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Impact of academic exposure on health status of university students

Impacto da exposição académica no estado de saúde de estudantes universitários

ABSTRACT

OBJECTIVE: To assess the impact of academic life on health status of university students.

METHODS: Longitudinal study including 154 undergraduate students from the Universidade de Aveiro, Portugal, with at least two years of follow-up observations. Sociodemographic and behavioral characteristics were collected using questionnaires. Students' weight, height, blood pressure, serum glucose, serum lipids and serum homocysteine levels were measured. Regression analysis was performed using linear mixed-effect models, allowing for random effects at the participant level.

RESULTS: A higher rate of dyslipidemia (44.0% vs. 28.6%), overweight (16.3% vs. 12.5%) and smoking (19.3% vs. 0.0%) was found among students exposed to the academic life when compared to freshmen. Physical inactivity was about 80%. Total cholesterol, high density lipoprotein-cholesterol (HDL-C), triglycerides, systolic blood pressure, and physical activity levels were significantly associated with gender ($p<0.001$). Academic exposure was associated with increased low density lipoprotein-cholesterol (LDL-C) levels (about 1.12 times), and marginally with total cholesterol levels ($p=0.041$).

CONCLUSIONS: High education level does not seem to have a protective effect favoring a healthier lifestyle and being enrolled in health-related areas does not seem either to positively affect students' behaviors. Increased risk factors for non-transmissible diseases in university students raise concerns about their well-being. These results should support the implementation of health promotion and prevention programs at universities.

DESCRIPTORS: Students. Universities. Health Status. Life Style. Risk Factors. Socioeconomic Factors. Longitudinal Studies. Portugal.

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RESUMO

OBJETIVO: Avaliar a influência da vida académica na saúde de estudantes universitários.

MÉTODOS: Estudo longitudinal envolvendo 154 estudantes de graduação da Universidade de Aveiro, Portugal, por pelo menos dois anos de acompanhamento. Características sociodemográficas e comportamentais foram recordados, por meio de questionários. Foram medidos peso, altura, pressão arterial, glicemia, perfil lipídico e os níveis séricos de homocisteína dos alunos. Foi realizada análise de regressão com modelos lineares mistos considerando as medidas repetidas de cada sujeito.

RESULTADOS: Estudantes expostos à vida académica, quando comparados àqueles de ingresso recente à universidade apresentaram proporção mais elevada de dislipidemia (44,0% versus 28,6%), sobrepeso (16,3% versus 12,5%) e tabagismo (19,3% versus 0,0%). No geral, foi observada alta proporção de sedentarismo (cerca de 80%). O colesterol total, lipoproteína de alta densidade, triglicérides, pressão arterial sistólica e níveis de atividade física apresentaram associação significativa com o género ($p < 0,001$). A exposição académica apresentou-se associada com o aumento dos níveis das lipoproteínas de baixa densidade (cerca de 1,12 vezes), e marginalmente com os níveis de colesterol total ($p = 0,041$).

CONCLUSÕES: Nem o alto nível de instrução parece ter papel protetor na adoção de estilo de vida saudável, tampouco o envolvimento com áreas de saúde muda o comportamento dos estudantes. Altas proporções de fatores de risco para doenças não-transmissíveis em jovens universitários podem afetar seu bem-estar. Os resultados podem servir de apoio às universidades no desenvolvimento de programas de prevenção e promoção da saúde.

DESCRITORES: Estudantes. Universidades. Nível de Saúde. Estilo de Vida. Fatores de Risco. Fatores Socioeconômicos. Estudos Longitudinais. Portugal.

