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Mobile Gamers versus Non-gamer students' endurance levels via Beep and 3-minute step test

Joseph Lobo[1ABCDE], Bryan Dale Bernardo[2ADE]

[1] *Academic Coordinator, Physical Education Department, City College of Angeles, Philippines*
[2] *Full-time Lecturer, Physical Education Department, City College of Angeles, Philippines*

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Abstract

Background and Study Aim: College students' activity levels are considerably affected by mobile gaming, according to multiple studies. There have, however, been no studies done to date comparing gamers and non-gamers in terms of their levels of endurance. This present study employed beep and 3-minute step tests to compare mobile gamers' and non-gamers endurance levels. In addition, the difference between demographic variables such as age, gender, and BMI and participants' aerobic capacity is a major area of study.

Material and Methods: Students at the City College of Angeles in the Philippines were selected using the Judgement Sampling Technique to take part in the research. Students who participated in the study are enrolled in the 1st Semester of the Academic year 2022-2023. A survey questionnaire consisting of four sections were utilized to obtain information from the respondents. Age, gender, body mass index (BMI), and an endurance test are all part of the personal profile. Both the beep test and the 3-minute step test were administered to the participants. Results from the participants' personal profiles, BMIs, and endurance tests were summarized using descriptive statistics like frequency (f) and percentage (%). The Paired T-Test was also used to find out if there was a significant difference in the participants' endurance between mobile gamers and non-gamers. Finally, the individuals' age, gender, and Body Mass Index (BMI) were validated with their endurance levels by performing Independent Samples T-Test and One-way ANOVA.

Results: Beep and 3-minute step tests showed that gamers and non-gamers have very different levels of endurance, with the latter group displaying much more stamina than the former. It was also shown that among the three factors studied, gender was the only one with a relationship to endurance.

Conclusions: The study did not take into account factors like health history including nutrition, diet, sleep pattern, lifestyle, health issues, and endurance level on other types of measures. Conducting an inquiry similar to the one that was done, but also taking into account the other variables indicated, is a highly suggested course. Several findings are established, and numerous suggestions for further research, as well as policy and educational applications, are provided.

Keywords: 3-minute step test, beep test, college students, endurance levels, mobile games, physical education

Introduction

People all throughout the world have had their lives profoundly altered as a result of the devastation caused by the COVID-19 virus [1]. It has impacted the government, the health care system, numerous business sectors, but most significantly education [2, 3, 4, 5]. The majority of educational institutions around the world, particularly those in the field of higher education, have been compelled to close their doors and have made a significant transition away from the more conventional classroom setting and toward an online learning environment [6]. These radical shifts in the nature of the educational setting have had a huge influence on the lives of the vast majority of college students, leading to difficulties with both their mental and, more importantly, their physical health [7, 8]. In physical education subjects, the emphasis is placed on student's physical well-being, and efforts are made to encourage students to lead physically active lifestyles even when they are in the comfort of their own homes. Even if convenience and security are the primary benefits of online education, students receive only a marginal increase in the skills and knowledge they possess as a result of their participation in physical education classes. When seen from this perspective, higher education institutions continue to face a wide range of roadblocks. Even if there have been recent breakthroughs in technology, the hands-on and social aspects of physical education cannot be adequately conveyed in an online environment [9]. The monotony of lessons within the restricted environmental conditions, along with the inefficiency of the educational material, makes it extremely difficult to convey the real purpose and value of physical education, resulting in disastrous consequences [10]. Additionally, a lack of skill in administering physical education activities among

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the teachers as a result of their having to learn the ropes via repeated trial and error has rendered it hard to carry out systematic evaluations. It has also been shown that motivating students in online classrooms is extremely challenging due to the lack of a visual connection that can be made between the student and the instructor. This is a problem that exists in addition to the challenges that online instructors face in administering these classes. [9]. It has also come to light that taking physical education lessons in an online environment does not seem to be beneficial in terms of enhancing one's ability to acquire motor skills or increasing one's level of physical activity [11]. It is possible that these factors are to account for the students' lack of practical training, disintegration of their drive and interest, as well as their restricted opportunities for interpersonal connections. Even in this post-pandemic era, the pieces of evidence discussed previously has highlighted the challenges that higher education institutions all over the world are today confronted with when it comes to the delivery of online classes. Because of the nature of the subject matter, it is possible that offering quality instruction in an online setting would not seem to be a viable method for lessons in physical education.

