Original Article

Relationship between Academic Performance with Physical, Psychosocial, Lifestyle, and Sociodemographic Factors in Female Undergraduate Students

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Abstract

Background: The purpose of this study was to investigate the relationship between physical, psychosocial, lifestyle and sociodemographic factors with academic performance in female undergraduate students. **Methods**: One hundred undergraduate female students from the Faculty of Science at the University of Quebec at Montreal participated in this study (mean age = 24.4 ± 4.6 years old). All participants provided their university transcript and had to complete at least 45 course credits from their bachelor degree. Body composition (DXA), handgrip strength, estimated maximal oxygen consumption (VO_2 max) (Bruce Protocol) and blood pressure were measured. Participants also completed a questionnaire on their psychosocial, academic motivation, lifestyle and sociodemographic profile. **Results:** Significant correlations were observed between GPA with estimated VO_2 max ($r = 0.32$), intrinsic motivation toward knowledge ($r = 0.23$), intrinsic motivation toward accomplishment ($r = 0.27$) and external regulation ($r = -0.30$, $P = 0.002$). In addition, eating breakfast every morning and being an atheist was positively associated with academic performance ($P < 0.05$). Finally, a stepwise linear regression analysis showed that external regulation, intrinsic motivation toward accomplishment, VO_2 max levels and eating a daily breakfast explained 28.5 % of the variation in the GPA in our cohort. **Conclusions:** Results of the present study indicate that motivational, physical and lifestyle factors appear to be predictors of academic performance in female undergraduate students.

Keywords: *Academic, body composition, lifestyle, motivation factors, psychosocial factors, VO_2 max*

Introduction

Higher education plays a crucial role for the advancement of society. Improving the academic performance of university students is a fundamental objective for any university. By improving their academic performance, university students could increase their probability of being accepted in a graduate studies program or in a professional health program (e.g.: medicine), obtain a bursary or an award as well as develop a greater self-satisfaction. This has led universities to find various support measures to improve the academic performance of students. Thus, the ability to predict the academic performance of a student has important implications for all universities and university students.

Well-established multiple factors have been shown to be consistently associated with the academic performance of students in elementary and high school such as the level of fitness (i.e., cardirespiratory fitness [VO_2 max]),[1,2] body composition (i.e., body mass index [BMI], fat mass),[2,3] psychosocial factors (i.e., stress, self-esteem [SE]),[4,5] academic motivation factors (i.e., intrinsic and extrinsic motivation toward studies),[6,7] lifestyle factors (i.e., sleep duration [SD], physical activity levels),[8,9] eating habits (i.e., daily breakfast),[10,11] and sociodemographic factors (i.e., household income, parent's level of education).[12,13] Recently, a novel factor identified as religious status has also been reported to be related with the level of education and intelligence.[14,15] That is, atheist individuals were associated with a higher level of education and intelligence.

However, a major limitation in this area is that most studies examining academic

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performance considered only the level of fitness, body composition, eating habits as well as lifestyle, psychosocial, academic motivation, and sociodemographic characteristics separately at a time. To our knowledge, no data appear to be available using a multivariate approach in one study. This approach may give us a better insight into a large variety of important factors involved in academic performance. In addition, most research that investigated the academic performance mainly focused on psychosocial and sociodemographic factors and did not explore other potential variables such as physical and lifestyle factors. Moreover, most of the studies on the relationship between physical factors and academic performance were performed on elementary or high school students rather than the university students.[16,17] Finally, the majority of research that examined academic performance was conducted in the United States of America with fewer studies in Canada.[16,17] Therefore, the purpose of this study was to examine the relationship between physical, psychosocial, lifestyle, and sociodemographic factors with academic performance in female undergraduate students. We hypothesized that academic performance would be associated with a favorable physical, psychosocial, lifestyle, and sociodemographic profile. It should be noted that there is evidence to suggests that female and male students seem to perform differently academically at the University level.[18,19] It appears that men have higher spatial and arithmetical abilities and lower verbal abilities than women,[20,21] which in turn could affect academic performance differently between both genders. Therefore, to avoid a potential confounding factor, only female students were chosen for this study.

