Evaluation of the determinants that affect academic performance on first-year medical students

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**Abstract**

**Background:** Medical students face many challenges during their formation. These go from socio-economic factors, a heavy academic load, and psychosocial factors that affect their academic performance. To identify these factors constitutes the first step to address them, and to prevent students to have an emotional and work overload that would lead to an inadequate formation or the dropout of the student.

**Methods:** We apply an eight-section survey each of which measured an indicator to 777 medical students, and we evaluated the influences of each of these indicators on student's academic performance.

**Results and Discussion:** There is an important but variable contribution from the different indicators to academic performance. These factors should be addressed from a perspective of improving the student’s experiences for an adequate formation.

**Keywords:** Academic Performance; Socio-economic factors; Student motivation; Medical Students.

**Introduction**

Medicine is one of the most demanded careers worldwide. There is no clear data about the exact number of medical students in the world, according to some authors, by 2012 they were around 469 000 medical students in 2597 School’s or Faculties of Medicine certified by the Educational Commission for Foreign Medical Graduates (Duvivier et al., 2014). Currently, according to the World Directory of Medical Schools (WDMS), there are 3220 School or Faculties of Medicine recognized by this institution in the world (WDMS, 2020). In Mexico, according to the National Association of Universities and Superior Education Institutions (ANUIES) for the 2018-2019 academic year, 134 101 students that finished high school applied to one of the 110 Medical institutions recognized by this institution. From these students, 24 495 were accepted (18.26%) (ANUIES, 2019).

Outer from the number of medical students, each of them faces a series of factors such as a high academic load, busy schedules, and economic and psychosocial factors that make a large proportion of them present a low academic
performance, which can lead to dropout. To identify those students with risk factors to develop a low academic performance should be a priority for every teacher and scholar authorities since acting in these groups with activities like mentoring programs, emotional support programs, or economic stimuli programs could substantially improve these student’s performance. To do this in the first’s years of the career could significantly reduce dropout.

An evaluation of academic performance must include different indicators of the range of factors that affect it. This research team selected those indicators from their experience and from described by other authors. The following were the measured indicators:

**Strength of Motivation:** Motivation represents an important aspect to acknowledge an effective study, more even in demanding careers like Medicine. To become a Doctor is a dream to many students worldwide, nevertheless, it requires time, effort, and a strong motivation. This was previously studied, and a previously created survey by Nieuwhof et al. was adapted by this team to measure motivation among students (Nieuwhof et al., 2004).

**Academic Factors:** It refers to the High School institution of which the student comes from. These institutions have a large variety in Mexico which reflects the necessity to evaluate them. First to determine if the student comes from a private or a public high school. Then, to evaluate the model of the high school, which according to the Mexican Ministry of Education are General High School, Technological High School, Professional Technician High School, Open High School, and Online High School. We consider that the time dedicated to the study of High School could affect the academic performance of the student because as most of the high school have a three-year program, some institutions offer a two or even a one-year high school program. Finally, since we conducted this research in a Faculty with a large variety of student’s origins, we evaluated if this foreigner students have different academic performance than local students.

**Socioeconomic Factors:** One of the most important factors is the economic one, and it is one of the most difficult to measure since is an indicator that varies in different countries and even in different regions of the same country. According to the United Nations, there are an estimated 783 million people that live in poverty conditions in the world (United Nations, 2020). Mexico has a variety of socioeconomic levels among its states. Nuevo Leon State, in which the research was conducted in is the Mexican State with less poor people in the country, according to the National Council for the Evaluation of Social Development Policy (CONEVAL) (CONEVAL, 2018). The questionnaire that we applied to measure this indicator was made by the Mexican Association of Research Agencies (AMAI) (AMAI, 2018)

**Adaptation to University:** There are a few students that immediately adapt to the university environment. Most of them go through an adaptation process that may vary according to different situations. Medical Students face a particularly challenging situation at the start of the career. Academic load is usually heavier than in other careers, schedules tend to be more prolonged and in more than one time they must buy materials that represent a significative spend. All these stressful factors that are accompanied by a different educational perception than the one that they have in High School affects negatively student’s academic performance. This Indicator was measured with a questionnaire adapted from Rodriguez-Ayan and Sotero (Rodriguez-Ayan and Sotero, 2014).

**Perception of the study method:** in this indicator, we measure the student’s perception of its own study method, and how is he satisfied with the results that the method gives to them. We also evaluated if the student has the tools necessary for an adequate study.

**Admission Profile:** Every student has personal aptitudes in different fields. It would be impossible to believe that the ability to do a determinate task is the same in every person. As it is possible that one person could develop the abilities to do any task that they wish, maybe they would experience greater difficulty if he or she doesn’t have those aptitudes. Most Universities have an admission profile for each of their careers. For this research, we adapted the UANL Faculty of Medicine’s Medical program Admission Profile in a seven-question survey. We evaluated if there
was a lower academic performance in those students that didn’t satisfy the admission profile (UANL, 2020).

