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KNOWLEDGE, ATTITUDES, AND BEHAVIOR IN RELATION TO COMPUTER VISION SYNDROME AND MUSCULOSKELETAL PAIN AMONG GADGET USERS AT SDN WONOTINGAL 01-02

Oktaviarum Slamet Utama[1,2], Rahmi Isma Asmara Putri[1,3], Hari Peni Julianti[1,3*]
[1]Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia
[2]Dr. Kariadi General Hospital, Semarang, Indonesia
[3]Diponegoro National Hospital, Semarang, Indonesia

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Corresponding Author:
E-mail: haripeniauthor@gmail.com

ABSTRACT

Background: Although recent studies have revealed associations between excessive use of gadgets with health problems such as Computer Vision Syndrome (CVS) and musculoskeletal pain, the role of knowledge, attitude and practice for these conditions is obscure. While clinical research has identified these associations between screen time and such health risks, there is less evidence about how the extent of children's awareness, or behaviors, might affect the presence of those problems. **Objective:** This study examines the relationship between knowledge, attitude, and behavior with the incidence of Computer Vision Syndrome (CVS) and musculoskeletal pain in gadget users at SDN Wonotingal 01-02. **Methods:** This study uses a quantitative methodology with an analytical observational design of a cross-sectional type. It aims to examine the relationship between knowledge, attitudes, and behaviors with the occurrence of Computer Vision Syndrome (CVS) and musculoskeletal pain in gadget users at SDN Wonotingal 01 and 02. The research was conducted in May 2024, involving fifth and sixth-grade students as the sample, using total sampling to include all eligible participants who met the research criteria. **Results:** CVS occurrence was strongly associated with knowledge ($P < 0.001$), attitudes ($P < 0.001$) and behaviors ($P < 0.001$). Moreover, there was a positive correlation between neck musculoskeletal pain with knowledge ($P < 0.001$) and behaviors ($P < 0.001$), thigh pain with Behaviors ($P = 0.008$), Calf pain with attitudes ($P = 0.013$) and behaviors ($P = 0.011$). **Conclusion:** This study discovered that knowledge, attitude, and behavior have an influence on the incidence of Computer Vision Syndrome (CVS) and musculoskeletal pain in gadget users at SDN Wonotingal 01-02. A significant relationship was observed between CVS status and musculoskeletal pain. More studies with a larger sample, particularly with respect to lower limb pain, need to be conducted, together with consideration of other aspects related to knowledge, attitudes, and behaviors.

INTRODUCTION

With this rise of technology (gadget like smartphones) in all aspects of our daily life like Socializing, fun, health monitoring and education. Though gadgets have several benefits, overuse of gadgets, especially among kids, is a matter of concern because it adversely affects health. Due to prolonged exposure to screens, 46.9% of children have gadgets addiction and 46.5% suffer from cognitive dysfunction. They use gadgets for multiple purposes like gaming, watching videos, listening to music, chatting with friends, browsing the internet, etc. Studies have found that early exposure to gadgets, particularly for watching videos, is associated with an increase in negative behavioral outcomes[1,2].

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Apart from cognitive issues, excessive use of gadgets may also lead to physical health issues; the most common being Computer Vision Syndrome (CVS). CVS is a group of eye and vision problems related to extended screen use on devices like smartphones, tablets, computers, and televisions. Symptoms may include strained or fatigued eyes, blurry vision, headaches and dry, irritated eyes. CVS symptoms have been reported in approximately 60% of American men and 65% of women based on prevalence studies. Prolonged screen time is associated with an increased risk of CVS, particularly using multiple devices simultaneously instead of one device at a time[3,4].

The other big concern with too-widely used gadgets is musculoskeletal pain, mostly linked to bad posture and repeated movements. Chronic musculoskeletal pain (CPMP) is common and causes physical frustration and functional limitations. Musculoskeletal disorders (MSDs) are one of the leading causes of disability worldwide, affecting approximately 47% of adults globally, the cause of which may be sudden movements, repetitive activities, or prolonged poor posture or uncomfortable body positions. Research has suggested that spending too much time with gadgets can cause lingering pain in the neck and shoulders and elbows and hands resulting from bad posture and repetitive actions (like holding a device in one hand and scrolling with one finger). Studies show that 43.3% of people suffer neck pain, 42.9% shoulder pain, and 27.9% elbow pain due to smartphone usage[5,6]. Long-term usage of digital devices, especially when done with bad posture, leads to increased risk of musculoskeletal pain.