Methods

Participants

The study sample comprised 100 female undergraduate students from the Faculty of Science at the Université du Québec à Montréal (UQAM). The ethnicity of our population was composed of 79 Caucasians, 11 African–Americans, 8 Arabs, 1 Hispanic, and 1 Asian. The Faculty of Science at the UQAM comprised approximately 3500 students, which include the following 6 departments: chemistry, biology, exercise science, mathematics, computer science, and geology. Volunteers were recruited using advertisement through E-mails and short presentations in the classrooms. Participants were included in the study if they met the following criteria: (a) female, (b) registered full time to an undergraduate program at the Faculty of Science at the UQAM, and (c) completed at least 45-course credits, which represents half of the credits in a bachelor degree. Exclusion criteria were: (a) cardiovascular diseases or diabetes, (b) orthopedic limitations, (c) medication that could affect blood pressure, and (d) students who are diagnosed with learning disabilities. All procedures were approved by the Ethics Committee of the Faculty of Science at the UQAM. All participants were fully informed about the nature, goal, procedures, and risks of the study and gave their informed consent in writing.

Study procedure

An E-mail interview was conducted to screen for the aforementioned inclusion criteria. One hundred and nine women originally volunteered to participate in the study, but nine were excluded as they did not meet the inclusion criteria. After screening, the students were invited for a visit to the Department of Exercise Science at the UQAM. All the participants refrained from consuming caffeine and foods 2 h before all of the measurements. In addition, women were tested in the follicular phase in the menstrual cycle. All the tests were completed individually in a single visit that lasted approximately 90 min in the following sequence: body composition, blood pressure and resting heart rate, muscle strength, questionnaires, and estimated VO_2 max. All measurements were performed by the same investigator (MMD).

Academic performance

The grade point average (GPA) of each participant was used to assess academic performance. All the participants provided their university transcript. It should be noted that the GPA at the UQAM is calculated on a scale of 4.30 (A+ =4.30; A = 4.00–4.29; A-=3.70–3.99; B+ =3.30–3.69; B = 3.00–3.29; B− =2.70–2.99; C+ =2.30–2.69; C = 2.00–2.29; C− =1.70–1.99; D+ =1.30–1.69; D = 1.00–1.29; and E = 0).

Body composition

Body weight, fat mass, and lean body mass (in kg) were measured using dual-energy X-ray absorptiometry (General Electric Lunar Corporation, standard mode; software version 12.30.008, Madison, MI, USA). Standing height (in m) was measured using a wall stadiometer (Perspective Enterprises, Michigan, USA). BMI (body weight/height) was calculated.

Blood pressure and resting heart rate

Systolic and diastolic sitting blood pressure (in mmHg) as well as resting heart rate (in bpm) was determined by an automatic sphygmomanometer machine (Spot Vital Signs® Devices, Welch Allyn, Mississauga, ON, Canada). An appropriate cuff size was selected for each participant based on the arm circumference. Conditions were carefully standardized: no talking, cuff on the right arm, and 5 min of rest. Three measurements with 3 min of rest between measures were taken. The average of the three measures was reported.

Muscle strength

Maximum voluntary handgrip strength (in kg) was measured with a hand dynamometer with adjustable grip (Hand Dynamometer, Lafayette Instrument, USA).

Participants were standing upright with their arm straight and slightly abducted. Participants then applied as much handgrip pressure as possible for at least 4 s. Three attempts on each hand were performed with 1 min of rest between each attempt. The maximum score, regardless of the hand used, was recorded. Muscle strength was then expressed in kg/body weight.

