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Factors associated with academic performance in undergraduate health sciences students enrolled in the human anatomy course

Factores asociados al rendimiento académico en la asignatura de anatomía humana en estudiantes de pregrado de ciencias de la salud

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Abstract

Introduction: Human anatomy is a core subject that poses a great academic challenge for students who are admitted to the health sciences undergraduate degree programs.
Objective: To know the socio-academic profile of first-year students of several health sciences undergraduate programs and to assess the association between, on the one hand, academic performance during secondary education, study habits and performance in the university admission science test and, on the other, academic performance in the human anatomy course.
Materials and methods: Cross-sectional correlational study conducted in 2018. The study population consisted of 306 first-year students enrolled in 7 health sciences undergraduate programs offered by the Faculty of Medical Sciences of a public university in Santiago de Chile, Chile. The Pearson correlation coefficient was used to determine the correlation between the variables of interest. Also, a multiple linear regression analysis was performed to establish the factors significantly associated with the final grade obtained in the course. A level of significance of $p<0.05$ was considered.
Results: The mean age of the participants was 19.8 years, 98.6% were single, and 65.3% were female. A significant association was observed between the final grade obtained in the course and the score obtained in the university admission test ($p=0.000$) and the high school grade point average ($p=0.001$); however, this association was not significant with the variables considered as study habits.
Conclusion: Academic performance in the human anatomy course was associated with the students' prior knowledge, but not with their study habits. Thus, educational interventions in this university should focus more on leveling students' knowledge, rather than on optimizing their study habits.
Keywords: Anatomy; Academic Performance; Students, Health Occupations; Universities; Chile (MeSH).

Resumen

Introducción. Anatomía humana es una asignatura básica que representa un gran desafío académico para los estudiantes que ingresan a programas de pregrado en ciencias de la salud.
Objetivos. Conocer el perfil socioacadémico de los estudiantes de primer año de varios programas de ciencias de la salud y evaluar la asociación entre, por un lado, el desempeño académico en la enseñanza media, los hábitos de estudio y el desempeño en la prueba de selección universitaria de ciencias y, por el otro, el rendimiento académico en la asignatura de anatomía humana.
Materiales y métodos. Estudio transversal correlacional realizado en 2018. La población de estudio consistió de 306 estudiantes de primer año de 7 programas de pregrado de ciencias de la salud ofrecidos por la Facultad de Ciencias Médicas de una universidad pública en Santiago de Chile, Chile. La correlación entre las variables de interés se determinó mediante el coeficiente de correlación de Pearson. Además, se realizó un análisis de regresión lineal múltiple para establecer los factores asociados significativamente con la nota final de la materia. Se consideró un nivel de significancia de $p<0.05$.
Resultados. La edad promedio de los participantes fue 19.8 años, 98.6% eran solteros y 65.3% eran mujeres. Se observó una asociación significativa entre la nota final de la asignatura y el puntaje de la prueba de selección universitaria de ciencias ($p=0.000$) y el promedio de notas de enseñanza media ($p=0.001$), pero no con las variables consideradas como hábitos de estudio.
Conclusiones. El rendimiento académico en la asignatura de anatomía humana se asoció con los conocimientos previos de los estudiantes, pero no con sus hábitos de estudio. Por tanto, se recomienda que las intervenciones educativas en esta universidad se centren más en la nivelación de los conocimientos de los estudiantes, que en la optimización de sus hábitos de estudio.
Palabras clave: Anatomía; Rendimiento académico; Estudiantes del área de la salud; Universidades; Chile (DeCS).

Introduction

The human anatomy course is an academic challenge for health students due to the high amount and novelty of the programmatic contents involved.[1] These characteristics make this subject a priority in the academic life of these students since their performance in it, particularly during the first year, has a significant impact on their training process.[2-4]

There is a consensus in the literature that academic performance prior to admission to higher education, based on the grades obtained during secondary education, study habits, and results on university admission tests, is a good indicator of university performance.[5-9]

In Chile, this academic performance is measured through the High School Grade Point Average (NEM by its acronym in Spanish), which represents the overall average obtained in the four years of secondary school and is used as a selection factor for admission to higher education.[10] Moreover, the University Selection Tests (PSU by its acronym in Spanish), which are nationally standardized tests developed by the Department of Educational Evaluation, Measurement and Registration (DEMRE) of the Universidad de Chile for admission to higher education, are also used to this end.[11,12]

