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Influence of Sociodemographic Factors on Academic Performance in the Subject of Human Gross Anatomy

Influencia de los Factores Sociodemográficos en el Rendimiento Académico en la Asignatura de Anatomía Macroscópica Humana

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SUMMARY: It has been demonstrated that the teaching and learning process of human anatomy is influenced by different external factors that can affect, in the short and long term, the academic and professional performance of medical students. In this sense, the present work aims to determine the relationship between sociodemographic factors and the academic performance of students belonging to the program of Medicine and Surgery of the Universidad del Valle, in Cali-Colombia, who were enrolled in the course of Human Gross Anatomy. Based on the organization of the course plan, the average grades obtained by the students in the different exams taken in the course were compared. Through a survey, sociodemographic data that have been reported as influential factors in academic performance were asked. The first stage of the analysis consisted of identifying the characteristics of the variables, then the correlation of the sociodemographic variables with the students' academic performance, and finally, a multiple linear regression model was implemented. Although the results did not show statistically significant correlations between the variables analyzed, a close relationship was observed with the sex and place of origin of the students, obtaining that women and students from other towns and cities presented lower academic performance compared to their peers. This highlights the importance of including activities to strengthen the learning process, as well as guiding support programs to maintain academic performance and reduce the inequality gap.

KEY WORDS: Human Gross Anatomy; University Teaching and Learning; Academic performance; Undergraduate students; Sociodemographic factors.

INTRODUCTION

The study of the human body dates back to the appearance of man on earth, with the purpose of developing survival mechanisms that would give an answer to the causality of disease and health problems that arose. In the literature, it is described that the Greeks, apart from their philosophical studies, also carried out works on medicine providing the first documents on anatomy (Hildebrandt, 2019).

Andrew Vesalius (1514-1564) was a physician and researcher, recognized as the founder of Modern Anatomy for his rigorous exposition and clarity of content. This anatomist was innovative in providing new methods for the teaching process of the subject, since in the past teachers used to teach their classes by reading classical texts, such as those of Galen, followed by an animal dissection performed by a barber, who exercised the role of surgeon without any formal training, under the direction of the teacher. According to Romero Reverón (2015), surgery was a different profession from Medicine, therefore, the great lack of knowledge in the area of Anatomy could be a consequence of the lack of prestige that surgery had at that time.

On the one hand, the teaching of the theory and practice of Human Gross Anatomy (HGA), as well as that of all sciences, was separated from the history and philosophy of science. Therefore, HGA focused on text content, with little encouragement of critical thinking and reflection on the part of the student (Matthews, 1994).

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On the other hand, this subject acquired prominence in the curricular context of the academic program of Medicine and Surgery during the medical education of the French school of the nineteenth century, there was a greater tendency to approach the formation of the being with a focus on semiology-diagnosis by observation, hearing and touch. In this way, it was recognized as the first clinical discipline and considered as an ideal space to introduce concepts of humanistic care (Hildebrandt, 2022), since anatomy, as a fundamental discipline in the medical curriculum, provides a first step in the educational path of empathetic and humane medical caregivers (Hildebrandt, 2019).

Under said method, the human being was approached holistically and anatomo-clinical training was privileged. Diseases were considered as organ or tissue injuries evidenced by signs graspable by the senses. Dinsmore *et al*. (1999) consider that a thorough knowledge and understanding of the architecture of the human being underlies proper clinical practice and, therefore, represents an early and indispensable curricular goal in all medical programs worldwide.

However, when evaluating the academic performance of students in the subject of HGA measured through theoretical and practical multiple-choice tests, studies show irregular results. Although some students achieve an excellent evaluation, most of them remain at the lowest levels or, more worryingly, do not achieve the minimum score to pass the course. Therefore, the objective of this study was to determine the relationship between sociodemographic factors and the academic performance of students of the academic program of Medicine and Surgery in the course of Human Gross Anatomy, in a public university in the city of Cali, Colombia.

MATERIAL AND METHOD

This research is framed within the project entitled Teaching, Learning and Evaluation of Human Gross Anatomy, which is endorsed by the Institutional Review Committee of Human Ethics of the Universidad del Valle, with code 014-021. A quantitative, non-experimental and correlational study was carried out with second year students of the academic program of Medicine and Surgery enrolled in the course of Human Gross Anatomy II, offered by the Department of Morphology of the same university.