Estimated VO_2 max

The Bruce protocol on the treadmill was used to measure VO_2 max (in ml/kg/min).[22] The first stage began at a treadmill speed of 2.7 km/h and an incline of 10% gradient for 3 min. A progressive increase in the level of intensity (inclination and speed) was subsequently increased after each 3-minute period until voluntary exhaustion was reached. The estimated VO_2 max was calculated using the following validated prediction equation: VO_2 max = 4.38 × T – 3.9, where T = Maximum time on the treadmill in minutes.[23]

Psychosocial factors

Body esteem (BE) was assessed using the validated Mendelson *et al*. BE scale,[24] a 23-item measure which includes three subscales: appearance (10 items), attribution, that is, how a woman perceives other people's evaluation of her body appearance (5 items), and weight (8 items). Scores were calculated for total BE and for each subscale, with higher scores reflecting greater BE. SE was assessed using the validated Rosenberg SE scale.[25] Scores were calculated for this 10-item measure, with higher scores reflecting greater SE. Perceived stress (PS) was assessed using the validated Cohen *et al*. PS scale.[26] Scores were calculated for this 14-item measure, with higher scores indicating greater stress. Quality of life (QoL) was measured using the validated Medical Outcomes Study General Health Survey (SF-20) with scores being transformed to a scale of 0%–100%;[27] higher scores indicate greater QoL. Scores were calculated for total QoL and for each subscale: physical and role functioning (8 items), mental health (5 items), health perceptions (5 items), social functioning (1 item), and pain (1 item).

Academic motivation factors

Academic motivation was evaluated using the validated 28-item academic motivation scale.[28] It assesses three subscales of intrinsic motivation (toward knowledge, 4 items; toward accomplishment, 4 items; and toward stimulation, 4 items), three subscales of extrinsic motivation (identified regulation, 4 items; introjected regulation, 4 items; and external regulation [ER], 4 items), and amotivation (AM) (4 items). Higher scores in each subscale represent higher levels of motivation except for AM.

Lifestyle and sociodemographic factors and eating habits

The following lifestyle and sociodemographic factors as well as eating habits were also measured: watching television, computer usage, SD, sleep onset latency, number of meals, civil status, housing with parents, parent's education level, employment and religious status, household income as well as daily serving of fruits and vegetables, and eating a daily breakfast.

Statistical analysis

The data are expressed as the mean ± standard deviation. We first verified the normality of the distribution of variables with the skewness and the kurtosis tests and found that all variables except the GPA were normally distributed (indices between −2 and 2). Pearson's correlations were performed to examine the relationship between GPA with physical, lifestyle, psychosocial, and academic motivation factors. Then, to perform a Chi-square test to analyze differences in eating habits and sociodemographic factors, participants were divided into two equal groups (n = 50) based on their GPA score. The lower 50th percentile represented the lower-GPA group, and the upper 50th percentile represented the higher-GPA group (median GPA = 3.29/4.30). Finally, a stepwise linear regression analysis was performed to identify predictors of the GPA. Based on significant correlations and differences between groups, independent variables considered in the final model for the GPA were estimated VO_2 max, intrinsic motivation toward knowledge (IMK), intrinsic motivation toward accomplishment (IMA), ER, eating a daily breakfast, and religious status. Statistical analysis

Table 1: Academic, body composition, physical, and lifestyle characteristics in female university students

Variables	Mean±SD
Grade point average (/4.3)	3.2±0.6
Number of course credits	63.8±16.9
Age (years)	24.4±4.6
Body weight (kg)	63.5±9.9
Height (m)	1.6±0.1
Body mass index (kg/m^2)	23.5±3.6
Fat mass (kg)	19.2±8.2
Lean body mass (kg)	41.8±4.5
Handgrip strength (kg/body weight)	0.5±0.1
Estimated VO_2 max (ml/kg/min)	41.7±8.5
Resting heart rate (bpm)	70.6±11.2
Systolic blood pressure (mmHg)	110.9±8.8
Diastolic blood pressure (mmHg)	72.6±6.3
Total screen time (h/week)	30.2±25.0
Sleep duration (h)	7.3±1.1
Sleep onset latency (min)	28.6±26.0
Number of meals/day	2.9±0.8

Values are mean±SD. SD=Standard deviation was performed using SPSS 21 for Windows (Chicago, IL, USA). Significance was defined at $P < 0.05$.