PSUs comprise two compulsory tests (mathematics, and language and communication) and two optional tests; one of them is science, which is a mandatory requirement for admission to health programs in all universities across the country and is assessed on a scale with a minimum of 150 points and a maximum of 850.[13] These tests also have a reliability coefficient of ≥0.91, a value that, according to international standards, is considered highly satisfactory because it indicates that 91% or more of the variance of the scores is the product of individual differences in the performance of the applicants.[14]

In this scenario and taking into account the relevance of the students' academic background in their university performance, the objectives of this research were to determine the socio-academic profile of first-year students of various health science programs and to evaluate the association between, on the one hand, academic performance in secondary school, study habits and performance in the Science PSU, and on the other, academic performance in the human anatomy course.

Materials and methods

Study type and population

Cross-sectional, correlational study. The study population consisted of all students who enrolled in the first year of one of the following undergraduate academic programs offered by the Faculty of Medical Sciences of a public university in Santiago de Chile, Chile, in 2018: Nursing; Sports Coaching; Kinesiology; Medicine; Obstetrics and Childcare; Physical Education Pedagogy; Physical Activity and Health Therapy; and Occupational Therapy (N=309).

For the selection of participants, the inclusion criterion was to be taking for the first time the human anatomy course in each of the programs included, while the exclusion criterion was not attending class on the day of the administration of the questionnaire. Thus, the final sample was made up of 306 students distributed as follows according to program: Nursing: 53 students, Sports Coaching: 27 students, Kinesiology: 26 students, Medicine: 65 students, Obstetrics and Childcare: 54 students, Physical Education Pedagogy: 27 students, Physical Activity and Health Therapy: 21 students, and Occupational Therapy: 33 students.

Study variables

The study variables were socio-academic background, study habits, and academic performance in the human anatomy course.

Instrument and procedures

The data collection instrument was a self-applied questionnaire designed by the authors that has two parts. Students' socio-academic information, which included study variables such as age, sex (male or female), number of children, marital status (single, married, divorced or widowed), paid job (yes/no), ranking score (selection factor that considers a student's academic performance in relation to his/her educational context), year of high school graduation, and type of school where the student completed these studies (municipal, subsidized private, or paid private school), was obtained in the first part. With regard to the latter variable, it should be noted that municipal schools in Chile are public institutions, that subsidized schools are private institutions that receive state funding, and that paid schools are private institutions that do not receive any kind of state funding.

The second part of the questionnaire collected information on the students' study habits, which were measured in six dimensions (study place, study schedule, motivation, organization, attention habits, and reading comprehension) through statements such as: "I use the same place to study," "I study at a specific time," "I organize my study time," "I am motivated to study," "I pay attention in class," "I understand what I read when I study," etc. These statements were measured using a Likert scale with scores from 0 to 3 (0: never, 1: sometimes, 2: almost always, and 3: always) to identify the frequency of the evaluated item and classifying them into bad (ranges 0 to 1.0), regular (1.1 to 2.0), or good (ranges 2.1 to 3.0) study habits.

This questionnaire was previously used in a pilot test conducted in 2016 to 10% (n=31) of first-year students of health programs in the same university to assess possible problems that could arise during its administration. The total scale of the study habits questionnaire showed a Cronbach's alpha coefficient of 0.649, which implies acceptable reliability.

On the other hand, information on the academic performance of the students was obtained from the official documents of the university's curricular registry, including the NEM average, the Science PSU score, and the final grade of the human anatomy course.

The human anatomy courses were taught by two faculty professors, who used a similar teaching methodology but adapted to the need of each program and with a different name for each program. Data were collected during the first week of classes, specifically during the first session of the course in question.

Statistical analysis

Data were analyzed using descriptive statistics. Quantitative variables were expressed using means and standard deviations (SD), and categorical variables with frequency and percentage. Subsequently, in order to establish how

the variables of interest were correlated, the Pearson correlation coefficient between NEM average, Science PSU score, study habits, and the final grade of the human anatomy course, was estimated. Finally, based on the results of this correlation analysis and in order to determine which of these factors were statistically significantly associated with the final grade of the course, a multiple linear regression analysis was performed; to this end, the variables that met the criteria (scalar variables that had a significant correlation with the dependent variable, $p<0.05$) were entered as independent variables, and the final grade of the human anatomy course was entered as a dependent variable.

