Identifying student profiles and their impact on academic performance in a Brazilian undergraduate student sample

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Abstract

The recognition of the student profile provides strategic information for planning educational policies in the university environment. The aims of this study were to identify natural segmentation of freshman undergraduate dental students based on demographic, socioeconomic and educational variables, and to subsequently investigate their impact on academic performance of Brazilian undergraduate students. Cluster analysis (two-step algorithm) was used to segment students who entered dental school in the time period from 1999 to 2001 ($n = 158$) into groups based on responses to a questionnaire completed by students at the time of the admission examination. Clustering analysis revealed three natural groups. Age, the parents' level of education, and performance on the first admission test were the most important variables for cluster segmentation. Cluster 1 ($n = 42$; 26.6%) was characterized by female students with higher socioeconomic status and better previous educational indicators. Cluster 2 ($n = 62$; 39.2%) represented disadvantaged socioeconomic profiles, with a predominance of females and older students. Cluster 3 ($n = 54$; 34.2%) showed similar socioeconomic characteristics to cluster 1, except for male prevalence, higher age, and experiencing difficulty in the admission test. Clusters' academic performance was satisfactory in both overall course and course groups (grade point average of at least 7.0), with average ranging from 7.89 (SD = 0.44) to 8.13 (SD = 0.31) and 7.37 (SD = 0.75) to 8.31(SD = 0.26), respectively. Our findings provide encouraging evidence for the current context of equality of access to education and reveal the importance of financial support to maximize successful educational experiences of socioeconomically disadvantaged dental students.

Introduction

Studies exploring student profile provide valuable information for planning educational strategies and policies, and improve faculty expertise on learning issues. Numerous studies on dental student attributes have mainly focused on socio-demographic characteristics and analysis of changes over time, as well as investigating their reasons for choosing dentistry, academic involvement, and future professional plans (1–7).

Recently, there has been increasing interest on inclusion policies and practices, such as attainment of equality in access to higher education and the relevance of cultural and social diversity in academic training of students and professionals in health care areas (8–16). The American Dental Education Association also has reinforced the need for diversity in the workforce to achieve professional excellence and address iniquities in the oral health care services (17, 18).

Reports about the process of socialization and professionalization of medical students stressed that the matrix of social relationships in which a student internalizes attitudes and values will strongly determine his/her professional behavior (19–24). Their findings support that minority students are more likely to practice in areas of physician shortage and treat disadvantaged and chronically ill patients (19, 23, 24). Moreover, despite the hypothesis that increasing the number of students from underrepresented segments of the population would result in decreased quality standards for the general undergraduate population, evidence has suggested that there is no difference in the academic performance of these 'underrepresented' students when compared to other students (20, 21).

In dental education literature, there is little to no evidence regarding the impact of demographic, socioeconomic and educational patterns on the academic performance. This is an especially relevant issue in developing countries, where major inequality in the distribution of wealth is a serious social concern. Improved knowledge of this relationship will provide a basis to guide the design of dental education programs, thus playing an important role in the current context of increasing

demand for higher education and implementation of access and inclusion policies in Brazil. Thus, the aims of this study were to identify natural segmentation of Brazilian freshman undergraduate dental students based on demographic, socioeconomic and educational variables, and to subsequently investigate their impact on academic performance.

Material and methods

A retrospective cohort study was designed to include all students who entered the School of Dentistry of Federal University of Goias, Brazil, from 1999 to 2001. This public dental school has a 5-year curriculum and offers 60 places annually to new incoming students. In the first 2 years of the graduation course basic and non-clinical courses are offered predominantly, while in the three subsequent years dental and clinical courses are predominant.

After the research protocol was approved by the local Institutional Review Board, data were gathered from the University Registrar's Office, including student scores on the dental school admission test, performance in undergraduate courses, and answers to a questionnaire completed by students at the time of the university admission test. Data retrieved from questionnaires provided the following demographic, socioeconomic and educational variables: age, gender, marital status, living arrangement in the last 2 years, parental education, monthly family income, employment experience, the need for financial aid or support from the university, information about high school, language proficiency, participation in preparatory courses for university admission, and previous submissions to the admission test.