INTRODUCTION

According to the World Health Organization (WHO) non-transmissible chronic diseases (NTCDs) affect developed countries more than developing countries.[a] The expansion of NTCDs reflects an industrialization process, urbanism, economic development and globalization of food affecting eating habits, increasing physical inactivity and tobacco consumption. According to the last National Health Survey (NHS) conducted by the Portuguese Ministry of Health, 18.6% of the population younger than 18 were overweight, and the rate of smokers between 15 and 24 years old was 24.2% (1.2% and 0.6%, respectively, in the same age group). Portugal also had the highest levels of sedentarism in the European Union.[30] In Portugal,[b] cardiovascular diseases, i.e., stroke and ischemic disease, are the most prevalent causes of morbidity, disability and mortality. Although genetics and age are major factors for the development of NTCDs, other risk factors are modifiable with the adoption of healthy lifestyles, including healthy eating behavior and physical activity.[11, 26, 28]

It is critical to identify risk factors and lifestyles among young adults for preventing NTCDs later in life. University students are subjected to particular conditions with their entrance into the university system. Academic life can produce lifestyle changes, with positive and negative implications in their health status. Previous studies suggest the need to evaluate health behavior determinants during the transition from high school to university.[6-7,9]

This present study aimed to assess the impact of academic life on health status of university students. This is the first study seeking to investigate the impact

[a] World Health Organization. Report of the 54. Session of Regional Committee for Europe; 2004 Sept 6-9; Copenhagen, DK: 2004.
[b] Portugal. Direcção Geral da Saúde. Ganhos de saúde em Portugal: ponto da situação: relatório do Director-Geral e Alto-Comissário da Saúde (1º semestre). 2 ed. rev. Lisboa; 2002.

of academic life on relevant risk factors to NTCDs in university students.

METHODS

Longitudinal study including undergraduate students registered in 2005–2006 to 2007–2008 academic years at Aveiro University, Central Portugal. A stratified random sample was drawn in the academic year 2005–2006 based on major areas of degree courses.[3] Aveiro University has a variety of undergraduate courses in seven scientific areas: Economics & Management, Sciences, Engineering, Communication & Art, Languages, Education and Health. Since the students selected would be part of a baseline sample of a longitudinal study, only undergraduate courses that would be functioning in the following academic year were considered in the sampling process. Of 27 courses in seven scientific areas meeting the inclusion criteria (course attendance from year one to four), 15 were randomly selected and one class from each year was selected to answer a structured questionnaire. The random selection of courses in each scientific area took into account the weight each area had in the university in terms of the number of students enrolled. A total of 378 students from all seven areas participated in the baseline examination that was carried out in the academic year 2005–2006.[3] One hundred and fifty four (40.7%) students with a mean age of 20.6 years participated in the longitudinal study with one or more follow-up examinations. Despite some missing data, all longitudinal data collected from participants with at least two years of follow-up observations were used in subsequent analyses. The seven scientific areas were grouped into two main scientific areas: health sciences and non-health sciences.

The academic years were grouped as non-academic exposure (first academic year and enrollment for the first time in higher education) versus academic exposure (other academic years). Since data collection was carried out during the first semester of each year, it can be assumed there was not enough time for students in the first academic year to acquire new habits. Although the other students were in different academic years, all of them partly shared a lifestyle for being exposed to the same university environment.

Information on sociodemographic characteristics, physical activity and smoking habits were collected using questionnaires. The students' weight, height, blood pressure, blood glucose, serum lipids and serum homocysteine levels were measured. Their lipid profile included serum lipids (total cholesterol, triglycerides) and lipoproteins (high density, low density).

A self-reported anonymous questionnaire was developed to collect sociodemographic information.

Dietary pattern was assessed using a semi-quantitative food-frequency questionnaire previously validated for the Portuguese population. This questionnaire included 82 food items. The average dietary intake was converted into nutrients through the Food Processor Plus v.5 program (ESHA Research, USA).[19]

Physical activity was assessed by an adapted questionnaire designed to estimate professional, domestic and leisure time activities, detailing intensity, duration and frequency of each activity reported.[18]

Weight and height were measured with the students wearing light clothing and no footwear. Weight was measured using an anthropometric scale and the student was positioned at the center of the weighing scale so that their weight was evenly distributed. Height was measured with a portable stadiometer with participants standing with their heels together and their head positioned in the Frankfurt horizontal plane, with their heels, buttocks, shoulder blades and head against the back of the stadiometer.