These variables were studied based on the academic performance that was evaluated as it is described. Academic performance represents the mean score of 4 exams of one of the basic sciences of the first-year Medical program, the subject of Embryology.

**Methods**

We developed an eight-section survey based on what we described before: Section one corresponds to the general data of the participant and each of the variables was measured and compared separately.

Section 2 corresponded to the measure of the Strength of Motivation and it consists of 16 questions on a Likert-Type scale from 1 to 5, meaning 1 totally disagree and 5 totally agree. This type of measurement was also used in sections 5, 6 and 7. Results were added and were classified into two categories: A low strength of motivation in 0 to 54 scores and high strength of motivation in 55 or higher scores.

Section 3 corresponded to academic factors and consists of 6 questions in which answers are evaluated and compared separately.

Section 4 measured the socioeconomic level of the participants, which is classified into seven categories named A/B, C+, C, C-, D+, D, and E from the highest socioeconomic level to the lowest. This section has six questions each of which answers have a predefined score. The total of these scores is the value upon which students were classified in one of the seven categories mentioned before.

Section 5 measured the adaptation to university and consisted of eleven questions, the total punctuation classified the student in an inadequate adaptation if they scored a result between 11 and 36 and an adequate adaptation if they scored between 12 and 37.

Section 6 measured the perception of the study method and consisted of seven questions, which total punctuation classified the participant in students with an inadequate perception if they scored between 7 and 25 and an adequate perception if they scored between higher than 25.

Section 7 measured if the student satisfied the admission profile, and consisted of seven questions which total score classified the participant in students that don’t satisfy the admission profile if they scored between 7 and 25 and students that satisfy the admission profile to those with scores higher than 26.

Finally, section 8 measured academic performance as described before. The complete survey is available as Supplementary File 1 of this article.

For the validation of the survey, we did a test/re-test assay on a pilot group of 40 students with a period between two applications of one month. We registered a Pearson correlation coefficient higher of 0.8 in all the participants. We also evaluated the survey with Cronbach’s Alpha test with results that were higher than 0.8 in each section and in the complete survey.

The survey was applied to 777 students of the first semester of the Medical degree program of the Autonomous University of Nuevo Leon’s Faculty of Medicine, in the city of Monterrey Mexico.

For the statistical analysis of data, we used a t-test for independent groups for dichotomic variables and the ANOVA test for the variables with more than two categories. We previously prove the normal distribution with the Kolmorov-Smirnoff test. The results are represented as the mean of the academic performance of the students of each group and the standard error of the mean. We set a p-value lower than 0.05 a statistically significant.
Results/Analysis

Demographic data of the participants are described in Table 1:

**Table 1: Demographic Characteristics of the participants**

| Variable          | N= 777 | Percentage | CI* 95%       |
|-------------------|--------|------------|---------------|
| **Age:**          |        |            |               |
| 16 to 18 years    | 454    | 58.4       | 54.93 – 61.85 |
| 19 to 20 years    | 280    | 36.0       | 32.74 – 39.47 |
| 21 to 22 years    | 21     | 2.7        | 1.77 – 4.10   |
| 23 to 24 years    | 10     | 1.3        | 0.70 – 2.35   |
| 25 to 26 years    | 6      | .8         | 0.35 – 1.67   |
| 27 to 28 years    | 4      | .5         | 0.20 – 1.32   |
| 28 years or more  | 2      | .3         | 0.07 – 0.93   |
| **Gender:**       |        |            |               |
| Female            | 475    | 61.13      | 57.66 – 62.34 |
| Me                | 302    | 38.87      | 35.50 – 42.34 |
| **Religion:**     |        |            |               |
| Catholic          | 555    | 71.52      | 68.25 – 74.58 |
| Christian         | 121    | 15.59      | 13.21 – 18.31 |
| Jewish            | 1      | 0.13       | 0.02 – 0.73   |
| Mormon            | 11     | 1.42       | 0.79 – 2.52   |
| Jehovah’s Witnesses| 3    | 0.39       | 0.13 – 1.13   |
| None              | 79     | 10.18      | 8.25 – 12.51  |
| Other             | 6      | 0.77       | 0.35 – 1.68   |
| **Marital Status**|        |            |               |
| Married           | 3      | 0.39       | 0.13 – 1.13   |
| Divorced          | 3      | 0.39       | 0.13 – 1.13   |
| Single            | 766    | 98.58      | 97.48 – 99.21 |
| Free union        | 5      | 0.64       | 0.28 – 1.50   |
| **Origin:**       |        |            |               |
| Local             | 496    | 63.84      | 60.40 – 67.14 |
| Foreigner         | 281    | 36.16      | 32.86 – 39.60 |

