SPMRJ Volume 6 No. 1 February 2024
SINTA 5 (Decree No: 200/M/KPT/2020)
DOI: 10.20473/spmrj.v6i1.49595
Available online at https://e-journal.unair.ac.id/SPMRJ

Original Research

Musculoskeletal Pain Descriptions in Adolescence with Internet Addiction: Community Engagement in Senior High School

Budiati Laksmitasari[1,2], Fitri Anestherita[1,2], Rizky Kusuma Wardhani[1,2], Peggy Sunarjo[1,2], Melinda Harini[1,2], Steven Setiono[1,2], Ibrahim Agung[1]
[1]Physical Medicine and Rehabilitation Department, Faculty of Medicine Universitas Indonesia/Dr Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia.
[2]Doctoral Program, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia.

Correspondent:
Peggy Sunarjo, Physical Medicine and Rehabilitation Department, Faculty of Medicine Universitas Indonesia-Dr Cipto Mangunkusumo National General Hospital, Jakarta 10430, Indonesia, Email: roswitapeggy@gmail.com, Phone: +628527892785

Article info:

Received: September 11, 2023

Received in revised: November 6, 2023

Accepted: January 31, 2024

Published: February 28, 2024

Cite this as: Sunarjo P, Budiati Laksmitasari, Fitri Anestherita, Rizky Kusuma Wardhani, Melinda Harini, Steven Setiono, Ibrahim Agung. Musculoskeletal Pain Description in Adolescence with Internet Addiction: Community Engagement in Senior High School. SPMRJ Vol 6 No. 1, 1-15.

Abstract

Background: A habit of accessing internet using gadget, especially with some bad postures, might lead to some complications in adolescence. Previous study reported that more than 50% of students have musculoskeletal pain due to internet use.
Aim: In this community engagement program, we tried to explore internet addiction and musculoskeletal pain proportions in some students. We also explored the descriptions of pain, including pain intensity and interference with activity.
Material and methods: This is a cross-sectional study conducted in a senior high school at Jonggol, West Java, in February 2023. Students were gathered to have an education class about good posture. Before the education session, we asked the students to explore whether they had internet addiction and musculoskeletal pain by filling out the Indonesian Internet Addiction Diagnostic Questionnaire and Cornell Musculoskeletal Discomfort Questionnaire.
Results: Thirty-nine students were involved in this study. As many as 19 (48.7%) students have an internet addiction. More than 50% of the addicted students often have moderate-severe pain in their neck, back and right wrist and reported that the pain interferes with their daily activities.
Conclusions: Almost half of students attending posture education class had internet addiction and musculoskeletal pain. A further study with a larger sample size needs to be conducted to show the correlation between internet addiction and musculoskeletal pain in adolescence and other factors that correlate with them.

Keywords: *adolescence, bad posture, internet addiction, musculoskeletal pain*

INTRODUCTION

Bad posture since childhood might lead to some complications, especially in adolescence with internet addiction. Research conducted on the posture and health of children has underscored the need to cultivate appropriate posture during the early stages of development. Improper body positioning assumed during early stages of development, whether in educational or everyday settings, can lead to deviations in postural growth and harm to the musculoskeletal structure.[1]

Modern lifestyles, characterized by increased sedentary behaviour and excessive use of technologies like television, video games, and the internet, have negatively affected human motor behaviour. Lack of regular physical activity and excessive gadget usage can lead to poor physical condition, contributing to anatomical or biomechanical modifications of the spinal cord and resulting in musculoskeletal issues.[2] Internet addiction is usually described as having no control over how much time is spent online.[3]

Previous study reported that more than 50% of university students have musculoskeletal pain regarding to the internet addiction.[4] Musculoskeletal pain is a widespread medical and socioeconomic issue worldwide, affecting bones, muscles, ligaments, tendons, and nerves. Chronic musculoskeletal pain can significantly diminish quality of life, leading to increased suffering in daily activities, higher drug consumption, and more frequent sick leave and disability pensions.[5]

