Original Research

Relationship between physical activity, academic achievement, gender, and learning styles in students of a Latin American Dental School: A cross-sectional study

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Abstract:

BACKGROUND: Little is known about the inference that physical activity (PA) may have on academic performance and learning styles of Latin American dental students.

MATERIALS AND METHODS: In this cross-sectional study, an administrative dataset and a voluntary university characterization provided information about PA and academic performance. Moreover, 218 dental students of the University of Antioquia in Colombia completed a structured questionnaire to identify their learning styles. To analyze the information obtained a Pearson correlation, and logistic and linear regression models were implemented.

RESULTS: A total of 131 (60%) students informed being physically active (PA group), and 87 (40%) did not report PA (non-PA group). The results showed a high-grade point average (GPA) in the PA group ($P = 0.01$). The PA group showed a preference for the theorist and pragmatist learning styles with statistically significant differences between the groups ($P = 0.004$ and $P < 0.0001$, respectively). It was also observed a statistically significant Pearson positive correlation between the theorist style and higher GPA ($r = 0.15$; $P = 0.04$). The multivariate regression model showed that PA protects against lower means of GPA (odds ratio = 0.3; 95% confidence interval [CI]: 0.09–0.7, $P = 0.01$). Furthermore, the adjusted linear regression models also showed that PA protects against lower means of the theorist ($\beta = -0.15$; 95% CI: −0.02 to − 0.002, $P = 0.002$) and pragmatist styles ($\beta = -0.18$; 95% CI: −0.03 to − 0.006, $P = 0.0006$). Interestingly, men were statistically significant in all multivariable models.

DISCUSSION: This study suggests that PA is associated with higher academic performance and the theorist and pragmatist styles. Male students were also more physically active; therefore, it is relevant to establish strategies to stimulate physical activities in dental students, especially in women, including extracurricular activities.

Keywords:

Dental students, education, learning, pedagogy, physical activity

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Introduction

The regional conditions of Latin America offer multifaceted challenges, comprising inclusive and equitable quality higher education, trustworthy community investigation, and encouraging constant learning chances for everyone. However, economic and social breaches and growing inequities make it difficult to achieve these purposes. increasing inequality challenging to accomplish these purposes.[1] Moreover, learning and teaching is a complicated mechanism in dental faculties, considering

factors such as the empathy among students, patients and professors, the program, the coherence of theoretical and applied knowledge, the context of the faculty, the scholastic features, and the culture.[2] Hence, the peculiarities of dental education list on pertinent curriculum components comprising patient oral health care, processes of training, and educational.[3]

On the other hand, dental education is perceived as stressful and arduous for students. In fact, the increase of stress can affect intellect, training, and academic achievement.[4] Instead, the benefits of physical activity (PA) routines in augmenting the students' learning talents and educational success have been documented.[5] Contemplating that PA behaviors can enrich learning competence in undergraduates,[6] it is fundamental to explore this theme. In this context is relevant to highlight that there are many learning styles.[7] However, four learning styles have been broadly documented ("activist, reflector, theorist, and pragmatist") from the Learning Styles Questionnaire (LSQ) recommended by Honey and Mumford;[8] the LSQ was validated in the United Kingdom and was adapted, validated, and translated into Spanish educational context (CHAEA) by Alonso *et al*.[7] The CHAEA questionnaire has been utilized in health sciences undergraduate programs to distinguish their learning styles.[9-11] However, the CHAEA questionnaire was also adapted into Latin America educational framework because of some complications noticed during its completion. Thus, the new form, named CAMEA40,[12] was validated at university students, and it may be a relevant tool to study the learning styles in dental students.

As was described above, various authors have reviewed the relationship between PA and academic performance in higher education;[5,6] however, its correlation with the learning styles has been barely studied. Thus, to the best of our knowledge, no study has investigated the inference that PA habits may have on the learning styles of dental students in Latin America. Therefore, this research aimed to identify the association between PA habits, academic performance, and learning styles in students of a dental public school.

Materials and Methods

Study design
A cross-sectional study was designed. This research included students enrolled during the second half of 2018 in one of the ten semesters of the dental school at the University of Antioquia in Colombia. This 5-year dental school program terminates in a Doctor of Dental Surgery degree, including 2 years of social-humanistic and basic sciences, preclinical and laboratory courses, and 3 years of initial clinical training. In the last year,

students take rotations in communities, hospitals, and health institutions, counting some international practice.