*CI: Confidence Interval

77.09% of the students came from public High Schools and 22.91% from private ones. About the high school modalities, 73.75% of the students came from a general high school, 24.20% came from a technological high school, 1.16% of the students from open high schools, and 0.90% of the students came from professional technical high schools. 57.92% of the students took a two-year high school program, while 41.44 took a three-year program and only 0.64% of the students took a one-year high school program. 90.35% of the participants scored a high level of strength of motivation and only 9.65% scored a low strength of motivation level. 52% of the participants had an A/B socioeconomic level, the highest, and none of the participants had an E level, the lowest. 82.88% of the participants scored an adequate adaptation to university while 17.12% were having an inadequate adaptation. 58.43% of the students said that they had an adequate perception of its study methods while 41.57% said that they have an inadequate perception. These demonstrate that many students recognize that the study methods are not effective. 91.51% of the students satisfied the admission profile of the Faculty of Medicine while 8.49% didn’t.
The inferential analysis of the variables based on the mean of the academic performance of each group of students is summarized in Table 2.

### Table 2: Inferential analysis of the variables based on academic performance

| Variable                        | Mean (SEM) | CI              | p      |
|---------------------------------|------------|-----------------|--------|
| **Gender**                      |            |                 |        |
| Male (n=302)                    | 53.73 (.85)| 52.06-55.39     | .410   |
| Female (n=475)                  | 52.88 (.61)| 51.68-54.07     |        |
| **Origin**                      |            |                 |        |
| Local (n=496)                   | 51.11 (.60)| 49.93-52.28     | .000   |
| Foreign (n=281)                 | 56.92 (.85)| 55.25-58.58     |        |
| **Institution Type**            |            |                 |        |
| Public (n=599)                  | 52.45 (.56)| 51.35-53.54     | .007   |
| Private (n=178)                 | 55.79 (1.08)| 53.67-57.90    |        |
| **Marital Status (Simplified)** |            |                 |        |
| Single (n=766)                  | 53.18 (.50)| 52.20-54.16     | .557   |
| Non single (n=11)               | 55.68 (4.40)| 47.05-64.30   |        |
| **Strength of Motivation**      |            |                 |        |
| High strength of motivation     | 53.51 (1.91)| 49.76-57.25     | .007   |
| Low strength of motivation      | 50.47 (.51)| 49.47-51.46     |        |
| (n=702)                         |            |                 |        |
| (n=75)                          |            |                 |        |
| **Years of High School**        |            |                 |        |
| 2 years or less (n=455)         | 50.60 (.63)| 49.36-51.83     | .000   |
| 3 years (n=322)                 | 56.91 (.76)| 55.42-58.39     |        |
| **Adaptation to University**    |            |                 |        |
| Inadequate adaptation (n=133)   | 51.93 (1.29)| 49.40-54.45     | .274   |
| Adequate adaptation (n=644)     | 53.48 (.54)| 52.42-54.53     |        |
| **Perception of the Study Method** |          |                 |        |
| Adequate perception (n=323)     | 48.89 (.71)| 47.49-50.28     | .000   |
| Inadequate perception (454)     | 56.29 (.65)| 55.01-57.56     |        |
| **Admission Profile**           |            |                 |        |
| Doesn’t satisfy admission profile (n=66) | 49.28 (1.84)| 45.67-52.88     | .028   |
| Satisfies admission profile (n=711) | 53.58 (.51)| 52.58-54.57     |        |

SEM: Standard Error of Mean.

There were significant differences in many of the evaluated indicators. Foreign students, either national or international had a higher academic performance than local students. This could be due to different factors. In our experience foreign students tend to dedicate more time to study than local students. Moreover, foreign students usually take a three-year high school program and local students, particularly in our city usually take two-year programs. Finally, the student’s address could have an important impact, foreign students usually live near their schools, taking short periods for transportation that could be used to study.

Students that came from private high schools showed a higher academic performance than those that came from public high schools, something very relevant for a country like Mexico in which most of its educational institutions are public. The higher scores could be since this type of institution has newer and most equipped campuses and a
lower number of students for each professor. Moreover, to be part of a high economic level allows the student to have more access to different resources for its education.

Motivation strength is a factor that affects academic performance, showing lower scores those who have a low strength of motivation and a higher those with higher strength of motivation. As was mentioned before, Medical students are frequently exposed to a high level of stress, with a large academic load, busy schedules, and other stressful factors.

This added to the fact that many students migrate from their city of origin to study, which leads to moving away from their family and friends, tend to decrease the student’s strength of motivation. There are some other factors related to the medical profession that contribute to the decrease of motivation, such as the student overpopulation on universities, the competition with the student peers and professionals, the lack of opportunities in a saturated health system, among others. It is increasingly common for universities to implement strategies to increase motivation and mental health of the students. As we described before, the duration of the high school programs of the student can impact its academic performance. This could be due to individual factors of the student such as incomplete emotional and academic maturity or with institutional factors, like a shorter program that doesn’t address to develop basic skills for adequate performance at university or at least not as a three-year program offers.

