ORIGINAL RESEARCH

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Effects of Smart Phone Gaming on Hand Strength and Dexterity

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ABSTRACT

Background: Mobile phones are becoming an absolute need in routine life. Mobile gadgets have developed into a portal to a wide selection of creative and competitive activities. The ease of use and cost effective of mobile phones has led to an increase in their popularity of gaming in past decade. Prior reports show that students who involve themselves in gaming activities on mobile phones, spend approximately 3 to 4.5 hrs on the activity. Due to scarcity of information and need to explore the association between hand strength and dexterity among smart phone gamers and its consequences on functions of hand.

Objective: To evaluate the hand strength and dexterity among gaming and non gaming population.

Method: After getting consent 288 subjects were recruited based on the inclusion and exclusion criteria from College's in and around Bangalore South for this study. Accordingly the candidates were divided into case and control group. The assessment for grip strength, pinch strength and dexterity using HHD, Pinch meter and Jebsen Taylor hand function test was done. The analysis of obtained data was done using descriptive and inferential statistics by SPSS.

Results: There is a statistically significance association seen in grip strength, pinch strength and dexterity with the p-value < 0.05.

Interpretation and Conclusion: There was a strong association existed between the hand strength and dexterity in gaming population compared to non gaming population

Keywords

Grip strength, pinch strength, hand dexterity, Students, Gamers, Non gamers.

Imprint

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Introduction

A Mobile phone is a gadget that allows you to make and receive phone calls over a radio link while travelling across a large region(1). Mobile phones have become an indispensable part of our daily lives. Many people feel incomplete without these small devices (1). Over the past ten years, popularity of mobile devices and games has increased as a result of their convenience, entertainment, and ease of use. A research on game play in Finland shows that in less than a decade (2009-2018), the percentage of individuals using mobile devices to play games increased dramatically, from 44% to 57% (4). With the rapid advancement in mobile technology, many desktop computer applications have been ported to mobile gadgets such as smart phones and tablets, particularly in the case of game applications (2). The modern environment mobile gaming when compared to gaming at the turn of the century, seems very different. Thanks to new generations of cellular networks (3G, 4G, 5G), powerful and relatively inexpensive touch screen consumer devices, and a continually updated stream of software and services. With today's prevalent technology players are able to connect with other gaming users through online gaming platforms. These video games have multiple components that make them very pleasurable: immersive surroundings, in-game accomplishments, and social play (1, 2). China Internet Network (CNNIC) study, the growth index of mobile online games has reached 9.6%, with teens being the dominant user demographic(6). Another research shows students who involve in gaming approximately spends around 3-4.5 hrs only on gaming. The term "problematic mobile video gaming" refers to a situation when players become excessively dependent on mobile games and are unable to quit playing them for an extended period of time.. The hand grips are important and basic functions for daily life activities. Stable hand grip and object manipulation are frequently used movements performed in activities of daily living (ADL) and occupational field. Any reduction in hand grip strength, control and coordination ability can be caused by physical and physiological factors (1, 2). Prehension is the act of grabbing or grasping, and prehensile refers to the adaption of

an organ for holding onto or encircling a hand object. Only the hand is a prehensile organ in humans. The risks and side effects of continuous usage of a smartphone include dry eyes, computer vision issues, neck and shoulder troubles, De Quervain's tenosynovitis, thumb and wrist weakness, and others (9). The thumb and wrist weakness is caused by repetitive flexion and extension movements over the wrist and fingers, as the amount of time spent on smart phone increases it produces discomfort and tiredness Furthermore, repeated wrist flexion and extension are recognized to be among the major causes of carpal tunnel syndrome. Hand, arm, and shoulder injuries are on the rise due to the increased use of computers and smart phones at work, home, and school. Play station thumb is a repetitive stress injury (RSI) brought on by playing PlayStation games nonstop for long periods of time. It can cause blisters on the thumb tips and soreness in the thumbs. Additionally discomfort, pain, stiffness, edema, numbness, or tingling in the hands, wrists, elbow and in long run affect the shoulders, back and neck. (11). These challenges would reduce the hand's functioning over time and might lead to psychological concerns as to a bad quality of life.

Materials and Methodology

Ethical Clearance was acquired from the institutional ethical committee approval from Krupanidhi College of Physiotherpahy, Bangalore (Ref. No: EC – MPT/21/PHY/010). The study design is an observational case control research study and a convenient sampling technique was performed in College's in and around Bangalore South. The study was conducted in between June 2021 – July 2022.People with neuropathy, such as CTS, radiculopathy, prior contracture, tendon lesions, anyone who had hand trauma in the previous six months, anyone experiencing hand pain or inflammation, participants using controllers or desktops to play mobile games, and individuals who induced in gaming for three hours or less were excluded. Each interested participant were signed the informed consent for the study was explained.

Participants were invited to volunteer in a Google Form survey exploration, and a pertinent link was sent to them through email, based on the information gathered from questionnaires submitted via a Google form. Assessment forms were allotted to the gaming population and the participants were asked to monitor their everyday gaming time duration and document it in the assessment form given. Relative report was collected every week for 16 weeks (2 months) and depending on the outcomes and criteria's the case and control group was chosen. Age, gender, dominant hand, and number of months spent playing games on a smartphone were all noted for each participant.