The occurrence of forward head posture (FHP) may be associated with neck pain that arises from continuous use of electronic devices. The application of excessive force on the neck resulting from flexion postures has the potential to induce muscular tension, disc herniation, arthritis, ligament instability within the cervical joints, and compression of spinal nerves, hence eliciting discomfort in the regions of the neck, shoulders, and back.[6]

Modern lifestyles, including sedentary behaviour and excessive internet use, can contribute to postural issues and

musculoskeletal pain. It is crucial to promote proper posture and physical activity, particularly in children, to ensure healthy development and reduce the risk of long-term complications.[1]

The objectives of this study were: 1) to explore internet addiction and musculoskeletal pain proportions and 2) to describe the pain intensity and interference with activity, in some students regarding to the internet addiction.

MATERIALS AND METHODS

The design of this study was cross-sectional, and the sample method was consecutive sampling. The research was conducted on senior high school students in Jonggol, West Java. The subject was excluded if he/she refuses to answer all questionnaire completely.

The data were collected in February 2023 in a community engagement event of the Doctoral Study Program. The analysis study was conducted in September 2023. The demographic data collected were age, sex, nutrition status, and internet addiction.

The Indonesian Internet Addiction Diagnostic Questionnaire, or *Kuesioner Diagnostik Adiksi Internet* (KDAI) is a valid and reliable questionnaire that is designed to be user-friendly for adolescents between the ages of 10 and 20. This questionnaire can be utilized by the parents and educators to assess the presence of internet addiction in teenagers at an early stage. The KDAI comprises a total of 44 statements. There are seven answer alternatives provided for each statement: seldom occurrence, occasional occurrence, regular occurrence, frequent occurrence, consistent occurrence, constant occurrence, and unsuitable. Adolescents possess the ability to select the statement that is best suited for a given context. Responses were chosen based on the state of the teenager during the preceding 12-month period.[7]

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) is a comprehensive tool that integrates both the frequency and intensity of musculoskeletal pain that has good validity and high reliability. This questionnaire is designed to assess and quantify the amount of pain experienced by individuals. Notably, the

CMDQ efficiently presents this information in a concise chart format, occupying only a single page. Three distinct items were provided to the participants in the Cornell questionnaire. In this discourse, the primary objective is to rephrase the user's text in an academic manner 1) During the previous work week, what was the frequency of instances in which you experienced discomfort, pain, or ache? 2) In the event that you encountered discomfort, pain, or ache, how would you rate the intensity of this sensation? 3) If you encountered discomfort, pain, or ache, to what extent did it impact your ability to do job tasks?[8,9]

This study had an independent variable (neck pain frequency, neck pain intensity, pain interferes with neck activity) and dependent variable (internet addiction).

The demographic data describing participants' characteristics (age, sex, nutrition status, internet addiction) were analysed descriptively, and the crosstab analysis of the characteristics of each variable was presented as frequency and percentage. Collected data were analysed using IBM SPSS Statistics V.24.

RESULT

This study involved 39 students at a Senior High School in Jonggol, West Java Province, Indonesia, who completed the questionnaire. The characteristics of participants' demographics is shown in Table 1. Of all the subjects, 89.7% of students were female, while 10.3% were male. The range of age was 15 to 18 years old, with a median age of 16 years old. Regarding the Body Mass Index (BMI), 33.3% of students were underweight, 51.3% were normal, and 15.4% were overweight or obese. The percentage of students without internet addiction was 51.3%, while the percentage of students with internet addiction was 48.7% (Table 1).

This study found that the proportion of female students who have internet addiction (51.4%) was slightly greater than that of female students without internet addiction (48.6%). Conversely, the proportion of male students who were not addicted (75%) was greater than that of those who were addicted (25%) (Table 2).

