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Comparative Analysis of the Physical Fitness Test Results of Undergraduate Students in Government University in Guangdong Province

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Abstract: The vitality of a nation is reflected in the physical fitness of its youth, a component integral to global health research. This study sought to reveal the current state of physical fitness among undergraduates at government university in Guangdong province, with the principal aim of providing an empirical basis for interventions and policy recommendations. Adopting a descriptive comparative approach, the research scrutinized physical fitness test records from 2020 through 2023. Quantitative analysis, employing mean, standard deviation, ANOVA, and post hoc tests, discerned significant disparities in physical fitness and BMI when stratified by academic year level. The findings indicated significant variations in physical fitness across different student groups, necessitating tailored approaches to health promotion.

Keywords: Comparative Analysis, Physical Fitness, Test Results.

1. Introduction

The physical fitness of young people is essential to a nation's future and prosperity and is a crucial component of global health research. As societies evolve with technological and material advancements, lifestyle behaviors shift accordingly, contributing to the rise of so-called "civilization diseases." These ailments have repercussions on the physical and mental well-being of populations worldwide, presenting significant public health and social challenges.

National surveys tracking Chinese students' physical fitness since 1985 indicate a downward trend, with a slight improvement post-2010 for primary and secondary students, but not for those in higher education. The "Opinions of The State Council on the Implementation of Healthy China Action" sets ambitious targets for student physical fitness, aiming for more than 50% by 2022 and 60% by 2030 to be rated as excellent or good. However, 2022 data from Guangdong Province reveals that college student fitness levels have not only failed to meet these benchmarks but have also regressed slightly since 2020. The fitness status of college students in Guangdong, and by extension potentially other regions, is a cause for concern.

This overview underscores the global urgency of enhancing youth physical fitness as a response to modern lifestyle-induced health challenges, with a need for sustained and effective strategies that can reverse negative trends and achieve health objectives.

2. Methodology

2.1. Research Design

The study was conducted using a descriptive comparative approach, focusing exclusively on the variations in physical fitness among college students. The comparative analysis delved into the differences and developments in physical fitness levels from a nuanced, micro perspective.

The research provided a clear snapshot of the physical fitness status across the student population, offering insights into the dynamics of fitness among college students without the integration of a follow-up qualitative component. In essence, this descriptive comparative study stood on quantitative data alone to delineate and understand the diverse fitness trajectories observed among the students at the micro level.

2.2. Sample and Sampling Technique

The undergraduate students of a government university in Guangdong Province were studied. Stratified random sampling strategy are adopted by this study.

Of the four grades, only the Grade 2020 has complete grades from the last four years. In order to compare the physical fitness test results of the past four years, students in Grade 2020 were selected as the subjects of the study. The Grade 2020 has 3,808 male students and 2,456 female students. With a 5% margin of error and a 95% confidence level, RaoSoft obtained a sample size of 350 recommendations for male students and 333 recommendations for female students.

All normal students should be included in the study. Students with chronic illnesses or disabilities are excluded because they cannot participate in vigorous exercise.

2.3. Research Instrument

The study conducted a meticulous examination of archival records, utilizing a retrospective review of the documented physical fitness test results. These records pertained to the cohorts of students who commenced their education at a government university in Guangdong Province over a four-year span, starting from 2020 and extending through 2023. This methodological approach allowed the researchers to systematically assess and analyze the progression and variation in physical fitness among the university's student population across successive academic years.

In conducting this review, the researcher accessed comprehensive data sets detailing the outcomes of the university’s standardized physical fitness assessments. These

assessments were part of the institution's routine health and wellness evaluations. The analysis of these records served as a crucial instrument in discerning patterns, trends, and changes in student fitness levels, providing a longitudinal perspective on the physical health and capabilities of the student body over time.

2.4. Data Analysis

The statistical treatment of the data in the study involved several techniques tailored to answer the research questions and test the hypotheses regarding the physical fitness levels of students at a government university in Guangdong Province. Below is the outline of the methods used:

1. Frequency and Percentage: The age and sex of the students for each year level were tabulated to provide basic demographic information. Frequency distribution was used to count the number of occurrences for each category of age and sex. Percentages were calculated by dividing the frequency of each category by the total number of students and then multiplying by 100.

