Original Article

Predictors associated with academic performance of medical students

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ABSTRACT

Aim

Ensuring a high level of academic performance among students is an important task for higher education systems. This study aims to identify key predictors of academic success, measured by GPA, among medical students.

Materials and Methods

A cross-sectional study was conducted with the participation of 112 students of the Faculty of Medicine at Al-Farabi Kazakh National University. Data collection was carried out using a questionnaire distributed via Google Forms, which reflected demographic characteristics, indicators of school activity, and measures of quality of life and/or subjective well-being. Multiple logistic regression was used to assess the influence of factors.

Results

The analysis showed that school performance significantly affects GPA: an increase in the level of school grades increased the likelihood of achieving a high GPA (Exp(B)=2.188, p=0.047). Sleep quality was another significant predictor: a decrease in sleep quality reduced GPA (Exp(B)=0.276, p=0.002). Maintaining a stable standard of living was associated with a higher GPA (Exp(B)=2.030, p=0.033). Factors such as gender, material well-being, and family relationships demonstrated borderline significance, requiring further analysis.

Conclusion

The results highlight the importance of academic preparation, quality of life, and emotional stability for achieving high academic performance. These findings may serve as a basis for the development of targeted interventions aimed at improving student success, as well as for identifying priority areas in medical education research.

INTRODUCTION

Modern higher education systems face a number of challenges related to ensuring a high level of academic training for students. This is particularly relevant for medical universities, where students are required not only to assimilate vast amounts of knowledge but also to acquire professional skills necessary for successful work in healthcare. One of the indicators of students' academic performance is the GPA, which reflects their overall level of educational achievement. Studying the factors influencing this indicator allows for a deeper understanding of the mechanisms underlying the educational process and for the development of measures to optimize it[1-4]. Previous studies emphasize the importance of a comprehensive approach to studying predictors of academic performance. These factors encompass both individual student attributes and external influences, including the quality of education, financial stability, and the presence of a supportive social environment. Nevertheless, within the Kazakhstani research context, the connection between students' academic performance and elements such as sleep quality, perceived life stability, and

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different types of leisure activities has not been thoroughly examined [5-8].The aim of this study is to identify factors associated with the academic success of medical students enrolled in undergraduate programs at Al-Farabi Kazakh National University. Special attention is paid to analyzing parameters of school activity, demographic characteristics, subjective well-being, and satisfaction with the educational process. The study results will not only clarify the role of various factors in achieving a high GPA but also offer specific recommendations for improving students' educational experience.

MATERIALS AND METHODS

Design: cross-sectional study. The main research method was a survey. The survey model was characterized by the following features: voluntary and identifiable participation, complete sampling, and the use of "closed questions" (except for some demographic items). Individual survey forms were administered through Google Forms. The participants were students of the Faculty of Medicine at Al-Farabi Kazakh National University (Kazakhstan) who met the following inclusion criteria: 1) undergraduate program; 2) specialty – "Public Health" and "Population Health." Data collection was carried out in 2024. A total of 112 students participated. Statistical processing of questionnaire data was carried out using IBM SPSS Statistics. Multiple logistic regression (backward stepwise Wald method) was used to assess the dependence of GPA (binary outcome: "1" = GPA 3.67–4.00; "0" = GPA below 3.67) on the studied predictors:
– **Group 1 factors** – school activity and educational preparation: "school performance (self-assessment from 1 to 5)," "participation in intellectual clubs at school (0 – no, 1 – yes)," "participation in creative clubs at school (0 – no, 1 – yes)," "participation in sports clubs at school (0 – no, 1 – yes)," "attendance at additional educational courses and/or tutoring before entering undergraduate studies (0 – no, 1 –yes)."

– **Group 2 factors** – demographic characteristics: "gender (1 – male, 2 – female)," "age at admission to undergraduate studies (years)," "marital status (1 – partnered, 2 –single)."

