HIGH SCHOOL EDITION
Journal of Student Research
Volume 13 Issue 3 (2024)

The Correlation of Fine Motor Skills and Video Games in Medical Residents

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ABSTRACT

Procedures are the essence of a physician's practice, being at every corner of the job. Procedures require significant cognitive and fine motor skills in order to excel. The aim of this study was to explore video games as a possible medium to enhance physicians procedural skill through analyzing its effects on fine motor skills. This study employed standardized tactics on large sample groups, utilizing surveys and the normalized nine hole peg test to measure emergency resident's fine motor skills and weekly video game play time. My results reported a faint relationship between greater video game play time and fine motor skills. Furthermore, I uncover a significant strong association between age and fine motor skills among physicians. My study opens a pathway towards future research on videogames and fine motor skills while uncovering the potential motor benefits of older physicians. Video games, along with their clear cognitive benefits, remain a possible activity that can enhance a physician's procedural skill.

Introduction

Procedures are a necessary part of physician training and medical practice; a medical procedure is any action performed by a physician to measure, diagnose, or treat a patient. Procedures are at the heart of a physician's skill set. However, teaching and learning them have proven to be difficult for students (Norris, et al., 1997). This is because medical procedures demand unique skill sets different from normal day activities. Difficulty in mastering and understanding procedures can lead to many medical students failing to advance and even leading to the endangerment of patients' lives if performed incorrectly. Due to the demanding requirements of medical procedures, researchers have looked into methods and activities that can help effectively train students. Procedures have high cognitive and motor ceilings, demanding a proficiency in fine motor skills (Sattelmayer, et al., 2016). Nevertheless, many of these fine movements are common in many other activities such as video games in which players engage in scenarios which capitalize on the utilization of a high level of precise movements and fine motor skills. Video games are heavily incorporated into the entertainment industry and are especially popular among young adults. For example, the Entertainments Software Association (2023) highlighted that over 65% of Americans play video games and 62% of Adults over the age of 18 also play video games. This has sparked interest across the medical field as many young adults play video games and research has looked into utilizing video games to enhance and help train doctors of the future through simulations and studies.

Not many studies have investigated the correlation of fine motor skills and video games. On the other hand, a handful of studies have looked into the effects of video games on procedural skills and potential usage of video games to help enhance skills in the future. Studies conducted on laparoscopic surgery have found that gamers have a small positive correlation between video games and procedural proficiency with simulations (Datta et al., 2020; Khimani et al., 2022; Rosser et al., 2007). Furthermore, other studies have looked into the correlation of time spent playing video games with development of motor pathways in the brain, finding that people who played video games for long terms had higher levels in motor and tier visual pathways (Zhang et al., 2021). These studies portray a uniform but small correlation between video games and procedural skill, explained by Zhang who illustrates a growth in motor and visual tier pathways, which can potentially enhance motor skills.

Despite this, only a few studies (e.g. Datta et al., 2020; Khimani et al., 2022; Rosser et al., 2007; Zhang et al., 2021) have observed the effects of video games on procedural skill and brain pathways. In contrast, these studies fail to measure gaming experience because they base it on whether or not they have played video games, not taking into account how much they play. To add on, previous studies have small sample sizes and report inconsistent results due to a lack of standardization of measurement of procedural proficiency. These studies themselves fail to demonstrate significant correlations between video games and fine motor skills. The extent to which time that is spent playing video games has an effect on fine motor skills among medical residents still remains an open question. I must close the information gap between the correlation of time spent playing video games with fine motor skills because of video game's potential to enhance a physician's procedural skills and demands.