The perception of the study method represents a self-view of the student. As its measures could not be one hundred percent precise it gives us a very good overview of how students feel about the challenges of the career. Our results showed that students with a low perception of its study method had a lower academic performance than that with a good perception of its study method. This is important since it tells us that the student is conscious that their study method is not appropriate and that it doesn’t get the results that they expect from it. So, if the student knows that they need to change this, the effort should be put in giving them the tools to address a better method.

Our results show that students that didn’t satisfy the Faculty’s admission profile had a significantly lower academic performance than those that did satisfy it. We can tell from it that many students apply to the Medical program for reasons different than the self-interest of study it, like having a family member that dedicates to some health-related science, the false idea that those with high grades should study medicine, and the stigma that Medicine is the career with the highest salaries are factors for not satisfying the admission profile.

About the modality of High School, we describe that those students that came from technological high schools had a higher academic performance than those that came from general high school. This could be related to the fact that students from technological high school study a technical career that could be related to the health-related area which allows the students to be more prepared in some areas before getting into medical school. These results are summarized in Table 3.

### Table 3: Evaluation of academic performance based on the High School modality

| Modality                      | Mean (SEM)  | CI           | p      |
|-------------------------------|-------------|--------------|--------|
| General High-School (n=573)   | 52.28 (.57) | 51.14-53.42  | .000   |
| Technological High School (n=188) | 56.62 (1.00) | 54.63-58.61  |        |
| Professional Technician (n=7) | 52.85 (4.54) | 41.74-63.97  |        |
| Open High School (n=9)        | 41.88 (5.22) | 29.83-53.94  |        |

Our results about how socioeconomic level affects the academic performance should be interpreted in the context of
the environment in which our research was conducted. As we show that socioeconomic level A/B, the higher one, showed a higher academic performance than any other group, we should keep in mind that more than half of the participants belonged to this group and just a small proportion represents the rest of the groups. Furthermore, there wasn’t a linear correlation between socioeconomic level and academic performance, since they were lower socioeconomic levels with a higher academic performance than the immediately superior level.

The economic factor is very important. The simple fact of studying a university career represents a challenge for a large percentage of the population that doesn’t have the economic resources. Medical career is one of the most expensive ones, so further academic research should intentionally look for a clearer relation between socioeconomic level and academic performance, especially in a country like ours where we have schools which fees range from being free in a few institutions to more than $10 000 U.S.D. in many others. These results are summarized in Table 4.

Table 4: Evaluation of academic performance based on the socioeconomic level

| Group     | Mean (SEM)  | CI          | p     |
|-----------|-------------|-------------|-------|
| D (n=5)   | 53.20 (7.43)| 32.54-73.85 | .029  |
| D+ (n=13) | 47.26 (2.86)| 41.02-53.51 |       |
| C- (n=42) | 52.85 (2.16)| 48.48-57.23 |       |
| C (n=112) | 49.67 (1.22)| 47.24-52.09 |       |
| C+ (n=198)| 53.28 (1.05)| 51.19-55.37 |       |
| A/B (n=407)| 54.38 (.68)| 53.04-55.72 |       |

We also did a Pearson correlation test to evaluate the relation between high school average grade and the student’s academic performance, obtaining a low positive correlation (0.209) meaning that not necessarily those with higher grades at high school have higher academic performances.

Discussion

We reported important information to increase our understanding of how different factors affect academic performance in students in its first year of Medical career. This first year is the period in which more students drop out of university. As we described before there are many factors that contribute to this. It is important to note that there is not a unique factor that correlates perfectly with low academic performance. Even those that were most related could be present in a student who, nevertheless, had a high academic performance.

Conclusion

This research contributes to understanding the environment to which first-year medical students are exposed and it is very important that academic authorities take this information for further decisions. It is very hard to study the extra-scholar environment of the students, especially in highly populated universities like ours, nevertheless, there must be an effort to get a better understanding of the student-university relation. At the end of the day, low academic performance and student dropout is a multifactorial subject and dynamic since every generation of students is different from the previous one. Academic research must continue to complement the information that we have today, with a student’s point of view.
Take Home Messages

There are many factors that impact students' academic performance.

- Medical Student’s High School type of institution could impact on their academic performance.
- Motivation is an important factor for students to have a better performance.
- The Socio-Economic Profile of the students could have a significant impact on their performance.
- There is a complex interaction of these factors in the way they impact medical students.

Notes On Contributors

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Appendices

None.

Declarations

The author has declared that there are no conflicts of interest.

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Ethics Statement

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