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College students' physical fitness test results and engagement in physical activity: A case study of a private university in Taiwan

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Abstract
The purpose of this study was to find out the effect between physical fitness test results and physical activity participation among university students. The researcher used quantitative research methods to collect the required data. One thousand one hundred and fifty-six students participated in this study. Data were analyzed on the results of physical fitness tests for the past three academic years (From 2017-2020). The study found that female trainees had better flexibility than males, with a decrease in flexibility across years. Male participants had better muscular endurance than female participants. Male student participants performed better than females in cardiorespiratory fitness. Female student participants had lower explosive power than males. There were significant differences in participation in physical activity by gender; however, there were no significant differences between students in the other colleges.

Keywords: Physical education, physical fitness test, body Mass Index, flexibility, cardio-respiratory fitness, muscular strength and endurance

1. Introduction
Exercise has always been regarded as a way to promote and improve personal health, improve physical activity and improve the quality of life, and sustained moderate exercise is a good way to effectively maintain a healthy body (Lachman and Lipsitz *et al*., 2018) [5]. In school education, physical education can take on important responsibilities, such as helping students develop regular exercise habits through physical activity, develop good all-round physical fitness, and become a healthy and happy person (Suma and Wallhead *et al*., 2018) [11].
In Taiwan, all universities have implemented physical fitness tests for their students. The data of these physical fitness tests are also well preserved in the university and accumulated into an extensive data database that physical education teachers can analyze. However, the actual participation in these physical activities for students is likely to indicate that teachers can test the quality of physical education curriculum design and modify physical education teaching.
In recent years, the Ministry of Education Taiwan has listed it as a key goal to promote students' healthy physical fitness. "Promotion in Progress" from 2004 to 2007 was established, the Five-Year Plan for primary and high School Students' Healthy Postures, which began in 2006 to handle the "Diversified Physical Fitness Information Promotion Plan", built a "Physical Fitness Data Upload Management System" and a "Healthy Sports Network Passport", which were uploaded through the data. In this way, the current physical fitness status can be updated in real time, and the school can accumulate records and analyze the physical fitness status of students, which can be used as a reference for future policy formulations by schools, local governments, and the Ministry of Education; students can obtain the "Health Sports Network Passport" Diversified exercise prescription consultation information, and then cultivate students' regular exercise habits (Ministry of Education, Taiwan, 2016).
According to the relevant literature, we know how to obtain the results of physical fitness tests scientifically. Therefore, if more scientific tools (eg, questionnaires) can be used to improve the reliability and validity of the results, then physical education teachers can discuss student engagement data with the results of physical fitness tests. Currently, there is no scientific study like this examining physical fitness test results, engagement in physical activities among selected PE students. Therefore, the purpose of this research is to explore the physical fitness of Chang Jung Christian University (CJCU) students from 2017 to 2020 and to analyze further the differences in the physical fitness tests, sports participation among college students with different backgrounds variables.

Finally, the results of this research are expected to help college physical education teachers understand the current situation of college students' sports physique and reflect on the design and teaching characteristics of existing courses, to improve students' sports physique. This task is also the responsibility of schools and physical education teachers.

2. Methods

The researcher utilized the quantitative method of research. Quantitative methods of research because this study used the descriptive-comparative-correlational type of research with documentary analysis using a questionnaire/checklist in gathering the needed data of the study.

2.1 Research locale of the study

The Chang Jung Christian University (CJCU) is a private university that has campus located in Tainan city, Taiwan. The study was carried out in CJCU.

2.2 Participants of the study

The study was conducted in CJCU and survey questionnaires were given to selected participants from different colleges in their PE class. To get variables in the participation, this study was separate student variables into gender, and college. Student participants are college students enrolled in physical education programs for three academic years, from 2018-2019, 2019-2020, and 2020-2021.

2.3 Instrumentation

The researcher utilized the following in gathering necessary data for the study;

2.3.1 Big data analysis of the result of the physical fitness tests of students in physical education courses for the three academic years.