Fine Motor Development and External Factors

Fine motor skills are a central factor in a child's development. Peak fine motor skills develop during the child's developmental age (ages 1-6 years) (Bondi, et al., 2022). This is when children develop strength, visuo-motor, perceptual, and cognitive skills; although, early fine motor development is largely dependent on gender and external factors; females demonstrate an early advantage in fine motor proficiency (Bondi, et al., 2022). Early fine motor development has been found to be heavily influenced by external factors such as play and computer usage. For example, active play is a fundamental component in development among young children in early school ages as it helps children develop gross and fine motor skills through the development of cognitive pathways (Sutapa, et al., 2021). Fine motor development can be affected by children's screen time displayed through a study done by Pablo Hidelbrando S. Souto and colleagues (2020). Souto's study exhibits the correlation between fine motor proficiency and tablet usage among young children; Souto demonstrated that tablet usage has proven to be beneficial to children's fine motor development in early ages. The development of fine motor skills, on the contrary, extends past the early stages of development being influenced by external factors such as age throughout life.

Age is an influential factor in fine motor development as proficiency deteriorates with age because of the natural deterioration of motor pathways (Curreri, et al., 2018). Age, however, is not the sole influencer of fine motor development among adults. For example, Florian Worschech and colleagues measured fine motor skill improvements among adults who practiced playing the piano for a year (Worschech, et al., 2023). Worschech (2023) emphasizes how adults continue to be influenced by external factors and activities in their later stages of life such as playing the piano. Worschech is further supported by a study done by astronauts which analyzed the effect zero gravity had on fine motor skills (Holden, et al., 2023). The study highlights that external factors such as microgravity can be detrimental to fine motor development. As supported by both Worsech and Holen, fine motor skills continually develop and change as an adult gets older. This confirms how an adult's fine motor skills in the later stages of life can still be influenced by external activities such as video games. With known literature, video games may serve as a potential external activity that can help preserve or enhance fine motor skills within gamers.

Video Games and Cognitive Skill

Certain technical video games demand complex decision making; this can enhance an important hurdle for cognitive development: efficient thought processing. Video games, not only exhibit social and emotional benefits, but also can display a wide range of cognitive improvement. For instance, they help gamers develop enhanced problem solving skills and efficiency through developing gamer's accurate attention allocation, spatial resolution in visual processing, and mental rotation abilities (Granic, Lobel, & Engels, 2014). It is clear that video games have cognitive benefits and action video games specifically have been a focus in studies. They have been found to greatly improve gamer's cognitive abilities, enhancing their motor loads and attentional control (Greene, Baveliar, 2012). Cognitive skill is imperative to fine motor skills as they have been to be correlative of each other (Peng & Feng, 2022). As highlighted, cognitive skill is imperative to motor skills and has a clear connection to procedural accuracy and efficiency. An increase in cognitive skills can often translate to greater fine motor skills in adults, although this has not been verified.

Procedural Skill and Video Games

Procedural skill is influenced by many factors such as practice, knowledge, cognitive skills, and fine motor skills (Norris, et al., 1997). Various studies have investigated the external factors of procedural skill and what can make someone a better physician. Of those studies, many have looked into the influence of activities such as video games on surgical performance. Dr. Rabi Datta (2020) conducted a study that investigated the correlation of proficiency between video games and laparoscopic surgery through testing laparoscopic residents with surgical simulations. Datta et al (2020) found that there is a small correlation between surgical proficiency and video games under the assumption of the demanding cognitive and motor activation video games demand. This correlation continues through endoscopic surgeons as through a study in which interns who had video game experience had significant improvement in surgical skill, especially speed and efficiency; instead, there still remains a lack of studies done on purely motor correlations.

The positive correlation between video games and procedural proficiency has spurred numerous studies investigating video games as a promising method to train residents. Dr. Kellie Middleton (2013) along with her colleagues tested a video game warm-up, which is two hours playing on the Wii, among laparoscopic surgeons. Middleton found that a warm-up before a procedure caused significant improvement in surgical skill and hand eye coordination. Video games may be a potential activity that can help train physicians in an entertaining way. This is because studies demonstrate its positive correlation with surgical procedures. Also, residency programs already utilize Virtual Reality simulations to help train physicians in procedures (Schlickum, et al., 2009). The usage of video games as an activity to enhance physician procedural skills may be a viable option.

While studies have illustrated that video game proficiency has a positive correlation with procedural proficiency, studies fail to measure the effect video games have on motor skills. These studies lack adequate sample sizes to display a clear correlation between the two variables, and they lack a clear definition for video game proficiency. To address these shortcomings, this study utilized a sufficient sample size to display a clear correlation between time spent playing video games with fine motor skills by using standardized procedures.