The HGA course is in the patient care domain, oriented towards the specific competency of applying knowledge of biomedical sciences to understand the normal biology of the human body. This course is taught in the first year of the curriculum of the academic program of Medicine and Surgery, which aims at recognizing and describing the organization of the human body concerning body regions, with an overview of how they work.

Generally, lectures are master classes and include basic anatomo-clinical correlations, where images from recognized anatomical atlases are described in detail. In addition to this, the practice in the morphology laboratory uses cadavers or previously dissected human anatomical pieces in a state of conservation. At the end of each module, a summative and content-focused exam of the topics covered in class is carried out.

For this research, students' average grades of the theoretical, practical, and optional exams of the course were compared. The first one is a multiple-choice questionnaire that seeks to evaluate the ability to identify and understand the morphology and function of the anatomical structures, and basic anatomo-clinical correlations. The practical exam, called "obstacle course", evaluates students' ability to identify anatomical structures in preserved human cadavers, as well as the use of international anatomical terminology: students go through several stations in the University Amphitheater, identify the structures and write their names on a sheet of paper using the correct terminology. As for the last exam, it is an optional evaluation which students may decide to take or not; it is similar to the theoretical exam, and evaluates a greater number of topics, since it covers two modules.

The course is divided in three modules and the theoretical and practical exams account for 78 % of the final grade; the quizzes represent 2 %; the dissection activity, which is performed on a cadaveric structure that is in a state of preservation, account for 10 %; finally, the clinical correlation workshops correspond to 10 % of the final grade. The average of the grade of the theoretical exam (60 %) and the practical exam (40 %) constitute the result for each of the three midterm exams. Students can take two optional exams. In case of obtaining a higher result, they can replace two of the lowest grades obtained previously when taking the midterm exams.

Students were asked to fill out a Google Forms, in which sociodemographic data that have been reported as factors influencing academic performance were collected: gender, number of siblings, people with whom they live, parents' education level, socioeconomic status, place of origin, type of school attended, state of health, medical treatment if any, family financial support to study, reading habits, preference of the way of studying Human Anatomy and repetition of the school year.

Grades were analyzed in three stages. Firstly, the characteristics of the variables were identified; then, the correlation of the sociodemographic variables with the academic performance of the students were established; and finally, the implementation of a multiple linear regression model was carried out. Based on these results, descriptive statistics and the crossing of the variables were performed.

Subsequently, the respective correlations were conducted. Taking into account the nature of the variables, Spearman's correlation coefficient, the t-student test, mean difference and analysis of variance (ANOVA) were used to identify whether there is a correlation between a qualitative variable with more than two categories (ordinal or nominal) and a quantitative variable. In addition, an analysis of variance was considered to identify if there were differences in at least one of the categories with respect to the others.

To apply the t-student and ANOVA tests, it was necessary to verify whether the response variable had a normal distribution. For this purpose, the Kolmogorov-Smirnov normality test was used, which consists of a statistical significance test to verify whether the sample data come from a normal distribution.

RESULTS

Of the 118 students enrolled in the course, 15 were repeaters (did not pass the HGA course the previous year), 5 canceled the course after the first midterm exam, and 29 students were not promoted to the following semester because they obtained grades below 2.95. Table I shows the average final grade obtained, broken down by sex. As for the results obtained in the Google Forms on the sociodemographic and academic factors, these are tabulated in Table II.

Table I. Average of the results obtained in the final grade of the HGA course.

Sex	Quantity	Mean	Standard Deviation	Deviation Error Average
Men	33	3.6242	0.63837	0.1111
Women	45	3.3577	0.6903	0.1029
Total of participants	78			

Regarding the academic results obtained in the students' exams, the average final grade was 3.47, with a standard deviation of 0.68 points with respect to the mean. The lowest grade obtained was 1.6, while the highest was 4.8 as shown in Table III. The average grade of optional exams tends to be lower than the average grade of the midterm exams.

Table II. Sociodemographic and academic characteristics of students.