Knowledge, attitudes, and behaviors play an important role in preventing the negative effects of excessive gadget use. The key to addressing screen time and posture issues is education having children and their guardians understand the dangers. Positive use lso includes promoting attitudes towards gadgets like screen time limits, being physically active, etc. Moreover, adopting healthy behaviors, such as keeping a safe distance from the screen, maintaining appropriate lighting, and going to the doctor if discomfort arises, can also decrease the risk of having negative health effects[2,7].

Schools, especially primary ones, are gradually turning into places where gadgets are used for both education and fun. Little research has investigated the association of knowledge, attitude and behavior with CVS and musculoskeletal pain among primary school children. The multiple studies so far mainly focused on behaviors, and paid little attention to the combined effects of knowledge and attitudes. The purpose of this study is to examine the relationship of knowledge, attitudes, and behaviors about CVS and musculoskeletal pain incidence in gadget users in SDN Wonotingal 01 and 02. Based on these discoveries, the researchers hope to recognize the factors that influence both these health conditions and contribute to the establishment of effective preventive strategies that can help to protect children's visual and musculoskeletal health in the digital age.

This innovative research fills an important gap in the literature by investigating the interrelationships between CVS and musculoskeletal pain through the combined effects of knowledge, attitudes, and behaviors; providing a broader perspective compared to previous studies that have primarily focused on behaviors. These findings should stimulate future studies examining additional variables contributing to child gadget-related morbidities so that preventive measures can be enhanced in this population.

METHODS

Subject

The respondents consisted of fifth and sixth-grade students at SDN Wonotingal 01 and 02 in Semarang in the 2023-2024 academic year. The target sample population of this research covers gadget user students at these schools. The sample in this study will include all students who meet the research criteria, which is being in the fifth and sixth-grade students at SDN Wonotingal 01 and 02, having permission to complete the research questionnaire, and using gadgets. The total sampling method was used in which all students who meet research criteria will be included in the study, no random sampling and the sample size is determined in total.

Intervention

This is a cross-sectional study and data have been used here for an observational analysis without direct intervention. Data obtained from the filled questionnaires allows for evaluating the level of awareness related to gadget usage and the prevalence of Computer Vision Syndrome (CVS) and such

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systemic pain among the students. If it did so, it would be effective in collecting information about students' gadget habits and health conditions without any active intervention or experimentation.

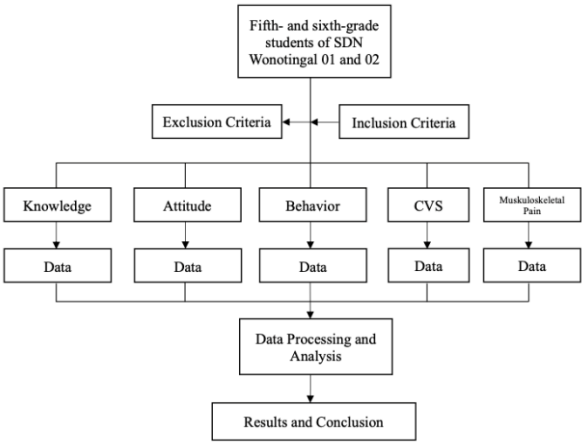

Figure 1. Study Flow Diagram

Measurement

This study operationalizes several variables through respective tools and scales. A questionnaire to assess levels of gadget use knowledge, attitudes, and behaviors was developed and each response was classified as "Good," "Sufficient," and "Poor." CVS-Q questionnaire was used to measure CVS, with a score of 6 or higher indicating the presence of CVS, and less than 6 indicating the absence of CVS. Musculoskeletal pain is evaluated by a Visual Analog Scale (VAS), categorizing pain severity as "No Pain," "Mild Pain," "Moderate Pain," or "Severe Pain", depending on the respondent's self-reported pain level experienced in the neck, shoulders, back, thighs, and calves.