Methods

In order to determine the correlation between fine motor skills and video game play time, 28 medical residents were tested through the use of the Nine Hole Peg Test, a standardized test that tests fine motor skills and hand dexterity, and surveyed about their video game play time through an online form. Emergency Medical Residents were chosen as subjects through cluster sampling to provide an accurate representation of Emergency Medicine residents. Also due to Emergency Medicine's wide range of procedures and skill they are often considered to be a medium to represent other doctor fields. With cluster sampling, I sampled all 28 residents within the class. Quantitative data from the sample was then collected and analyzed, determining the correlation between percentile of fine motor proficiency and time spent on video games.

Nine Hole Peg Test

The Nine Hole Peg Test is a standardized method of testing fine motor skills and is commercially available. It has demonstrated to be an accurate method in quantitatively evaluating fine motor skills of all age ranges quickly and easily through many studies (Czell, et al., 2019; Mathiowetz, et al., 1985; Smith & Hong, 2000). Commercially available Nine Hole Peg Tests (Baseline Nine Hole Wooden Pegboard, model 12-3141, Fabrication Enterprises Inc., White Plains, New York) were used in this study and consist of a wooden board (200 x 200 x 75 mm) with 9 holes (6.35 mm diameter and 19 mm depth) separated apart by 50 mm and a container under the board for the pegs, which are 6.35 mm diameter and 38 mm depth, for storage. The participants were instructed to place the pegs with one hand from outside the board into the holes, one by one, and take them out of the board as quickly as possible. The time that the subject touches the first peg to release the last needed peg was recorded by a stopwatch. This process was repeated for both hands of the participants twice; non-dominant hand first and dominant hand second. Scores are based upon time taken to complete each test in seconds. Scores were distributed by hand and participants were surveyed on their dominant hand. Scores were further synthesized into participants percentile compared to the population utilizing tables 3 and 4 within Mathiowetz's normative study (Mathiowetz, et al., 1985). This study serves as a baseline tool to evaluate fine motor proficiency among occupational therapists as it provides normative data of the Nine Hole Peg Test. Quantitative data acquired from the Nine Hole Peg Test was used to evaluate subjects fine motor proficiency through standardized means and analyzed data was compared to the subject's time spent on video games. The Nine Hole Peg Test, overall, allows for quick, accurate, and standard quantitative evaluation of subjects' fine motor skills.

Survey

We administered a survey by laptop or tablet to subjects in order to measure subjects' average weekly video game play time. The survey asked subjects for personal information including name, age, gender, and dominant hand to measure demographics and necessary information. Subjects were then asked the question "How many hours of Video Games do you play on average a week?" and had multiple ranges to choose from: 0 - 1 hours, 2 - 4 hours, 5 - 7 hours, 8 - 10 hours, and 10 + hours. I chose these broad ranges because preliminary ranges can help activate the subject's brain and cause them to give more accurate answers for similar themed questions (Artino et al., 2022). Subjects were then asked to give a quantitative response, inputting a number in the range they selected to increase accuracy and convenience for data analysis. Example of questions asked is displayed in Appendix A. This survey effectively evaluates the average weekly play time subjects participate in among video games through providing a range and discrete number for subjects to choose from to ensure accurate evaluation. Subjects then were analyzed to find the correlation between time spent on video games and fine motor proficiency based on the evaluation in the Nine Hole Peg Test. This survey effectively established a standardized baseline and collection of time spent on video games among participants.

Procedures

Table 1. Nine Hole Peg Test Normative Chart, Male and Female (Mathiowetz, et al., 1985).