Variable	Category	Frequency
Sex	Men	33
	Women	45
Number of siblings	0	10
	1	29
	2	22
	3	11
	4	3
	5	1
	6	1
	7	1
Position among siblings	First	33
	Middle	14
	Last	22
	Other	9
People they live with	Just the mother	20
	Just the father	1
	Mother and father	29
	Others	28
Mother's education level	None	2
	Primary school	4
	Highschool	47
	Postgrade	25
Father's education level	None	3
	Primary school	11
	Highschool	37
	Postgrade	27
Socioeconomic strata	1	23
	2	21
	3	19
	4	10
	5	5
From Cali	No	53
	Yes	25
Family financial support to study	No	4
	Yes	67
	Otro	7
Type of school	Public	55
	Private	23
Repeated any school year	No	71
	Yes	7
Has previously been in any undergraduate or technical studies	No	49
	Yes	20
	Partially	9
Reading habits	Bad	1
	Regular	20
	Good	50
	Very good	7
Preferred study method	YouTube videos	24
	Reading books	30
	Amphitheater	18
	Virtual reality	5
	Writing	1

Figure 1 shows the behavior of the grades during the academic period evaluated. The grades of the theoretical exams tend to increase as the semester progresses, the grades of the practical exams tend to vary more, and the grades of the midterm exams tend to be stable.

Correlations. To evaluate the correlation between the final grade and the dichotomous qualitative variables, a comparison of the means of each group was made. To do

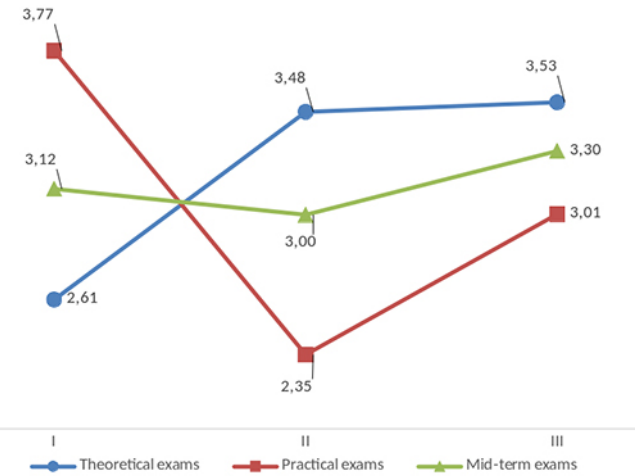

Fig. 1. Evolution of grades by type of evaluation.

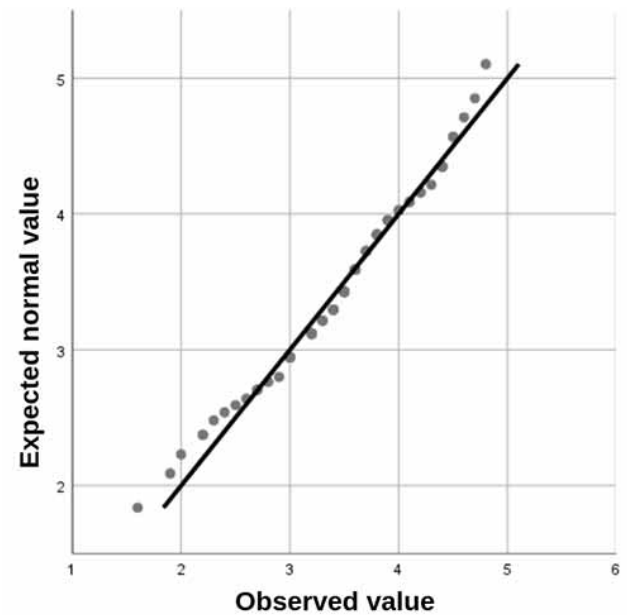

Fig. 2. Q-Q (quantile-quantile) plot of the final grade.

this, it was necessary to verify whether this variable had a normal distribution. Figure 2 shows that the points are close to a straight line, indicating that the final grade data tend to a normal distribution. As a statistical test, the Kolmogorov-Smirnov test was used, obtaining as a result that the normality hypothesis is not rejected, when using an α=0.1 (Table IV).

Table IV. Kolmogorov-Smirnov normality test for the variable final grade.

Kolmogorov-Smirnov		
Statistic	df	Sig.
0.094	78	0.083

Considering that the final grade data are considerably close to the normal distribution, the respective t-tests and ANOVA were performed. According to the statistical analysis performed, no strong correlations were found at a significance level a=0.05. However, there is a correlation to consider in the variables of sex and place of origin (p_value < α=0.1 or fairly close) (Table V).

When analyzing the differences in the means of each of these groups, the results in Table VI were obtained. It can be evidenced that there are differences to be considered in the mean grades obtained in each of the groups. On average, male students and students who live in the city of Cali obtain better grades in the exams.

