American Journal of Sports Science
2025, Vol. 13, No. 2, pp. 24-31
https://doi.org/10.11648/j.ajss.20251302.11

Research Article

The Influence of Gender and Academic Specialization on the Physical and Anthropometric Traits of Cameroonian Students in Sports Programs

Bonoy Lamou[1,*], Benjamin Nchegang[2], Mbame Jean-Pierre[1]

[1]Department of Physical Education, Health and Leisure, Faculty of Education, University of Ngaoundere, Ngaoundere, Cameroon

[2]Department of Fisheries and Aquatic Ecosystems Management, Institute of Fisheries and Aquatic Sciences at Yabassi, University of Douala, Douala, Cameroon

Abstract

Understanding the physical and anthropometric profiles of students in sciences and techniques of physical and sports activities (STPSA) programs is crucial for developing effective training strategies. This study aimed to examine the impact of gender and academic specialization on the physical fitness and body composition of 136 Cameroonian STPSA students (98 males, 38 females) aged 18 to 25. Various parameters were assessed, including anthropometric measurements (height, weight, body mass index), body composition (fat percentage, muscle mass), hemodynamic parameters (systolic and diastolic blood pressure, resting heart rate), and physical fitness tests (upper body, leg, and trunk strength, as well as aerobic endurance). Results showed no significant differences in height and weight across academic levels, suggesting that these traits stabilize before university. However, significant gender differences were found, with males being taller and heavier than females ($p<0.001$). Females also had higher body fat percentages and lower muscle mass compared to males ($p<0.001$). Regarding hemodynamic, level 3 students exhibited significantly higher diastolic blood pressure than those in levels 1 and 2 ($p<0.05$). Gender differences were also significant, with females showing lower systolic blood pressure and higher resting heart rates than males ($p<0.001$ and $p<0.01$, respectively). In physical performance, no significant differences were found based on academic level, but females demonstrated lower endurance in upper and lower limbs, and reduced trunk strength compared to males ($p<0.01$ - $p<0.001$). Additionally, female students had significantly lower aerobic endurance ($p<0.05$). These results highlight the importance of gender-specific interventions in STPSA programs. While academic level did not significantly affect physical fitness, gender differences in body composition and performance suggest that tailored training programs are needed to improve overall fitness outcomes for female students.

Keywords

Physical Profiles, Anthropometry, Body Composition, Gender Differences, Stpsa Students, Physical Fitness

*Corresponding author: lamloukessi007@yahoo.fr (Bonoy Lamou)

Received: 13 February 2025; **Accepted:** 3 March 2025; **Published:** 10 April 2025

1. Introduction

The physical and anthropometric profiles of university students, particularly those enrolled in specialized programs such as STPSA (Sciences and Techniques of Physical and Sports Activities), provide valuable insights into the relationship between academic progression, gender, and physical performance. While gender-specific differences in body composition, muscle mass, and cardiovascular health are well-documented [1-4], there remains a gap in understanding how these factors are influenced by academic level and the specific physical demands of STPSA programs.

STPSA programs are designed to train future professionals in physical activity and sports science, requiring students to develop a high level of physical fitness as part of their curriculum. These programs combine both theoretical and practical components, with significant physical training focused on strength, endurance, and cardiovascular capacity. However, it is important to distinguish between the academic specializations within STPSA programs, as the physical workload and practical demands differ considerably from theoretical courses. Specifically, students in practical specializations face more intense physical demands, requiring a specific focus on their physical condition throughout their training. The distinction between theoretical and practical specializations is crucial for understanding the specific effects of each type of program on students' physical and anthropometric characteristics.

Research has shown that students' body composition and fitness levels can significantly impact their academic and professional performance in such programs [5, 6]. However, few studies have explicitly addressed how these physical profiles are influenced by the unique demands of STPSA education. Moreover, while gender differences in physical performance, including muscle mass, strength, and cardiovascular endurance, have been widely explored in other contexts [7-9], it remains unclear how these disparities evolve or are mitigated within the context of an STPSA program, and how they are influenced by theoretical versus practical academic specializations. Yet, the way these differences manifest and evolve within the framework of a physically demanding STPSA curriculum remains underexplored. In particular, while some studies suggest that male students generally outperform female students in areas such as strength and cardiovascular endurance [8, 10], it is unclear how these disparities interact with the academic level and specific physical training undertaken during STPSA education.