Table 1. Participants Demographic Characteristics

Characteristics	**Frequency (Percentage)**	**Median (min-max)**
Gender:		
Male	4 (10.3%)	
Female	35 (89.7%)	
Age (years)		16 (15-18)
Body Mass Index		
Underweight	13 (33.3%)	
Normal	20 (51.3%)	
Overweight and Obese	6 (15.4%)	
Internet Addiction		
Non-Addiction	20 (51.3%)	
Addiction	19 (48.7%)	

Table 2. Proportion of Addiction and No Addiction per Gender

		Internet Addiction		**Total**
		Not Addicted	**Addicted**	
Gender	Man	3 (75%)	1 (25%)	4
	Woman	17 (48.6%)	18 (51.4%)	35
Total		20 (51.3%)	19 (48.7%)	39

Table 3. Proportion of Addiction and No Addiction with Frequency, Intensity, and Interference with Activities in Neck Pain

	Internet Addiction	
	Not Addicted	**Addicted**
Pain Frequency		
Not often	18 (90%)	6 (31.6%)
Often	2 (10%)	13 (68.4%)
Total	20 (100%)	19 (100%)
Pain Intensity		
Light	10 (50%)	0 (0%)
Moderate -Severe	10 (50%)	19 (100%)
Total	20 (100%	19 (100%)
Activity Pain Interference		
Not interference with activity	11 (55%)	9 (47.4%)
Interference with activity	9 (45%)	10 (52.6%)
Total	20 (100%)	19 (100%)

Table 4. Proportion of Addiction and No Addiction with Frequency, Intensity, and Interference with Activities in Back Pain

	Internet Addiction	
	Not Addicted	**Addicted**
Pain Frequency		
Not often	16 (80%)	13 (68.4%)
Often	4 (20%)	6 (31.6%)
Total	20 (100%)	19 (100%)
Pain Intensity		
Light	11 (55%)	1 (5.3%)
Moderate-Severe	9 (45%)	18 (94.7%)
Total	20 (100%)	19 (100%)
Activity Pain Interference		
Not interference with activity	18 (90%)	5 (26.3%)
Interference with activity	2 (10%)	14 (73.7%)
Total	20 (100%)	19 (100%)

Table 5. Proportion of Addiction and Not Addiction with Frequency, Intensity, and Activity Interference in Hip Pain

	Internet Addiction	
	Not Addicted	**Addicted**
Pain Frequency		
Not often	17 (85%)	12 (63.2%)
Often	3 (15%)	7 (36.8%)
Total	20 (100%)	19 (100%)
Pain Intensity		
Light	10 (50%)	1 (5.3%)
Moderate-Severe	10 (50%)	18 (94.7%)
Total	20 (100%)	19 (100%)
Activity Pain Interference		
Not interference with activity	12 (60%)	9 (47.4%)
Interference with activity	8 (40%)	10 (52.6%)
Total	20 (100%)	19 (100%)

Table 6. Proportion of Addiction and No Addiction Student with Frequency, Intensity, and Activity Interference in Right Wrist Pain

	Internet Addiction	
	Not Addicted	**Addicted**
Pain Frequency		
Not often	17 (85%)	9 (47.4%)
Often	3 (15%)	10 (52.6%)
Total	20 (100%)	19 (100%)
Pain Intensity		
Light	10 (50%)	1 (5.3%)
Moderate - Severe	10 (50%)	18 (94.7%)
Total	20 (100%)	19 (100%)
Activity Pain Interference		
Not interference with activity	15 (75%)	6 (31.6%)
Interference with activity	5 (25%)	13 (68.4%)
Total	20 (100%)	19 (100%)

The proportion of addiction and not addiction related to frequency, intensity and interference with activity of neck pain are reported in table 3. It showed that among students who were addicted, the proportion of those who often experienced neck pain (68.4%) was greater than that of those who seldom experience neck pain (31.6%). Of all subjects in the not-addicted group, 90% seldom experience neck pain. All the students with internet addiction experienced moderate to severe neck pain. Meanwhile, only half of the students without internet addiction experienced moderate-severe neck pain. More than half of addicted students reported that their pain interfered with their activity (52.6%), while less than half of non-addicted students reported that their pain interfered with their activity (45%). Table 4 showed the proportion of addiction and not addiction related to the frequency, intensity, and interference with activity of back pain. Among students who were not addicted, 20% of them often experienced back pain. Meanwhile, 31.6% students with addiction often experiences back pain.