Table VI. Comparison of average final grade vs Sex and Place of origin.

Variable	Category	Quantity	Mean	Deviation
Sex	Men	33	3.624	0.638
	Women	45	3.358	0.690
From	No	53	3.379	0.592
Cali	Yes	25	3.664	0.810

Table III.Measures of central tendency and dispersion of student grades throughout the course.

Measures of central tendency and dispersion	Final	Theoretical exam I	Practical exam I	Mid-term I*	Optional exam I	Theoretical exam II	Practical exam II	Mid-term II*	Theoretical exam III	Practical exam III	Mid-term III*	Optional exam II
Mean	3.47	2.61	3.77	3.12	2.95	3.48	2.35	3.00	3.53	3.01	3.30	2.35
Median	3.50	2.40	4.20	3.20	3.00	3.55	2.40	3.00	3.40	3.20	3.30	2.20
Standard deviation	0.68	0.88	1.26	0.85	0.93	0.86	1.28	0.96	0.68	1.32	0.85	0.70
Sample variance	0.46	0.77	1.60	0.73	0.86	0.73	1.65	0.92	0.46	1.75	0.73	0.49
Range	3.20	3.90	4.80	4.00	4.50	5.00	5.00	4.60	2.80	5.00	3.50	3.10
Minimum	1.60	1.10	0.20	0.80	0.00	0.00	0.00	0.00	2.10	0.00	1.40	1.20
Maximum	4.80	5.00	5.00	4.80	4.50	5.00	5.00	4.60	4.90	5.00	4.90	4.30

*Mid-terms correspond to the average of the practical and theoretical exams.

Table V. Final grade correlation vs Dichotomous qualitative variables.

Variable	t	Degrees of freedom	p-value	95% confidence interval of the difference	
				Inferior	Superior
Sex	1.738	76	0.086	- 0.039	0.572
From Cali	1.755	76	0.083	-0.608	0.038

DISCUSSION

Academic performance has been recognized as one of the indicators of academic quality in the higher education system (Garbanzo Vargas, 2013). The grade obtained by students in the different subjects must be higher or equal to 2.95 to pass the courses, if the student obtains a result lower than this grade they must repeat the subject again and, in case this is a prerequisite of another,they will fall behind in the semesters.

These quantitative measures of learning have been widely criticized, but they continue to be used. Sociodemographic factors are considered to influence student academic performance; Becerra *et al*. (2017) state that these factors influence the academic performance of students of higher education in Colombia, so it is necessary for institutions to make decisions regarding the hiring of teachers, encourage research and improve administrative processes in order to counteract the negative impact of students' the conditions and other environmental factors.

Educational and psychological factors also influence academic performance and school dropout. The most prevalent indicators in these situations are economic difficulties, personal history, family history and shortcomings in secondary education (Zambrano Verdesoto *et al*., 2018).

Vanegas-Pissa & Sancho-Ugalde (2019) conducted a study on student desertion in Medicine and Surgery at the University of Medical Sciences in Costa Rica, between 2008-2009. They found that 55.2 % of the students dropped out of the program in the first six semesters, with multi-repetition in basic science courses as the main cause. In addition, they identified the need to innovate the didactic methods of the courses, the pedagogical strategies, to work on the curricular design and to favor the study methodologies.

In the present study, the HGA course is organized by three modules that are evaluated through theoretical-practical exams, quizzes, dissection activity and clinical correlation workshops. The average grades obtained in the HGA course indicate an acceptable academic performance in most of the students, although low since a grade higher or equal to 2.95 is required to pass the course. The average of the first and third midterm was between 3.1 and 3.3. When correlating the results with the sociodemographic variables by means of the Student's t-test, no statistically significant differences were found. However, students who were not from the city of Cali and women presented a lower academic performance compared to their peers; this is reflected in the results of the test, which were close to 0.05.

In terms of learning, it should be noted that in order to understand the HGA students need to be able to locate spatially the anatomical reference position and be able to identify, differentiate and relate the anatomical structures. The study of the isolated organs and the anatomical sections, both in two-dimensional images, 3D models and diagnostic images is of high complexity. Research on spatial ability shows that better performance has been reported in males compared to females in terms of spatial perception (determining spatial relationships) and mental rotation ability (ability to quickly and accurately rotate two- or three-dimensional figures in the imagination) (Hegarty, 2018).