Cluster analysis was used as an exploratory data analysis technique designed to reveal natural grouping from latent patterns in a large dataset on the basis of a minimal within-group and a maximal between-group variation. Two-step cluster analysis was used to segment samples into n number of clusters based on the socioeconomic variables, using an auto-clustering algorithm, to allow for continuous and categorical variables (25, 26).

The importance of each variable in determining the cluster segmentation was ranked by Chi-square test (for nominal variables) or t-test (for continuous variables) in which each cluster group was tested against the overall group. Since multiple tests were performed, Bonferroni adjustments were applied to control the false-positive error rate. An alternative importance measure, which has the advantage of placing both types of variables on the same scale, is based on statistical significance values using $-\log_{10}$ of the statistical significance ($-\log_{10}$ P-value). This transformation stretches the original scale to 0 to infinity (instead of a small band from 0 to 1), so that larger values of $\log_{10}$ of P-value equate to greater significance (25).

Subsequently, the clusters were explored according to demographic, socioeconomic and educational variables. The influence of the student's group classification on academic performance was also analyzed. It was hypothesized that the groups obtained by cluster analysis segmentation can be associated with distinct academic performance levels. In this study, academic performance in undergraduate courses was measured as the mean value of four bimonthly examinations, rated quantitatively on a 0—10 scale. A grade point average of 7.0 in all courses is required for approval of the student in our school. Thus, this parameter was used to define a satisfactory performance.

Overall academic performance refers to the grade point average from all undergraduate courses. Academic performance in course groups relates to performance in basic and dental, and non-clinical and clinical courses. The term 'basic courses' refers to biomedical and behavioral sciences, i.e. non-dental courses, while 'non-clinical courses' represents those that don't involve clinical practice, including dental courses.

SPSS 16.0 software (SPSS Inc., Chicago, IL, USA) was used for all computations related to descriptive analysis and the two-step cluster analysis.

Results

The study sample included 158 students, 58.2% females. Mean age was 19.58 years (SD = 1.83) at the time of dental school admission and 23.55 years (SD = 1.81) at the time of graduation. Proportion of married students was only 2% and <10% had previous employment experience. In general, students from this study experienced comfortable lifestyles, came from parents with high levels of education and high monthly income, and had a great investment in their education (Table 1).

The auto-clustering algorithm combined 100% of the cases in a three-cluster solution, enclosing 26.6%, 39.2% and 34.2% of the sample. Table 1 shows, for each variable, the descriptive summary by cluster and between-group comparisons. The descriptive summaries consist of means and standard deviations for continuous variables and proportions for categorical variables. Only the variables 'marital status', 'time that the subjects attended high school (daytime/night-time)', and 'rank in dental school admission test' were not different among the clusters. Significant variables for segmentation of each cluster are shown in Table 2, where within-group rank of variable importance for cluster segmentation is depicted for each of the three clusters.

Cluster 1 (n = 42; 26.6%) was characterized by a predominance of female and younger students without previous employment experience, living in Goiania, and their parents have higher levels of education and monthly incomes. These families tend to make large investments in their children's education, paying private schools and language courses. Students of this segment had significant success in the university entrance examination immediately after high school. Favorable socioeconomic status was related to a smaller need to receive financial aid or support from the university since these students are primarily supported by their families. In contrast, cluster 2 (n = 62; 39.2%) represented a more disadvantaged socioeconomic status, with a predominance of females and older students. Cluster 3 (n = 54; 34.2%) showed similar characteristics to the first cluster, except for a prevalence toward males and older students, more retakes of university entrance examinations, and more participation in preparatory courses for admission.

