,749 people per year and more of them occur in people who use their hands repeatedly. This also occurs in women, which is about 2.8% of cases per 1000 inhabitants per year compared to men which are 0.6% per 1000 inhabitants per year. Residents aged 40 years and over have a higher prevalence of about 2% per 1000 population, compared to those under 20 years old, which is about 0.6% per 1000 population.^{5,6} Based on research conducted at Karachi University, Pakistan, there is a relationship between the Finkelstein test and the duration of writing short



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messages through cell phones, out of 130 students, 96 (64%) experienced a positive Finkelstein test, while another 56 (37%) Finkelstein tested negative. The progressively increasing average duration of smartphone use further shows positive results for Finkelstein tests and experiencing De Quervain's Syndrome. In Indonesia, a person's risk of developing De Quervain's Syndrome is at 10%. The risk of De Quervain's Syndrome in Desa Bener, Kecamatan Ngrampal, Kabupaten Sragen reaches 5% due to the duration of playing PlayStation games and their long smartphone use.^{7,8}

Based on the background above, researchers see that several studies have a possible relationship or influence of the average duration of smartphone use with the incidence of De Quervain's Syndrome. However, these studies used research subjects in the form of parents or self-made research instruments that were different from the researchers' targets, namely adolescents and young adults. Therefore, researchers want to know the relationship between the average duration of use and how to use smartphones with the incidence of De Quervain's Syndrome using the research subjects of Diponegoro University Medical students.

METHODS

The research was carried out at the Faculty of Medicine, Diponegoro University online in September-October 2022 with an analytical design method with a cross-sectional research design. The subjects of this study was 113 Diponegoro University Medical students who met the inclusion criteria and did not meet the exclusion criteria selected using the consecutive sampling technique. The inclusion criteria in this study were registered as Diponegoro University medical students aged 19-24 years, using smartphones every day, as well as being willing to be a respondent. Meanwhile, the exclusion criteria in the study were having a history of injuries to the thumb and wrist, a history of DM, RA, osteoarthritis, and gout arthritis, a history of deformities and changes in the shape of the finger joints, a history of surgery in the wrist and finished maternal area, as well as doing sports that often use hands such as badminton, tennis, golf, rowing, volleyball, and bowling every day.

The bivariate analysis with the Spearman correlation test which is used to assess the correlation between the variables studied. Bivariate analysis was used to prove the relationship between the research variables i.e. the independent variable and the dependent variable (De Quervain's Syndrome (DQS)). The independent variables analyzed are the average duration and mode of use. A independent variable with a p-value of <0.05 indicates a significant relationship with De Quervain's Syndrome (DQS). Gender analysis using the Mann-Whitney test to examine for the relationship of gender variables to dependent variables De Quervain's Syndrome (DQS). Data collection and analysis are carried out by researchers independently so that the confidentiality of research data is ensured to be maintained.

RESULTS

There were 113 subject subjects that met the inclusion criteria. Univariate analysis is carried out first to obtain data related to the distribution of independent variables. The results of the univariate analysis can be seen in Table 1.

Table 1. Results of Univariate Analysis of Subjects

Variable	Frequency	%
Gender		
Female	65	57.5
Male	48	42.5
Age		
18	5	4.4
19	25	22.1
20	41	36.3
21	33	29.2
22	9	8.0
Duration		
2-6 hours/day	37	32.7
>6 hours/day	76	67.3
How to Use		
One-handed	54	47.8
Two hands	59	52.2
Incidence of Right Hand DQS Pain		
Not experiencing	58	51.3
Low risk	41	36.3
Medium risk	10	8.8
High risk	4	3.5
Incidence of Left Hand DQS Pain		
Not experiencing	81	71.7
Low risk	24	21.2
Medium risk	7	6.2
High risk	1	0.9



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The results of the Spearman correlation test showed a weak positive significant correlation strength between the average duration of smartphone use and the incidence of DQS pain from the DQST results. Significant relationships are indicated by the

value of $p=0.011$ (<0.05), correlation coefficient $p=0.239$. The results of the bivariate test between the mean duration and the incidence of right-handed DQS can be seen in Table 2.

