The effect of duration gadget uses during COVID-19 pandemic on neck pain, neck disability, and sleep quality

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ABSTRACT

During the coronavirus disease 2019 (COVID-19) pandemic, nation-wide social restriction policy is implemented to prevent virus spread. Medical students are relying on gadget and internet-based services for online learning. Prolonged use of gadget is related to various medical condition. This study aimed to determine correlation between duration of gadget use and their relationship to neck pain, neck disability, and sleep quality among medical student. This was a cross-sectional study conducted using numeric pain rating scale (NRS), Oswestry disability index (ODI), and Pittsburgh sleep quality index (PSQI) in online form. Sample was selected with simple random sampling from the population of medical student of Universitas Sebelas Maret. A total of 271 students were included in this study. Statistically significant correlation between duration of gadget uses and neck pain (p=0.014); neck disability (0.471, p=0.042); and sleep quality (0.571, p=0.023). Duration of gadget use increased the incidence of neck pain by 3.028 times (95% CI 2.272-4.327, p=0.037); incidence of neck disability by 2.144 times (95% CI 1.174-3.461, p=0.015); and decreased sleep quality by 2.384 times (95% CI 1.107-3.661, p=0.007). Duration of gadget use increased the incidence of neck pain, neck disability, and decreased sleep quality of medical student. Awareness of the importance of proper ergonomics while using gadget for medical education during COVID-19 pandemic should be raised among students, lecturers, and healthcare professional.

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1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a respiratory tract infection caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). This virus is highly contagious and has been declared as a pandemic by the World Health Organization (WHO) since March, 2020 [1]. The Indonesian Government implements nation-wide social restriction policy to prevent virus spread. This policy affects almost all sectors, including education. Medical student is not excluded from this policy, thus learning process is done with online strategy [2].

Social restriction forced most people to stay at home and reduced opportunities for direct interactions, thus people rely on gadget and internet-based services to communicate. Technology was also used to overcome boredom and anxiety, which is increased due to the pandemic and prolong time spent at home [3]. Technology and internet usage are increased during COVID-19 pandemic. Sun *et al*. showed that 16.6% of the subject had use internet longer, and 46.8% of the subjects reported increasing dependence on internet use, compared to pre-pandemic time [4]. Similar result is discovered in Indonesia, where there was increasing duration spent online by 52% compared to time before pandemic [5].

Prolonged use of gadget is related to various medical condition, like headache, eyestrain, neck pain, and sleep disorder [6], [7]. Neck pain is often arise due to non-ergonomics work space, in which, flexed neck cause an increase in cervical load and higher cervical muscle activity [3], [8]. Neck musculoskeletal disorder caused by gadget use may result in long term disability if left untreated [9]. Sleep disorder, like insomnia, hypersomnia, and parasomnia is related to gadget use, which may cause decreasing sleep quality [6], [7].

It is essential to promote musculoskeletal health so that medical students are able to use gadget for online learning without increasing the risk of future health problems. The aim of this study is to determine correlation between duration of gadget use and their relationship to neck pain, neck disability, and sleep quality among medical student. To our knowledge this is the first Indonesian study which assessed this relationship with objectively measured exposure factor, and taken into account the potential confounding of individual characteristics like body mass index (BMI), gender, and age.

2. RESEARCH METHOD

2.1. Design, patient, and sampling

This was an analytic observational study with cross-sectional design. This research was conducted using online form and was carried out on March, 2021 in Surakarta, Indonesia. Inclusion criteria of this study was medical student of Universitas Sebelas Maret, the year of entrance 2017-2020, who were willing to participate in this study. The exclusion criteria for this study were students with history of neck injury, neck surgery, neck disease or structural abnormalities, and history of neck pain for more than three months. Sample was selected with simple random sampling technique by Slovin’s formula. Population size was 800 medical students (200 medical students per batch) and margin of error was 5%, which make the minimum sample size was 267 medical students. This study was ethically approved by Health Research Ethics Commitee of Faculty of Medicine, Universitas Sebelas Maret with approval No. 12/UN27.06.6.1/KEP/EC/2021.

2.2. Variables

The independent variable of this study was the duration of electronic gadget use. This variable was categorized as 0-5, 6-10, 10-15, and >15 hours daily. The dependent variable of this study was neck pain, neck disability, and sleep quality. Neck pain was defined as pain experienced from the occiput to the top of the neck and extends to the outer and upper border of the scapula. Neck pain was measured using numeric pain rating scale (NRS), where participants were asked to rate their neck pain, with 1 being no pain, and 10 being worst pain possible. Each participant then categorized to mild pain (score: 1-3), moderate pain (score: 4-6), and severe pain (score: 7-10).