2. Mean and Standard Deviation: For continuous data such as physical fitness test results and BMI, the mean (average) provided a central tendency measure, indicating the typical performance of students. The standard deviation was computed to assess the variability or dispersion of the fitness test scores and BMI around the mean, indicating how spread out the measurements were.

3. ANOVA (Analysis of Variance): ANOVA was employed to compare the physical fitness test results and BMI across different year levels. This analysis determined whether there were any statistically significant differences in the mean scores among the groups representing different academic years.

4. Post Hoc Test (Bonferroni Method): Following ANOVA, the Bonferroni post hoc test was conducted whenever the ANOVA showed significant differences. This test adjusted for multiple comparisons to avoid type I errors, controlling for the likelihood of observing a significant difference when none exists. It provided pairwise comparisons between group means to identify where the significant differences lay.

3. Results And Discussion

3.1. Profile of the Respondents

Table 1. Demographic Profile of the Participants in 2023

Demographic Profile		Frequency	Percentage
Sex	Male	350	51.24
	Female	333	48.76
	Total	683	100.00
Age	21 y/o	392	57.39
	22 y/o	213	31.19
	23 y/o	65	9.52
	24 y/o	11	1.61
	25 y/o	2	0.29
	Total	683	100.00

Table 1 presents a comprehensive demographic breakdown of participants within an educational cohort. The participants' demographic variables are categorized by sex and age.

In the last academic year, the cohort consists of 683 students, with a slight majority of males at 51.24% (350 students) and females constituting 48.76% (333 students). The age distribution within this group shows a predominant age of 21 years, accounting for 57.39% (392 students). The second most represented age is 22 years, comprising 31.19% (213 students), followed by 23-year-olds at 9.52% (65 students). There is a small representation of students aged 24 and 25, making up 1.61% (11 students) and 0.29% (2 students), respectively, cumulatively contributing to less than 2% of the cohort.

This table provides a clear view of the stability in the demographic composition of the cohort across the four academic years, which is instrumental for analyzing trends and patterns in the associated physical fitness test results or any other longitudinal studies conducted on this population. The consistency in the demographic data ensures that any changes observed in the cohort's performance can be attributed to variables other than demographic shifts. This table sets the foundation by detailing the demographic distribution of students by sex and age across the first to the fourth year. According to Guseman et al. (2020) and Li et al. (2023), physical fitness is influenced by hereditary and environmental factors, and this demographic breakdown is critical for understanding how these factors might play out in the observed fitness trends.

3.2. Difference in Physical Fitness Across Grade Levels

Table 2 provides a longitudinal analysis of the differences in physical fitness levels of students from their first year to their fourth year in college, based on various fitness tests. The analysis includes the mean scores, standard deviations (SD), F-values, and p-values, leading to decisions on the significance of the differences observed over time.

For Vital Capacity, there is a gradual increase in mean scores from the first year to the fourth year, starting from 2931.25 mL in the first year and ending with 3150.63 mL in the fourth year. The F-value of 10.45 and a p-value of 0.00 indicate that the changes across the years are statistically significant, leading to the rejection of the null hypothesis (H0).

The 50 Meter Run shows an increase in mean times from 8.63 seconds in the first year to 8.96 seconds in the fourth year, suggesting a slight decrease in speed. The F-value of 13.59 and a p-value of 0.00 suggest that the progression of times over the years is significant, justifying the rejection of H0.

In the Standing Long Jump, there's an initial increase in mean distance from the first to the third year, followed by a decrease in the fourth year, returning to near the first-year level. With an F-value of 4.05 and a p-value of 0.00, the variation across the years is considered significant, leading to the rejection of H0.