Blood pressure was taken and two blood samples were collected between 8 and 10 am after a 12-hour fasting.

Blood pressure was measured[c] with a mercury manometer by trained nursing students on a single session. The final measure was the average of two readings taken at a 2-minute interval.

Blood samples were placed in a centrifugation tube and spun at 2000 g for 10 min. Within 2 hours after collection, they were transported to the Pathology Laboratory of São Sebastião Hospital in tanks containing ice packs in order to maintain a temperature of 3º to 4°C. One aliquot was used for blood analysis of total cholesterol (TC), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C), glucose and homocysteine levels on the same day of collection. Serum homocysteine was analyzed with a commercial standard kit.[d]

Body mass index (BMI) (weight in kilograms divided by the square of the height in meters) was used as a measure of overall adiposity. Overweight was considered when BMI was above 25 kg/m^2.

Based on the European Society of Hypertension (ESH) and European Society of Cardiology (ESC) guidelines,[22] dyslipidemia was considered when TC was above 190

[c] American Heart Association. Blood pressure testing and measurement: AHA recommendation [Internet]. Dallas; 2006[cited Dec 2006]. Available from: http://www.americanheart.org/presenter.jhtml?identifier=4470
[d] Total Homocysteine in Plasma [database on the Internet]. Abbott Diagnostics. Division of Laboratory Sciences. Center for Disease Control and Prevention (C.D.C.). 2006[cited 2008 Jul 7]. Available from: http://www.cdc.gov/nchs/data/nhanes/nhanes_05_06/hcy_d_met.pdf.

mg/dL, LDL-C above 130 mg/dL, HDL-C below 40 mg/dL and triglycerides above 150 mg/dL.

Homocysteine was considered above the normal range when higher than 12 μmol/L.[8]

High blood glucose was considered when glucose was above 109 mg/dL[e]

According to ESC and ESH criteria,[22] hypertension was considered when systolic blood pressure (SBP) was ≥140 mmHg and diastolic blood pressure (DBP) was ≥90 mmHg.

Participants were classified as physically inactive when their physical activity corresponded to a total mean of less than 1.5 MET per hour.[18] They were classified as smokers if they smoked at least one cigarette per day.

A descriptive analysis was performed for the characterization of the study population. Some continuous variables were converted into natural logarithms to normalize skewed distributions. The assumption of normality was verified using explicit statistical and graphical criteria.

Univariable regression analysis was performed with risk factors studied as dependent variable to assess which variable (academic exposure, academic area or gender) was associated with the outcome. Factors found to be significantly associated at $p<0.15$ were included in a multiple regression analysis. At a second step, a stepwise approach was applied. Both forward and backward selection methods were used to obtain the smallest number of explanatory variables that provided a good-fitting model. Finally, the regression model was calculated only with independent variables that were found to have a significant effect.

The regression analysis was performed using linear mixed-effect models, allowing for random effects at the participant level.[16] The model was identical to that used in ordinary multiple regression, but the methods used to estimate regression coefficients were modified to account for the correlation between repeated measures of the same participant. Correlation among observations from the same participant arose from sharing unobserved variables. In random effects models the outcome is modeled as a function of measurable characteristics of the individual, and unobserved variables are modeled implicitly. This method can easily accommodate (participants with) missing data from an academic year due to incomplete follow-up.

Calendar years were not controlled for during this study as preliminary analysis indicated that there were no significant year-to-year differences in the risk factors analyzed.

All analyses were performed with SPSS (version 16.0) at a two-sided 5% significance level.

Information about the objective of the study was provided to all participants. They all agreed to participate and signed an informed consent form. The study was approved by the Hospital São Sebastião Research Ethics Committee (CE-056/05) and was carried out in compliance with the Helsinki Declaration.

RESULTS

Longitudinal data collected from 154 participants with at least two years of follow-up observations comprised 344 observations.