Statistical Methods

The collected data will be analyzed by appropriate statistical methods. Descriptive statistics will be applied for summary of demographic data and knowledge, attitude, and behavior levels. Inferential statistics (e.g., chi-square test) will be used to examine the association between CVS & musculoskeletal pain and the different variables (knowledge, attitude, behavior) that we collected. A significant level of $p < 0.05$ will be used for all tests. Results will be obtained using statistical software to answer the research questions.

RESULTS

Participants for the study consisted of 200 students aged between 10 and 13 years. 56% of students were aged 11 years, 21.5% were aged 10 years, and 21.5% were aged 12 years. Moreover, the participants included 57.5% female participants, and 50.5% of the participants were in the 6th grade (Table 1).

Table 1. Baseline Characteristic

Characteristic	Frequency	Percentage (%) n = 200
Age		
10 years old	43	21.5
11 years old	112	56.0
12 years old	43	21.5
13 years old	2	1.0
Gender		
Male	85	42.5
Female	115	57.5
Grade		
5	99	49.5
6	101	50.5

The majority of respondents showed good knowledge (38.0%), good attitudes (65.0%), and good behavior (64.5%) regarding gadget uses and eye health (Table 2).

Table 2. Sample Population on Knowledge, Attitude and Behavior Overview

Characteristic	Frequency	Percentage (%) n = 200
Knowledge		
Poor	64	32.0
Sufficient	60	30.0
Good	76	38.0
Attitude		
Poor	28	14.0
Sufficient	42	21.0
Good	130	65.0
Behavior		
Poor	16	8.0
Sufficient	55	27.5
Good	129	64.5

The majority of the respondents (65.0%) were not found with CVS. For musculoskeletal pain, most had absence of pain in the neck (76.0%), shoulders (83.0%), back (79.0%), thighs (84.0%), and calves

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(80.0%). The percentage of respondents with mild pain was 14.5%, 9.0%, 16.5%, 12.5%, and 10.0%, respectively (Table 3).

Table 3. Sample Characteristic on CVS and Musculoskeletal Pain

Characteristic	Frequency	Percentage (%) n = 200
CVS Status		
CVS	70	3.0
No CVS	130	65.0
Musculoskeletal Pain		
Neck Pain		
No Pain	152	76.0
Mild Pain	29	14.5
Moderate Pain	15	7.5
Severe Pain	4	2.0
Shoulder Pain		
No Pain	166	83.0
Mild Pain	18	9.0
Moderate Pain	11	5.5
Severe Pain	5	2.5
Back Pain		
No Pain	158	79.0
Mild Pain	33	16.5
Moderate Pain	9	4.5
Severe Pain	0	0.0
Thigh Pain		
No Pain	168	84.0
Mild Pain	25	12.5
Moderate Pain	4	2.0
Severe Pain	3	1.5
Calf Pain		
No Pain	160	80.0
Mild Pain	20	10.0
Moderate Pain	16	8.0
Severe Pain	4	2.0

The bivariate analysis revealed a significant association between CVS knowledge and CVS status ($p<0.001$) and neck pain ($p<0.001$). Conversely, no significant association between such knowledge and shoulder pain, back pain, thigh pain, and calf pain was observed (Table 4).

Table 4. Relationship Between Knowledge and the Prevalence of CVS and Musculoskeletal Pain

Characteristic	Knowledge (%) Poor (n=64)	Sufficient (n=60)	Good (n = 76)	p
CVS Status				
CVS	18 (28.1)	43 (71.7)	69 (90.8)	<0.001*
No CVS	46 (71.9)	17 (28.3)	7 (9.2)	
Musculoskeletal Pain				
Neck Pain				
No Pain	40 (62.5)	53 (88.3)	59 (77.6)	<0.001*
Mild Pain	11 (17.2)	7 (11.7)	11 (14.5)	
Moderate Pain	9 (14.1)	0 (0.0)	6 (7.9)	
Severe Pain	4 (6.3)	0 (0.0)	0 (0.0)	
Shoulder Pain				
No Pain	50 (78.1)	53 (88.3)	63 (82.9)	0.224
Mild Pain	7 (10.9)	5 (8.3)	6 (7.9)	
Moderate Pain	3 (4.7)	2 (3.3)	6 (7.9)	
Severe Pain	4 (6.3)	0 (0.0)	1 (1.3)	
Back Pain				
No Pain	43 (67.2)	50 (83.3)	65 (85.5)	0.051
Mild Pain	15 (23.4)	8 (13.3)	10 (13.2)	
Moderate Pain	6 (9.4)	2 (3.3)	1 (1.3)	
Severe Pain	0 (0.0)	0 (0.0)	0 (0.0)	
Thigh Pain				
No Pain	50 (78.1)	56 (93.3)	62 (81.6)	0.181
Mild Pain	12 (18.8)	2 (3.3)	11 (14.5)	
Moderate Pain	1 (1.6)	1 (1.7)	2 (2.6)	
Severe Pain	1 (1.6)	1 (1.7)	1 (1.3)	
Calf Pain				
No Pain	46 (71.9)	53 (88.3)	61 (80.3)	0.210
Mild Pain	9 (14.1)	3 (5.0)	8 (10.5)	
Moderate Pain	6 (9.4)	4 (6.7)	6 (7.9)	
Severe Pain	3 (4.7)	0 (0.0)	1 (1.3)	