Less than half of the non-addicted students experienced moderate-severe intensity of back pain (45%), while majority of the addicted students experienced moderate-severy intensity of back pain (94.7%). In non-addicted group, only 10% of students feel interfered with by their back pain while doing daily activities. In contrast, 73.7% students reported that their daily activities are hampered by back pain.

Table 5 showed the proportion of addiction and non-addiction with frequency, intensity, and interference with activity regarding to the hip pain. Among students who were not addicted, the proportion of students who often experience hip pain was 15%. Meanwhile, in the group of addicted students, 36.8% of students often feel hip pain. Regarding pain intensity, half of the non-addicted students have moderate-severe hip pain (50%), while almost all of the addicted students have moderate-severe hip pain (94.7%). In the non-addicted group, 40% of students reported interference from their hip pain with activity. Of all the students in the addicted group, 52.6% felt that their hip pain interfered with their activities.

Table 6 showed the proportion of addiction and non-addiction student with

frequency, intensity, and activity pain interference regarding to the right wrist pain. Among students who were not addicted, 15% often experience right wrist pain. Meanwhile, 52.6% of students who were addicted often experience right wrist pain. Half of the non-addicted students have moderate-severe right wrist pain (50%), while majority of the addicted students have moderate-severe right wrist pain (94.7%). Only 25% of students in non-addicted group reported interference with their right wrist pain with activity. Conversely, 68.4% of students in the addicted group felt that their wrist pain interfered with their daily activities.

DISCUSSION

This is a descriptive study using a cross-sectional design to describe the data regarding internet addiction and the risk of musculoskeletal discomfort in adolescents. We reported the characteristics of musculoskeletal pain in several joints, including neck, back, hip, and wrist pain.

In all subjects, the percentage of students who were addicted to the internet was 48.7%. The proportion of internet addiction in this study is quite similar to the previous study in Asia. It was reported that 40% of adolescents in Asia were addicted to the internet.[10] According to a 2015 survey conducted by Jacob Poushter (2016), approximately 48.7% of students had internet addiction.[11] A study in Indonesia also reported the prevalence of internet addiction, but they used different assessment tools and the subjects are university students with prevalence of 3.2%.[4] The university students and senior high school students may have different characteristics of maturation. Adolescents are more susceptible to internet addiction than adults. There are factors that could affect this susceptibility, such as the personality, mental function, psychological condition, and brain development.[3]

The proportion of female students with addiction was greater than that of male students. It is difficult to compare proportions based on gender, as the number of female and male subjects was much different. However, previous studies reported that females were more dependent on the Internet compared to males. [12,13]

Of all students with internet addiction, more than 50% often have moderate-severe pain in the neck, back, hip

and right wrist. Teenagers devote a great deal of time to education. Low back pain and muscle fatigue may be exacerbated by prolonged periods of uncomfortable posture at school, where workstations and chairs cannot be adjusted like those at home. [14,15] In a survey conducted by Jacob Poushter (2016), the likelihood of experiencing negative health consequences from internet addiction, including symptoms associated with improper body positions, escalated with higher frequency and longer length of device usage.[11]

According to a study conducted at a high school located in Probolinggo, a significant proportion of students, specifically 58.2%, reported experiencing neck discomfort as a result of smartphone usage.[16] A cross-sectional study in 283 subjects by Kumari et al. from India, also found a high incidence of mild to severe neck pain, defined as *"text neck syndrome"* from smartphone user in Indian college students. Out of all subjects, 36.5% reported mild intensity, 23.4% reported moderate intensity, 2.1% reported severe intensity of text neck syndrome, and 35.7% did not suffer from text neck syndrome. In addition, 73.4% of participants reported mild to severe pain in neck and upper back region.[17]