Moreover, academic progression in STPSA programs could affect physical performance in complex ways. As students advance through different academic levels, they may face increased physical and psychological demands. Research has suggested that stress and workload can influence physical health markers, including blood pressure, heart rate, and body composition [11-13]. This highlights the need for longitudinal studies to track the evolution of physical fitness in STPSA students over time, providing a clearer understanding of how gender and academic level shape physical profiles.

Given the importance of physical fitness for professional success in the field of physical education and sports science, evaluating the physical parameters of STPSA students during their training is essential. Tailoring physical fitness programs to address gender differences in body composition and performance could enhance students' health outcomes and better prepare them for the demands of their future careers. Furthermore, understanding these dynamics is crucial for informing curriculum design, ensuring that students receive targeted interventions that support their physical and professional development.

2. Materials and Methods

2.1. Participants

This cross-sectional study took place from 7 to 15 October 2023 and involved 136 Cameroonian students (98 men and 38 women). All those students were enrolled in the sciences and techniques of physical and sports activities course and were aged between 18 and 25. Students gave informed written consent before participating in the study, which met all legal requirements and the criteria of the Declaration of Helsinki. The study was approved by the institutional ethics committee for human health of the ministry of public health of Cameroon (N °535/L/RA/DSP/BFP/NGD).

2.2. Measurements

2.2.1. Anthropometry

Body weight and body height were recorded with participants dressed in light clothing, after overnight fasting, without shoes and having washed their feet with an alcoholic disinfectant. Body weight was measured with a bio-impedance meter scale Tanita BC-532 (Tanita Corp., Tokyo, Japon). Body height was measured using a precision stadiometer (Seca 220, Seca) to the nearest 0.1 cm. Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared (kg/m^2).

2.2.2. Body Composition

The percentages of body fat and muscle were obtained from a Tanita impedance meter scale (BC-401). After the scale has been calibrated, the participants were asked to step onto the platform barefoot, and their muscle mass and body fat value were recorded.

2.2.3. Hemodynamic Parameters

A Chinese-made CK-W133 automatic electric wrist blood pressure monitor was used to measure systolic (SBP) and diastolic (DBP) blood pressure and resting heart rate (HRR). After at least 30 minutes' rest, the electric sphygmomanometer was placed on the participant's left arm. The values for SBP and DPB (in mmHg) and resting heart rate (HRR) were read directly from the dials on the monitor.

2.2.4. Flexed Arm Suspension Test

This was used to measure the muscular endurance of the participants' arms. The principle of this test is to keep the arms bent in a suspended position from a bar for as long as possible. The participant was placed under the bar and, with the help of the examiner, gripped it with his hands pronated and his thumbs opposite, following the distance between the shoulders. The supinated grip was accepted, but the thumbs should be in opposition. The examiner then helped the participant to rise until his chin was above the level of the bar. The participant held this position for as long as possıble without leaning on his chin. The test was stopped when the participant's eyes dropped below the bar and the time taken in seconds was noted.

2.2.5. Chair Test

This test was used to assess the endurance of the participant' legs. It requires the patient to place their back against the wall, with their feet 20 centimetres apart, and then slide downwards by bending their legs and moving their feet so that there is a 90-degree angle between the trunk and the thighs. The aim of the chair exercise or chair test is to hold this position for as long as possible without falling. The chair exercise is also often referred to as the isometric chair, as there is no body movement during the muscle contraction. During the chair test or fitness test (chair exercise), the muscles contract, but the thighs and legs do not move and the insertion points at the ends of the tendons are fixed. The time taken for each participant to hold this position was recorded in seconds.

2.2.6. Sit-Up Test

This test measures the endurance of the abdominal and hip-flexor muscles. The aim of this test is to perform as many sit-up as you can in 30 seconds. Lie on the mat with the knees bent at right angles, with the feet flat on the floor and held down by a partner. The fingers are to be interlocked behind the head. On the command, the participant raise the chest so that the upper body is vertical. He continues the movement for 30 seconds and the maximum number of correctly performed sit up is recorded.