Neck disability was measured with Oswestry disability index (ODI) score, which analyzed level of function or disability in activities of daily living in patient suffering from neck pain. The ODI is the most commonly used questionnaire to measure pain outcome in hospital setting. It is a self-administered questionnaire divided into ten sections designed to assess limitations of various activities of daily living. Each section is scored on a 0–5 scale, 5 representing the greatest disability. The index is calculated by dividing the summed score by the total possible score, which is then multiplied by 100 and expressed as a percentage. Thus, for every question not answered, the denominator is reduced by 5. If a patient marks more than one statement in a question, the highest scoring statement is recorded as a true indication of disability. The questionnaire takes 3.5–5 minute to complete and approximately one minute to score [10].

Sleep quality was quantified with Pittsburgh sleep quality index (PSQI), which consists of self-report questionnaire to assess sleep quality in the past one month. The PSQI consists of 19 questions evaluating seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The 19 self-rated questions are grouped to form seven component scores. Each component score is rated from 0 to 3 (0, no in the past month; 1, less than once per week; 2, once or twice per week; and 3, three or more times per week). The global score ranges from 0 to 21, with higher scores indicating worse sleep quality [6].

2.3. Statistical analysis

Distribution of data was analyzed using Kolmogorov-Smirnov test. Correlation and odds ratio (OR) between duration of gadget use and NRS was done using ordinal regression followed by backward elimination analysis. Correlation and OR between duration of gadget use and ODI or PSQI score was analyzed using logistic regression followed by backward elimination analysis. P-value of <0.05 was considered statistically significant. Statistical program used for data analysis was SPSS version 25.

3. RESULTS

3.1. Subject characteristics

A total of 271 students met the inclusion and exclusion criteria were included in this study. The respondent's characteristics are summarized in Table 1. The mean age was 19.88 years (range, 17-22 years) and 80.1% of the subjects were female. The most common gadget used were smartphone (59.8%) and notebook (36.5%), mostly (45.4%) used for 11-15 hours daily. Mean ODI score was 1.74±3.65, and mean PSQI score was 4.90±3.87. All data obtained was normally distributed.

Table 1. The respondent's characteristics

Variable	Category	n (%)
Age	17 years old	4 (1.5%)
	18 years old	45 (16.7%)
	19 years old	48 (17.7%)
	20 years old	80 (29.5%)
	21 years old	65 (23.9%)
	22 years old	29 (10.7%)
Gender	Female	217 (80.1%)
	Male	54 (19.9%)
Gadget type	Notebook	99 (36.5%)
	Smartphone	162 (59.8%)
	Personal computer	6 (2.2%)
	Tablet	4 (1.5%)
Duration of electronic gadget use	0-5 hours	3 (1.0%)
	6-10 hours	80 (29.6%)
	11-15 hours	123 (45.4%)
	>15 hours	65 (24.0%)
	1-3 (mild pain)	92 (33.9%)
Neck NRS	4-6 (moderate pain)	132 (48.8%)
	7-10 (severe pain)	47 (17.3%)

NRS: Numeric pain rating scale

3.2. Neck pain

From ordinal regression analysis, we found statistically significant correlation between duration of gadget use and neck numeric pain rating scale (NRS) score (p=0.014) representing neck pain. Furthermore, the determination coefficient of gadget use on neck pain was 0.414. Backward elimination analysis for OR of gadget use on neck pain, unadjusted and adjusted to body mass index (BMI), gender, and age is detailed in Table 2.

Table 2. OR of duration of gadget use on neck pain, neck disability, and sleep quality

Variables		OR	p
Neck pain	Unadjusted	3.028 (95% CI 2.272-4.327)	0.037*
	Adjusted with BMI	2.025 (95% CI 1.531-3.781)	0.028*
	Adjusted with gender	2.490 (95% CI 1.068-3.988)	0.018*
	Adjusted with age	1.046 (95% CI 1.026-1.130)	0.056
Neck disability	Unadjusted	2.144 (95% CI 1.174-3.461)	0.015*
	Adjusted with BMI	2.006 (95% CI 1.155-3.067)	0.048*
	Adjusted with gender	3.164 (95% CI 1.894-4.434)	0.002*
	Adjusted with age	1.200 (95% CI 1.089-1.310)	0.139
Sleep quality	Unadjusted	2.384 (95% CI 1.107-3.661)	0.007*
	Adjusted with BMI	2.006 (95% CI 1.057-3.045)	0.028*
	Adjusted with gender	2.178 (95% CI 1.349-3.704)	0.048*
	Adjusted with age	1.160 (95% CI 1.023-1.303)	0.055

OR: odds ratio, p: significance, BMI: body mass index, *: statistically significant

3.3. Neck disability

We performed logistic regression analysis to determine the correlation and determination coefficient between duration of gadget use and ODI score representing neck disability we found moderate correlation (0.471) between duration of gadget use and neck disability and determination coefficient of gadget use on neck disability was 0.329. Correlation and determination coefficient of gadget use and neck disability adjusted with BMI, gender, and age is detailed in Table 3. Backward elimination analysis for OR of gadget use on neck disability, unadjusted and adjusted to BMI, gender, and age is detailed in Table 2.