Gender differences in spatial ability are well established in adulthood, particularly when measured by tasks requiring mental rotation of objects; this male advantage remains a matter of debate (Lauer *et al*., 2019). While males and females do not differ in levels of general intelligence, gender differences apparently exist for more specific cognitive abilities, such as these spatial skills (Reilly *et al*., 2017). These results could indicate the reason for finding higher academic performance in this HGA course in males compared to females.

Another sociodemographic factor of interest that was found was the case of students from other cities and towns, who obtained a lower average in their final grade than peers who come from or live permanently in the city of Cali. This could be explained by the difference in the cultural, economic and social capital of the students, since some of them come from families that lack dominant economic and cultural capital, which affects the possibility of success as it depends on the distribution of capital among individuals (Huang, 2019).

Likewise, when students find themselves in an unfamiliar environment, they may feel restless, ambivalent, insecure and uncertain, since it is difficult for them to maintain connections with their social, family and cultural environment (Ready *et al*., 2009). These emotions could affect the student's ability to concentrate and hinder their learning process. In a study conducted by Guevara Vila (2018), different patterns of student dropout were identified in the university, including older married men and women with low GPA, women with moderate disability, students in academic programs related to health areas, and foreign students with low GPA.

Previously, the academic credits and hours devoted to the teaching and learning of Human Anatomy were very extensive in the curricula of the different academic programs of Medicine. As new subjects and new knowledge necessary for medical practice were included, the number of hours allocated for this learning has progressively decreased, to

such an extent that for some authors its teaching has fallen below safe levels for the patient (Turney, 2007).

Between 1872 and 1883, at the University of Chile, Anatomy was taught to only four students and had a duration of three years (Brunstein, 2014), a similar situation to that at the Universidad del Valle in 1931, where the subject lasted two years. Currently, Anatomy courses aimed at the academic program of Medicine and Surgery usually have on average groups of 80 to 100 students and have a duration of one year, as a consequence of policies that seek greater coverage in higher education.

The teaching and learning of the different structures of the human body used to include anatomical drawing and detailed dissection of different regions of the body with cadavers as a pedagogical resource. The latter is considered the best method for learning human anatomy, as they favor the location in space and the understanding of three-dimensionality. However, these practices have been eliminated from syllabi due to different governmental, economic, religious, ethical and curricular restrictions (Moro *et al*., 2017).

In the case of Colombia, access to cadaver donation for medical practices is difficult; the National Institute of Legal Medicine and Forensic Sciences, in its Resolution 382 of 2015 regulates the registration of entities for the procurement of cadavers, anatomical components and tissues for research and teaching purposes, institutions must have a modern Morphology Laboratory, with all the biosafety standards, and be responsible for the custody and burial process. The costs and maintenance of these provisions has led some institutions not to include dissection within their curricula due to lack of resources.

Despite having less and less academic work time for both the teacher and the student, the same amount of content is still handled, which can generate superficial learning and lack of understanding of the topics. This can be reflected in the increase of demands from patients, as a result of misdiagnosis, incorrect treatments and damage to structures close to the anatomical region operated on (Ellis, 2002).

This situation has generated that students express their discontent with the number of hours of face-to-face and independent work required (approximately 12 hours per week), to achieve to cover all the themes of the Gross Anatomy syllabus, which do not correspond to the number of credits assigned (4 credits). Taking into account that most of the subjects corresponding to the basic cycle are in the same situation, students perceive medical education as stressful because they are unable to engage in other complementary activities such as sports, recreation and leisure, all of which are necessary for their comprehensive training process.

Research conducted with medical students has reported a high prevalence of moderate and severe stress, especially during the first three years of study, related to a negative effect on learning. Among the causes, an authoritarian, rigid and exhausting educational system has been found, which encourages competition instead of cooperation among learners (Abdulghani *et al*., 2011).

Regarding the HGA, it is important to take into account that this is characterized by presenting a broad content, specialized language and lacking a consensus in the terminology used, a relevant aspect that represents a difficulty in the learning process in the career. The structures used to be called after their discoverer or as denominations according to the experience of the time, however, research was carried out independently by several scientists, so it is possible to find that a structure may have several names.