Table 2. Difference in Physical Fitness Level of Students From First Year to Fourth Year

Physical Fitness	Grade	Mean	SD	F-value	p-value
Vital Capacity	First Year	2931.25	802.96	10.45	0.00
	Second Year	3127.86	792.22		
	Third Year	3120.00	840.83		
	Fourth Year	3150.63	849.11		
50 Meter Run	First Year	8.63	1.06	13.59	0.00
	Second Year	8.93	1.10		
	Third Year	8.84	1.06		
	Fourth Year	8.96	0.99		
Standing Long Jump	First Year	185.55	34.88	4.05	0.00
	Second Year	189.93	34.09		
	Third Year	190.07	33.68		
	Fourth Year	185.38	33.46		
Sit And Reach	First Year	13.34	8.61	18.62	0.00
	Second Year	16.00	6.98		
	Third Year	15.28	7.19		
	Fourth Year	15.86	6.83		
800 Meter Run (F) - 1000 Meter Run (M)	First Year	247.47	23.16	246.32	0.00
	Second Year	264.35	31.69		
	Third Year	279.61	57.53		
	Fourth Year	333.83	103.23		
Pull Ups (M) - Sit Ups (F)	First Year	17.99	16.26	1.08	0.36
	Second Year	18.35	16.38		
	Third Year	17.39	15.41		
	Fourth Year	16.92	15.79		
Body Mass Index	First Year	20.19	2.78	10.52	0.00
	Second Year	20.38	2.80		
	Third Year	20.80	3.12		
	Fourth Year	21.00	3.26		

The Sit And Reach test presents an overall increase in flexibility from the first year to the fourth year, although the third year shows a slight dip. The F-value of 18.62 and a p-value of 0.00 demonstrate significant changes over the years, which leads to the rejection of H0.

The endurance test, involving the 800 Meter Run for females and 1000 Meter Run for males, shows a significant increase in mean times from 247.47 seconds in the first year to 333.83 seconds in the fourth year. The large F-value of 246.32 and a p-value of 0.00 indicate that endurance performance has significantly changed over time, and H0 is rejected.

The strength test comparison (Pull Ups for males and Sit Ups for females) is the only category where the change over the years is not statistically significant, with an F-value of 1.08 and a p-value of 0.36. Therefore, the null hypothesis is accepted for this category.

Lastly, the Body Mass Index (BMI) increases from an average of 20.19 in the first year to 21.00 in the fourth year. The F-value of 10.52 and a p-value of 0.00 suggest significant changes in BMI over the years, leading to the rejection of H0.

In summary, Table 2 indicates that there are significant differences in the physical fitness levels of students over the course of four years in almost all the aspects measured, except for the strength test. These findings reveal that while there are expected changes in physical fitness as students progress through college, not all fitness components exhibit the same trends over time. This table, which shows variations across years, may be interpreted in light of the gradual decline in physical fitness noted by Bi et al. (2020) and the global decline in physical fitness among children and adolescents reported by Fühner et al. (2021).

3.3. Post-Hoc Analysis of Vital Capacity

The comparison between the first and second year shows a mean difference of -196.61, with a significant p-value of 0.00, indicating that there is a statistically significant increase in vital capacity from the first to the second year. This significant difference is also observed when comparing the first year with the third year (-188.74) and the fourth year (-219.38), with both p-values being 0.00, which suggests that students' vital capacity significantly increases throughout their college years when compared to their first year.

When looking at the second year compared to the first, the mean difference is 196.61, which is simply the positive counterpart of the first comparison, and it is also significant. However, comparisons within the subsequent years (second to third, second to fourth, third to fourth, and vice versa) show mean differences that are not statistically significant, as indicated by the p-values ranging from 0.92 to 0.99. These p-values suggest that there are no significant changes in vital capacity from the second year onwards.

In essence, the only significant changes in vital capacity occur between the first year and the other three years. After the second year, the vital capacity levels out, and no significant differences are observed between the second, third, and fourth years. This could imply that while there is a notable improvement in lung function after the first year of college, the subsequent years do not exhibit a statistically significant change in this aspect of physical fitness. The asterisks denote those comparisons where the results are significant at the 0.05 level, which is a standard threshold for statistical significance.

The significant changes in vital capacity between the first year and subsequent years align with findings from Yan et al. (2023) where trends in lung capacity have remained relatively

stagnant despite increases in height and weight. The lack of significant change after the first year might suggest that students reach a plateau in this aspect of fitness.