2.2.7. Ruffier and Dickson Test

This test, developed by Ruffier, measures the recovery capacity of participants and is based on the measurement of a subject's heart rate taken at three different times: Pl = resting pulse, P2 = pulse as soon as the coded effort is stopped and P3 = pulse after one minute's rest. After resting in a seated position (taking Pl), the subject performs 30 squats in 45 seconds; these are performed with the torso upright, arms stretched forward, heels glued to the floor, with a full squat on the calves and total uprightness. The Ruffier Index (RI) is (Pl+P2+P3 - 200)/10.

2.2.8. Maximum Oxygen Consumption (Bleep Test)

The test was administered in a sports hall (temperature 20-25℃) and involved running between two lines set 20 m apart at a pace dictated by a recording emitting tones at appropriate intervals. Velocity was 8.5 km h^{-1} for the first minute, which increased by 0.5 km h^{-1} every minute thereafter. The test score achieved by the subject was the number of 20 m shuttles completed before the subject either withdrew voluntarily from the test, or failed to be within 3 m of the end lines on two consecutive tones. Afterwards, the last level shuttle was scored on the performance recording sheet. The maximum oxygen consumption (VO_2max) was estimated as per the regression equation developed by Leger et al. [14].

2.3. Statistical Analyses

Data were expressed as mean ± standard deviation and were analysed using the SPSS statistical package version 21. Consequently, ANOVA followed by the Tukey-Kramer post-test were used to compare student data by level of study. The Unpaired t-test was used to establish statistical differences between male and female students. P value was set at 5% for all statistical analyses.

3. Results

The results of the anthropometric parameters according to level of study and gender are presented in Table 1. Analysis of the data showed that there was no significant difference in the height and weight of students according to level of study ($p>0.05$). However, the age of level 3 undergraduate students was significantly higher than that of level 1 and 2 undergraduate students ($P<0.001$). In addition, female students had significantly lower heights and weights than male students ($p<0.001$).

Table 2 shows the results for body composition parameters (% body fat and % muscle mass) of students according to level of study and gender. Analysis of the data showed no significant difference in the body composition parameters of students according to level of study ($p>0.05$). On the other hand, comparison by gender showed a significantly higher percentage of fat mass associated with a significantly lower percentage of muscle mass in female students compared with male students ($p<0.001$).

Table 3 shows the results of the haemodynamic parameters of the students according to level of study and gender. Analysis of the data showed a significant difference in diastolic blood pressure according to the students' level of study ($p<0.05$). Level 3 undergraduates had higher diastolic blood pressure (84.62 ± 10.51 mmHg) than level 1 undergraduates

(75.28 ± 13.99 mmHg) and level 2 undergraduates (80.06 ± 13.31 mmHg). A gender-based comparison also revealed a significant difference in systolic blood pressure (p<0.001) and resting heart rate (p<0.01) between male and female students. Female students had a lower systolic blood pressure and a higher resting heart rate than male students.

Table 4 presents the results of the students' upper and lower limb endurance and trunk strength as a function of level of study and gender. Analysis of the data revealed no significant differences in these parameters according to level of study (p>0.05). However, significant decreases in upper and lower limb endurance and trunk strength were observed in female students compared with male students (p<0.01-p<0.001).

The cardiovascular capacity of the students as a function of level of study and gender is presented in Table 5. Exploitation of the data showed no significant difference in the recovery capacity and aerobic endurance of the students according to level of study (p>0.05). On the other hand, the female students showed significantly lower aerobic endurance than the male students (p<0.05). The gender difference in cardiorespiratory endurance was 26.80%.