Based on the results of the bivariate test using the likelihood ratio test above, a significant relationship was found between attitude and CVS status ($p<0.001$) and calf pain ($p=0.013$). However, no significant relationship was found between attitude and neck pain, shoulder pain, back pain, or thigh pain (Table 5).

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Table 5. Relationship Between Attitude and the Prevalence of CVS and Musculoskeletal Pain

Characteristic	Attitude (%) Poor (n=28)	Sufficient (n=42)	Good (n = 130)	p
CVS Status				
CVS	2 (7.1)	14 (33.3)	114 (87.7)	<0.001*
No CVS	26 (92.9)	28 (66.7)	16 (12.3)	
	(n=28)	**(n=28)**	**(n=28)**	
Musculoskeletal Pain				
Neck Pain				
No Pain	21 (75.0)	31 (73.8)	100 (76.9)	0.258
Mild Pain	3 (10.7)	5 (11.9)	21 (16.2)	
Moderate Pain	2 (7.1)	6 (14.3)	7 (5.4)	
Severe Pain	2 (7.1)	0 (0.0)	2 (1.5)	
Shoulder Pain				
No Pain	22 (78.6)	31 (73.8)	113 (86.9)	0.128
Mild Pain	2 (7.1)	6 (14.3)	10 (7.7)	
Moderate Pain	1 (3.6)	4 (9.5)	6 (4.6)	
Severe Pain	3 (10.7)	1 (2.4)	1 (0.8)	
Back Pain				
No Pain	22 (78.6)	29 (69.0)	107 (92.3)	0.156
Mild Pain	3 (10.7)	10 (23.8)	20 (15.4)	
Moderate Pain	3 (10.7)	3 (7.1)	3 (2.3)	
Severe Pain	0 (0.0)	0 (0.0)	0 (0.0)	
Thigh Pain				
No Pain	23 (82.1)	31 (73.8)	114 (87.7)	0.089
Mild Pain	2 (7.1)	10 (23.8)	13 (10.0)	
Moderate Pain	2 (7.1)	0 (0.0)	2 (1.5)	
Severe Pain	1 (3.6)	1 (2.4)	1 (0.8)	
Calf Pain				
No Pain	20 (71.4)	31 (73.8)	109 (83.8)	0.013*
Mild Pain	3 (10.7)	2 (4.8)	15 (11.5)	
Moderate Pain	4 (14.3)	6 (14.3)	6 (4.6)	
Severe Pain	1 (3.6)	3 (7.1)	0 (0.0)	

Based on the results of the bivariate test using the likelihood ratio test above, significant relationship was found between behavior and CVS status (p<0.001), neck pain (p<0.001), thigh pain (p=0.008), and calf pain (p=0.011). However, no significant relationship was found between behavior and shoulder pain and back pain (Table 6).