In this way, it was also possible to compare which variables (among those significant for the model) explain to a greater extent the final grade obtained in this course; in addition, the sex of the students was used as a control variable. These statistical analyzes were carried out in the IBM-SPSS 24 software. A significance level of $p<0.05$ was considered for all statistical analyzes

Ethical considerations

The study took into account the ethical principles for medical research in human subjects of the Helsinki Declaration.[15] The research was endorsed by the Institutional Ethics Committee of the university where the study was conducted according to Minutes No. 103 of March 12, 2018. The participants signed an informed consent for the collection of the data after being explained about the objectives of the study.

Results

Of the 306 participants, the majority were single (98.69%), female (65.36%) and had no children (97.71%); none had a paid job, and the average age was 19.87 years (SD: ±2.2, range: 17-36 years).

In addition, more than half of the sample (57.84%) was made up of students who had developed a continuous student trajectory, i.e., they graduated the previous year (2017) from high school. Of the remainder, 39.22% graduated in 2016, while 2.94% graduated between 1999 and 2015. With regard to the type of secondary education school they attended, most graduated from subsidized private schools (57.52%), followed by municipal schools (24.51%), and private paid schools (17.97%).

Concerning students' study habits, it was found that those in the *motivation subdimension had the best scores, while those in the study schedule* sub-dimension had the worst (Table 1).

In the distribution of study habits per program, it was found that nursing students generally had the best habits (average of 6 sub-dimensions), while students of Physical Education, Sports Coaching, and Physical Activity and Health Therapy had the worst (Table 2).

Table 1. Study habits dimensions in students of the medical science programs analyzed.

Sub-dimension	Mean	SD	No. of items	Cronbach's Alpha
Place of study	1.89	±0.63	3	0.78
Study schedule	1.44	±0.65	5	0.76
Motivation	2.08	±0.34	5	0.46
Organization	1.70	±0.55	4	0.62
Attention habits	1.96	±0.39	5	0.42
Reading comprehension	2.06	±0.56	3	0.54
Total study habits	1.85	±0.36	25	0.84

SD: standard deviation.
Source: Own elaboration.

Table 2. Academic variables of the students of the analyzed health sciences faculty programs. Descriptive data.

Academic program	High school grade point average*			Science university selection test scores †			Study habits ‡			Final grade in the human anatomy course *			
	Minimum	Maximum	Mean (SD)	Minimum	Maximum	Mean (SD)	Minimum	Maximum	Mean (SD)	Highest	Lowest	Mean (SD)	% of approval
Nursing	6.18	6.8	6.51 (0.13)	537	709	636.77 (33.92)	1.17	3	1.97 (0.41)	5.9	1.6	4.60 (0.76)	95%
Sports Coaching	5.8	6.73	6.16 (0.26)	409	699	571.00 (67.55)	0.95	2.42	1.68 (0.41)	6.4	1.1	3.73 (1.48)	57%
Kinesiology	5.55	6.78	6.31 (0.24)	457	704	587.04 (58.45)	1.31	2.47	1.87 (0.31)	5.3	3.8	4.46 (0.42)	96%
Medicine	6.2	6.95	6.74 (0.14)	443	830	758.17 (67.18)	1.11	2.44	1.88 (0.28)	6.3	1.8	5.07 (0.85)	91%
Obstetrics and Childcare	6.13	6.95	6.51 (0.17)	470	768	648.06 (51.56)	1.06	2.53	1.87 (0.36)	6.4	4.3	5.49 (0.52)	100%
Physical Education Pedagogy	5.63	6.6	6.23 (0.26)	349	727	578.37 (76.38)	1.21	2.13	1.70 (0.27)	6.2	2.2	4.52 (0.91)	79%
Occupational Therapy	5.98	6.65	6.39 (0.17)	537	714	617.79 (43.67)	1.45	2.49	1.94 (0.29)	6.6	4.0	5.35 (0.63)	100%
Physical Activity and Health Therapy	5.48	6.35	5.97 (0.20)	392	646	563.35 (62.93)	0.97	2.4	1.67 (0.39)	5.8	1.0	4.22 (1.28)	73%

SD: standard deviation.
* Grade scale from 1 to 7.
† Evaluation scale with a minimum score of 150 points and a maximum score of 850 points.
‡ Evaluation ranges from 0 to 3.
Source: Own elaboration.