NINE-HOLE PEG SET – MALE
(Time – In Seconds)

Age Group	Percentile									
	10th		25th		50th		75th		90th	
	Hand									
	R	L	R	L	R	L	R	L	R	L
20–24	21.0	21.5	18.0	19.0	15.5	16.5	13.0	13.5	10.5	11.0
25-29	22.0	22.5	19.0	20.0	16.5	17.5	14.0	14.5	11.5	12.0
30-34	23.0	24.0	20.0	21.5	17.5	18.5	15.0	16.0	12.5	13.5
35-39	24.0	25.0	21.0	22.5	18.5	20.0	16.0	17.0	13.5	14.5
40-44	25.0	26.0	22.0	23.5	19.5	21.0	17.0	18.0	14.5	15.5
45-49	26.0	27.0	23.0	24.5	20.5	22.0	18.0	19.5	15.5	16.5
50-54	27.0	28.5	24.0	26.0	21.5	23.0	19.0	20.5	16.5	18.0
55-59	28.0	29.5	25.0	27.0	22.5	24.0	20.0	21.5	17.5	19.0
60-64	29.0	30.5	26.0	28.0	23.5	25.5	21.0	22.5	18.5	20.0
65-69	30.0	31.5	27.0	29.0	24.5	26.5	22.0	24.0	19.5	21.0
70-74	31.0	32.5	28.0	30.0	25.5	27.5	23.0	25.0	20.5	22.0
75-79	32.0	34.0	29.0	31.5	26.5	28.5	24.0	26.0	21.5	23.5
80-84	33.0	35.0	30.0	32.5	27.5	29.5	25.0	27.0	22.5	24.5

NINE-HOLE PEG SET – FEMALE
(Time – In Seconds)

Age Group	Percentile									
	10th		25th		50th		75th		90th	
	Hand									
	R	L	R	L	R	L	R	L	R	L
20–24	21.0	22.5	18.5	20.0	16.5	17.0	14.5	14.0	12.5	11.5
25-29	22.0	23.5	19.5	21.0	17.0	18.0	15.0	15.0	13.0	12.5
30-34	22.5	24.5	20.0	22.0	17.5	19.0	15.5	16.0	13.5	13.5
35-39	23.0	25.5	20.5	22.5	18.5	20.0	16.5	17.0	14.0	14.0
40-44	23.5	26.5	21.5	23.5	19.0	21.0	17.0	17.5	15.0	15.0
45-49	24.5	27.5	22.0	24.5	19.5	22.0	17.5	18.5	15.5	16.0
50-54	25.0	28.5	22.5	25.5	20.5	22.5	18.0	19.5	16.0	17.0
55-59	25.5	29.0	23.5	26.0	21.0	23.5	19.0	20.5	16.5	17.5
60-64	26.5	30.0	24.0	27.0	22.0	24.5	19.5	21.5	17.5	18.5
65-69	27.0	31.0	24.5	28.0	22.5	25.0	20.0	22.5	18.0	19.5
70-74	27.5	32.0	25.5	29.0	23.0	26.0	21.0	23.0	18.5	20.5
75-79	28.0	33.0	26.0	30.0	23.5	27.0	21.5	24.0	19.5	21.0
80-84	29.0	33.5	26.5	30.5	24.5	28.0	22.0	25.0	20.0	22.0

All subjects were chosen through volunteers and given consent forms. After consent, participants were tested for fine motor skills through the Nine Hole Peg Test in which their timed results were recorded. After this, participants were administered a survey. This survey collected key demographic information of gender, age, and dominant hand. Users were then asked within the survey their average time spent on video games weekly. Survey questions were made to minimize the collection of sensitive personal information. Subject results were recorded and analyzed. These were accurately replicated for each participant to maintain consistency.

Statistical Analysis

For each of the procedures, surveyants' responses were divided among demographics of dominant hand and gender, shown to be influential factors of fine motor proficiency (John, et al., 2017). Subject's responses and Nine Hole Peg Test scores were standardized into groups and fine motor skills measured as a percentile utilizing Mathiowetz's normalized study of the Nine Hole Peg Test (Mathiowetz, et al., 1985). This is a normative study that is often utilized by occupational therapists to test fine motor skills with the Nine Hole Peg Test and is the most commonly used normative reference and measurement tool. Subject's times were quantified and averaged with the average score of their dominant hand as a measure of their overall fine motor proficiency. Their average scores were quantified and made into a percentile compared to the general populace using the chart in Table 1 from Mathiowetz's normalized study.