Table 2: Psychosocial and academic motivation characteristics in female university students

Variables	Mean±SD
Self-esteem (/40)	31.2±4.8
Total body esteem (/92)	55.1±15.4
Body esteem subscales for	
Appearance (/40)	23.9±7.3
Attribution (/20)	12.0±2.9
Weight (/32)	19.2±7.4
Total quality of life (/84)	67.5±7.9
Quality of life subscales for	
Health perceptions (0%-100%)	82.2±13.0
Pain (0%-100%)	70.4±23.2
Physical and role functioning (0%-100%)	94.6±10.6
Social functioning (0%-100%)	94.8±12.6
Mental health (0%-100%)	63.5±15.1
Perceived stress (/56)	23.7±8.2
Academic motivation scale	
Intrinsic motivation	
Knowledge (/28)	24.3±3.6
Accomplishment (/28)	21.2±5.1
Stimulation (/28)	16.0±5.4
Extrinsic motivation	
Identified regulation (/28)	23.6±3.9
Introjected regulation (/28)	18.0±6.8
External regulation (/28)	18.2±7.4
Amotivation (/28)	5.4±2.6

Values are mean±SD. SD=Standard deviation

Results

Academic, body composition, physical, and lifestyle characteristics of the participants are presented in Table 1. Psychosocial and academic motivation characteristics of the participants are shown in Table 2.

Correlations between GPA, body composition, physical, lifestyle, psychosocial, and academic motivation factors are presented in Table 3. Significant correlations were observed between GPA with estimated VO_2 max ($r = 0.32$, $P = 0.001$), IMK ($r = 0.23$, $P = 0.024$), IMA ($r = 0.27$, $P = 0.007$), ER ($r = -0.30$, $P = 0.002$), and number of meals per day ($r = 0.20$, $P = 0.044$; not shown). We also performed partial correlations between VO_2 max and GPA controlling for either IMK ($r = 0.29$, $P = 0.003$), IMA ($r = 0.33$, $P = 0.001$), and ER ($r = 0.27$, $P = 0.006$).

Table 4 shows the eating habits of higher- and lower-GPA groups. It should be noted that the mean GPA of the higher-GPA group was 3.61/4.30, which represents a grade of B + but closer to A- and the mean GPA of the lower-GPA group was 2.72/4.30, which represents a grade of B- but closer to C+. We observed that participants in the higher-GPA group were significantly more likely to report eating a daily breakfast compared to the lower-GPA group (94 vs. 78%, respectively; $P = 0.02$). In addition, a strong tendency for a higher prevalence of three or more servings of fruits and vegetables were noted in the higher-GPA group compared to the lower-GPA group (81.6 vs. 64.6%, respectively; $P = 0.058$).

Table 3: Pearson's correlations (*r*) between grade point average, body composition, physical, lifestyle, psychosocial, and academic motivation factors in female university students

	GPA	FM	HS	VO_2	TST	SD	SE	BE	QoL	PS	IMK	IMA	IMS	EID	EIN	EXR
GPA	–															
FM	−0.17	–														
HS	0.19ǂ	−0.71**	–													
VO_2	0.32**	−0.62**	0.55**	–												
TST	−0.11	−0.00	0.03	−0.13	–											
SD	0.07	−0.16	0.05	0.00	−0.23*	–										
SE	0.05	−0.08	−0.00	0.11	0.06	0.15	–									
BE	0.04	−0.40**	0.26**	0.27**	0.09	0.18	0.58**	–								
QL	0.04	−0.35**	0.18ǂ	0.29**	−0.04	0.12	0.37**	0.47**	–							
PS	−0.08	0.35**	−0.23*	−0.28**	0.13	−0.17	−0.43**	−0.54**	−0.71**	–						
IMK	0.23*	−0.20*	0.05	0.19ǂ	0.14	−0.08	0.20*	0.17	0.19ǂ	−0.23*	–					
IMA	0.27**	0.04	−0.11	0.01	0.10	0.00	0.26**	−0.02	0.06	−0.12	0.47**	–				
IMS	0.08	0.04	−0.19ǂ	−0.03	0.05	0.02	0.14	0.20*	0.10	−0.10	0.54**	0.50**	–			
EID	−0.14	−0.03	−0.19ǂ	0.00	0.01	0.07	0.02	−0.04	−0.04	0.08	0.06	0.24*	0.08	–		
EIN	−0.14	0.17	−0.16	−0.24*	−0.06	0.16	0.07	−0.18	−0.18	0.16	0.00	0.47**	0.15	0.47**	–	
EXR	−0.30**	0.08	−0.16	−0.23*	−0.04	0.07	0.03	−0.16	−0.29**	0.29**	−0.14	0.13	−0.14	0.51**	0.59**	–
AM	−0.19ǂ	0.20*	−0.03	−0.16	−0.10	0.03	−0.18	−0.17	−0.22*	0.33**	−0.43**	−0.46**	−0.23*	−0.16	−0.04	0.09