Another study from Ahmed et al. reported the prevalence rate of musculoskeletal pain in the neck, shoulder, and elbow in students with smartphone addiction is 43.3%, 42.9%, and 27.9% respectively. They also found a significant relationship between addiction and neck disability index (NDI) ($p = 0.047$, CI 95%).[18]

Al Abdulwahab et al. reported that smartphone addiction can lead to poor posture causing significant disability to the neck. Continuous smartphone usage can lead to the development of faulty postures such as forward head and neck. It may further increase the risk of cervical spine injuries that can cause cervical pain.[19] The occurrence of forward head position is reported to be 66% among those aged 20-30 years, with a higher incidence observed in women (24.1%) compared to males (9.1%).[20]

The entirety of the addicted population has a level of pain that ranges from mild to severe in severity. A recent study was conducted to examine smartphone usage patterns among high school students

in Jakarta. The study included a sample size of 164 participants, specifically targeting individuals aged between 15 and 20 years. A significant majority of 84.1% among them expressed experiencing neck pain as a consequence of smartphone usage.[21]

The association is further substantiated by the results of a study carried out in Saudi Arabia, whereby it was reported that 71.2% of students who were examined as research participants had instances of neck discomfort as a consequence of prolonged usage of electronic devices.[22]

Moreover, results of this study indicated more than 50% of students defined that the pain substantially interfered with their activity, including pain in the back, neck, hip, and right wrist. Back pain may occur because of bad posture. The occurrence of neck musculoskeletal disorders, specifically those involving altered cervical posture, has been found to be associated with thoracic kyphosis and rounded shoulder position.[23,24]

People who spend a long duration of time in front of the computer or phone have a risk of forward head posture. This is a postural disorder where the center of gravity (COG) shifts in front of the cervical spine, increasing the load on the neck and causing neck strain. As a result, mechanical stress occurs in the region, which causes an imbalance in the muscles in the region. Muscle imbalance led to a synchronous postural disorder, including increased shoulder elevation, increased thoracic kyphosis, and forward head posture. As the cervical and thoracic vertebrae are affected, an increase in thoracic kyphosis angle is observed. There was a significant relationship between thoracic kyphosis angle and both internet addiction and duration of internet use. The increase in thoracic kyphosis angle with the duration of the internet usage is caused by the inability of a person to maintain their proper body postures during internet use.[25]

Study from Maria et al. showed a similar report that internet or smartphone addiction may result in postural disorder. Smartphone usage significantly affected shoulder protraction on the non-dominant side ($p = 0.000$); thoracic kyphosis ($p = 0.000$); lateral neck flexion ($p = 0.029$ left and $p = 0.001$ right); and pelvic obliquity ($p = 0.000$ left and right). The results

indicate that smartphones negatively affect postures and may result in severe long-term clinical implications such as chronic neck pain, upper back pain, low back pain, headaches, and decreased concentration.[26]

In this study, most of the addicted students who suffered right wrist pain had moderate to severe pain intensity (94.7%) and had interference or disability in their daily activities (68.4%). Many smart phone or internet addicts experience pain in the thumb or wrist. This pain can be due to certain types of hand injuries as well as inflammation of the extensor pollicis brevis and the abductor pollicis longus tendon sheaths, known as De Quervain tenosynovitis. Ayman et al. conducted a study to evaluate the association between smartphone addiction with wrist and thumb pain. Of 387 medical students who participated in this study, 257 (66.4%) participants were smartphone addicts, and 74 (19.1%) of them had positive Finkelstein test as indication of possible De Quervain's syndrome.[27]

In the current study, 52.6% of all participants often experienced pain in the right wrist. This is similar to the findings from previous studies. In a study from China, 43.4% of participants experienced thumb or wrist pain due to the use of different electronic devices.[28] A study from Pakistan reported 42% of adolescents have pain in the thumb or wrist due to smartphone use.[29]

Gold et al. observed 90% of subjects who type with a non-neutral wrist have severe risk for disorders of the arm and hand, especially for carpal tunnel syndrome, which may also contribute to wrist pain and disability.[30] With respect to the wrist, every deviation from neutral position between 15° flexion and extension is assessed as a risk factor for musculoskeletal disorders. If the wrist is flexed or extended above 15°, it scores as an even greater risk for musculoskeletal disorders, according to Tegtmeier et al. [31]