The rise of mobile games during and after the pandemic

When offered at no cost for download, mobile games, which are a subgenre of the online video game genre that can be accessed and played via the internet, see massive levels of player engagement and adoption rates [12]. These games are compatible with a wide range of portable devices, and they can be played either by a single player or by multiple players at the same time [13]. In recent years, the popularity of mobile games—also known as *"e-games"*—has skyrocketed as a result of its accessibility to young people [14], especially amongst college-aged individuals, not just in the Philippines but everywhere else around the globe [15,16]. The devastating impact of the COVID-19 pandemic has made it even harder for college students to make connections and has increased their feelings of alienation from their peers [17]. Because of this, in addition to the many other social media platforms that are accessible to college students, some find that playing mobile games provides a higher level of entertainment. College students still place a high value on mobile gaming even in the wake of the recent pandemic. Numerous research has been carried out to investigate the positive and negative impacts that are associated with playing a variety of mobile games. According to recent studies, college students who regularly engage in mobile gaming have a wide range of good effects, including cognitive simulation, social opportunities, and improvements in a variety of mental health indicators [18, 19]. Studies have shown that mobile gaming can lead to addiction, which in turn can lead to poor academic performance, which is in contrast to the beneficial impacts of mobile gaming [20, 21]. In addition to this, there are a variety of behavioral, social, psychological, and health-related hazards that are strongly linked with mobile gaming addiction [22]. These studies, which were carried out over the course of the past few years, are in direct opposition to one another. Even now, educational researchers are still investigating this topic in the hopes of proposing a variety of different practical implications that will help close the gaps that have been identified as a result of playing mobile games.

Emerging study on the relationship of mobile gaming to students' endurance levels

According to a plethora of researchers, endurance may be defined as the capacity of the body to continue participating in an activity for a considerable amount of time, synonymous to an individual's aerobic capacity [23, 24]. Multiple reports have found that college students' levels of physical activity are significantly impacted by COVID-19 and mobile gaming [25, 26, 27], thus resulting to poor physical health. Unfortunately, the association of mobile gaming on the endurance of college students around the world has not been the subject of any research. In this regard, the purpose of this experimental investigation is to determine whether mobile gaming is associated with the stamina of college students. Importantly, the purpose of this research was to compare the endurance levels of collegiate gamers and non-gamers based on their age, gender, and Body Mass Index after completing a series of endurance tests.

Materials and Methods

Participants

Students at the City College of Angeles in the Philippines were selected using the *Judgement Sampling Technique* to take part in the research. Students who participated the study are enrolled in the 1st Semester of the Academic year 2022-2023. It's a form of non-probability sampling in which people take part in the study based on the researcher's subjective assessment of who will produce the most useful data for meeting the goals of the research [28].

Ethical considerations

The respondents had an understanding of the objectives, instruments, and constructs that were going to be measured and evaluated throughout the course of the experiment. In addition, the positive effects that the investigation will have on higher education institutions and the scientific community have been outlined. There was also discussion of the possibility of less significant risks, such as feeling uncomfortable when responding to personal and sensitive survey questions and receiving no financial

compensation for the information provided. In light of these considerations, respondents were required to indicate their agreement by checking the box next to the attached agreement in the survey questionnaire.

Research Design

This study used an experimental design to compare the endurance levels of college students who regularly play mobile video games to those who rarely do so, controlling for participants' ages, sexes, and body mass indexes (BMI). A scientific method is a way of conducting a study in a structured and methodical manner, with the goal of achieving the highest possible degree of accuracy and drawing the most precise conclusions possible with respect to a hypothesis [29]. As have mentioned earlier, the participants for the study are selected based on the characteristics that are needed for this experimental study. In this regard, a selection criterion is developed in order to acquire the most reliable data possible from the participants. The following characteristics are desirable in people who play video games on a mobile phone:

- -must be a legitimate City College of Angeles student;
- - must be at least 19 years old;
- - can be either male or female;
- - must have played mobile games for at least 6 months;
- - must play a minimum of fifteen hours per week; and
- - must only play mobile games.
- In contrast, the requirements for non-gamers are as follows:
- - they must be students at City College of Angeles;
- - they must be at least 19 years old; and
- - they can be either male or female.