288 college students of age ranging between 18–25 years were embraced in the study. Among the 288 pupils, 144 regularly played games on their smart phones considered as case group, whereas the other 144 did not considered as control group.

Clinical Assessment of Grip strength, pinch strength and dexterity.

The dominant and non-dominant extremity were assessed for grip and pinch strengths (measured in kilograms). They were determined using a Jamar hand dynamometer and pinch meter (Sammons Preston, Inc., Bolingbrook, IL, USA). The participants maintained their arms in the positions recommended by the American Society of Hand Therapists while sitting: elbow bent 90 degrees, forearm in neutral, wrist in neutral, shoulder abducted and rotated in a neutral position. Each participant squeezed as hard as they could on the dynamometer handle while maintaining maximum grip contraction. With a 30- second pause in between each repetition, Three times this movement was performed. Poorer grip and pinch strengths were indicated by lower scores, which were determined as the average of the three trials.

Similarly dexterity is also tested using Jebsen taylore hand function scale (JTHFT). The test is given while the subjects were made to sit in front of an adjustable table following the JTHFT's defined protocols. The test is made up of seven subsequent subtests that represent fine motor, non-weighted, and weighted function of hand in ADL. These include writing, turning over 3-by-5-inch cards (which simulates turning pages), lifting small everyday objects, simulating feeding, and stacking checkers, picking up empty large cans, and picking up weighted large cans. The subtests were presented in the same order, starting with the non-dominant hand and working up to the dominant hand. All subtests included verbal standardized instructions, followed by particular questions to guarantee test familiarity. The measurement outcome included how long it took to complete each subtest (in seconds); the most time allowed for a subtest was 120 seconds. After computing the total duration for each of the seven subtests, the final score was calculated.

Greater degrees of hand function were indicated by lower scores. The data was created and filled in a excel spread sheet. There was a comparison among the two groups. Results of an appropriate data analysis were documented.

Statistical Analysis:

SPSS (version 29.0) was used in analysis of data for windows. Descriptive statistics was performed for the demographic variables and outcome variables. Chi Square test was used to find association between the variables such as hand held dynamometer used for grip strength, pinch meter for pinch strength and Jebsen Taylor hand function test to access hand dexterity

Hypothesis

Null hypothesis (H0):

There is no association between hand grip and dexterity amongst gamers as compared to non-gamers population.

Alternative hypothesis (H1)

There is a association between in hand strength and dexterity when compared between gamers and non-gamers population.

Results

According to the study, the students were included based on inclusion criteria and record of their playing duration in mobile phone for a minimum of 4 hours to be considered for case group and others were considered for control group. Table 1- shows that out of 288 participants, 144 participants belonged to the gaming group and 144 participants belonged to the Non-gaming group. Therefore there is equal distribution in both the groups

Table 1

Frequency Distribution of Gamers

No of participants	Gamers	Non gamers
288	144	144

In the above table 2, descriptive analysis was done to compare grip strength between gamers those who played in mobile phone for a minimum of 4.5 hours and non-gamers,. Mean and Standard deviation of right and left hand was 24.9±9.53 and 25.27±8.684 for grip strength with game playing students in case group. when compared to subjects in control group were mean and Standard deviation of grip score in right and left hand was 25.58±10.229 and 26.50±8.873 of non gamers.

Table 2

Descriptive Statistics of grip strength

Grip strength	Gamers		Non gamers	
	Right	Left	Right	Left
Mean	24.90	25.27	25.58	26.50
Standard deviation	9.538	8.684	10.229	8.873

In the above table 3, mean and standard deviation test was performed. Students of case and control group's pinch grip (key pinch) were calculated with pinch meter. The subjects mean score in the case group ranged between 1.66 – 8.16. A mean and SD of 4.86 ±2.47 and 4.298±2.410 was seen in above table which showed pinch strength with gaming in both right and left hand. The subject in the control group showed mean and SD of 5.0±2.08 and 5.0±2.03 where the subjects mean score ranged between 2 – 8.16 in non gaming students in both right and left hand

Table 3

descriptive analysis of pinch strength

Pinch strength	Gamers		Non gamers	
	Right	Left	Right	Left
Mean	4.86	4.29	5.005	5.0056
St. deviation	2.47	2.41	2.087	2.0388

Table 4

Descriptive analysis of dexterity

Dexterity	Gamers		Non gamers	
	Right	Left	Right	Left
Mean	37.803	50.02	38.157	50.921
Standard deviation	3.4313	4.101	4.3043	6.1409

Dexterity was calculated using jebsen taylor hand function test, mean and SD of right and left hand was 38.157±4.304 and 50.921 ± 6.140 in the above table indicates for dexterity with in case group when compared to subjects in control group where their mean and SD of dexterity score in right and left hand was 38.157±4.304 and 50.921 ± 6.140 respectively.