In the last two decades, musculoskeletal pain has been increasingly common in adolescents, with rates anywhere from 4–70%, making them comparable to those of adults. Reports of low back discomfort rise with age, reaching a peak around age 14.[32]

Improvements in posture, body alignment, and balance can all be achieved with the help of physical therapy.[23] Engaging in physical activity effectively mitigates the development of scoliosis. The implementation of exercises aimed at strengthening weak muscles, extending tight muscles, and enhancing motor control.[33]

This is the first study to describe musculoskeletal pain related to internet addiction among senior high school students in our country. There are several drawbacks to this study. The significance of the proportion difference was not analysed because of the limitation of the sample size. Causal inferences are difficult to establish due to the cross-sectional character of the data. There was no report about several subjects who suffer multi-region of pain. The participants were limited to senior high school students and excluded students who had dropped out or were missing on the day of the screening.

CONCLUSION

This cross-sectional study found that 48.7% of high senior school students have an internet addiction. It is also indicated that students who have internet addiction have more musculoskeletal pain than students who are not addicted. The intensity of pain and the interference in daily activity are also greater in the group of students with internet addiction. Additional research using a larger sample size is warranted to establish a correlation between internet addiction and musculoskeletal discomfort in adolescence, as well as to identify other characteristics and factors that may be associated with these phenomena.

DISCLOSURES

Conflict of interest

All authors have no conflict of interest.

Author Contribution

All authors have contributed to all processes in this research, including preparation, data gathering and analysis, drafting, and approval for publication of this manuscript.

REFERENCES

1. Maekawa M, Yoshizawa E, Hayata G. et al. Physical and psychological effects of postural educational intervention for students experienced school refusal. Curr Psychol. 2023; 42: 3510–9. DOI:10.1007/s12144-021-01677-9.

2. Quka N, Stratoberdha Dh, Selenica R. Risk factors of poor posture in children and its prevalence. Acad J Interdisciplinary Stud. 2015; 4(3): 97-102. DOI: 10.5901/ajis.2015.v4n3p97.