Additionally, to collect data from the participants, a survey questionnaire with four (4) parts was used. Personal profile such as age and gender, Body Mass index (BMI), and endurance test are all included. The participants were required to do the beep test as well as the 3-minute step test for the purpose of the research. This was done, most critically, so that the researchers could determine the individuals' levels of endurance. The beep or "bleep" test is a multi-stage fitness test that is used to determine an individual's maximum oxygen uptake (VO_{2max}) as well as their cardiovascular fitness [30, 31]. The participants were also asked to perform the three (3) minute step test to which it was used in testing endurance levels. This is an assessment designed to measure a person's aerobic (cardiovascular) fitness of an individual [32, 33].

Statistical Analysis

In this experimental research, descriptive statistics such as the frequency (*f*) and percentage (%) were used in order to summarize the personal profile, Body Mass Index (BMI), and endurance test results of the participants. Also, the study has utilized *T-Test* to determine the difference concerning mobile-gamers and non-gamers' cardiovascular endurance levels. It is a parametric test that compares the means of two groups [34]. In order to understand the relationship and difference of gender, age, and body mass index to endurance level, Independent Samples T-test and One-way ANOVA was used [35].

Results

The personal profiles of the individuals are displayed in Table 1, which includes information about their ages, genders, and Body Mass Indices (BMI). According to the data in the table, there were a total of 20 people that volunteered to take part in the experiment project, with the majority of the participants being males [(N_{male} = *17*(85.00%), N_{female} = *3*(15.00%)]. In addition, the majority of participants are 18 years old, with those aged 19 and 20 coming in second and third, respectively [(N_{18yo} = *15*(75.00%), N_{19yo} = *4*(20.00%), N_{20yo} = *1*(5.00%)]. Last but not least, in terms of the participants' Body Mass Index (BMI), the majority of them fall into the Normal category, followed by those who are underweight and obese [(N_{normal} = *16*(80.00%), $N_{underweight}$ = *3*(15.00%), N_{obese} = *1*(5.00%)].

Table 1. Personal information of the participants

Variables	Items	N(%)
Gender		
	Male	17(85.00%)
	Female	3(15.00%)
Age		
	19	15(75.00%)
	20	4(20.00%)
	21	1(5.00%)
Body Mass Index (BMI)		
	Normal	16(80.00%)
	Underweight	3(15.00%)
	Obese	1(5.00%)

The outcomes of the Beep and 3-minute step test completed by gamers and non-gamers are shown in Table 2. Both gamers and non-gamers, with the exception of gamer "G5" for the beep test, performed very poorly in the study. In addition, 60% of the non-gamer participants scored "very poor" on the 3-minute step test, with the remaining participants' endurance level rating ranging from poor to below average.

Finally, to understand the relationship and difference of gender, age, and body mass index to endurance level, the results of Independent Samples T-test and One-way ANOVA are

illustrated in Table 4 and 5. Based on the findings, no significant difference was observed between gender after performing 3-minute step test [t(3.314) = .860, p =.448]. Surprisingly, a significant difference was observed between gender after performing beep test [t(11.670) = 2.341, p =.038], positing that male (5.00 ± 1.90) has higher scores compared to female (3.67 ± .58). It is possible to

Table 2. Contingency table on participants' endurance level based on Beep and 3-minute step test

	Beep Test				3-Minute Step Test		
Non-gamer	Endurance level	Gamer	Endurance level	Non-gamer	Endurance level	Gamer	Endurance level
NG1	Very Poor	G1	Very Poor	NG1	Poor	G1	Poor
NG2	Very Poor	G2	Very Poor	NG2	Very Poor	G2	Very Poor
NG3	Very Poor	G3	Very Poor	NG3	Very Poor	G3	Very Poor
NG4	Very Poor	G4	Very Poor	NG4	Very Poor	G4	Very Poor
NG5	Very Poor	G5	Poor	NG5	Poor	G5	Very Poor
NG6	Very Poor	G6	Very Poor	NG6	Average	G6	Very Poor
NG7	Very Poor	G7	Very Poor	NG7	Below average	G7	Poor
NG8	Very Poor	G8	Very Poor	NG8	Very Poor	G8	Very Poor
NG9	Very Poor	G9	Very Poor	NG9	Very Poor	G9	Very Poor
NG10	Very Poor	G10	Very Poor	NG10	Very Poor	G10	Very Poor