Table 2. Relationship between Average Duration of Smartphone Use and Right-Hand DQS Occurrence

Variable	Incidence of Right-Hand DQS from DQST Results				Total	Sig. (2-tailed) (p)	Correlation Coefficient
	NE	LR	MR	HR			
Duration						0.011 ^a	0.239
2-6 hours/day	24	13	0	0	37		
>6 hours/day	34	28	10	4	76		
Total	58	41	10	4	113		

a = Spearman's rho test

Based on Table 3, Spearman's correlation test results showed that there was no significant association between the average duration of

smartphone use and the incidence of left-handed DQS pain from DQST results [$p=0.082$ (>0.05)].

Table 3. Relationship between Average Duration of Smartphone Use and Left-Hand DQS Occurrence

Variable	Incidence of Right-Hand DQS from DQST Results				Total	Sig. (2-tailed) (p)	Correlation Coefficient
	NE	LR	MR	HR			
Duration						0.082 ^a	0.165
2-6 hours/day	30	7	0	0	37		
>6 hours/day	51	17	7	1	76		
Total	81	24	7	1	113		

a = Spearman's rho test

The results of the Spearman correlation test showed that there was no significant relationship between the way smartphones were used and the incidence of DQS pain, both right-handed and left-

handed, from the DQST results (right $p=0.193$; left $p=0.067$). The data can be seen in Table 4 and Table 5.

Table 4. The Relationship between How to Use Smartphones and the Incidence of right-Hand DQS

Variable	Incidence of Right-Hand DQS from DQST Results				Total	Sig. (2-tailed) (p)	Correlation Coefficient
	NE	LR	MR	HR			
How to Use a Smartphone						0.193 ^a	0.123
One-handed	31	18	3	2	54		
Two hands	27	23	7	2	59		
Total	58	51	10	4	113		

a = Spearman's rho test

Table 5. The Relationship between How to Use Smartphones and the Incidence of Left-Hand DQS

Variable	Incidence of Right-Hand DQS from DQST Results				Total	Sig. (2-tailed) (p)	Correlation Coefficient
	NE	LR	MR	HR			
How to Use a Smartphone						0.067 ^a	0.173
One-handed	43	9	1	1	54		
Two hands	38	15	6	0	59		
Total	81	24	7	1	113		

a = Spearman's rho test



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The statistical test used to analyze the gender relationship with the incidence of right-hand DQS pain from the DQST results was the Mann-Whitney test. The use of the Mann-Whitney Test is based on a sample consisting of gender which is a nominal sample type of unpaired dichotomous.

Results of the Mann-Whitney test on gender relationship with the incidence of DQS pain of the

right and left hands from the DQST results, there was no significant relationship between the gender of the subjects and the incidence of DQS pain, both right hand and left hand from the DQST results [$p=0.088$ (>0.05); right $p=0.088$; left $p=0.074$]. The data can be seen in Table 6 and Table 7.

Table 6. The Relationship between Gender and the Incidence of Right-Hand DQS

Gender	Incidence of Right-Hand DQS from DQST Results				Sig. (2-tailed) (p)
	NE	LR	MR	HR	
Male	20	21	4	3	0.088‡
Female	38	20	6	1	

‡ = Mann-Whitney test

Table 7. The Relationship between Gender and the Incidence of Left-Hand DQS

Gender	Incidence of Left-Hand DQS from DQST Results				Sig. (2-tailed) (p)
	NE	LR	MR	HR	
Male	30	12	6	0	0.074‡
Female	51	12	1	1	

‡ = Mann-Whitney test

DISCUSSION

The final results of this study based on bivariate analysis using Spearman correlation obtained an interpretation of a significant relationship with weak correlation strength between the average duration of smartphone use and the incidence of right hand DQS pain from DQST results ($p = 0.011$), but no interpretation was obtained of a significant relationship between the average duration of smartphone use and the incidence of left-handed DQS pain from DQST results ($p = 0.082$). Based on these results, it can be concluded that there is an association between the average duration of smartphone use and the incidence of right-hand DQS pain complaints from DQST results, but no relationship was found between the average duration of smartphone use and the incidence of left-handed DQS pain complaints from DQST results. Many things can cause and affect the results of such measurements.

According to research conducted by Baabdullah in 2020, it is known that although there was a significant relationship between the duration of excessive smartphone use and musculoskeletal disorders of the hands and wrists ($p<0.05$), there was no significant relationship between the duration of excessive smartphone use and the emergence of DQS.