3. Maekawa M, Yoshizawa E, Hayata G. et al. Physical and psychological effects of postural educational intervention for students experienced school refusal. Curr Psychol. 2023; 42: 3510–9. DOI:10.1007/s12144-021-01677-9.
4. Quka N, Stratoberdha Dh, Selenica R. Risk factors of poor posture in children and its prevalence. Acad J Interdisciplinary Stud. 2015; 4(3): 97-102. DOI: 10.5901/ajis.2015.v4n3p97.
5. Lu R. Adolescents' internet addiction: influence factors, risks and neuroscience connectivity. J Educ Hum Soc Sci. 2023; 8: 483-90. DOI: 10.54097/ehss.v8i.4293.
6. Pratama GB, Widyanti A. internet addiction among Indonesia university students: musculoskeletal symptoms, physical and psychosocial behavior problems. IOP Conf Ser: Mater Sci Eng. 2019; 528: 1-8.
7. Clinch J, Eccleston C. Chronic musculoskeletal pain in children: assessment and management. Rheumatology (Oxford). May 2009; 48(5): 466-74. DOI: 10.1093/rheumatology/kep001.
8. Soetomo CT, Primayanti IDAI, Sundari LPR. The correlation between posture, duration of gadget usage and physical activity during COVID-19 pandemic to the occurrence of neck pain among medical students in Udayana University. Sports Fitness J. 2022; 10(1): 37-44. DOI: 10.24843/spj.2022.v10.i01.p06.
9. Kurniasanti KS. Development of Kuesioner Diagnostik Adiksi Internet for Adolescents: Brain Functional Connectivity through fMRI BOLD, Study of Prevalence, Risk Factors, and Protective Factors [dissertation]. Jakarta: Universitas Indonesia; 2019.
10. Hedge A. Cornell Musculoskeletal Discomfort Questionnaires (CMDQ). Cornell University Ergonomics Web [Internet]. 1999. Available from: http://ergo.human.cornell.edu/ahmsquest.html.
11. Maekawa M, Yoshizawa E, Hayata G. et al. Physical and psychological effects of postural educational intervention for students experienced school refusal. Curr Psychol. 2023; 42: 3510–9. DOI:10.1007/s12144-021-01677-9.
12. Quka N, Stratoberdha Dh, Selenica R. Risk factors of poor posture in children and its prevalence. Acad J Interdisciplinary Stud. 2015; 4(3): 97-102. DOI: 10.5901/ajis.2015.v4n3p97.
13. Lu R. Adolescents' internet addiction: influence factors, risks and neuroscience connectivity. J Educ Hum Soc Sci. 2023; 8: 483-90. DOI: 10.54097/ehss.v8i.4293.
14. Pratama GB, Widyanti A. internet addiction among Indonesia university students: musculoskeletal symptoms, physical and psychosocial behavior problems. IOP Conf Ser: Mater Sci Eng. 2019; 528: 1-8.
15. Clinch J, Eccleston C. Chronic musculoskeletal pain in children: assessment and management. Rheumatology (Oxford). May 2009; 48(5): 466-74. DOI: 10.1093/rheumatology/kep001.
16. Soetomo CT, Primayanti IDAI, Sundari LPR. The correlation between posture, duration of gadget usage and physical activity during COVID-19 pandemic to the occurrence of neck pain among medical students in Udayana University. Sports Fitness J. 2022; 10(1): 37-44. DOI: 10.24843/spj.2022.v10.i01.p06.
17. Kurniasanti KS. Development of Kuesioner Diagnostik Adiksi Internet for Adolescents: Brain Functional Connectivity through fMRI BOLD, Study of Prevalence, Risk Factors, and Protective Factors

[dissertation]. Jakarta: Universitas Indonesia; 2019.
18. Hedge A. Cornell Musculoskeletal Discomfort Questionnaires (CMDQ). Cornell University Ergonomics Web [Internet]. 1999. Available from: http://ergo.human.cornell.edu/ahmsquest.html
19. Shariat A, Tamrin SBM, Arumugam M, Ramasamy R. The bahasa Melayu version of Cornell Musculoskeletal Discomfort Questionnaire (CMDQ): reliability and validity study in Malaysia. Work. 2016; 54(1): 171–8. DOI:10.3233/wor-162269.
20. Kurniasanti KS, Wiguna T, Wiwie M, Winarsih NS. Internet Addiction Among Adolescents in Jakarta: A Challenging Situation for Mental Health Development. J Int Dent Med Res. 2018; 11(2): 711-7.
21. Poushter J. Smartphone ownership and internet usage continues to climb in emerging economies [Internet]. 2016 [cited 2023 February 1]. Available from: https://www.pewresearch.org/global/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/
22. Yang G, Cao J, Li Y, Cheng P, Liu B, Hao Z, et al. Association between internet addiction and the risk of musculoskeletal pain in Chinese college freshmen - a cross-sectional study. Front Psychol. 2019; 10: 1959. DOI: 10.3389/fpsyg.2019.01959.
23. Malak MZ, Khalifeh AH, Shuhaiber AH. Prevalence of internet addiction and associated risk factors in Jordanian school students. Comput Hum Behav. 2017; 70: 556–63.
24. Ojha R, Sindhu B, Sen S. Effects of smartphone addiction on sitting neck posture & hand discomfort: a cross sectional study. Int J Health Sci. 2022; 6(S2): 13642-50. DOI: 10.53730/ijhs.v6nS2.8595.
25. Jung KS, Jung JH, In TS, Cho HY. Effects of prolonged sitting with slumped posture on trunk muscular fatigue in adolescents with and without chronic lower back pain. Medicina. 2020; 57(1): 3. DOI: 10.3390/medicina57010003.
26. Widhiyanto A, Munawir A, Prayitno H. The effect of duration of smartphone usage on neck pain. Dama Int J Researchers. 2017; 2(11): 54–6.
27. Kumari S, Kumar R, Sharma D. Text Neck Syndrome: The Pain of Modern Era. Dama Int J Researchers. 2021; 11: 161–5.
28. Ahmed S, Mishra A, Akter R, Shah M, Sadia A. Smartphone addiction and its impact on musculoskeletal pain in neck, shoulder, elbow, and hand among college going students: a cross-sectional study. Bulletin of Faculty of Physical Therapy. 2022; 27: 5.
29. Al-Abdulwahab SS, Kachanathu SJ, Al-Motairi MS. Smartphone use addiction can cause neck disability. Musculoskelet Care. 2017;15:10–2. DOI: 10.1002/msc.1170
30. Wiguna NP, Wahyuni N, Indrayani AW, Wibawa A, Thanaya SAP. The relationship between smartphone addiction and forward head posture in junior high school students in North Denpasar. Jurnal Epidemiologi Kesehatan Komunitas. 2019; 4. 84-9.
31. Yustianti YT, Pusparini. Hubungan intensitas pemakaian gawai dengan neck pain pada usia 15-20 tahun. Jurnal Biomedika dan Kesehatan. 2019; 2(2): 71-76.
32. Al Zaera BK, Patil SR. Mobile phone head and neck pain syndrome: proposal of a new entity. J Oral Health Dent Manag. 2015; 14(15): 313-7.
33. Fernández-de-las-Peñas C, Alonso-Blanco C, Cuadrado ML, et al. Forward head posture and neck mobility in chronic tension-type headache: a blinded, controlled study. Cephalgia. 2006; 26: 314–9.
34. Park HC, Kim YS, Seok SH, et al. The effect of complex training on the children with all of the deformities including forward head, rounded shoulder posture, and lumbar lordosis. J Exerc Rehabil, 2014, 10: 172–5.