Subjects' video game play time was quantified by asking participants their specific video game time collected through a survey. Among these two variables a correlation was determined with video game play time being the independent variable and fine motor proficiency being the dependent value. The correlation of the two variables was determined using correlational analysis. The correlational values are noted by the R^2-values displayed which indicate the linearized relationships between the video game play time and fine motor proficiency. I used an α of 0.05 to determine if my results are statistically significant. If the p-value, which is the statistical probability of my results occurring by chance with a null hypothesis of $\beta = 0$ or slope = 0, is less than α then I failed to reject the null hypothesis and conclude that my results demonstrate no significant correlation.

Results

In total, I collected data on 28 medical residents. Experience ranged from 1 - 3 years within the program, as it ranges 1 - 3 years and has separate classes for each year. Age groups ranged from 27 - 53 years with a mean age of 34 years and a standard deviation of 6.886 years. The sample consisted of 19 males and 9 females. Of the 19 males, 2 were left handed and 17 were right handed. All of the females were right handed. The mean video game time of all groups was 2 hours weekly. I found a negative correlation between age and weekly video game time. Younger male age groups had a higher average of weekly video game play time with males ages 30 and under having a mean play time of 3.4 hours weekly. However, a large number of residents didn't play video games with 11 answering 0 weekly video game play time on the surveys. Concerning their 9 hole peg test scores, female emergency medical students generally performed better than their male counterparts with an average percentile of 69% on their dominant hand compared to the general population and an average Nine Hole Peg time of 16.37 seconds on their dominant hand. On the other hand, male emergency medical residents had a dominant percentile of 50% and an average dominant time of 18.29 seconds.

I found that emergency residents that played more than 3 hours of video games had 8% percent higher Nine Hole Peg Test percentile scores on their dominant hand. This is further supported by Nine Hole dominant hand minimum times. Emergency residents with more than 3 hours of video games weekly scored 3.2% lower times than their non-gamer counterparts.

As seen in Figure 1, which is a comparison of the weekly video game time of subjects to their Nine Hole Peg Test percentile score, there was a small negative correlation between weekly video game play time and Nine Hole Peg Test Percentile scores. As video game time increased, Nine Hole Peg Test Percentile scores decreased. The correlation had an R^2-Value of 0.0192 and a slope of -0.9279. On the other hand, there was little to no significant correlation between the two variables with a degrees of freedom of 25 and a P-value of 0.49, which means that there is a 0.49 chance that my results occurred by chance. Since $0.49 > \alpha$, the possibility of a negative correlation between the two variables is extremely unlikely. Therefore, if there exists an association between fine motor ability and video game play time, the association may not be very strong.

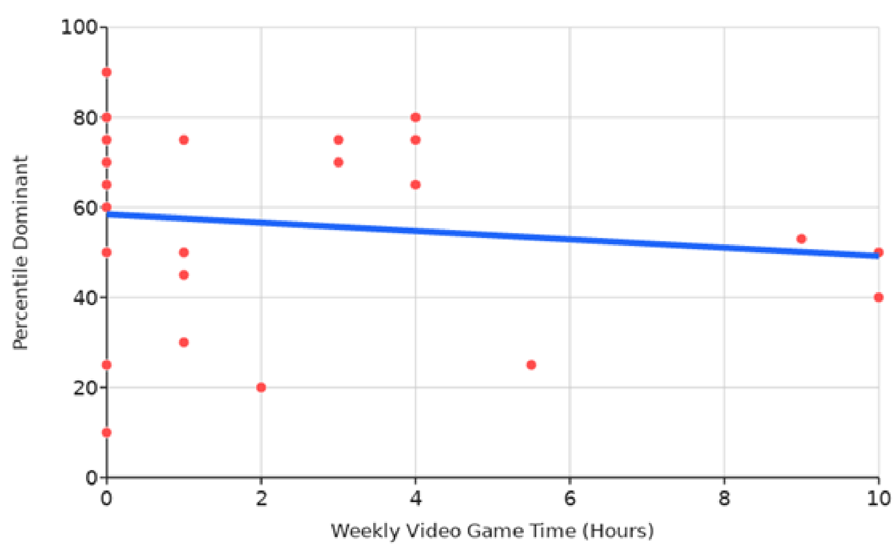

Figure 1. Comparison of the Weekly Video Game Time to Nine Holel Peg Test Percentile Scores of all Samples.