ǂTendency ($0.05<P<0.07$), *$P<0.05$, **$P<0.01$. GPA=Grade point average, FM=Fat mass, HS=Handgrip strength, VO_2=Estimated VO_2 max, TST=Total screen time, SD=Sleep duration, SE=Self-esteem, BE=Body esteem, QoL=Quality of life, PS=Perceived stress, IMK=Intrinsic motivation toward knowledge, IMA=Intrinsic motivation toward accomplishment, IMS=Intrinsic motivation toward stimulation, EID=Identified regulation (extrinsic motivation) EIN=Introjected regulation (extrinsic motivation), EXR=External regulation (extrinsic motivation), AM=Amotivation

Sociodemographic variables are presented in Table 5. No significant differences between groups were noted for civil status, housing with parents, the level of education of both parents, employment status, and household income. However, a higher prevalence of atheists was observed in the higher-GPA group compared to the lower-GPA group (75 vs. 46%, respectively; $P = 0.003$).

Table 4: Eating habits of the lower- and higher-grade point average groups

Variables	Lower-GPA (*n*=50)	Higher-GPA (*n*=50)	*P*
Servings of fruits and vegetables (%) (/day)			
<3	35.4	18.4	0.058
≥3	64.6	81.6	
Eating a daily breakfast (%)			
Yes	78.0	94.0	0.02
No	22.0	6.0	

Table 5: Sociodemographic characteristics of the lower- and higher-grade point average groups

Variables	Lower-GPA (*n*=50)	Higher-GPA (*n*=50)	*P*
Civil status (%)			
Married/cohabitation	34.0	26.0	0.38
Single	66.0	74.0	
Housing (%)			
With parents	46.0	34.0	0.22
Without parents	54.0	66.0	
Mother's level of education (%)			
University	40.0	29.2	0.26
High school	60.0	70.8	
Father's level of education (%)			
University	46.0	45.8	0.99
High school	54.0	54.2	
Employment status (%)			
Working<20 h/week	61.3	68.4	0.54
Working 20 h and more/week	38.7	31.6	
Religious status (%)			
Believer	54.0	25.0	0.003
Atheist	46.0	75.0	
Household income (%)			
<$20,000	33.3	43.2	0.36
$20,000 and more	66.7	56.8	

We performed stepwise linear regression analysis to examine the independent predictors of academic performance. Table 6 illustrates the summary of the model. Our results showed that ER, IMA, VO_2 max levels, and eating a daily breakfast were independent predictors of GPA, explaining 28.5% of the variance.

Discussion

We hypothesized that a favorable physical, psychosocial, and sociodemographic profile would be associated with higher-GPA values in female undergraduate students. Results from the present study support our hypothesis. That is, we observed a significant correlation between VO_2 max levels and GPA. This correlation was independent of academic motivation factors. This finding is consistent with the results of several other studies in children and adolescents[2,29] and seems to be explained by the enhancement of cognitive functions such as inhibition and memory.[30,31] Therefore, university educators may want to target, develop, or strengthen VO_2 max levels to facilitate improvements in academic performance. For example, university educators could promote the importance of performing endurance training exercises.