35. Karacan K, ÇeliK H, Erdoğan M. Evaluation of the Relationship between Internet Addiction and the Thoracal Kyphosis Angle on Medical Faculty Students. J Contemp Med. 2021; 11(1): 57–61.
36. Maria E, Tshabalala MD, Hlatswayo NC, Modipana RM, Makibelo PP, Mashale EP, et al. The short-term effect of smartphone usage on the upper-back postures of university students. Cogent Eng. 2019; 6(1): 1627752.
37. Baabdullah A, Bokhary D, Kabli Y, Saggaf O, Daiwali M, Hamdi A. The association between smartphone addiction and thumb/wrist pain. Medicine (Baltimore). 2020; 99(10): e19124.
38. Woo EH, White P, Lai CW. Musculoskeletal impact of the use of various types of electronic devices on university students in Hong Kong: an evaluation by means of self-reported questionnaire. Man Ther. 2016; 26: 47–53.
39. Ali M, Asim M, Danish SH, et al. Frequency of De Quervain's tenosynovitis and its association with SMS texting. Muscles Ligaments Tendons J. 2014; 4: 74–8.
40. Gold JE, Driban JB, Thomas N, Chakravarty T, Channell V, Komaroff E. Postures, typing strategies, and gender differences in mobile device usage: an observational study. Appl Ergon. 2012; 43(2): 408–12.
41. Tegtmeier P. A scoping review on smart mobile devices and physical strain. Work. Jan 2018; 59(2): 273–83.
42. Ozdemir S, Gencbas D, Tosun B, Bebis H, Sinan O. musculoskeletal pain, related factors, and posture profiles among adolescents: a cross-sectional study from Turkey. Pain Manag Nurs. Aug 2021; 22(4): 522-30. DOI: 10.1016/j.pmn.2020.11.013.
43. Kowalski IM, Dwornik M, Lewandowski R, Pierożyński B, Raistenskis J, Krzych ŁJ, et al. Early detection of idiopathic scoliosis–analysis of three screening models. Arch Med Sci. 2015; 11(5): 1058.