2.3.2 Research–made Survey questionnaire for the PE students. (Selected the department students of each college: total 1,156 students)

2.4 Data analysis procedure

The researchers utilized the following statistical tools:

2.4.1 The frequency distribution table t shows students' questionnaire results and performance on various physical fitness tests.

2.4.2 Use the independent samples t-test and ANOVA to compare the means of each group.

2.5 Reliability and validity of questionnaire

All completed questionnaires were analyzed by including the associated data into the SPSS software version 26.0. In practice, Cronbach's alpha of at least. 70 has been suggested to indicate adequate internal consistency (Taber, 2018). In this study, we were referring to relevant literature and use a self-compiled questionnaire to test the degree of student-participant participation. The questionnaire consisted of ten questions, with the highest score of 1 (very agree) and the lowest score of 4 (very disagree). The overall value of Cronbach Alpha is. 926. It's considered to be very high and acceptable.

3. Results and Discussion

3.1 Profile of the student-respondents

In this study, the gender ratio, males, accounting for 43.6%, and females accounting for 56.4%. In College of Management accounting for 28.2%, College of Humanities and Social Sciences accounting for 25.5%, College of Health Sciences accounting for 20.8%, College of Safety and Health Sciences 12.6%, College of Information and Design colleges 9%, and College of Fine Arts 3.8%.

Table 1: Profile of the student – respondents

		Frequency	Percent
Gender	Male	504	43.6%
	Female	652	56.4%
College	Management	326	28.2%
	Health Sciences	241	20.8%
	Humanities and Social Sciences	295	25.5%
	Information and Design	104	9.0%
	Safety and Health Sciences	146	12.6%
	Fine Arts	44	3.8%
	Total	1156	100.0%

3.2 The results of the physical fitness tests of the student-respondents

3.2.1 Profile- Gender

According to Table 2, men's sit-ups are higher than women's; cardiorespiratory fitness is better than women's; standing long jump is better than women's.

Table 2: Profile of the physical fitness tests – Gender

Gender	Male (N = 504)		Female (N =652)	
	Mean	Std.	Mean	Std.
Muscular fitness (sit-ups)	33.6548	8.80492	25.6902	9.55166
Flexibility (seated body forward bend)	24.1806	10.8076	33.5169	13.70239
Cardiorespiratory endurance	9.0776	2.58144	4.8091	1.25484
Muscular strength, explosive power (standing long jump)	198.9425	33.23515	149.75	24.99525

3.2.2 Profile-College

According to Table 3, the physical fitness test items of the students of each college were surveyed. In the Muscular fitness (sit-ups), Fine Arts College has the lowest average with an average of 27.0682 (standard deviation 11.19260), and the highest is Safety and Health Sciences School with an average of 31.7397 (standard deviation 9.28481). In Flexibility (seated body forward bend), the School of Information and Design had the lowest mean with Information and Design (standard deviation of 11.26872), and the School of Health Sciences had the highest with a mean of 5.9159 (standard deviation of 17.51791). In Cardiorespiratory endurance, the School of Health Sciences had the lowest, averaging 21.6334 (standard deviation of 2.48789). The School of Information and Design had the highest with an average of 8.0690 (standard deviation of 3.08652). In terms of Muscular strength, and explosive power (standing long jump), the School of Health Sciences has the lowest with an average of 165.1286 (standard deviation is 37.72980), and the highest in the School of Information and Design with an average of 179.6635 (standard deviation is 35.46189).