The distribution of sociodemographic characteristics and lipid profile among participants by exposure to academic life is shown in Table 1. Although not statistically significant ($p>0.061$) students exposed to the academic life had higher rates of dyslipidemia (44.0% vs 28.6%) and overweight (16.3% vs 12.5%) than freshmen. A high rate of physical inactivity (80%) was seen among all participants. A higher proportion of smokers were found among participants already in the university than freshman (19.3% and 0.0%, respectively).

Table 2 shows the cardiovascular profile of students by gender and academic exposure. Regardless of academic exposure, both genders showed average levels within the recommended values for all parameters evaluated. However, females showed higher average lipid values, while males showed higher average levels of glucose, BMI and blood pressure.

In both male and female participants, lower levels of physical activity were seen among students already in the university when compared to freshmen. All other parameters evaluated in female students generally increased with academic exposure. In men, the lipid profile generally changed toward an unfavorable direction with increasing levels of TC and LDL-C and decreasing HDL-C and triglycerides, although blood glucose, homocysteine and systolic blood pressure showed a slight decrease.

Linear mixed-effect models accounting for the dependency of repeated measures of the same participant due to follow-up was used to assess the associations between selected NTCD risk factors and academic exposure, scientific area and gender (Table 3). After controlling for academic exposure and scientific area, TC, HDL-C, blood glucose, triglycerides, BMI, systolic blood pressure and physical activity levels were significantly associated with gender. TC levels

[e] Khatib OMN. Guidelines for the prevention, management and care of diabetes mellitus. Cairo: WHO Regional Office for the Eastern Mediterranean; 2006. (EMRO Technical Publications Series, 32).

Table 1. Characteristics of the student sample by academic exposure. Aveiro, Portugal, 2005–2008.

Variable	Academic exposure			
	No[a] (n = 49)		Yes (n = 295)	
	N	(%)	N	(%)
Sociodemographic				
Gender				
Male	18	(36.7)	89	(30.2)
Female	31	(63.3)	206	(69.8)
Scientific area				
Health	16	(32.7)	105	(35.6)
Non-health	33	(67.3)	190	(64.4)
Clinical				
Overweight	6	(12.5)	48	(16.3)
Hypertension	0	(0.0)	4	(1.4)
Hypercholesterolemia	10	(20.4)	83	(28.3)
High LDL-C	6	(12.2)	56	(19.1)
Low HDL-C	0	(0.0)	3	(1.0)
Hyperglicemia	0	(0.0)	2	(0.7)
Hypertryglicerides	10	(20.4)	96	(32.8)
Hyperhomocysteinemia	6	(15.0)	20	(8.1)
Dyslipidemia	14	(28.6)	129	(44.0)
Behavioral				
Physical inactivity	39	(79.6)	238	(80.7)
Smoking	0	(0.0)	57	(19.3)

LDL-C: low density lipoprotein-cholesterol; HDL-C: high density lipoprotein-cholesterol
[a] Non-academic exposure (first academic year and first enrollment in higher education);

in female participants were around 1.11 ($e^{0.1043}$) times greater than those in males, HDL-C was 1.06 ($e^{0.056}$) times greater and triglycerides were 1.44 ($e^{0.3679}$) times greater. But male participants had on average higher levels of systolic blood pressure and physical activity closer to recommended levels.

Academic exposure was associated with increased LDL-C (on average 1.12 times), and marginally with TC (p=0.041), and with decreased homocysteine levels (p=0.017).

Academic area was only associated with blood glucose with higher levels in health sciences students.

DISCUSSION

To the best of our knowledge this is the first longitudinal study that assessed the impact of academic life on relevant risk factors for NTCDs in university students. The major advantage of a repeated measures compared to a traditional cross-sectional design is that it represents reality far better than just two or three measurements considering different academic years. The linear mixed-effect model considered, with a continuous outcome variable, is identical to a linear regression analysis with an additional correction. It accounts for the dependency of repeated measures within the same participant due to follow-up.

A preliminary analysis also confirmed there were no significant year to year differences in the risk factors studied. The analysis of the students was not made by calendar year but rather by exposure to the academic life. Freshmen were considered not to have been influenced by academic life since data collection was carried out during the first semester of each year, and probably there was not enough time for them to acquire new habits.