Table 6. Relationship Between Behavior and the Prevalence of CVS and Musculoskeletal Pain

Characteristic	Behavior (%) Poor (n=16)	Sufficient (n=55)	Good (n = 129)	p
CVS Status				
CVS	5 (31.3)	17 (30.9)	108 (83.7)	**<0.001***
No CVS	11 (68.8)	38 (69.1)	21 (16.3)	
	(n=16)	**(n=16)**	**(n=16)**	
Musculoskeletal Pain				
Neck Pain				
No Pain	12 (75.0)	33	107	
Mild Pain	0 (0.0)	12	17	<0.001*
Moderate Pain	3 (18.8)	7	5	
Severe Pain	1 (6.3)	3	0 (0.0)	
Shoulder Pain				
No Pain	12 (75.0)	41 (74.5)	113 (87.6)	
Mild Pain	2 (12.5)	8 (14.5)	8 (6.2)	0.226
Moderate Pain	1 (6.3)	3 (5.5)	7 (5.4)	
Severe Pain	1 (6.3)	3 (5.5)	1 (0.8)	
Back Pain				
No Pain	13 (81.3)	40 (72.7)	105 (81.4)	
Mild Pain	2 (12.5)	10 (18.2)	21 (16.3)	0.357
Moderate Pain	1 (6.3)	5 (9.1)	3 (2.3)	
Severe Pain	0 (0.0)	0 (0.0)	0 (0.0)	
Thigh Pain				
No Pain	11 (68.8)	41 (74.5)	116 (89.9)	
Mild Pain	3 (18.8)	10 (18.2)	12 (9.3)	0.008*
Moderate Pain	2 (12.5)	1 (1.8)	1 0.8)	
Severe Pain	0 (0.0)	3 (5.5)	0 (0.0)	
Calf Pain				
No Pain	10 (62.5)	38 (69.1)	112 (86.8)	
Mild Pain	2 (12.5)	9 (16.4)	9 (7.0)	0.011*
Moderate Pain	2 (12.5)	6 (10.9)	8 (6.2)	
Severe Pain	2 (12.5)	2 (3.6)	0 (0.0)	

Based on the analysis, a significant relationship was found between CVS status and neck pain (p<0.004), shoulder pain (p=0.001), back pain (p=0.003), thigh pain (p=0.001), and calf pain (p<0.001) (Table 7).

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Table 7. The Correlation Between Computer Vision Syndrome (CVS) and Musculoskeletal Pain

Muskuloskeletal	CVS Status (%)		p
	No CVS (n=130)	CVS (n=70)	
Neck Pain			
No Pain	105 (80.8)	47 (67.1)	0.004*
Mild Pain	19 (14.6)	10 (14.3)	
Moderate Pain	6 (4.6)	9 (12.9)	
Severe Pain	0 (0.0)	4 (5.7)	
Shoulder Pain			
No Pain	116 (89.2)	50 (71.4)	0.001*
Mild Pain	8 (6.2)	10 (14.3)	
Moderate Pain	6 (4.6)	5 (7.1)	
Severe Pain	0 (0.0)	5 (7.1)	
Back Pain			
No Pain	111 (85.4)	47 (67.1)	0.003*
Mild Pain	17 (13.1)	16 (22.9)	
Moderate Pain	0 (0.0)	0 (0.0)	
Severe Pain	2 (1.5)	7 (10.0)	
Thigh Pain			
No Pain	118 (90.8)	50 (71.4)	0.001*
Mild Pain	11 (8.5)	14 (20.0)	
Moderate Pain	1 (0.8)	3 (4.3)	
Severe Pain	0 (0.0)	3 (4.3)	
Calf Pain			
No Pain	114 (87.7)	46 (65.7)	<0.001*
Mild Pain	12 (9.2)	8 (11.4)	
Moderate Pain	4 (3.1)	12 (17.1)	
Severe Pain	0 (0.0)	4 (5.7)	

DISCUSSION

In modern times, the use of gadget has become common as it started to affect every part of life especially health. Excessive gadget usage leaves children experience CVS and musculoskeletal pain. Studies show that 40-50% of children suffer CVS, which increase significantly in the use of online teaching learning methods as noted in this study and similar studies CVS is more common in women[8-10] with studies indicate that hormonal differences influence on tear production may be a contributing factor, further studies are required to confirm this[11]. Musculoskeletal pain, especially neck, shoulder and upper back pain, is frequently reported, with literature reporting its prevalence from 17.3% to 89.9%[12-14]. In our study, neck and back pain were similarly the most frequent complaints. According to a study conducted by Fazilah Abdul Aziz et al (2022) reported a high percentage of participants not having any pain in the lower extremities while Susilowati et al. (2022) found 57.5% of their subjects reported thigh pain, although they found neck and back pain appeared more predominant[15,16].