The histogram of the overall academic performance is given in Fig. 1. Most students showed satisfactory performance, with grade point average between 7.0 and 8.0 (n = 69; 43.7%) or more than 8 points (n = 86; 54.4%), and only 1.9% (n = 3)

TABLE 1. Characterization of clusters according to socioeconomic variables within each cluster (expressed as %)

Variables	Total	Clusters		
		1 (*n* = 42)	2 (*n* = 62)	3 (*n* = 54)
Age at admission (years)[1]	19.58 (1.83)	18.21 (0.56)	20.30 (2.06)	19.83 (1.64)
Gender – Female	58.2	78.57	66.13	33.33
Marital status – Single	98.1	97.62	96.77	100
Reside with parents	84.2	92.86	69.35	94.44
Public high school	17.1	2.38	37.10	5.56
Daytime high school	95.6	100	93.55	94.44
Traditional high school (3 years)	95.6	100	90.32	98.15
Participation in preparatory courses for admission	62.0	0	83.87	79.63
Approved in first admission test – Yes	26.6	83.33	11.29	0
Need for financial aid or support from university	75.9	66.67	98.39	57.41
Need for own resources for support during undergraduate	34.2	11.90	51.61	31.48
Employment experience at time of dental admission test	9.5	0	22.58	1.85
Previous employment experience	17.1	4.76	32.26	9.26
Family living in Goiania	71.5	78.57	56.45	83.33
Father with high level of education	53.8	71.43	11.29	88.89
Mother with high level of education	47.5	57.14	16.13	75.93
Monthly family income >R$ 1.200,00[2]	67.1	92.86	33.87	85.19
Family had greater investment in their education	67.7	78.57	56.45	72.22
Foreign language proficiency	57.0	71.43	33.87	72.22
Rank in admission test[1]	28.58 (16.59)	26.01 (14.72)	29.33 (18.71)	30.50 (16.08)

[1]Mean (SD).
[2]Approximately four times Brazilian minimum wage.

TABLE 2. Within-group rank of variable importance for cluster segmentation

Clusters	Variables	Chi-square or *t*-test value*	$-\text{Log}_{10}$ *P*-value**	*P*-value
1	Age at admission (Younger)	−15.77	18.18	<0.001
	Approved in first admission test (Yes)	69.3	16.08	<0.001
	Participation in preparatory courses for admission (No)	68.6	15.92	<0.001
	Monthly income (Higher)	12.6	3.42	<0.001
	Need for own resources for support during undergraduate (No)	9.3	2.63	<0.01
2	Father with high level of education (No)	45.1	10.72	<0.001
	Monthly income (Lower)	31.0	7.58	<0.001
	Mother with high level of education (No)	24.4	6.11	<0.001
	Type of high school (Public)	17.5	4.55	<0.001
	Need for financial support from university (Yes)	17.1	4.45	<0.001
	Language proficiency (No)	13.5	3.62	<0.001
	Participation in preparatory courses for admission (Yes)	12.6	3.4	<0.001
	Employment experience at time of dental admission test (Yes)	12.4	3.36	<0.001
	Living arrangement in the last 2 years (Living without parents)	10.2	2.86	<0.01
	Previous employment experience (Yes)	10.1	2.82	<0.01
	Age at admission (Older)	2.1	2.74	<0.01
3	Father with high level of education (Yes)	26.8	6.64	<0.001
	Approved in first admission test (No)	19.6	5.01	<0.001
	Mother with high level of education (Yes)	17.5	4.55	<0.001
	Gender (Male)	13.8	3.68	<0.001
	Participation in preparatory courses for admission (Yes)	12.3	3.34	<0.001
	Need for financial support from university (No)	10.2	2.84	<0.01

*Chi-square or *t*-test was used for nominal or continuous variables, respectively.
**$-\text{Log}_{10}$ *P*-value: larger value is more significant.

had averaged <7.0 points. Analysis of clusters' academic performance (Table 3) revealed that all clusters showed a good performance in both overall course and course groups, with grade point average ranging from 7.89 (SD = 0.44) to 8.13 (SD = 0.31) and 7.37 (SD = 0.75) to 8.31(SD = 0.26), respectively.