Figure 2 illustrates a comparison of the weekly video game time and the minimum Nine Hole Peg time on the non-dominant hand. As seen in Figure 2 I found interesting relationships between minimum Nine Hole Peg time on the non-dominant which gives reason to analyze. My correlational analysis reports a R^2 value of 0.0287 and a slope of -0.0959. With degrees of freedom of 25 I again found little to no evidence of a relationship between minimum Nine Hole Peg Test time and weekly video game play time. With a P-value of 0.4 I have little to no evidence of a relationship between the two variables and fail to demonstrate a correlation because $0.4 > \alpha$.

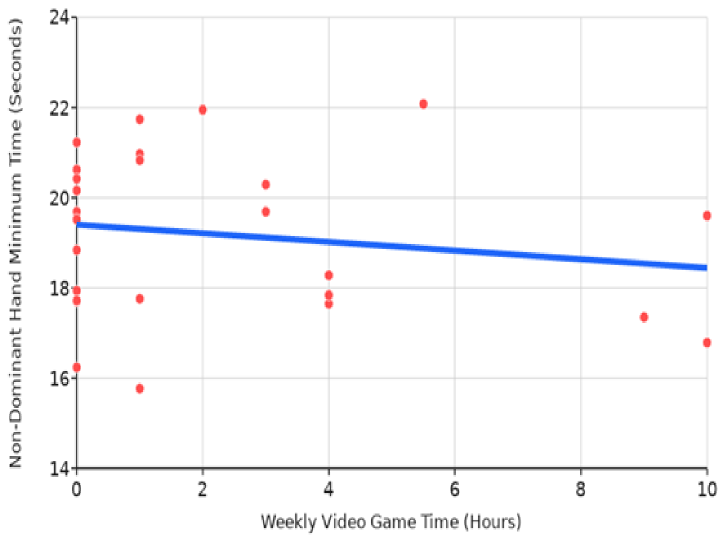

Figure 2. Comparison of the Weekly Video Game Time to Non- Dominant Hand Minimum Time.