The students incorporated in this study congregated the following selection criteria: scholars registered in the second semester of 2018 that signed the informed consent, to complete the CAMEA40[13] questionnaire, grade point average (GPA) data of the previous semester (first half of 2018), undergraduates with whole information associated to demographic characters and physical activities behaviors.

Data collection
The participants completed the CAMEA40[12] questionnaire after signing the informed consent.

CAMEA40 was applied to identify the learning styles. The first part of the questionnaire asks a series of questions related to the socio-academic information; it is also asking if the student has been working. The second part includes the questionnaire that contains 40 short questions with five possibilities of response: always, usually, many times, sometimes, and never, with assigned values of 5, 4, 3, 2, and 1, respectively. All questions are of equal value; consequently, the score on the questionnaire is the sum of all the responses. The range of the CAMEA40 scale runs from 0 to 50 for each of four learning styles. There is an approximate order to that of the CHAEA; nonetheless, CAMEA40 has a minor quantity of questions and more response opportunities, created as a model of Likert type scale.

The questionnaire is randomly structured; thus, ten questions correspond to each learning style: activist, reflector, theorist, and pragmatist. To interpret the four styles of learning, Alonso *et al*.[7] proposed a scale to categorize the results in five preferences: very high, high, moderate, low, and very low, for example, very high active, very low pragmatic, etc., Therefore, a scale labels the findings in five options: very low (0–18), low (19–26), moderate (27–34), high (35–42), and very high (43–50), for instance, moderate (27–34) reflector and very high (43–50) activist. The characteristics of the questionnaire allow that the same student prefers more than one style of learning. This questionnaire was adapted and validated in a study with university students (Cronbach's alpha: 0.85).[12]

The questionnaires were completed in the classroom. Students were invited to participate voluntarily; the objectives of the study and how to complete the form were described.

Besides, it was used as an administrative dataset that supplies records related to the students. This information is part of a voluntary characterization

that was implemented on students. Thus, this dataset presents evidence on each student's PA habits and sports involvement at the university, including the type of sporting and PA, as well as the frequency of each one. The recommendation of the World Health Organization[14] that advises that adults participate in moderate-intensity PA, 5 days/week, for at least 30 min/session (150 min weekly) was also an inclusion criterion.

The GPA is considered an indicator of academic achievement; thus, GPA in our university is a continuous variable oscillating from 0 to 5. Official GPA records for the previous semester were obtained from the administrative dataset of the Faculty.

The Bioethics Committee of the Faculty of Dentistry of the University of Antioquia (IRB 03-03-19) approved this study. All participants signed the informed consent voluntarily, accepting the participation in this study.

Statistical analysis

First, a descriptive analysis was conducted, using means and standard deviation for the quantitative variables and frequencies and percentages for the qualitative. To establish the data distribution, the Kolmogorov–Smirnov normality test was applied. We also performed bivariate analyses using statistical tests of association (Chi-square) and correlation (Pearson). To establish the mean differences between the groups, a Student's t-test was used. Considering the statistically significant results obtained by the bivariate analysis, logistic and linear regressions were performed, expressed in odds ratios (ORs) or β, plus confidence intervals (CIs) of 95%. $P < 0.05$ was registered statistically significant. Assumptions of logistic regressions including dependent variable arrangement, observation independence, and nonexistence of multicollinearity were confirmed. All analyses were completed with statistical software (SPSS version 25.0; SPSS, Chicago, IL, USA).

Results

In this research, we enrolled 218 students (85% of all students) who participated in voluntary university characterization and who also responded to the CAMEA40 questionnaire that identified their learning style; among them, 156 (72%) were female and 62 (28%) were male. A total of 131 (60%) students informed being physically active (PA group), and 87 (40%) did not report PA (non-PA group). The most selected PA modality was work out at the gym (60%), followed by soccer (30%).

Table 1 presents the socio-academic characteristics of the 218 students. Among the PA group, 82 (63%) were female and 49 (37%) were male; however, the percentage of men PA was higher compared with men in the non-PA group,

with statistically significant differences ($P < 0.0001$). The results showed a higher GPA in the PA group ($P = 0.01$). Furthermore, more students in the PA group had a job ($P = 0.01$). Interestingly, it was observed a statistically significant Pearson positive correlation between the theorist style and higher GPA ($r = 0.15$; $P = 0.04$).