The study has some limitations. The use of invalidated self-reported data means that some responses could be socially conditioned such as physical activity and food frequency. Food intake and physical activity were assessed by self-reported questionnaires that are subject to recall bias and other biases and cannot provide assessments as accurate as an objective instrument. Nonetheless, for large epidemiologic surveys as the present study, the use of a questionnaire is the most feasible way to measure physical activity[23] and food frequency.[18]

Only a small number of students accepted to participate two or more times in the follow-up study maybe because it was required fasting and blood collection early in the morning at the university (collection of two blood samples between 8 and 10 am after a 12-hour fasting), as reported when students were personally invited to participate. Low participation reduced the possible number of follow-up observations, considering the baseline sample drawn by stratified random sampling. Nevertheless, the sample size obtained was similar to or even greater than that reported in other comparable[1,5] and larger studies.[29]

Although these are important limitations, the study results found reflect lifestyles and the health profile of a young population with access to higher education.

An exploratory analysis was performed to compare freshman students and those already in the university. There were a higher proportion of smokers (19.3%) among the latter than the former (0.0%). This is consistent with the findings from previous studies where unhealthy behaviors like smoking increase with the transition and retention of students in academic life.[6] The proportion of smokers among higher education students was similar to that found (20% of current smokers)[20] in a similar population in Spain, the neighboring country of Portugal, and in the United States.[27] However, other studies showed lower rates, 12% in Italy,[4] 15.9% in the United Kingdom[12] and 0.7% in

Table 2. Health profile of the students by gender and academic exposure, uncorrected geometric means and 95% confidence intervals. Aveiro, Portugal, 2005–2008.

Parameter	Non-academic exposure			Academic exposure		
	Geometric	95%CI		Geometric	95%CI	
	Mean	Lower	Upper	Mean	Lower	Upper
TC (mg/dL)						
Male	154.17	141.89	167.51	158.5	152.84	164.34
Female	164.1	153.4	175.7	177.6	173.3	182.0
HDL-C (mg/dL)						
Male	79.33	70.65	89.08	88.03	83.49	92.81
Female	83.04	74.23	92.89	94.44	90.99	98.01
HDL-C (mg/dL)						
Male	53.85	52.26	55.5	50.89	49.68	52.13
Female	53.86	51.56	56.28	54.47	53.72	55.23
Triglycerides (mg/dL)						
Male	99.85	80.94	123.18	80.25	70.88	90.86
Female	112.69	92.20	137.74	120.45	111.17	130.51
Blood glucose (mg/dL)						
Male	87.06	83.19	91.11	86.82	85.35	88.32
Female	83.41	80.71	86.21	83.97	83.02	84.94
Homocysteine (µmol/L)						
Male	11.15	8.11	15.32	8.03	7.59	8.48
Female	8.62	7.88	9.42	8.67	8.36	8.99
Body Mass Index						
Male	23.18	21.99	24.44	23.22	22.74	23.72
Female	21.26	20.41	22.14	21.98	21.61	22.35
Systolic blood pressure (mmHg)						
Male	120.19	114.29	126.40	117.21	114.56	119.93
Female	104.50	99.11	110.17	109.90	108.12	111.71
Diastolic blood pressure (mmHg)						
Male	68.10	63.97	72.50	69.12	66.90	71.41
Female	64.73	61.13	68.54	68.55	67.21	69.91
Physical activity (MET*day)						
Male	2870.94	2474.31	3331.14	2504.11	2406.28	2605.92
Female	2093.53	1851.68	2366.97	2085.28	1996.80	2177.68

TC: total cholesterol; LDL-C: low density lipoprotein-cholesterol; HDL-C: high density lipoprotein-cholesterol.