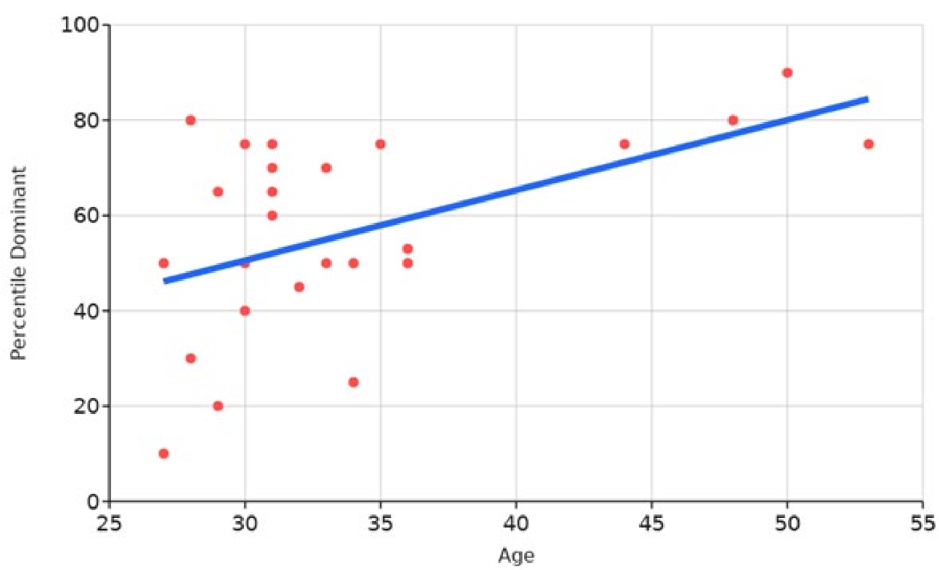

Figure 3. Comparison of Age to Nine Hole Peg Test Percentile Dominant Score

Figure 3 portrays a comparison of age of subjects to their Nine Hole Peg Test Percentile Dominant Score. Using the percentile of subjects from Table 1, I found a very strong positive relationship between age and better Nine Hole Peg Test scores. With an R^2 value of 0.234 and a slope of 1.47 I found a P-value of 0.01. Since $0.01 < \alpha$ I have suitable evidence that there is a strong positive correlation between age and Nine Hole Peg Test scores due to the positive slope and low P-value. I have significant data that there is a positive relationship between age of medical residents and their fine motor proficiency which contradicts previous research.

To conclude, my results demonstrate no significant correlation or relationship between video play time and fine motor ability within the subject's dominant hand. However, they do highlight a faint relationship between non-dominant fine motor skills and video game play time as portrayed by Figure 2. I also indicated a strong correlation between age and fine motor proficiency among medical residents, depicted in Figure 3. Although, my results should be approached with caution as I did not meet all the necessary criteria for a strong correlational analysis test as my data had a slight skew and my sample was only 28 ER medical residents.

Discussion

In reviewing previous literature, it is clear that video games can establish greater cognitive ability and procedural skill among physicians (Datta et al., 2020; Greene, Bavelier, 2012; Khimani et al., 2022; Middleton, et al., 2013; Rosser et al., 2007). This study was able to fill the gap in previous research through addressing video games effects on physician's fine motor proficiency through a larger sample study. In contrast, my findings reject my original hypothesis in which video game play time should have a clear positive effect on fine motor skills based on previous trends in research. Nevertheless, I found a small improvement in fine motor proficiency among video game subjects, but it is good to note that the sample size of my study was only 28 and had a moderate skew so my results should be approached with caution.

Looking at my data, emergency residents who played video games performed slightly better than their non-gamer counterparts. Residents with more than 3 hours of weekly video game play time reported 8% higher scores and 3.2% lower minimum times on their non-dominant hand. To add on, I also found a slight negative correlation between greater video game play time and minimum scores among subjects with a slope of -0.0959. My results loosely match previous studies done on video game play time and procedural score with my negative slope. Studies similarly found that video game playtime can lead to faster procedures, and my results generally demonstrate increased fine motor proficiency in subjects dominant hand with faster Nine Hole Peg Times (Datta, et al., 2020; Middleton, et al., 2013).

Also, I found a small decrease in minimum time in the subject's non-dominant hand with greater weekly video game play time, as illustrated in Figure 2. Prior studies have demonstrated that computer usage can help enhance neural pathways and fine motor skills and my results broadly match that with higher lower non-dominant hand scores (Wei, et al., 2013). The outcomes of my study match previous results because subjects with higher video game play time had lower minimum Nine Hole Peg times. This supports evidence of greater fine motor proficiency with mouse usage illustrated clearly by the decrease in minimum times.

However, my findings are contradictory, as displayed in Figure 1, and lack significance because of their high P-values and low R^2 values less than 0.1. My data fails to depict significant correlation in improvements of motor skill among emergency residents and I cannot make sufficient assumptions about correlations between the two variables as it is likely that my results happened by chance.

Although, I report a significant, strong positive correlation between age and fine motor skills which is illustrated in Figure 3. It shows an R^2 value of 0.234 and a slope of 1.47 . This contradicts previous research which addresses that should lead to a deterioration of fine motor skills (Curreri, et al., 2018). Nevertheless, this can be explained through other studies which address that professional jobs can help preserve cognitive function and reduce the chance of Alzheimer's throughout old age (Coleman, et al., 2023). An emergency physician is considered a professional job that demands extreme cognitive skill because of its procedural focus (Datta, et al., 2020). my strong relation, not only agrees with previous research but also displayed a strong preservation of fine motor skills in older physicians with all of my subjects. Of my subjects above the age of 40, all of them scored above the 75th percentile for their age group. This suggests a clear relation between age and preservation of fine motor skills and can be explained due to the extreme cognitive and motor demands physicians have. my results progress previous research, highlighting the connection between cognitive skills and fine motor skills as previous studies have hypothesized (Sutapa, et al., 2021); it suggests a new hypothesis of having an occupation of a physician can help preserve fine motor skills and cognitive skills.