Taking in account these associations, a logistic regression model was run. Table 2 shows the simple and multivariate models. The association among the PA group with GPA was statistically significant in the simple model ($P = 0.02$). Interestingly, the simple model showed that PA protects against lower means of GPA (OR = 0.26; $P = 0.02$), and the male students were statistically significant in the multivariable model (OR = 4.3; $P = 0.01$).

The mean of learning styles between the groups was compared [Table 3]. The PA group and non-PA group preferred the theorist and reflector styles. However, it was statistically significant differences between the groups in the theorist style ($P = 0.004$), being higher for the PA group. Similarly, the pragmatist style showed a moderate scale in the PA group, while the non-PA group had a low value in that style with statistically significant differences between the groups ($P < 0.0001$).

With this information, linear regressions were performed [Tables 4 and 5]. The unadjusted linear regression models showed that PA protects against lower means of the theorist ($\beta = -0.19$; 95% CI: -0.03 to -0.006; $P = 0.004$)

Table 1: Socio-academic characteristics in 218 students

Parameter	PA group (*n*=131), *n* (%)	Non-PA group (*n*=87), *n* (%)	*P*
Age (years)	21.7±3.1[a]	21.2±3.1[a]	NS
Female	82 (53%)[b]	74 (47%)[b]	NS<0.0001*
Male	49 (79%)[b]	13 (21%)[b]	
GPA[d]	3.97±0.3[b]	3.85±0.3[b]	0.01*
Public high school	91 (57%)[b]	69 (43%)	NS 0.01*
Job (yes)	38 (75%)[b]	13 (25%)[b]	

*Statistically significant, [a]Values are presented as a mean±SD, [b]Values are presented as number and percentage. NS=Not statistically significant, GPA=Grade point average, PA=Physically active, SD=Standard deviation

Table 2: Multivariable regression analysis among physical activity group and grade point average

Variable	Crude OR (95% CI)	*P*	Adjusted[&] (95% CI)	*P*
GPA	0.3 (0.1-0.8)	0.02	0.3 (0.09-0.7)	0.01*
Male			4.4 (1.8-10)	0.001*
Age (years)			1.01 (0.8-1.1)	NS
Semester enrolled			0.9 (0.8-1.1)	NS

*Statistically significant, [&]Adjusted for gender, age, and semester enrolled. NS=Not significant association, OR=Odds ratio, CI=Confidence interval, GPA=Grade point average

Table 3: Mean values and rating scale of the learning styles in physically active group and nonphysically active group

Learning style	PA group (n=131)	Rating scale	Non-PA group (n=87)	Rating scale	P
Activist	26±5	l	25±5	l	NS
Reflector	33±5	m	32±4	m	NS
Theorist	33±5	m	31±5	m	0.004*
Pragmatist	29±4	m	26±4	l	<0.0001*

*Statistically significant. Values are presented as a mean±SD. Rating scale: VH, M, L, VL. NS=Not statistically significant, VH=Very high, H=High, M=Moderate, L=Low, VL=Very low, SD=Standard deviation

Table 4: Simple and multivariate linear regression models for physically active group and the theorist style

Model	β CI and explanatory variables
Simple Ts	-0.19 CI (-0.03--0.006) Ts*
Multivariate Ts	-0.15 CI (-0.02--0.002) Ts*-0.21 CI (-0.37--0.09)*male-0.04 age**

*P<0.05, **NS. Ts=Theorist style, CI=Confidence interval, NS=Not significant association

Table 5: Simple and multivariate linear regression models for physically active group and the pragmatist style

Model	β CI and explanatory variables
Simple Ps	-0.23 CI (-0.04--0.01) Ps*
Multivariate Ps	-0.18 CI (-0.03--0.006) Ps*-0.19 CI (-0.35--0.07)*male-0.05 age**

*P<0.05, **NS. Ps=Pragmatist style, CI=Confidence interval, NS=Not significant association

and pragmatist styles ($\beta = -0.23$; 95% CI, -0.04 to -0.01; $P < 0.0001$). The multivariate model for PA and the theorist style presented that this statistically significant association remained after adjusting for gender and age ($\beta = -0.15$; 95% CI: -0.02 to -0.002; $P = 0.02$) and similarly occurred for the multivariate model for PA and the pragmatist style ($\beta = -0.18$; 95% CI: -0.03 to -0.006; $P = 0.006$). Both multivariate models showed that male students were statistically significant ($P = 0.001$ and $P = 0.004$, respectively).