Table 3. Logistic regression and determination coefficient of duration of gadget use on neck disability and sleep quality

Variables		Correlation	Determination coefficient	p
Neck disability	Unadjusted	0.471	0.329	0.042*
	Adjusted with BMI	0.570	0.429	0.032*
	Adjusted with gender	0.568	0.528	0.019*
	Adjusted with age	0.659	0.585	0.008*
Sleep quality	Unadjusted	0.571	0.340	0.023*
	Adjusted with BMI	0.598	0.439	0.011*
	Adjusted with gender	0.659	0.518	0.008*
	Adjusted with age	0.695	0.525	0.005*

p: significance, BMI: body mass index, *: statistically significant

3.4. Sleep quality

We performed logistic regression analysis to determine the correlation and determination coefficient between duration of gadget use and PSQI score representing sleep quality. We found moderate correlation (0.571) between duration of gadget use and sleep quality and determination coefficient of gadget use on sleep quality was 0.340. Correlation and determination coefficient of gadget use and sleep quality adjusted with BMI, gender, and age is detailed in Table 3. Backward elimination analysis for OR of gadget use on sleep quality unadjusted and adjusted to BMI, gender, and age is detailed in Table 2.

4. DISCUSSION

Significant correlation between duration of gadget use and neck pain (p=0.014) was observed in this study. Similar finding was reported by Al Zarea and Patil showing that cervical pain was the most common symptoms found in 71.2% university student that use smartphone daily [11]. Smartphones usually held below the eye level, with hands and thumb is used to operate, and neck flexed to see the smartphone. Neck flexion cause an increase in cervical load and higher muscle activity in the cervical erector spinae and upper trapezius muscle [3], [8]. A study using surface electromyography (EMG) shows muscle activation and angular changes after 5, 10, and 15 minutes of smartphone use [12]. Another study using an ultrasound-based motion analysis found that greater upper and lower cervical flexion angle was correlated with neck pain [13]. Prolonged neck extension puts excess strain on the upper trapezius, reducing its pressure pain threshold [8]. From determination coefficient analysis of duration of gadget use on neck pain, we found that 41.4% of neck pain was associated with the duration of gadget use. Other factor associated with neck pain was history of previous neck pain, stress, and taller posture [14], [15]. Strongest factor related to neck pain was history of work require high physical activity [16].

Duration of gadget use increased the incident of neck pain by 3.028 (95% CI 2.272-4327) times. Subjects using gadget more than five years was more prone to neck pain, compare to subjects using gadget for less than a year [11]. After adjustment with BMI, OR was increased to 2.025 (95% CI 1.531-3.781), which indicates that BMI correlate with neck pain. BMI was positively associated with increased risk of chronic musculoskeletal pain, including neck pain. Higher BMI also had lower elasticity in the sternocleidomastoid and upper trapezius muscles [17], [18]. Obesity was also associated with leptin and other hormones, which play a role in complex physiological processes in inflammation that can lead to painful conditions [19]. Adjustment with gender shows an increase of OR to 2.490 (95% CI 1.068-3.988), which indicates a significant relationship between gender and neck pain. Adolescent females were more likely to report neck pain, compared to their males counterparts, since females had more neck flexion than males while operating computer [20]. After further adjusted with age, OR was decreased to 1.046 (95% CI 1.026-1.130), which indicates that age was not correlate with neck pain. This finding may be caused by our subjects being medical student, with age range of 17-22 years old. Incidence of neck pain increased along with age, peaked around age of 35-49, and after which, the risk begins to decline [16]. A study including broader range of age may show significant correlation between age and neck pain.

Moderate correlation (0.471) between duration of gadget uses and neck disability was found from logistic regression analysis. Duration of gadget use also increased the incident of neck disability by 2.144 (95% CI 1.174-3.461). Several studies examined the effect of smartphone use on neck function generate similar result. Shah *et al*. found a positive correlation between the smartphone addiction and neck musculoskeletal disorder, particularly on female, which may result in long term disability if left untreated [9].