3.4. Post-Hoc Analysis of 50-Meter Run

The results show significant improvements in 50-Meter Run times when comparing the first year to subsequent years. There is a mean time reduction of -0.30 seconds from the first to the second year, -0.21 seconds from the first to the third year, and -0.33 seconds from the first to the fourth year, with all p-values at 0.00. These results are marked with an asterisk, indicating that the improvements are statistically significant.

Comparing the second year to the first shows the positive counterpart of the first comparison, which is also statistically significant. However, when comparing the second year to the third and fourth years, as well as the third year to the fourth year, the mean differences are 0.09 seconds and -0.03 seconds, and -0.12 seconds, respectively, with p-values of 0.49, 0.95, and 0.20, which are not statistically significant.

This pattern suggests that while there are significant improvements in the 50-Meter Run times from the first to subsequent years, the times between the second, third, and fourth years do not significantly change. This analysis could imply that the most substantial gains in sprint performance occur after the first year, and performance stabilizes or slightly fluctuates in the following years without significant further improvement or decline. The asterisks denote the comparisons where the differences are significant at the conventional 0.05 alpha level.

The decreasing performance in the 50-Meter Run as students advance in years can be contextualized with Russo et al.'s (2020) assertion that physical fitness comprises various abilities, including speed. This decline in speed might reflect broader trends of reduced physical activity levels.

3.5. Post-Hoc Analysis of Standing Long Jump

From the first year to the second and third years, there are negative mean differences (-4.37 and -4.52, respectively), but these are not statistically significant as their p-values (0.13 and 0.11) are above the conventional threshold for significance of 0.05. Similarly, the comparison between the first and fourth years shows a mean difference of 0.17, with a p-value of 1.00, indicating no significant change.

When the second year is compared to the first year, the mean difference is positive (4.37), which is the same value but positive due to the direction of comparison, and it is still not statistically significant (p-value of 0.13). The comparison between the second and third years and between the second and fourth years (mean differences of -0.14 and 4.54) also shows no significant differences, with p-values of 1.00 and 0.11, respectively.

The third year compared to the first year and the second year yields mean differences of 4.52 and 0.014, which are not statistically significant, as indicated by p-values of 0.11 and 1.00. However, the mean difference between the third and fourth years is 4.70, which is close to significance with a p-value of 0.09, just above the cutoff.

Comparisons involving the fourth year show no significant changes when compared back to the first and second years, as well as to the third year.

In summary, there are no statistically significant changes in the performance of the Standing Long Jump across the four years of college, as all p-values are above the significance threshold of 0.05. Despite some fluctuations in mean differences, the overall analysis suggests that there is stability in the students' Standing Long Jump performance throughout their college years.

The stability indicated in the Standing Long Jump might contradict the declining trends reported in other studies (Masanovic et al., 2020), potentially suggesting that certain attributes of physical fitness, like explosive power, may not be as susceptible to the general decline seen in other areas.

3.6. Post-Hoc Analysis of Sit and Reach

The comparisons of the first year with the second, third, and fourth years all show negative mean differences (-2.67, -1.94, and -2.52, respectively) with p-values of 0.00, which are statistically significant as indicated by the asterisks. This signifies that students' flexibility, as measured by the Sit and Reach test, improved significantly after their first year.

When the data are viewed from the perspective of the second, third, and fourth years compared to the first year, the mean differences are positive (2.67, 1.94, and 2.52) and remain significant, reinforcing the trend of improved flexibility after the first year.

However, comparisons within the subsequent years (second to third, second to fourth, and third to fourth) show mean differences of 0.73, 0.14, and -0.58, with p-values of 0.35, 0.98, and 0.55, respectively. These values are not statistically significant, indicating that the most substantial gains in flexibility occur after the first year, and subsequent years do not experience statistically significant changes.

Overall, significant improvements in the Sit and Reach performance are evident from the first year to subsequent years, but once these improvements occur, the following years do not show significant differences among each other. This suggests that while there might be a notable development in flexibility early in the college experience, this aspect of physical fitness stabilizes in the following years.