Table 3. Gamers versus non-gamers' endurance level difference

	Endurance Test	Paired Differences				t	df	Sig.
		M ± SD	SE	95% Confidence Interval of the Difference				
				Lower	Upper			
1	3min_A-3min_B	-1.20 ± 2.09	.663	-2.701	.301	-1.809	9	.104
2	Bleep_A-Bleep_B	1.40 ± .189	.600	.043	2.757	2.333	9	.045

Table 4. Gender in terms of Endurance Level

Endurance Level	N	M ± SD	SE	df	t-test	Sig.	Decision
3-minute step Test							
Male	17	127.53 ± 1.97	.478	3.314	.860	.448	Not significant
Female	3	126.67 ± 1.53	.882				
Beep Test							
Male	17	5.00 ± 1.90	.462	11.670	2.341	.038	Significant
Female	3	3.67 ± .58	.333				

Table 5. Age and Body Mass Index in terms of Endurance Level

Endurance Level		Sum of Squares	df	Mean Square	F	Sig.
Age (3-minute step test)	Between Groups	9.867	2	4.933	1.423	.268
	Within Groups	58.933	17	3.467		
	Total	68.800	19			
Age (Beep Test)	Between Groups	7.117	2	3.558	1.079	.362
	Within Groups	56.083	17	3.299		
	Total	63.200	19			
Body Mass Index (3-minute step test)	Between Groups	17.696	2	8.848	2.943	.080
	Within Groups	51.104	17	3.006		
	Total	68.800	19			
Body Mass Index (3-minute step test)	Between Groups	5.596	2	2.798	.826	.455
	Within Groups	57.604	17	3.388		
	Total	63.200	19			

define this in such a way that each gender has something to do with the amount of endurance. This particular finding has been supported by various studies that males are predominantly advantageous in terms of VO_{2max} and level of endurance [36, 37]. However, these findings are not conclusive due to the fact that no other research pertaining to this topic has been carried out as of yet. As a result, it is strongly recommended that a study with the same objectives be carried out to either confirm or contradict these findings. In terms of age ($F(9.867, 58.933) = 1.423$, $p = .268$), ($F(7.117, 56.083) = 1.079$, $p = .362$) and body mass index ($F(17.696, 8.848) = 2.943$, $p = .080$), ($F(5.596, 57.604) = .826$, $p = .455$) for both 3-minute step test and beep test, no significant difference was observed between groups. It is possible to deduce from this that the participants' levels of endurance are not differentiated by age and body mass index.

Discussion

The results of this study contradict prior studies that found a link between advancing age and a decrease in people's endurance. Individual differences in lifestyle choices and inactivity mediate the deterioration of physiological function that comes with advancing age [36]. Based from previously conducted scientific studies, at first, performance seems to hold steady until around age 35–40, then it gradually diminishes until age 50, and finally, the biggest drops in performance happen around age 70 [37, 38]. This is because there is mounting data that demonstrates a decline in musculature and function (specifically, muscle strength and power) with age [39, 40]. Achieving and maintaining a high level of physical fitness and activity throughout the life span, on the other hand, may be an effective method to slow the loss in physiological functions that naturally occurs with age [41, 42]. It is important to note that the majority of participants in this study are young adults (aged 18–20), therefore it is reasonable to assume that their current level of endurance has not declined much over time. It's also worth noting that the test subjects' overall endurance performance is relatively low. It's concerning that, at such a young age, the participants are unable to perform at or above the average rating. Teachers of physical education should encourage their students to take part in a variety of physical activities with the goal of increasing their endurance, which will become increasingly important as they grow.