The academic performance of the participants before initiating their higher education studies, as evidenced by the NEM score, was similar in the various programs; however, differences were found in the Science PSU scores, in both the average between programs and between the lowest and highest scores of students in the same program. The highest grade point average for the human anatomy course was obtained by the students of the Obstetrics and Childcare and Occupational Therapy programs (Table 2).

In the correlation analysis performed for the variables NEM average, ranking score, PSU Science score, study habits (six sub-dimensions) and final grade for the human anatomy course, it was observed that a large number of the combinations showed positive and statistically significant correlations with a $p<0.01$. The final grade variable had the strongest correlation with the variable Science PSU score, followed by the variables NEM average and ranking score. The only study habits sub-dimensions that showed a statistically significant correlation with the final grade were study schedule and reading comprehension (Table 3).

Table 3. Pearson correlation coefficient matrix (n=306).

Study habits	Average NEM	Ranking score	CCS test
Place of study	0.153 *	0.121 *	0.145 *
Study schedule	0.215 ‡	0.178 ‡	0.164 ‡
Motivation	-0,061	0,014	-0,082
Organization	0.153 *	0.123 *	0.161 ‡
Attention habits	0.019	0.062	0.007
Reading comprehension	0.234 ‡	0.176 ‡	0.159 ‡
Human anatomy subject grade	0.347 †	0.318 †	0.369 †

NEM: secondary education grades; CCS: science.
* The correlation is significant at the 0.05 level (bilateral).
† The correlation is significant at the 0.01 level (bilateral).
Source: Own elaboration.

For the multiple linear regression analysis model, which aimed to identify factors associated with the final grade obtained in the human anatomy course, all variables that had a statistically significant correlation with the latter were considered (NEM average, Science PSU score, study schedules and reading comprehension), with the exception of the variable ranking score due to the high collinearity it had with the NEM average variable. In addition, the sex variable was included (female: 0; male: 1) as a control variable, that is, to safeguard that the association between independent variables and make sure that the dependent variable was not correlated to being male or female.

The model was statistically significant ($p<0.001$), with an adjusted R^2 of 0.199, i.e., it explained 19.9% of the variance of the dependent variable (final grade of the human anatomy course). The variables Science PSU scores, NEM average, and sex were significantly associated with the final grade of the course ($p=0.000$, $p=0.001$, and $p=0.017$, respectively); however, the association with variables related to study habits (study schedules and reading comprehension) was not statistically significant.

When comparing the standardized beta coefficients, it was found that the Science PSU score variable had more weight than the NEM average in the model (Table 4), which did not present collinearity problems according to the variance inflation factor since the results were <10 for each of the variables analyzed.

Table 4. Multiple linear regression analysis (n=306).

Dependent variable: grade in the anatomy course.	B	Std. beta	95%CI for B		p-value
(Constant)	-0.003		-0.824	1.863	0.996
University selection of science test	0.003	0.254	0.002	0.004	0.000
High school grade point average	0.004	0.219	0.001	0.005	0.001
Study Habits - Study Schedule	0.090	0.059	-0.072	0.271	0.304
Study Habits - Reading Comprehension	0.111	0.062	-0.151	0.263	0.282
Sex	-0.290	-0.136	-0.530	-0.051	0.017

B: beta; Std: standardized.
Source: Own elaboration.

Discussion

The human anatomy course is of great importance in health science programs because it is the foundation of medical education for students and professionals in the area who use clinical reasoning.[2] In other words, knowledge of this subject is fundamental to academic progress in all health careers.

Given this scenario, multiple research works have been carried out to assess the impact of performance in this subject on the overall performance of students. For example, Vanegas-Pissa & Sancho-Ugalde[16] conducted a study in which they analyzed the scores obtained by 256 students from a medical program medical at a university in San José, Costa Rica, who enrolled in Physiology for the first, second or third time between 2008 and 2011. They found that passing the course "Anatomy I" increased 2.85 times the passing ratio for the Physiology course, since the former contains aspects that contribute considerably to the knowledge of future core subjects.