Improvements in the Sit and Reach test might indicate an increase in flexibility, which could be a positive deviation from the generally observed decline in physical fitness components like flexibility reported by Wang et al. (2019).

3.7. Post-Hoc Analysis of 800 Meter Run (F) - 1000 Meter Run (M)

The data show significant increases in the time it takes to complete the runs as students progress from their first year to subsequent years. The negative mean differences indicate that times became slower: from the first year to the second, there's an increase of 16.83 seconds; to the third year, an increase of 32.14 seconds; and to the fourth year, a significant increase of 86.36 seconds, with all p-values indicating strong statistical significance (0.00).

When comparing the second year against the first, the positive mean difference of 16.87 seconds is also statistically significant, as are the differences when the second year is compared to the third (-15.26 seconds) and to the fourth year (-69.49 seconds).

Comparisons involving the third year show that times increased significantly from both the first year (32.14 seconds) and the second year (15.26 seconds), and there's a significant increase in times when comparing the third year to the fourth year (-54.22 seconds).

Finally, when the fourth year is compared back to the first, second, and third years, the negative mean differences (-86.36 seconds from the first year, -69.49 seconds from the second, and -54.22 seconds from the third) are all statistically significant.

All the p-values are marked with an asterisk, denoting significance at the 0.05 level. This suggests that as students progress through college, their endurance as measured by the runs significantly decreases. The tests get consistently slower over time, which could be due to a variety of factors, including changes in physical activity levels, increased academic demands, lifestyle changes, or a shift in priorities away from physical fitness.

The increase in run times, indicating a decrease in endurance, supports the concerns raised by Raghuveer et al. (2019) that only a minority of youth meet healthy cardiorespiratory fitness levels, and it underscores the decline in physical fitness over time.

3.8. Post-Hoc Analysis of Body Mass Index

From the first year to the second, there's a minimal mean difference in BMI of -0.19, which is not statistically significant (p-value of 0.72). However, when comparing the first year to the third and fourth years, the mean differences become more pronounced (-0.61 and -0.81, respectively) and are statistically significant, as indicated by p-values of 0.00. This signifies that there's a significant increase in BMI as students progress from their first to their third and fourth years in college.

When the second year is compared back to the first year, the mean difference is a positive 0.19, but it's not significant (p-value of 0.72). Comparing the second year to the third shows a difference of -0.42, which approaches significance (p-value of 0.08), and to the fourth year shows a significant difference of -0.62 (p-value of 0.00).

The comparisons involving the third year indicate a significant increase in BMI from the first year (0.61, p-value of 0.00) and a non-significant difference from the second year (0.42, p-value of 0.08). There's also a non-significant minor difference when compared to the fourth year (-0.20, p-value of 0.66).

Finally, the fourth-year comparisons show significant increases in BMI from both the first (0.81, p-value of 0.00) and second years (0.62, p-value of 0.00). The difference from the third year is minor and not significant (0.20, p-value of 0.66).

The asterisks denote the comparisons where the differences are significant at the 0.05 level. This analysis suggests that while there is no significant change in BMI from the first to the second year, there is a notable and statistically significant increase in BMI from the first year to the later years, with the highest BMI recorded in the fourth year. This trend may reflect changes in lifestyle, diet, and physical activity levels as students progress through their college years.

The gradual increase in BMI is in line with global concerns about weight gain and obesity and shows that, despite the rising trend in height and weight, fitness levels may not be improving correspondingly, as seen in the research by Dong et al. (2019) and Song et al. (2020).

4. Conclusion

The research reflects trends consistent with the literature, such as the slight increases in height and weight among college students and the significant disparities in physical fitness components based on gender. These patterns resonate with global observations of both improvements and declines in adolescent and young adult fitness over time, a dynamic described in comprehensive works of scholars on documentation of the global decline in cardiorespiratory endurance.

Furthermore, the study advocates for continued monitoring and evaluation of physical fitness initiatives to ensure that they meet the evolving needs of the student population. In doing so, it contributes valuable insights to the ongoing discourse on youth fitness, emphasizing the need for an integrated approach to health that is responsive to the complex interplay of factors affecting young adults today.

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