China.[15] Despite anti-smoking campaigns in Portugal and Law No. 37/2007 of 14 August that "adopt standards for citizen protection against involuntary exposure to tobacco smoke and measures to reduce tobacco addiction and cessation of its consumption," the academic life appears to be a motivating factor for smoking since the proportion of smokers increased significantly among freshmen in the university. It could be that these students begin to change their lifestyles previously controlled by parents or surrogates and find new alternatives.[24] At the time of this study, the Portuguese law (No. 37/2007) prohibited smoking in schools, including classrooms, libraries, gyms, halls and corridors, bars, restaurants, canteens, cafeterias and playgrounds, regardless of students' age and level of education. At the Universidade de Aveiro, some additional actions were considered such as raising awareness about the harmful effects of tobacco during the "World No Tobacco Day" and free access to tobacco smoking cessation counseling to all students. However, in spite of the law, smoking outdoor was still common at the university campus, including the area at the entrance of various academic departments. There is a need for adequate and effective policies and legislation to ensure a smoke-free environment.

Irrespective of the exposure to academic life, a sedentary lifestyle was seen in about 80% of the students studied,

Table 3. Variables associated with relevant risk factors[a] in the univariable and multivariable regression models. Aveiro, Portugal, 2005–2008.

Variable	Univariable analysis				Multivariable analysis[b]			
	Coeff.	95%CI		p-value	Coeff.	95%CI		p-value
TC								
Gender[c]	0.1055	0.0476	0.1634	<0.001	0.1043	0.0468	0.1619	<0.001
Academic area[d]	0.0144	-0.0419	0.0708	0.614				
Academic exposure[e]	0.0354	0.0020	0.0689	0.038	0.0348	0.0015	0.0682	0.041
LDL-C								
Gender[c]	0.0653	-0.0181	0.1488	0.124				
Academic area[d]	0.0173	-0.0625	0.0973	0.668				
Academic exposure[e]	0.1132	0.0542	0.1721	< 0.001	0.1132	0.0542	0.1721	< 0.001
HDL-C								
Gender[c]	0.0560	0.0272	0.0847	< 0.001	0.0560	0.0272	0.0847	< 0.001
Academic area[d]	-0.0034	-0.0324	0.0256	0.816				
Academic exposure[e]	-0.0259	-0.0550	0.0032	0.082				
Blood glucose								
Gender[c]	-0.0355	-0.0594	-0.0116	0.004	-0.0295	-0.0538	-0.0052	0.017
Academic area[d]	-0.0312	-0.0542	-0.0082	0.008	-0.0245	-0.0479	-0.0012	0.039
Academic exposure[e]	0.0039	-0.0179	0.0259	0.721				
Triglycerides								
Gender[c]	0.3679	0.1997	0.5361	< 0.001	0.3679	0.1997	0.5361	< 0.001
Academic area[d]	0.0387	-0.1316	0.2090	0.654				
Academic exposure[e]	-0.0927	-0.2386	0.0530	0.211				
Homocysteine								
Gender[c]	0.2414	-0.0486	0.0969	0.513				
Academic area[d]	-0.0188	-0.08859	0.0509	0.594				
Academic exposure[e]	-0.1078	-0.1964	-0.0197	0.017	-0.1078	-0.1964	-0.0197	0.017
Body Mass Index								
Gender[c]	-0.0560	-0.09600	-0.0161	0.006	-0.0560	-0.09600	-0.0161	0.006
Academic area[d]	-0.0117	-0.0469	0.0233	0.509				
Academic exposure[e]	0.0066	-0.0054	0.0187	0.280				
Diastolic blood pressure								
Gender[c]	-0.0084	-0.0560	0.0390	0.725				
Academic area[d]	-0.0194	-0.0641	0.0253	0.393				
Academic exposure[e]	0.0255	-0.0036	0.0546	0.086				
Systolic blood pressure								
Gender[c]	-0.0719	-0.1102	-0.0336	< 0.001	-0.0719	-0.1102	-0.0336	<0.001
Academic area[d]	-0.0358	-0.0733	0.0017	0.061				
Academic exposure[e]	0.0126	-0.0114	0.0367	0.303				
Physical activity								
Gender[c]	-0.2025	-0.2765	-0.1286	< 0.001	-0.2025	-0.2765	-0.1286	<0.001
Academic area[d]	0.0072	-0.0715	0.0861	0.855				
Academic exposure[e]	-0.0547	-0.1419	0.0324	0.217				