Table 3: Profile of the Physical Fitness Tests – College

College	Management (n=326)		Health Sciences (n=241)		Humanities and Social Sciences (n=295)		Information and Design (n=104)		Safety and Health Sciences (n=146)		Fine Arts (n=44)	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
Muscular fitness (sit-ups)	29.4233	9.54916	27.6515	10.44763	29.1017	10.82152	29.2885	7.96555	31.7397	9.28481	27.0682	11.1926
Flexibility (seated body forward bend)	28.7055	11.98329	32.1369	17.51791	29.1492	12.02455	25.2885	11.26872	30.6438	11.41248	28.0455	12.68758
Cardiorespiratory endurance	6.9097	2.988	5.9159	2.48789	6.4148	2.78471	8.069	3.08652	6.9104	2.97302	6.6348	2.35948
Muscular strength, explosive power (standing long jump)	169.5951	37.35125	165.1286	37.7298	172.4339	39.16051	179.6635	35.46189	177.6781	35.13755	166.5	40.63822

3.3 Differences in Physical Fitness Test Results of Student Respondents - Using Personal Profile as a Test Factor

3.3.1 Profile- Gender

In Table 4, there are significant differences between genders for all physical fitness test items.

Table 4: T-test result for gender

	Male (N =504)		Female (N=652)		df	t-test result for gender		Interpretation
	Mean	Std.	Mean	Std.		t value	p value	
Muscular fitness(sit-ups)	33.6548	8.80492	25.6902	9.55166	1154	14.543	.000*	Significant difference
Flexibility (seated body forward bend)	24.1806	10.8076	33.5169	13.70239	1154	-12.57	.000*	significant difference
Cardiorespiratory endurance	9.0776	2.58144	4.8091	1.25484	685.853	34.135	.000*	significant difference
Muscular strength, explosive power (Standing long jump)	198.9425	33.23515	149.75	24.99525	905.287	27.718	.000*	significant difference

*p<.05

The results showed that the performance of males in muscle strength was better than that of females. The results of this study pointed out that by referring to students' sit-up scores in gender. This is in line with the findings of Choi *et al*., (2021) [1] that greater muscle strength is associated with lower body fat percentage. This study found that males had better cardiorespiratory fitness than female student participants. However, this study is limited by different test criteria. This study points out that female student-participant have better cardiorespiratory fitness than females, and Machado-Rodrigues *et al*. (2012) [6] point out that adolescents classified as "sedentary" are all girls, i.e., women are more likely to be physically inactive than men, which is in line with our findings are consistent. In this study, the standing long jump was used to test the strength and explosiveness of the respondents. The results showed that the explosive strength of male student participants was stronger than that of females. Research by Ortiz, *et al*. in 2021 [9] also shows that even with muscle strength training, women cannot perform better than men in standing long jump tests.

3.3.2 Profile-college

Table 5 shows the analysis of variance test results of various physical fitness tests in each college. The results showed that in terms of Flexibility (seated body forward bend), the 32.1369 of the college of Health Sciences was significantly higher than the 28.7055 (p=.000) of the College of Management; the college of Health Sciences' 32.1369 was significantly higher than the college of Information and Design's 25.2885 (p=.000); the college of Safety and Health Sciences' 32.1369 was significantly higher than the college of Information and Design's 25.2885 (p=.000). In addition, the Muscular strength and explosive power (standing long jump) of students from different colleges were significantly different, $F_{(5, 1150)}$ =4.610, p=.000. Muscular strength and explosive power (standing long jump) of students in each college were not equal (Levene test=2.64, p=.933), so Tukey was used for the post-hoc test. The results show that: the College of Information and Design's 179.6635 is significantly higher than the College of Health Sciences' 165.1286 (p=.004), while the College of Safety and Health Sciences' 177.6781 is significantly higher than the College of Health Sciences' 165.1286 (p=.004).

Table 5: ANOVA-College- Flexibility (seated body forward bend), & Muscular strength, explosive power (standing long jump)

	Management (n=326)	Health Sciences (n=241)	Humanities and Social Sciences (n=295)	Information and Design (n=104)	Safety and Health Sciences (n=146)	Fine Arts (n=44)	F(5, 1150)	p	Tukey Post Hoc Tests
	Mean	Mean	Mean	Mean	Mean	Mean			
Flexibility (seated body forward bend)	28.7055	32.1369	29.1492	25.2885	30.6438	28.0455	4.610	.000	H.S. >M. H.S.> I.D. S.H.S.> I.D.
Muscular strength, explosive power (standing long jump)	169.5951	165.1286	172.4339	179.6635	177.6781	166.5000	3.498	.004	I.D.> H.S. S.H.S.> H.S.