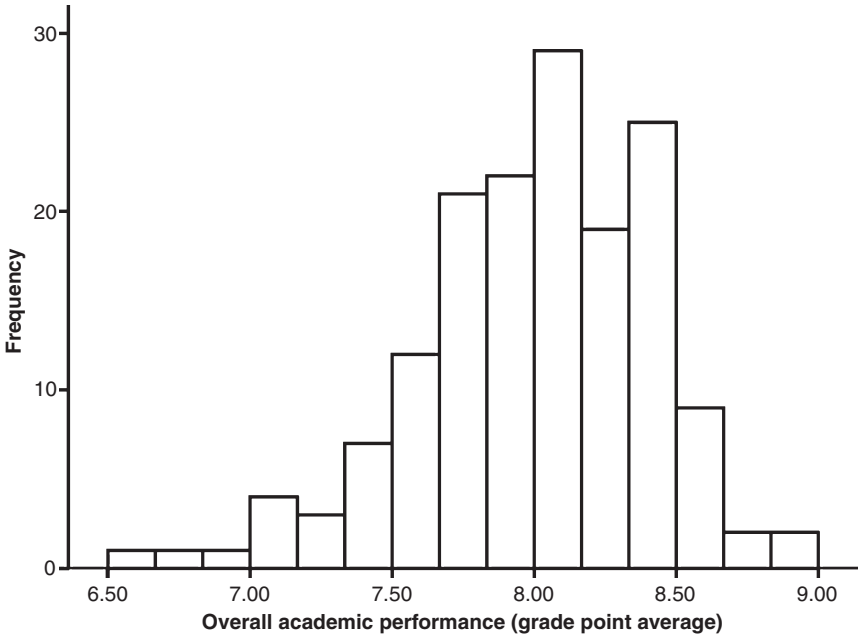

Fig. 1. Frequency distribution of the students' overall academic performance (n = 158).

Discussion

Socioeconomic characteristics play an important role in the development of students' intellectual and non-intellectual faculties, and may influence their commitment level to a profession (22). Analysis of socioeconomic status of undergraduate students is important in understanding their background, priorities, and socialization and academic process (4, 7). The present study assessed demographic, socioeconomic and educational status of Brazilian dental students and the impact of these characteristics on their academic performance. As original method, we perform the cluster analysis for identification demographic, socioeconomic and educational patterns. Data clustering is a powerful technique for identifying natural grouping. Subsequently, we compare academic performance among clusters in both overall course and course groups.

TABLE 3. Descriptive analysis of the academic performance among clusters

Courses	Clusters	Min—Max	Mean (SD)	Median
Overall courses	1	7.40—8.64	8.13 (0.31)	8.17
	2	7.04—8.88	8.00 (0.43)	8.03
	3	6.60—8.84	7.89 (0.44)	7.92
Basic courses	1	6.67—8.57	7.74 (0.45)	7.80
	2	5.88—9.08	7.59 (0.63)	7.55
	3	5.40—9.06	7.37 (0.75)	7.38
Dental courses	1	7.65—8.77	8.26 (0.29)	8.31
	2	7.12—8.97	8.13 (0.39)	8.19
	3	6.91—8.82	8.05 (0.38)	8.08
Non-clinical courses	1	6.94—8.60	7.92 (0.40)	7.94
	2	6.36—8.98	7.76 (0.55)	7.74
	3	5.89—9.00	7.58 (0.60)	7.59
Clinical courses	1	7.76—8.74	8.31 (0.26)	8.32
	2	7.07—8.91	8.20 (0.37)	8.24
	3	7.06—8.74	8.14 (0.34)	8.18

Predominance of females among dental students is reported in Australia (1, 3, 6), Canada (19), Denmark (7), France (2), New Zealand (3), Nigerian (4), United Kingdom (16), and United States (10). Besides a growing trend of feminization in the field of dentistry, previous studies have indicated that women follow a pattern different from their male counterparts in relation to working organization, time spent at work, and income (2, 3, 5, 7).

Brazilian universities accept dental school students directly from high school. Thus students of our research are young, with a mean age of 19.58 years (SD = 1.83) at the time of dental school admission. In educational systems where students must possess a previous degree prior to entering dental school, this age is obviously higher. In Sydney, for example, Marino et al. (3) found that first-year dental students have a mean age of 24.6 years.