Conclusions

Overall, this study addressed the relationship between fine motor skills and weekly video game play time among emergency medicine residents through the Nine Hole Peg Test and larger sample sizes than previous research. Fine motor skills remains a central skill in physicians procedural skills and it is important not to overlook video games effects on cognitive function and procedural skill. This study attempted to address the gap in research on fine motor skills but failed to highlight any significant correlation between the weekly video game time and fine motor skills. Instead, I illustrated a faint improvement in fine motor skills and with emergency residents with more than 3 hours of video games.

Our results should be taken lightly though, as there are many limitations to this study. Although, I am able to report a significant correlation between age and Nine Hole Peg scores relative to age groups. My results highlight a clear preservation of fine motor skills in old ages among physicians. Altogether, I fail to portray a significant correlation between video game play time and fine motor skills, and I unveil a significant relation between older physicians and higher motor proficiency. Video games still remain an open activity that may enhance fine motor skills, but it is clear that the demands of a physician can preserve their fine motor skill throughout old age. Due to the limitations of this study, future research is needed to further validate these findings.

Limitations and Implications

This study exhibited numerous limitations. First, in generalizing study results, Emergency Medicine residents are only representative of Emergency Medicine Residents and not all physicians or residents as a whole. Although, they are a great medium as their required skill sets and necessary procedures encompass a wide field of medicine. The difficulty in providing representative samples for all physicians remains apparent because of the diversity of medicine.

Also, this is a correlation study, and causality cannot be determined. It is possible that video games may cause an increase or decrease in fine motor skills but my study does not meet the necessary criteria to demonstrate causality. But, it is clear that there is a small benefit from playing video games and fine motor skills. It is likely that video games and especially mouse movement can help predict fine motor proficiency.

Another limitation is that my results must be met with caution because the conditions for correlational analysis are not fully met. This is because my sample size is 28; a sample size of 30 or more would allow for the assumption of a normal distribution for correlational analysis. To add on, my data demonstrated a slight skew as a large amount of my sample played no video games. Due to this, my results must be approached with attention as I do not meet all of the conditions for correlational analysis. In order to combat these limitations I can reproduce this study with a larger sample size. This study already addresses prior limitations but a larger sample size will help address normality and will yield stronger confidence of evidence there is a correlation between fine motor skills and video game play time or age. This suggests a future direction for research.

In addition, in analyzing my results for this study, I found an interesting correlation between age and fine motor skills among Emergency Medicine Residents. This differed from my original goals and also contradicted previous beliefs of fine motor deterioration. With these known results, a new gap is opened. It is imperative that future studies address the effect of age in professional or physician jobs on fine motor skills through larger and more thorough studies. In order to form a more comprehensive picture of the preservation of fine motor skills in order for physicians and other professionals, future studies must use a larger sample size and a more evenly distributed age group to analyze it accordingly. This is important for a complete understanding of how the human brain works and develops especially at old age among professionals, which remains relatively unknown.

Ultimately, the outcomes for this study have implications towards the medical field and the future training methods for future medical residents. My results open a gateway into future research conducted on video games and age's effect on fine motor skills. My results highlight a small increase in fine motor proficiency however future studies are needed to clarify this. This adds to existing knowledge in the industry as I portray a small increase in fine motor proficiency with greater video game play time. With this known, video games remain a possible medium to help train and enhance physician's procedural skill. It is imperative that future research is conducted to address video game and age's effect on fine motor skills among physicians in order to advance knowledge of human's cognitive and motor development and answer newly open questions from my results.

Acknowledgments

I would like to thank my advisor for the valuable insight provided to me on this topic.

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