Table 1. *Anthropometric parameters according to level of study and gender of students.*

	Ages (Years)	Height (m)	Weight (kg)	BMI (kg/m^2)
Level 1 undergraduate (N=60)	20.92 ±1.82	172.33 ±8.17	67.25 ±9.29	22.70 ±2.59
Level 2 undergraduate (N=55)	22.42 ±2.09	172.38 ±8.41	68.97 ±11.74	23.20 ±4.30
Level 3 undergraduate (N=21)	23.95 ±1.24***	168.05 ±11.0^{ns}	64.64 ±9.86^{ns}	22.60 ±2.3^{ns}
Male student (N=98)	22.07 ±2.10	175.26 ±6.67	69.76 ±9.92	22.56 ±3.11
Female student (N=38)	21.79 ±2.28^{ns}	162.30 ±6.68***	62.23 ±10.04***	23.72 ±3.^{ns}

*difference according to level of study or gender, ***P<0.001

Table 2. *Body composition parameters of students according to level of study and gender.*

	% Graisse	% MM
Level 1 undergraduate (N=60)	17.14 ±6.22	78.77 ±6.01
Level 2 undergraduate (N=55)	16.42 ±6.06	74.60 ±11.82
Level 3 undergraduate (N=21)	20.45 ±7.87^{ns}	75.46 ±7.56*
Male student (N=98)	15.10 ±4.05	78.04 ±9.20
Female student (N=38)	28.42 ±4.11***	67.55 ±4.44***

*difference according to level of study or gender, *P<0.05, ***P<0.001

Table 3. *Haemodynamic parameters of the students according to level of study and gender.*

	SBP (mmHg)	DBP (mmHg)	HRR (bpm)
Level 1 undergraduate (N=60)	118.38 ±18.92	75.28 ±13.99	77.53 ±14.72
Level 2 undergraduate (N=55)	123.06 ±15.32	80.06 ±13.31	84.53 ±31.92
Level 3 undergraduate (N=21)	122.48 ±17.70^{ns}	84.62 ±10.51*	82.19 ±13.40^{ns}
Male student (N=98)	123.64 ±17.60	79.39 ±13.94	77.55 ±23.26
Female student (N=38)	113.33 ±14.54***	76.58 ±12.46^{ns}	90.18 ±20.79**

*difference according to level of study or gender, *P<0.05, **P<0.01, ***P<0.001

Table 4. *Physical parameters of the students as a function of level of study and gender.*

	Arm Endurance (seconds)	Trunk Strength (number of sit-ups)	Leg Endurance (seconds)
Level 1 undergraduate (N=60)	28.31±8.40	20.38±5.52	130.59±46.35
Level 2 undergraduate (N=55)	32.13±9.39	22.42±3.63	147.00±62.91
Level 3 undergraduate (N=21)	30.86±7.17^{ns}	20.57±6.11^{ns}	146.36±52.12^{ns}
Male student (N=98)	32.34±7.82	21.88±4.84	147.33±50.58
Female student (N=38)	21.23±6.57***	17.31±4.15***	108.15±63.85**

*difference according to level of study or gender, **P<0.01, ***P<0.001

Table 5. *Cardiovascular capacity of the students as a function of level of study and gender.*

	Ruffier Index	VO_2max (ml/kg/min)
Level 1 undergraduate (N=60)	12.85±4.94	28.11±5.46
Level 2 undergraduate (N=55)	13.60±5.84	27.86±5.06
Level 3 undergraduate (N=21)	11.78±3.97^{ns}	26.03±4.91^{ns}
Male student (N=98)	12.97±5.04	29.93±4.06
Female student (N=38)	12.94±6.01^{ns}	21.91±3.01***

*difference according to level of study or gender, ***P<0.001

4. Discussion

This study aimed to investigate the physical and anthropometric profiles of Cameroonian students enrolled in Physical and Sports Activity Programs (STPSA), focusing on the impact of gender and academic specialization. The results reveal notable differences in anthropometric parameters, body composition, haemodynamic factors, and physical performance, highlighting both gender specific and academic-level differences. These findings carry important scientific implications, particularly within the context of STPSA training programs.

The results show no significant differences in height and weight across academic levels (p>0.05), suggesting that the students' anthropometric characteristics had stabilized by the time they reached university. This finding is in line with previous studies [15-17], indicating that most of the growth in height and weight occurs during adolescence, prior to university education. Within the context of STPSA training, where students are exposed to physical activities from the onset of their studies, these findings suggest that anthropometric characteristics such as height and weight are likely set before entering university and may not be significantly influenced by the academic level.