TC: total cholesterol; LDL-C: low density lipoprotein-cholesterol; HDL-C: high density lipoprotein-cholesterol
[a] In factors levels; [b] Univariable and multivariable linear regression analysis included a random effect for participant so that p-values take into account repeated observations due to follow-up in the analysis; [c] Male as reference; [d] Health sciences as reference; [e] First academic year as reference

a finding that has also been reported in other studies in Portugal and other countries.[25,30] Lack of exercise is a well-known contributing factor to a number of health problems affecting people worldwide, such as diabetes, obesity and heart disease. Our results confirm the estimates published in The World Health Report that physical activity declines with age, starting in adolescence.[f] Girls and women are generally more inactive than men. Regarding the influence of gender on the level of physical activity, a longitudinal study conducted in Netherlands showed that, in general, physical activity decreased sharply between the age of 13 and 16 years in both boys and girls, and to a more moderate extent between the age of 16 to 27.[13] This trend appears to be confirmed in our study. Increased physical activity would increase the level of protection against NTCDs, especially cardiovascular disease. A change from a sedentary to an active lifestyle can reduce cardiovascular disease risk by about 33%.[17] A higher level of education does not seem to have a protective effect on the adoption of a healthy lifestyle. Being enrolled in health-related courses does not seem to affect students' behaviors.

Dyslipidemia is one of the main risk factors of NTCDs, though it is partially modifiable.[2] As shown in the present study, the fact that the participants were enrolled in higher education did not result in a lower proportion of dyslipidemia (44% vs 28.6% in freshmen). These students showed a trend in increasing levels of TC and LDL-C during the transition from high school to university.

Hypertension and high blood glucose were seen in 1.4% and 0.7%, respectively, of the students studied. This is similar to that reported in the 2006 National Health Survey (NHS) conducted by the Portuguese Ministry of Health (1.2% and 0.6%, respectively, in the same age group).

The rate of overweight found in the studied population enrolled in higher education for more than one year was 16.3%, higher than that found in the general Portuguese population (13.8%). Obesity and overweight are known to increase the risk of cardiovascular diseases and type 2 diabetes mellitus,[10] reinforcing the need to implement dietary interventions.[14]

About one fourth of the participants were enrolled in health-related areas (33.8%) but this fact does not seem to affect health-related behaviors. The observed trends in major risk factors for NTCDs were similar to those seen in students from other scientific areas. This finding is of concern since health students that participated in the study were enrolled in undergraduate courses in nursing, physiotherapy, speech therapy, radiology, gerontology and medical biosciences. All these courses teach students health promotion and disease prevention during their clinical and academic training. The follow-up of these students throughout their academic life did not show a positive effect of the academic life on their health status, as would be expected due to knowledge acquired during the course. The currently adopted curriculum structure and/or teaching and learning strategies do not seem to integrate the knowledge acquired in a health-related area with health promotion and disease prevention among students.

The present study found that a significant proportion of young university students had risk factors for NTCDs: overweight or obesity, smoking, sedentary lifestyle, dyslipidemia, and hypertension. Since risk factors in young adults are strong predictors of the incidence of cardiovascular disease and mortality in older age,[21] we emphasize the need for surveillance of this young population. Freshman students (non-academic exposure*)* showed slightly more positive behaviors than other students (academic exposure).

Although the study conclusions are being drawn for a particular university, they emphasize the need for implementing prevention strategies and recommendations among university students to prevent or delay consequences of inadequate lifestyles, even for those students enrolled in a health-related area.

In conclusion, higher level of education does not seem to have a protective effect on the adoption of a healthy lifestyle and being enrolled in health-related areas does not seem to positively affect students' behaviors.

Increased risk factors for NTCDs can affect the well-being of university students and impact their health in adulthood. These results should support the implementation of health promotion and prevention programs at the university.

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The authors declare that there are no conflicts of interest.