Knowledge, attitude and behavior play a crucial role in preventing CVS which is a condition that has effect 50-90% gadget users[17]. Previous studies have shown that knowledge of preventive measures, including 20-second rule, decreases the risk of CVS. This indicates that well-informed subjects present the least number of symptoms[18,19]. Positive attitudes towards gadget use such as awareness and importance of eye breaks greatly correlated with CVS incidences based on research by Pratiwi and Lestari (2023) and other studies in Malaysia[20,21]. Also, behaviour plays a big role, as bad habits like bad posture and no breaks, increase the risk of CVS significantly. Not surprisingly, research published by Tribhuwana Tunggadewi University (2018) and several meta-analyses show that those with good ergonomic practices and healthy gadget usage habits are less likely to experience CVS (10,22). In conclusion, knowledge, attitude and behavior are all significantly associated with CVS prevention and proper intervention can lead to reduced prevalence of CVS.

Sustained use of digital devices, especially in the case with bad posture, results in musculoskeletal pain caused by mechanical stress on the muscles and spine, which most commonly associate with neck, shoulder, back. The Forward Head Posture (FHP) is one of the main causes of neck shoulder and back pain[23-25]. Though understanding proper ergonomics can decrease pain, awareness is not enough as working behavior changes such as postural changes and taking breaks are equally needed[26-33]. As a result, even though there is awareness, many people do not follow preventive behaviors to avoid musculoskeletal pain[34,35]. Similar problems arise in the back, which is more susceptible to injury due to bad posture and long-term use of devices, increasing the incidence rate of low back pain (LBP), where behavior change such as improving posture and increasing physical activity is the main thing to prevent LBP[32,36,37]. Avoiding ergonomic practices like staying near the screen to engage in the process of gadget use makes them experience thigh and even calf pain by sitting too long[38,39]. Sitting or poor posture limits circulation and increases pressure to worsen calf pain (Odole et al., 2020). We see studies revealing the gap between knowledge, attitude and behavior, as even if many people are aware, they do not apply proper posture, which means a need for further research in this aspect [26,27,30,31,34].

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The Increased use of digital devices, particularly people with many hours spent on screens, has found Computer Vision Syndrome (CVS) contributing to a greater prevalence in recent times[40-43]. This research finds significant results in the correlation of neck, shoulder, back, thigh and calf. Other studies found that CVS is usually linked significantly to musculoskeletal pain especially on neck, shoulder, and back problems[40-47]. There is limited research examining the relationship between CVS and lower limb pain where [41,47,48] mention a small prevalence on foot pain, but none proving direct cause-effect relation with CVS, emphasizing the need for more studies. Several studies have demonstrated that poor ergonomics and prolonged screen time worsen these musculoskeletal symptoms and emphasized the significance of trying to circumvent the implications of CVS and musculoskeletal disorders[40,49]. For example, Das et al. (2022) showed a significant relationship between CVS presence and musculoskeletal symptoms prevalence, while CVS significantly correlated with poor ergonomic practices and high screen time [43]. Maintenance of an ergonomic posture leads to a significant improvement in the symptoms [42].

One advantage of this study is its detailed assessment of pain in both the upper and lower limbs which has not been extensively reported in the literature, particularly in relation to primary school-aged children. However, the study has some limitations. External factors such as ergonomic setups, lifestyle habits that could potentially impact the results were not studied. These gaps serve to identify areas for future studies to enable more focused interventions.

CONCLUSION

Knowledge, attitude, and behavior affect the incidence of Computer Vision Syndrome (CVS) and musculoskeletal pain in gadget users at SDN Wonotingal 01-02. CVS status was largely correlated with musculoskeletal pain. More larger sample studies focusing on lower limb pain and other knowledge, attitude and behavior related factors are needed.

ETHICAL APPROVAL

The Research Ethics Committee at the Health and Medical Research Ethics Commission of RSUP Dr. Kariadi Semarang, Indonesia granted ethical approval with the ethical clearance number No. 289/EC/KEPK/FK-UNDIP/VI/2024

CONFLICTS OF INTEREST

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