Most parents of dental students have high levels of education and income. Students are predominately single, without employment experience, reside with their parents, and are financially dependent (1–7, 19). Cluster 1 and 3 characteristics (n = 96; 60.8%) corroborate previously published trends that most dental students came from more privileged socioeconomic groups (1–7, 19). There are no tuition or entrance fees in public universities, as imposed by the Brazilian Federal Constitution, but since universities accept only a small fraction of applicants, only well-prepared students succeed in the university entrance exam. The school admission is carried out according to the student rank in the admission test, which includes issues of all disciplines of secondary education, considering a limited number of places. As consequence, most dental students of public universities come from private high schools and

middle or upper class families. In Brazil, the better quality of private high schools is remarkable, which explains the predominance of students from this type of school in our findings.

In our study, almost 40% of students (cluster 2) had lower socioeconomic status than their collegues, which does not imply that this group corresponds to a representative sample of the overall disadvantaged population. On the contrary, the presence of economic, cultural, and social barriers to access higher education is still a major problem in Brazilian society and a primary reason for social inequity. Hung et al. (10) reinforced that a lack of diversity on campus and limited social, academic, and financial support are significant barriers for recruiting and retaining minority students.

Clusters' academic performance was satisfactory and relatively uniform in both overall courses and course groups, regardless of their demographic, socioeconomic and educational characteristics. Surprisingly, cluster 2 represented the second best academic performance. Despite disadvantaged socioeconomic status and a need for self-support during completion of their degree, this segment revealed significant ability to overcome personal and academic difficulties. This evidence reinforces the importance of financial support from the universities to enhance the successful educational experience of these students. Moreover, a better understanding of the reasons and associated factors with students' academic performance is need in future studies.

This evidence is potentially meaningful for the current context of equality of access to education. Our findings are encouraging for dental schools in the planning and implementation of policies for recruiting, admitting, and retaining of minority students. Recently, universities have introduced academic support programs as well as lower academic criteria for admission of underrepresented segments (8–16). On the other hand, our results show that socioeconomically disadvantaged students have satisfactory academic performance (20, 21, 27), even when they need financial help. Bediako et al. (27) found that an academically rigorous high school program for minority and economically disadvantaged students with resources for individualized attention led to higher rates of application and admission to medical school. Fredericks et al. (20, 21) revealed that social class was not related to the National Board Examination Scores and to academic performance. In corroboration with these studies (20, 21, 27), our results suggest that increasing the number of students from disadvantaged socioeconomic status will not lead to a lowering of academic standards.

Assessment of the impact of today's societal and economic changes and expansion on dental care systems in characteristics of freshman undergraduate students is important for the context of expansion of higher education (2, 3, 7). Progressive increases in the diversity of the student population will have an impact on undergraduate, continuing, and postgraduate education, professional retention, and practice location (3, 23). Longitudinal approaches are essential to elucidate the effectiveness of different strategies to attract, recruit, and retain minority students and assess their impact in professional practice.

In our literature search, we identified few reports regarding academic performance in dental literature. They are predominantly cross-sectional studies conducted in small samples, focused on the relationship between school admission criteria or gender and academic performance in dental exams or specific disciplines, especially in basic and preclinical courses. Our study may be one of the first presenting evidence regarding the impact of demographic, socioeconomic and educational patterns on the academic performance of dental students.

Additional studies are needed to confirm the present results since regional and cultural differences may play a role in student profile and academic performance. The design of our study does not infer the factors associated with academic performance in different clusters. This question needs to be studied at greater depth and may result in the formulation of educational strategies to maximize the successful educational experience of dental students. Moreover continuous assessments of the impact of demographic, socioeconomic and educational characteristics on academic performance are crucial to reaffirming patterns and identifying new trends, mainly after curriculum reformulation and policies of expansion of higher education.

Conclusion

Cluster analysis was a valuable method for identifying natural groupings from demographic, socioeconomic and educational variables. This allowed further investigation of academic performance according to the student socio-demographic profile. Clusters' academic performance was satisfactory in both overall course and course groups, providing encouraging evidence for the emerging context of equality of access to education. Our findings also reveal the importance of financial support to maximize successful educational experiences of socioeconomically disadvantaged Brazilian dental students.

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