We also showed that higher intrinsic academic motivation and lower extrinsic academic motivation were associated with a better academic performance, which is in line with other studies.[6,7] Accordingly, these variables may be the primary factors in the present study that could be directly addressed by university educators by considering different motivational theories and social structures to help ameliorations in academic performance. Furthermore, eating a daily breakfast was associated with higher-GPA values. Similar results have been reported by other studies that also showed the beneficial effect of eating a daily breakfast in children and adolescents.[10,11] This finding seems to be explained by better cognitive functions.[32-34] In fact, previous studies have noted that consuming a daily breakfast has a positive effect on memory and attention span,[33,34] which might, in turn, influence academic performance.[32] Interestingly, the higher-GPA group had a higher prevalence of atheist individuals. The mechanism that could explain this phenomenon is presently unknown. However, a recent meta-analysis showed a significant negative association between intelligence and religiosity.[14] Finally, no significant correlation was observed between SD or sleep

Table 6: Stepwise regression analysis regarding independent predictors of academic performance in female university students

Dependent variable	Step	Independent variable	Partial r^2	Total r^2 cumulative	*P*
Grade point average	1	Extrinsic motivation - ER	0.101	0.105	0.001
	2	Intrinsic motivation - AC	0.090	0.195	0.002
	3	Estimated VO_2 max	0.055	0.250	0.010
	4	Daily breakfast	0.035	0.285	0.037

ER=External regulation, AC=Toward accomplishment onset latency with GPA. However, there is also evidence, which suggests that insufficient sleep or poor sleep quality may be associated with a lower academic performance in elementary and high school students.[8,9] Taken together, studies characterizing academic performance may want to consider several outcome measures (e.g., psychosocial and physiological) in different domains to have a complete understanding of the academic performance profile of university students. Thus, this multivariate approach may give us a better insight into a large variety of important factors involved with academic performance and to the ones that university educators may want to focus on more.

In the present study, we also attempted to develop a model that includes multiple physical, psychosocial, motivation, lifestyle, and sociodemographic measurements that may help us better understand predictors of academic performance. Results from the stepwise regression analysis showed that ER, IMA, VO_2 max levels, and eating a daily breakfast were independent predictors of GPA. This suggests that lower levels of ER, higher levels of IMA, higher levels of VO_2 max, and eating a daily breakfast seem to be associated, at least in part, to higher-GPA values and were the only variables that effectively predicted academic performance among a wide range of parameters. The mechanism(s) that may explain the relationship between ER, IMA, higher levels of VO_2 max, and eating a daily breakfast with better GPA values in the present study remain(s) unclear. However, an intrinsic motivation profile, contrary to an external one, may promote personal responsibility and initiative which may lead to adopt a favorable behavior and in turn to a better academic performance.[35,36] Furthermore, a potential mechanism that could explain the relationship between levels of VO_2 max and eating a daily breakfast with better GPA values may be better levels of cognitive function.[37,38] For example, increases in VO_2 max levels have been shown to increase brain activity, which could lead to improvements in attention, memory, inhibition, enhanced coping as well as information processing, storage, and retrieval.[30,31,39,40]

There are limitations in the present study. Our findings are limited to a population of female undergraduate students from a faculty of science. Furthermore, we used a cross-sectional approach, which does not allow us to conclude to any causal associations between physical, psychosocial, motivation, lifestyle, and sociodemographic factors and academic performance in our cohort. Nonetheless, our results are strengthened by studying a homogeneous population, which includes a wide range of measurements. Finally, the results of the present study may be considered preliminary, but they may hopefully stimulate interest for a greater characterization of university students from different programs in both genders.

Conclusions

Results of the present study show that academic performance was associated, at least in part, with ER, IMA, VO_2 max levels, and eating a daily breakfast in female undergraduate students. Indeed, other factors such as motivational styles and personality traits could also be considered in future studies. Furthermore, this study may give a better understanding of the interrelationship between academic performance with physical, psychosocial, motivation, lifestyle, and sociodemographic factors to university educators that could help guide them in the development of effective intervention programs, which may lead to better GPA values. That is, university educators could consider planning a great variety of free intervention programs to promote the importance of improving intrinsic motivation toward academics, VO_2 max levels, and eating a daily breakfast to students on university campuses and/or in the classrooms (e.g.: organized sport activities, fitness center access, motivational speaker for academics, kinesiologist, and nutritionist consultation as well as workshops on adopting a healthy lifestyle). Ultimately, a better academic performance in university students has the potential of increasing the probability of being accepted in a graduate studies program or in a professional health program (e.g.: medicine), obtain a bursary or an award as well as develop a greater self-satisfaction.

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Conflicts of interest

There are no conflicts of interest.

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