*p<.05

Table 6 shows the analysis of variance test results of various physical fitness tests in each college. The Muscular fitness (sit-ups) of students in different colleges was significantly different, $F_{(5, 506.306)}$= 3.485, p=.004, rejecting the null

hypothesis. Using Games-Howell for post hoc comparison, it was found that the performance of Muscular fitness (sit-ups), 31.7397 of the college of Safety and Health Sciences, was significantly higher than that of the college of Health Sciences of 27.6515. In addition, the $F_{(5, 77.412)}$ statistic value after Cardiorespiratory endurance calculation was 9.709, with a significant P value=.000<.05, rejecting the null hypothesis, indicating that students' performance of cardiorespiratory fitness in different colleges is significantly different. Using Games-Howell for post hoc comparison, it was found that: 6.9097 of the college of Management is significantly higher than 5.9159 of the college of Health Sciences; 8.0690 of the college of Information and Design is significantly higher than 6.9097 of the college of Management.

Table 6: ANOVA-College- Muscular fitness (sit-ups) & cardiorespiratory endurance

	Management	Health Sciences	Humanities and Social Sciences	Information and Design	Safety and Health Sciences	Fine Arts	F	p	Games-Howell Post Hoc Tests
	Mean	Mean	Mean	Mean	Mean	Mean			
Muscular Fitness (sit-ups)	169.5951	165.1286	172.4339	179.6635	177.6781	166.500	3.485	.004*	S.H.S.>H.S
Cardiorespiratory endurance	6.9097	5.9159	6.4148	8.0690	6.9104	6.6348	9.709	.000*	M> HS ID> M ID> HS SHS> HS ID> HSS ID> SHS ID> FA

*p<.05

3.4 The extent of engagement in physical activities of the student-respondents

Evaluated from the respondents' answers, students are generally highly engaged in their physical education classes, with scores ranging from 1.51 to 1.85 on a four-point scale. The overall mean is 1.63 which is interpreted as strongly agree and the standard deviation is. 479 (Table 7).

Table 7: Result of the student – respondents engage in the different physical activities

Indicators	Mean	Std. Deviation	Verbal Interpretation
My PE teacher motivates me to participate in the different physical activities	1.52	.522	highly engaged
I attend my physical education classes because the activities are enjoyable	1.57	.581	highly engaged
I enjoy doing the different exercises because my teacher teaches very well	1.55	.558	highly engaged
I attend physical education classes because it helps me improve my stamina	1.57	.553	highly engaged
I attend physical education classes because it gives me self-fulfillment	1.65	.603	highly engaged
I join in the different physical education activities because I gain self-confidence	1.67	.611	highly engaged
The different physical activities help me improve my health	1.51	.531	highly engaged
I enjoy playing ballgames when there are enough equipment and the facilities are clear and safe to use	1.66	.630	highly engaged
I can do the different physical fitness tests because I am healthy	1.79	.669	engaged
I actively participate in the different physical activities.	1.85	.838	engaged
Composite mean	1.63	.479	highly engaged

*1.00-1.75 – Highly engaged; 1.76-2.50 – Engaged; 2.51-3.25 – Moderately engaged; 3.26-4.00 – Not engaged

Above, the results show that the overall satisfaction is very satisfactory, indicating that students are happy with the general curriculum arrangement in physical education. The results are consistent with the research of Herbert *et al*. (2020) [4]; through short-term aerobic exercise, college students can relieve their stress at low and medium intensity. Depression and perceived stress after six weeks of aerobic exercise. The articles on students' active participation in various sports activities are the least satisfying part of the questionnaire, indicating that teachers can do more to encourage students to participate in different sports activities actively.