It was also discovered that BMI has no significant statistical difference with physical endurance. It's reasonable to assume that one's stamina doesn't improve as their body mass index declines or increases. This discovery goes against the findings of other scholarly articles that have shown a correlation between the two variables. For example, the findings of [43] have reported that, reduced performance on the 3-minute Burpee test is associated with being overweight or obese. The findings of [44] have also found that BMI was negatively associated with cardiorespiratory fitness. Likewise, the study of [45] have also reported that adolescents whose body mass index (BMI) is either above or below the average range are less physically fit than their normal-weight peers. Contrastingly, the findings of [46] have reported that BMI is not significantly associated with endurance level for volleyball athletes during the COVID-19 pandemic. The results of this study, however, do not apply to mobile gaming players. Students who spend a lot of time on their mobile devices are likely to have higher rates of overweight and obesity, so a comprehensive study on this topic is strongly recommended.

Surprisingly, gender has been observed to have a significant difference with endurance level. This particular finding has been supported by various studies that males are predominantly advantageous in terms of VO_{2max} and level of endurance [47, 48]. Higher body fat (and less muscular mass) and maximum oxygen intake and lower levels of hemoglobin in females explain the absolute disparities in endurance performance between sexes [49, 50]. Sex differences in VO_{2max}, a critical indicator of aerobic performance, have been linked to differences in endurance-exercise performance [47]. Likewise, the findings of [52] have reported that all the fitness tests used in the study showed a substantial difference between the sexes from a sample of university men and women. Therefore, the intensity of exercises are different between males and females [51]. However, these findings are not conclusive due to the fact that no other research pertaining to this topic has been carried out as of yet. As a result, it is strongly recommended that a study with the same objectives be carried out to either confirm or contradict these findings.

To conclude, various published scholarly works have shown that mobile game players are less likely to engage in other forms of physical activity. Such as the online survey conducted by [53], It was discovered that 80.3% of esports players do not get enough exercise to meet World Health Organization guidelines. Consequently, esports participants appear to have a higher rate of inactivity than the wider populace [54]. In this context, teachers of physical education should motivate their students by organizing a variety of endurance-related activities for them to participate in. The goal is to pique the students' interest, specifically, those who play on mobile devices, in these activities in relation to the maintenance of their physical health, which is of critical significance.

Conclusions

In this novel research project, an examination was carried out to compare the levels of endurance possessed by gamers and non-gamers drawn from a population of undergraduate students attending City College of Angeles. Following the completion of the experiment, it is possible to draw the conclusion that there is a considerable gap in the levels of endurance possessed by those students who play mobile games and those students who do not. This research also demonstrated that gender has a significant role in determining the degrees of endurance possessed by gamers and non-gamers alike. Additionally, there was a significant link found between gender and endurance level. This finding might be interpreted as possibly indicating a causal relationship between the two variables. Therefore, it is strongly recommended that an approach to study based on causal relationships be taken. In addition, the Beep test and the 3-minute step may not be suitable for determining the endurance level of particular samples when considering ethnicity and several other biologic requirements. In this regard, this study would like to underline some practical implications that are extremely helpful for both types of participants for policy and educational applications by utilizing such studies as this in the formulation of physical activities meant to improve the endurance of students. Teachers of physical education should strictly monitor the physical fitness of students who have poor cardiovascular endurance. Ergo, a pre-test and a post-test should be used by teachers of physical education to identify students who are at risk and to encourage those students to participate in activities that will improve their fitness levels. Lastly, it is important to take into account the restrictions imposed by this study. Other characteristics such as health history including nutrition, diet, sleep pattern, lifestyle, health issues, and endurance level on other types of measures were not taken into consideration in this study. Therefore, carrying up a similar study but also taking into account the other factors indicated before is a highly proposed course of action.

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Conflict of interest

The authors declare no conflict of interest.

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Information about the authors:

Joseph Lobo; (Corresponding Author); https://orcid.org/0000-0002-2553-467X; josephlobo@cca.edu.ph; City College of Angeles; Angeles City, Philippines.

Bryan Dale Bernardo; https://orcid.org/0000-0003-1498-8390; bryandalebernardo@cca.edu.ph; City College of Angeles; Angeles City, Philippines.

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