This is due to many musculoskeletal complaints of the hands due to inflammation or disturbances in the EPL in the third dorsal compartment, the flexor muscle of the pollicis longus, thenar eminence, as well as disorders of the median nerve due to continuous repetitive movements over a certain time so that it can cause complaints similar to DQS, where in DQS the disturbed muscles are other than the EPB muscle and the APB muscle.^{9,10}

Based on research conducted by Abdulqodir A in 2014, the percentage of the left-handed population in Indonesia only amounts to about 10%, which means that the majority of Indonesians use the right hand as their dominant hand, this leads to the use of smartphones that are more often used on the dominant hand, namely the right hand.¹¹ The results of the research conducted obtained different results on the right hand and left hand of the subject. In this study, it was not possible to know more specifically about the dominance of the hand used by the subject in using a smartphone because in the questionnaire there were no questions that asked about the dominant hand used.

The final results of this study based on bivariate analysis using Spearman correlation obtained an interpretation of the absence of a relationship between



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how to use smartphones and the incidence of right-handed DQS (p-value = 0.193) and left-hand (p-value = 0.067) from DQST results. Based on these results, it can be concluded that there is no relationship between how to use smartphones and the incidence of right and left hand DQS pain from the DQST results.

The results of this study are not in line with the results of You Lim Kim's research which shows a higher risk of using smartphones that use fewer hands due to muscles that contract more often and are easier to experience fatigue.¹² The use of smartphones using a keypad is known to be riskier to increase excess muscle activity on the thumb, ring finger, and index finger which has the potential to cause the appearance of musculoskeletal disorders when compared to the use of touchscreen smartphones. This is caused by thumb movement when performing median flexion, extension, and lower rotation compared to using a smartphone keypad.¹³ In addition, the length of the fingers also affects the balance of the hand muscles when holding or typing a smartphone. When holding a smartphone, usually four fingers other than the thumb hold the smartphone on the back and the thumb holds the smartphone on the front. The size of long fingers requires less muscle contraction activity than people with short finger sizes to hold or withstand the weight of a smartphone.^{13,14,15}

The absence of a significant relationship between the way smartphones are used and the incidence of DQS pain can also be caused by bias from the results of filling out the questionnaire as a research instrument. In this study, it is not possible to know more specifically about how to use smartphones because in this study there is only one question that leads to how to use smartphones in the form of how many hands the subject uses in using smartphones. In addition, the absence of a significant relationship between the way smartphones are used and the incidence of DQS pain may also be due to the absence of control over the type of smartphone used, the size of the smartphone, the position of smartphone use, and the dominance of the hands used by the subject.^{9,11,15}

This study is a cross-sectional analytical study to find out whether there is a relationship between the average duration and how to use smartphones with the incidence of De Quervain's Syndrome. The limitations of this study are that there is no specific assessment on the type of smartphone used because it

can affect the use of hands in using smartphones, the size of smartphones that can affect the number of hands used to hold and use smartphones, the position of smartphone use which can affect the duration and load on hand resistance when holding and using smartphones, as well as the dominance of the hands used by the subject so that allows the occurrence of bias in the results of the studies carried out.

CONCLUSION

There is a weak relationship between the average duration of smartphone use and incidence of right-handed DQS pain, but there is no relationship between the average duration of smartphone use and the incidence of left-handed DQS pain from DQST results, and there is no relationship between how to use smartphones and the incidence of DQS in Diponegoro University Medical students. For the next research, it is hoped that further research will be carried out using other variables that have not been studied and using subjects with characteristics that are different from this study, not only Diponegoro University Medical students so that more varied and representative research results are obtained. Then, the results of this study are expected to be able to become the basis for improving the quality of public health through promotional and preventive efforts which also include education about De Quervain's Syndrome, especially about the duration and how to use smartphones in daily life.

ETHICAL APPROVAL

The research was conducted after obtaining ethical clearance from the Ethics Committee in Health and Medical Research (KEPK) Faculty of Medicine, Universitas Diponegoro, Semarang with no. 359/EC/KEPK/FK-UNDIP/IX/2022.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

Indra Hidayat developed the theoretical formalism, performed the analytic calculations and performed the numerical simulations. Indra Hidayat, Rahmi Isma Asmara Putri and Erna Setiawati



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contributed to the final version of the manuscript. Tanti Ajoe Kesoema, Rahmi Isma Asmara Putri and Erna Setiawati supervised the project provided.

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