3.5 Difference in the extent of engagement of student respondents - using personal profile as a test factor

3.5.1 Profile- Gender

The results after F test have a significant p value=.602>.05, and there is no significant difference in the number of variances between the two groups, so it belongs to the first column (assuming the variance is equal). The calculated t statistic value is -3.327, and the two-tailed significance p value=.001<.05 (Table 8), which can reject the null hypothesis. It means that there is a significant difference between Male and Female student-participants' participation. There was a significant difference between male and female student respondents in their participation in different physical activities during their physical education classes.

Table 8: The number, average, standard deviation and independent samples T test for gender

	Gender				Sig. (2-tailed)	*t* value	interpretation
	Male (N =504)		Female (N =652)				
	Mean	Std.	Mean	Std.			
Extent of engagement	1.58	.471	1.673	.473	.001	-3.327	Significant

*p<.05

Similar support has been found in many other early studies of gender differences in physical education curriculum (Mota, 1994; Stratton, 1997) [8, 10]. As for the possible reasons, Cockburn's (2001) research suggests that women may not like to exert too much force in gym class, or that girls are less motivated to exercise than boys (Fairclough, 2003) [13].

3.5.2 Profile- College

Table 8 showed that there are 326 students from College of Management (M=1.624, Std.=4.55), 241 from College of Health Sciences (M=1.600, Std.=.450), 295 from College of Humanities and Social Sciences (M=1.651, Std.=4.88), 104 from College of Information and Design (M=1.619, Std.=.507), 146 from College of Safety and Health Sciences(M=1.644, Std.=.483), and 44 from College of Fine Arts student-participants in this analysis(M=1.734, Std.=.539).

Table 9: Descriptive statistics of College

College	N	Mean	Std.	interpretation
Management	326	1.624	.455	Highly engaged
Health Sciences	241	1.600	.450	Highly engaged
Humanities and Social Sciences	295	1.651	.488	Highly engaged
Information and Design	104	1.619	.507	Highly engaged
Safety and Health Sciences	146	1.644	.483	Highly engaged
Fine Arts	44	1.734	.539	Highly engaged
Composite mean	1156	1.632	.474	Highly engaged

*1.00-1.75 – Highly engaged; 1.76-2.50 – Engaged; 2.51-3.25 – Moderately engaged; 3.26-4.00 – Not engaged

In Table 9, the calculated F statistic value is. 772, the significance p value =.570>.05, and the null hypothesis is accepted. It means that the extent of engagement in the course is not significantly different between different colleges.

Table 10: ANOVA of College

	Management (n=326)		Health Sciences (n=241)		Humanities and Social Sciences (n=295)		Information and Design (n=104)		Safety and Health Sciences (n=146)		Fine Arts (n=44)		$F_{(5,1150)}$	p
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.		
Extent of engagement	1.624	.455	1.600	.450	1.651	.488	1.619	.507	1.644	.483	1.734	.539	.772	.570

*p<.05

In this study, there is no significance difference in the engagement of students from different colleges, and the reason for the high level of engagement may be that students with different professional backgrounds can find favorite sports in the physical education curriculum of this school. As Chung (2008) [2] pointed out, if college students can find favorite sports in PE class, they can learn motor skills and improve their health and fitness level. According to the research results, we can also find that college students of different colleges do not have different levels of involvement in engaging in sports courses because of their different academic and professional backgrounds.

4. Conclusion

Based form the findings of the study, the following are being concluded:

1. Male- respondents have higher level of physical fitness performance than the female-respondents.
2. Physical Fitness level of the student -respondents improve as they grow older.
3. Male students have better muscle endurance than female students, and the general students perform better in sit-ups, indicating better muscle strength.
4. Male student-respondents perform better than females in cardiorespiratory fitness.
5. Female student- respondents had lower explosiveness than males, reiterating that students of different backgrounds were associated with physical performance.
6. It can be inferred also that it is essential for physical education classes to design appropriate systems for students with different cultural and knowledge backgrounds, and teachers can adjust the lessons according to local conditions to meet the needs of students.

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