However, significant gender differences were found in height and weight, with male students being taller and heavier than female students (p<0.001). These findings are consistent with the established biological differences between men and women, where men generally possess greater height and muscle mass, partly due to higher testosterone levels during puberty [18]. In STPSA training, these gender differences may affect how male and female students approach physical activities, as larger body size and muscle mass in males often correlate with advantages in strength-based tasks and certain sports performance measures. The observed differences may also suggest that, in STPSA programs, male students could have a predisposition to excel in activities requiring strength and power, while female students may need additional support and specific training strategies to enhance their physical performance.

In terms of body composition, no significant differences were found according to academic level (p>0.05). This result suggests that, within the STPSA context, students' body composition remains relatively stable throughout their academic journey. However, a significant gender difference was observed, with female students exhibiting higher body fat percentages and lower muscle mass compared to male students (p<0.001). These results align with a wide body of research that shows females generally have a higher percentage of body fat, due to hormonal influences like oestrogen, which encourages fat storage [19-21]. Conversely, males typically have greater lean muscle mass due to the anabolic effects of testosterone, which promotes muscle hypertrophy [18, 22].

These differences in body composition are critical for STPSA students, as they directly influence performance in both academic and practical training components. For example, activities requiring endurance, flexibility, and strength might be more challenging for female students unless specifically addressed through tailored fitness programs. STPSA programs could benefit from incorporating gender-specific physical training regimens, particularly strength and resistance training, to help female students reduce body fat percentage and increase muscle mass. Such interventions would enhance overall physical fitness and contribute to better academic and practical outcomes in the program.

Regarding haemodynamic parameters, significant differences were observed in blood pressure and heart rate, both based on academic level and gender. Students in the third level of study (level 3) showed higher diastolic blood pressure compared to those in levels 1 and 2 ($p<0.05$), reflecting an age-related increase in blood pressure. This is likely due to the physiological changes associated with aging, such as increased vascular resistance and reduced arterial elasticity, which naturally occur as individuals move through their twenties [23, 24]. Furthermore, higher levels of academic stress, especially in the later years of study, might contribute to elevated blood pressure [12]. In the context of STPSA, students may experience significant physical and mental stress during their studies, which can contribute to these elevated measures. This finding highlights the importance of addressing cardiovascular health through interventions aimed at reducing stress and improving overall fitness, particularly for older students.

Gender differences were also significant, with female students displaying lower systolic blood pressure and higher resting heart rates compared to male students ($p<0.001$ and $p<0.01$, respectively). These differences are consistent with well-documented physiological patterns where women tend to have lower systolic blood pressure and higher heart rates due to hormonal and autonomic nervous system differences [24-27]. In STPSA programs, understanding these gender-based physiological differences is essential for developing personalized cardiovascular training programs that cater to the specific needs of male and female students. These differences may also have implications for endurance performance, with females potentially requiring additional cardiovascular conditioning to improve performance in aerobic and endurance-based tasks.

No significant differences were found in muscular endurance or strength based on academic level, suggesting that the progression through the STPSA program does not markedly influence these parameters in a significant way. This may indicate that while the STPSA program offers a broad range of physical training activities, the specific type or intensity of physical training may not vary substantially between academic levels, or students may not engage in sufficiently intense resistance training throughout their university studies to result in marked improvements in these parameters.

However, significant gender differences were noted, with female students exhibiting lower endurance in upper and lower limb strength, as well as reduced trunk strength compared to male students ($p<0.01$-$p<0.001$). These results are consistent with previous studies showing that women typically have lower muscular endurance and strength due to hormonal differences and a lower proportion of lean muscle mass [20, 21]. In the STPSA context, these findings suggest that female students may face more challenges in strength and endurance tests, which could affect their performance in practical assessments that are part of their academic training. To address these disparities, STPSA programs should consider incorporating more targeted strength training and muscular endurance exercises for female students. These interventions would help reduce the performance gap between male and female students and support better outcomes in both academic and practical training modules.