Neck was often flexed while operating smartphone on, putting on load on neck, and on long term could result in serious permanent damage, such as spinal misalignment, arthritis, spinal degeneration, disc herniation, disc compression, and nerve damage. Those damage will precede to long term neck disability [21]. After adjusted with BMI, it shows moderate correlation (0.570) of gadget use and neck disability. Longer duration of gadget use, adjusted with BMI, also increased the incidence of neck disability of 2.006 (95% CI 1.155-3.067) times. Patients with higher BMI exhibited significantly worse neck functional status. Obesity will add pressure to the intra-discal and mechanical stresses upon other spinal structures, that will exacerbate back pain severity, which in turn, will decrease the functional status [22], [23].

Moderate correlation (0.568) of gadget uses and neck disability, was also found after adjustment with gender. The incident of neck disability adjusted to gender was also increased 3.164 (95% CI 1.894-4.344) times, due to longer use of gadget. Gender differences were reported on work-related neck symptoms which will lead to neck disability. On study testing cervical spine muscle strength, it was found that women displayed less strength than men. Having comparable workloads with their male counterparts, female carried a relatively higher muscular load that will result in neck pain and end in neck disability [24]. After adjusted with age, there was moderate correlation (0.659) of gadget use and neck disability. OR gadget use on neck disability adjusted with age was also increased to 1.200 (95% CI 1.089-1.310). The process of aging was often accompanied neck pain, which may contribute to balance and gait disturbance. Uthaikhup *et al*. found that elders with neck pain demonstrated greater deficits in eye movement control, perception of verticality and balance, that will cause difficulties in doing daily activity, rated by ODI score [25].

Determination coefficient of gadget use on neck disability was 0.329. This shows that 41.4% of neck disability was associated with the duration of gadget use. After adjustment with BMI, gender, and age, determination coefficient was increased to only 0.429, 0.528, and 0.585 respectively. It indicates low influence of BMI, gender, and age to neck disability. Other factors that influence neck disability are a history of neck trauma and non-ergonomics work space [26].

Logistic regression analysis suggests moderate correlation (0.571) between duration of gadget use and sleep quality. Duration of gadget use also increased the incident of worse sleep quality by 2.384 (95% CI 1.107-3.661) times. Longer duration of gadget use will result in dysregulation of the melatonin secretion. Melatonin was a hormone playing central of role in sleep-wake cycle. This dysregulation will disrupted sleep process and natural circadian rhythm [27], [28]. After adjusted with BMI, it shows moderate correlation (0.598) of gadget use and sleep quality, and OR of 2.006 (95% CI 1.057-3.045). Much evidence suggests an association between body weight and sleep duration and quality. Decreased sleep duration was known to correlate with changes in leptin and ghrelin, increased hunger, and promote weight-gain [29]–[31].

We also observed a moderate correlation (0.659) of gadget use and sleep quality, adjusted with gender. Adjustment with gender also increased OR to 2.178 (95% CI 1.349-3.704). Worse sleep quality was prevalent in adult, especially female. Female are 1.88 times more likely to suffer from insomnia compared to male. Monthly changes in the levels of ovarian steroids are associated with an increased prevalence of sleep disruption [32], [33]. After adjusted with age, there was moderate correlation (0.695) of gadget use and sleep quality, and OR increased to 1.160 (95% CI 1.023-1.303). The prevalence of insomnia was higher in older adults compared to younger adults. It was thought that insomnia, especially in geriatric patient was a result degeneration of suprachiasmatic nucleus of the anterior hypothalamus that will ends in desynchronization of circadian rhythms [34], [35].

Determination coefficient of gadget use on sleep quality was 0.340. This shows that 34.0% of sleep quality was associated with the duration of gadget use. After adjustment with BMI, gender, and age, determination coefficient was increased to only 0.439, 0.518, and 0.525 respectively. It indicates low influence of BMI, gender, and age to sleep quality. Other factors that influence neck sleep quality are psychological pain, environmental factors, medication, and history of sleep disorder, like insomnia, hypersomnia, and parasomnia [6].

5. CONCLUSION

Duration of gadget use increased the incidence of neck pain, neck disability, and decreased sleep quality of medical student. Awareness of the importance of proper ergonomics while using gadget for medical education during COVID-19 pandemic should be raised among students, lecturers, and healthcare professional.

A major limitation of this study was its cross-sectional design, which the exposure and outcome are simultaneously assessed, and causal inference can not be determined. This study also uses online form, with lots of question items, and the actual clinical conditions is not evaluated directly. Further study, with prospective cohort design and clinical examination is needed to assess causal inference of gadget use and neck pain, neck disability, and sleep quality. Another limitation in this study was participant’s age range of 17-22 years old. Incidence of neck pain peaked around fourth and fifth decade of life. Study including those age range may provide better description of the effect of age on neck pain, neck disability, and sleep quality.

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