Knowledge acquired during secondary education is also a factor that influences academic performance in the university.[17] Therefore, various studies have been conducted to demonstrate the relationship between the academic performance of the students in this period and their academic performance in higher education. One of such works was conducted by Vergara-Díaz & Peredo-López,[9] who, from a sample of 440 Chilean Commercial Engineering students from the Universidad Austral de Chile, found that the NEM average explains student academic

performance better by having the best correlation with academic performance in the first semester and more strongly in the second semester.

Similarly, Medina & Flores,[18] in a sample of 386 first-year dentistry students enrolled at the Universidad de Concepción de Chile between 2004 and 2008 who were admitted under the PSU process, found that the variable most strongly associated with academic performance was NEM average. By the same token, Pérez *et al.*,[8] in a study conducted in 117 Chilean first-year medical students, concluded that NEM was the best predictor of the cognitive and attitudinal characteristics of the students, which are determinants of their university success.

At the international level, Schutte[19] conducted a study with 5 133 Anatomy students between 2004 and 2010 at a university in the USA and demonstrated that higher education admission scores were associated with academic achievement in this course.

The results exposed above follow the line of the evidence shown in the present research since, in these studies, the Science PSU score is identified as the factor most strongly associated (within the evaluated variables) with academic performance in human anatomy, followed by the NEM average.

Similarly, study habits are considered a relevant academic background that students acquire in high school and impact academic achievement. Moreover, for some authors, these habits are essential as they consider them "the initial step in activating and developing students' learning capacity."[20, p28]

Likewise, Jafari *et al.*,[21] based on a cross-sectional study conducted between November 2017 and April 2018 with 380 health students from an Iranian university, found that the mean GPA of the students was 15.73±1.5 out of 20, the mean of total status of study habits was 45.70±11.36 out of 90, and the state of study habits in 81.3% of the students was moderate. As a result, the Pearson correlation test showed a direct and significant relationship between academic performance and study habits ($r=0.235$, $p<0.001$).

In contrast, Alzahrani *et al.*,[22] in a comparative study conducted in 2015 at a university in Saudi Arabia and in which 257 medical students divided into 2 groups (one group with grades >3.5 (out of 4.0) and another with grades <3.5) were included; they found that, when evaluating different study habits, approximately 59% of students with high grades studied two or more weeks before the final exam, compared to 53% in the lower-grade group. Thus, the authors concluded that study habits are an important factor influencing academic performance.

However, other authors such as Montes-Iturrizaga[23] report that study habits may not be linked to mastery of an area of knowledge. The postulates of this author are in accordance with the results of the present research, since it was observed here that no study habit sub-dimension was significant when tested as a factor associated with academic performance in human anatomy; this could be related to the characteristics of the course, as it has a wide range of content linked to scientific-biological knowledge that must be addressed by the students.

In this sense, students with better prior knowledge would be in a more favorable position to acquire, in a better way, knowledge in the scientific-biological field. This is related to Ausubel's model of meaningful learning, which states that learners extend their new knowledge by building on their pre-existing knowledge.[24]

Strengths and limitations

The strengths of the present study were that PSUs were the same for all students evaluated, that human anatomy subjects were taught and evaluated by the same team of professors in all programs, and that all evaluation data (scores and grades) were collected from the official records of the university, characteristics that reinforce the internal validity of the study.

One of the limitations is the fact that the academic level of the schools from where the students graduated was unknown, which would allow verifying a possible relationship with the performance in the human anatomy course. This lack of knowledge could be established as a possible line of research in future studies.

Concerning the external validity of the study, it is evident that it can be extrapolated to other courses taught in health programs, such as Physiology, an area that requires similar knowledge as a condition for good academic performance.

Conclusions

According to the results of the present study, it was established that the sociodemographic profile of first-year students of the health science programs analyzed is homogeneous and that academic performance in human anatomy courses was associated with the previous knowledge of the students but not with their study habits.

These findings suggest that academic performance in this course, which involves learning a large amount of scientific-biological content, is facilitated by the student's prior knowledge and not by study habits. Therefore, it is recommended that educational interventions at this university focus more on the leveling of students' knowledge than on the optimization of their study habits.

Conflicts of interest

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