The above table shows significant association between the case and control of grip strength score for right and left hand with $\chi 2 = 500.33$ and x2= 614.076, $p = 0.001$ $p(<0.05)$ and right and left hand score with

x2= 300.681 and x2 =354.819, p = 0.001 p(<0.05) for dexterity. This shows that the variables are statistically significant (<0.05).

Table 5

Chi-square test for association of hand strength and dexterity

GRIP STRENGTH			
		Value	P
RT	Pearson Chi-Square	500.33	0.001
LT	Pearson Chi-Square	614.076	0.001
DEXTERITY			
RT	Pearson Chi-Square	300.681	0.001
LT	Pearson Chi-Square	354.819	0.001

In such cases, null hypothesis is rejected and alternative hypothesis is accepted for the variables grip strength and dexterity. This indicates that there is statistical association between grip strength and dexterity score suggesting that the grip strength, pinch strength and dexterity is affected in the students who involve in mobile gaming

Discussion

Nowadays, it's typical for students to play smart phone games for several hours a day, assuming inappropriate postural positions. As a result, these students might experience musculoskeletal problem. This study analyzed the interactions between the level of smart phone gaming and the consequences of smart phone overuse on students functional hand performance with in general pinch strength, and hand grip. In our study, samples of 500 students were screened, and 288 participants were picked based on inclusion and exclusion criteria. These contestants were split into case and control groups, with the case group indicating our gaming population. The case group participants were further asked to monitor there total gaming time everyday for 4 weeks Both the case- control group were then assessed for grip strength, pinch strength and hand dexterity using hand dynamometer, pinch gauge and jebsen taylor hand function test and results were obtained and documented

During our investigation, our results showed significance of all the variables in which the case group had high risk of having reduced hand strength and dexterity comparatively to the control group.

Ahmad Osailan (2021) conducted a study in which extended use of mobile devices was linked to poorer hand-grip and pinch-grip. Although the modest association, the study found that smart phone usage length, along with age, may be a role in hand muscle strength.

Nadia L. Radwan, (2020 jan) conducted a study, the level of smartphone use, according to the results, dramatically reduced grip strength, hand-pinch strength, and DASH scores. In the group of high-frequency smart phone users, grip and hand-pinch strength were weaker on the dominant side than the non-dominant side which might be the result of the repetitive finger motions required for modern smart phone designs, which include clicking, scrolling, swiping, tapping, gaming and hitting buttons. These conditions may have an impact on muscular effort, tendon excursion, and fingertip forces.

İNal EE, Demirci K, et al (2015) gave a study that contrasted two groups of young adults who used smart phones excessively (high and low) with subjects in the control group did not use smart phones, it was discovered that high-frequency smart phone users had an enlarged median nerve, more pain in the thumb, decreased pinch strength, and impaired hand functions compared to low-frequency smart phone users.

Jonsson P, Johnson PW et al (2011) concluded that holding cell phones while keeping your fingers and wrist flexed could be damaging. Flexing and extending the fingers and wrist repeatedly is necessary for texting or playing video games, which would probably put a lot of stress on the joints, tendons, and associated muscles.

Deepak Sharan, MathankumarMohandoss (2015) conducted a study where statistically suggested that mobile phones and gadgets like notepads, tablets etc which promote the predominant use of thumb or single finger while texting or utilizing the controls were associated with higher prevalence of MSDs.

According to our study it was evident that there is significant difference between grip strength, pinch strength and dexterity Score which proves significant association between mobile gaming and hand strength and dexterity (p<0.005) in student population. The possible significant result could be due to prolong hours of gaming, repetitive thumb movements to access the game controls on screen, the practice of incorrect hand position during gaming, practice of odd postures which not only affect the hand but also can lead to pain and distress to upper extremity and neck.

A lack of social and out door participation, poor social contact particularly in this pandemic condition.

Additionally with regards to ergonomic and psychological factors interact to increase the risk of musculoskeletal disorder

Conclusion

There is a considerable significance found between the hand strength (grip and pinch strength) and dexterity in gaming and non gaming participants. There is positive association in hand strength and hand function among participants who belong to gaming population when associated to the non gaming population. To lower the prevalence of hand disorders, it is essential that prevention efforts are consider among students, specifically on the duration of playing and position of hand during the game.

Limitations

- Limited sample size.
- The study period was insufficient
- Study was conducted over a single population
- Limited age group
- No consideration of people who participate in workout or sports was taken
- No consideration of BMI was taken.

Future Scope of Studies

Further studies can be conducted on a larger sample size and diverse population. study duration should be considered. People who participate in activities such as sports, gym/any other activity that would hamper the study should be taken into consideration. Prevalence studies should be conducted. Some occupational related education camps can be organized in the Colleges about the risk factors of prolong gaming and its effects on hand and other musculoskeletal problems.

Conflict of interest

There is no conflict of interest for all authors.

Ethics statement

This research was approved by the ethical committee of Krupanidhi College of Physiotherapy (no–EC –MPT/21/PHY/010).

Informed consent was obtained in written format.

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