Discussion

The scientific evidence has revealed that PA is associated absolutely to academic performance.[13,15] Thus, this study observed a higher GPA in the PA group, and remarkably, the association among the PA group with male students was statistically significant in the multivariate logistic regression model. Interestingly, the multivariate model also showed that PA protects against lower means of GPA. Furthermore, different researchers have shown a correlation between GPA and PA in their multivariate models.[5,6,16] Similarly, to the present study, Al-Drees et al.[5] and Chung et al.[17] showed that male students were significantly involved more in PA. It has been proposed that the disparity in PA involvement and achievement between genders is induced by sexual stereotypes and gender roles.[18] However, investigators that have

assessed sports participation and academic performance by sex have confirmed mixed outcomes.[19]

In the present study, the theorist style was statistically higher in the PA group. Unfortunately, it is complicated to contrast these results, considering the scarce reports in the scientific literature, especially concerning dental schools. A study that characterized the learning styles of diverse groups of athletes categorized according to the level of performance and sports showed that the reflector style was the most common followed by the theorist style, however, no significant differences in learning styles, between different sports and physical activities, were observed,[11] similar to our results. The theorist style has also been preferred for literature,[12] pharmacy,[9] and medical students.[10] Thus, persons with a predilection in the theorist style prefer to evaluate problems from multiple perspectives; they are more observers, and they learn systematically, analyzing the information with fewer tendencies to mechanical learning.

Regarding the level of performance, Gónzalez-Haro et al.[11] reported that the pragmatist style was significantly lower in professional athletes than amateur and recreational athletes. Similarly, in the present study, the pragmatist style showed a moderate scale in the PA group. Besides, it has been described that pragmatist was more efficacious in problem-based learning programs in medical undergraduates.[20]

This research showed that the activist style was observed in the PA group and non-PA group on a low scale; these results corroborate those presented in students of dental schools from other cultural contexts.[21] However, studies completed at different health programs described mixed results of predominant learning styles in students.[22] In eastern and western cultures, it has been described that the context and their peculiarities affect learning styles.[2] Moreover, it has been documented that Hispanic-Latino reported a different learning style preference; their learning styles and environmental contexts involve some particularities.[23] No specific learning style has been regularly linked with better learning effects. This condition is probably due to the flexible aptitudes of university undergraduates.[24]

Interestingly, this paper found associations between gender and some specific learning styles. Two recent

studies reported that males and females have different preferences for learning styles in medical students in Asian universities.[25] Thus, it appears that women more possible than men learn more by gradual discerning and reasonable succession.[26] This information is very important, considering that female students continuing to increase in dental programs.[27] Moreover, a higher number of women study in dental schools in Latin America, including Colombia,[28] Brazil,[29] and Chile.[30] Furthermore, some authors indicate that cultural diversities can make a difference in the preferences of learning styles; they relate them to cognitive and communication styles.[2,22] These arguments could explain the trends found in the present study.

The CAMEA40 questionnaire has been previously used in higher education students,[12] and it has been translated recently into the Italian language.[31] Due to its recent adaptation from the Honey-Alonso questionnaire of learning styles[7] and bearing in mind that learning styles and scales used are like those of the CAMEA40 questionnaire,[12] it is possible to compare it with other studies. However, learning styles in dentistry programs have been researched barely.

This research has several limitations. First, this cross-sectional study does not allow a sequential causal relationship. Secondly, the sample size in this study is not representative of the country; however, the university is the second-largest university in the country that collects a significant amount of the applicants from different regions of the country. These results also significantly contribute to the lack of studies in dental higher education-related preferences in learning styles and PA and their associated variables. More studies researching learning styles in PA groups in the Faculties of Dentistry are required to contrast these results with different cultural backgrounds.

Conclusions

Considering the influence that PA has on academic performance, and the association that PA has with some learning styles, it is relevant to establish strategies to stimulate physical activities in dental students, especially in women, including extracurricular activities (allowing to validate optional credits), modifying the classic curricula offering essential facilities within the universities. Moreover, these results constitute important referents to include PA in the education policies to create holistic educational strategies programs in dental schools and other higher education programs in Latin America and around the world.

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Conflicts of interest
There are no conflicts of interest.

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