The study revealed no significant differences in aerobic endurance or recovery capacity based on academic level ($p>0.05$), suggesting that aerobic fitness levels remain relatively stable throughout the students' progression in the STPSA program. This could be due to the fact that aerobic fitness is often developed early in life and may not be significantly influenced by academic level alone, but rather by the type and intensity of physical activity students engage in outside the academic framework [3].

However, significant gender differences were observed in aerobic endurance, with female students demonstrating significantly lower endurance than male students ($p<0.05$). This is a common finding, as men generally have higher aerobic capacity due to larger lung volumes, greater heart size, and higher red blood cell counts, which facilitate oxygen transport to muscles [7-10]. Given that STPSA students are likely to engage in both aerobic and anaerobic training, these gender differences in aerobic fitness might influence the students' overall physical performance, especially in sports that require prolonged physical effort, such as running or swimming. STPSA programs could benefit from incorporating specific aerobic training programs for female students, focusing on improving cardiovascular endurance through activities like running, cycling, and swimming. Implications for Scientific and Practical Application.

5. Conclusion

In conclusion, the results of this study highlight significant gender-based differences in physical fitness, body composition, and haemodynamic parameters among Cameroonian students in STPSA programs. While academic level did not show major effects on physical fitness, the findings suggest that tailored training programs, particularly for female students, are essential for enhancing their physical performance and overall health. These results emphasize the importance of considering gender and academic level when designing physical education and sports science curricula to support the diverse needs of all students.

Abbreviations

BMI	Body Mass Index
STPSA	Sciences and Techniques of Physical and Sports Activities
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
HRR	Resting Heart Rate

Acknowledgments

The authors would like to express their sincere gratitude to the academic authorities of the University of Ngaoundere for their unwavering support and facilitation throughout the course of this study. We also extend our heartfelt thanks to the students who participated in this research for their cooperation and commitment. The authors declare no potential or actual conflicts of interest. This research was conducted in full compliance with the applicable laws and regulations governing scientific research in Cameroon, ensuring ethical standards and respect for all participants were maintained throughout the study.

Author Contributions

Bonoy Lamou: Conceptualization, methodology, writing original draft, Writing – review & editing

Benjamin Nchegang: Data collection, Data curation, Visualization

Mbame Jean-Pierre: Formal analysis, Investigation, Methodology, Supervision, Validation

Funding

This work is not supported by any external funding.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Bonoy Lamou is a sports and exercise physiologist. He completed his doctoral studies (PhD) from 2014 to 2019 at the University of Yaounde 1. Lecturer and head of Department of Physical Education, Health and Leisure at the University of Ngaoundere (Cameroon), he has been a permanent teacher at the National Institute of Youth and Sports of Yaounde from 2011 to 2019. He is the author of several articles related to the effects of physical and sporting activities on the physical and mental health of people suffering from chronic pathologies. He serves on the Editorial Boards of numerous publications and has been invited in several conferences.

Benjamin Nchegang is a lecturer at the Department of Fisheries and Aquatic Ecosystems Management, Institute of Fisheries and Aquatic Sciences at Yabassi, University of Douala, Cameroon. He earned his PhD in 2018 from the University of Yaounde 1 in Animal Biology and Physiology. His research focuses on health physiology, reproductive physiology, and biology. Through his work, he aims to deepen understanding in these fields and contribute to advancements in aquatic ecosystems management and animal health. His expertise helps in bridging knowledge gaps in the biological sciences, particularly within the context of fisheries and aquatic environments.

Mbame Jean-Pierre, holder of a PhD in social psychology from the University of Yaoundé I, is a lecturer at the University of Ngaoundéré, where he teaches in the physical education department and coordinates the entrepreneurship research unit. A former instructor at the INJS (2016-2022), he has expertise in education and sports. His research focuses on sports psychology, health psychology, inclusive education, and pedagogical adaptation, aiming to promote physical and mental well-being as well as accessible learning. His commitment is reflected in his student training and innovative research.

Research Field

Bonoy Lamou: Sport physiology, pharmacology, chronical diseases, physical education, sport psychology, psychomotor learning

Benjamin Nchegang: Pharmacology, health physiology, biology, toxicology, gastroenterology, neurophysiology

Mbame Jean-Pierre: Sport psychology, psychomotor learning, physical education, sports training, health psychology, social psychology