The anatomical terminology that had become chaotic in the 19th century was codified in the 1895 Basle Nomina Anatomica (BNA), when 5,000 terms were selected from 50,000 existing names. Incidentally, all nomenclatures are in Latin and it was decided to use the upright posture as the base anatomical position and the elimination of eponyms. For teaching, learning and research, this nomenclature has been of great benefit by reducing the names used for the same structure, providing a consistent and internationally accepted standard (O'Rahilly, 1989).

Conceptual difficulties in learning Gross Anatomy may be intrinsic to the subject, related to the students' thinking and way of reasoning, derived from learning and attributed to the instructional process (Caamaño & Oñorbe, 2004). It should be emphasized that the teaching, learning and evaluation (T-L-Ev) of Human Anatomy, as well as most of the basic subjects of the academic program of Medicine, follow a traditional teaching method, in which transmission-reception predominates, focused on academics and memorization of contents (Martin *et al*., 2000).

Similarly, it has been suggested that Basic Sciences teaching has been done without a clinical relevance to understand the purpose of learning as a result of multiple factors, such as the fact that the Medical curriculum is fragmented, obsolete and static (Frenk, 2015). The traditional way of teaching HGA has been through lectures, and laboratory practice often becomes just another lecture: the teacher explains the different regions in the theoretical class with the help of two-dimensional drawings and, during

practice, the lecture with the real piece or with anatomical model is repeated. The evaluation is corroborated with a theoretical multiple-choice test and a practical obstacle course-type exam. Accumulation of information is evaluated, although these tests commonly do not assess the student's associative, explanatory, argumentative and creative capacity (Brunstein, 2014).

Yaqinuddin *et al*. (2013) consider that this type of practical test does not really relate to the level of knowledge that students have. Therefore, he proposes that it is necessary to develop objective tools to assess higher cognitive skills, such as clinical application of anatomical knowledge.

CONCLUSION

Sociodemographic factors play an important role in students' academic performance. Although no statistically significant correlations were found between them in this research, a correlation to be considered between gender and place of origin of the student with the average obtained in grades was evidenced.

It seems that there are gender differences in spatial thinking ability; these results could indicate part of the reason for the lower academic performance of women in this subject. Likewise, foreign students obtained lower grades in the exams, possibly due to the difference in cultural, economic and social capital.

The most common student errors evidenced in the exams correspond to confusion of the generalities of HGA, incorrect use of anatomical terminology, difficulty in differentiating structures and poor spatial location. Generally, HGA courses assume T-L-Ev processes in a disintegrated fashion.

These results may indicate the need to include in the HGA program the evaluation of students' spatial thinking and, when necessary, to include activities to strengthen the learning process. Similarly, it is necessary to deepen the knowledge about the difficulties and needs of foreign students, in order to guide the creation of support programs to help them maintain their academic performance and reduce the inequality gap.

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RESUMEN: Se ha demostrado que en el proceso de enseñanza y aprendizaje de la anatomía humana inciden diferentes factores externos que pueden afectar, a corto y largo plazo, el desempeño académico y profesional de los estudiantes de Medicina. En este sentido, el presente trabajo tiene como objetivo determinar la relación existente entre los factores sociodemográficos y el rendimiento académico de los estudiantes que pertenecen al programa de Medicina y Cirugía de la Universidad del Valle, en Cali-Colombia, matriculados en la asignatura de Anatomía Macroscópica Humana. A partir de la organización del plan del curso, se comparó el promedio de las notas obtenidas por los estudiantes en los diferentes exámenes realizados en la asignatura. A través de una encuesta, se preguntaron algunos datos sociodemográficos que han sido reportados como factores influyentes en el rendimiento académico. La primera etapa del análisis consistió en identificar las características de las variables, a continuación, la correlación de las variables sociodemográficas con el desempeño académico de los estudiantes y, finalmente, se implementó un modelo de regresión lineal múltiple. Si bien los resultados no arrojaron correlaciones estadísticamente significativas entre las variables analizadas, sí se observó una estrecha relación con el sexo y el lugar de procedencia de los estudiantes, obteniendo que las mujeres y los estudiantes foráneos presentaron menor rendimiento académico en comparación con los demás compañeros. Esto resalta la importancia de incluir actividades que permitan fortalecer el proceso de aprendizaje, así como guiar programas de apoyo para mantener el rendimiento académico y disminuir la brecha de desigualdad.

PALABRAS CLAVE: Anatomía Macroscópica Humana; Enseñanza y aprendizaje universitarios; Rendimiento académico; Estudiantes universitarios; Factores sociodemográficos.

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