– **Group 3 factors** – quality of life and subjective well-being: "material well-being (self-assessment 1 to 5)," "life prospects (self-assessment 1 to 5)," "leisure opportunities (culture, sports, entertainment) (self-assessment 1 to 5)," "favorite activity or ability to express oneself (self-assessment 1 to 5)," "family relationships (self-assessment 1 to 5)," "communication with friends or people with similar interests (self-assessment 1 to 5)," "quality of nutrition (self-assessment 1 to 5)," "quality of sleep (self-assessment 1 to 5)," "health status (self-assessment 1 to 5)," "emotional state (self-assessment 1 to 5)," "social and legal security (sense of safety) (self-assessment 1 to 5)."

– **Group 4 factors** – beliefs about life changes: "I am satisfied with how this year of my life went (all aspects) (agreement scale 1 to 5)," "This year, there have been positive changes in my life (agreement scale 1 to 5)," "This year, I did not face major problems (agreement scale 1 to 5)."

– **Group 5 factors** – characteristics of study workload and satisfaction with the process: "availability of free time during undergraduate studies (self-assessment 1 to 5)," "satisfaction with the academic part of the educational process (1 to 5)," "satisfaction with the extracurricular part of the educational process (1 to 5)."

Ethical clearence

This study was conducted in accordance with ethical standards. Ethical approval was obtained from the appropriate institutional review board, and informed consent was secured from all participants prior to data collection.

RESULTS

At the initial stage, the socio-demographic and educational characteristics of medical students were analyzed. Table 1 presents the descriptive statistics of the studied characteristics. Among respondents, the majority were female (94 students, 83.9%), while males accounted for 16.1% (18 students). The mean age was 18 years, the median and mode were 17 years, with a minimum of 16 and a maximum of 32 years. A total of 23.2% (26 students) were in a relationship, while 76.8% (86 students) were single. Students were enrolled in two educational programs: 6B10107 "Public Health" (61 students, 54.5%) and 6B10105 "Population Health" (51 students, 45.5%). GPA ranged from 3.00 to 3.96, with a mean of 3.48, a median of 3.51, and a mode of 3.25, reflecting a high level of academic performance. The GPA letter distribution showed that most students received grades in the "A" range (including "A" and "A-") – 64.3%, while "B" grades (including "B" and

"B+") accounted for 35.7%.

Table 1 – Descriptive characteristics of respondents

Characteristics	Descriptive statistics	
Gender	Male – 18 (16.1%)	Female – 94 (83.9%)
Age at admission	Mean = 18; Median = 17; Mode = 17; Min = 16; Max = 32	
Marital status	In relationship – 26 (23.2%) /	Single – 86 (76.8%)
Specialty	6B10107 Public Health – 61 (54.5%) /	6B10105 Population Health – 51 (45.5%)
GPA (numeric)	Mean = 3.48; Median = 3.51; Mode = 3.25; Min = 3.00; Max = 3.96	
GPA (letter)	A- – 45 (40.2%); A – 27 (24.1%) B – 4 (3.6%); B+ – 36 (32.1%);	

The main analysis focused on studying factors associated with a high GPA. Logistic regression was applied to determine which variables influenced the probability of achieving a high GPA. Table 2 presents predictors identified as associated with high academic performance. The overall accuracy of the model (step 18) was 73.2%. The accuracy of predicting a GPA in the 3.67–4.00 range increased from 84.7% at step 1 to 90.3% at step 18.

It was established that "school performance" had a significant effect on GPA. A positive regression coefficient with $p < 0.05$ and Exp(B)=2.188 indicated that higher school performance more than doubled the likelihood of achieving a high GPA.

The next significant variable, "sleep quality," assessed on a 5-point scale, was also a statistically significant predictor. Results (B = -1.288, p = 0.002, Exp(B) = 0.276) showed that reduced sleep quality significantly lowered the probability of achieving a high GPA. This underlines the importance of maintaining adequate sleep as a key factor for student success.

Responses to the statement "This year I did not face major problems," reflecting students' subjective perception of life stability, were also associated with higher GPA. Results (B = 0.708, p = 0.033, Exp(B) = 2.030) indicated that each additional point on this agreement scale more than doubled the probability of achieving a GPA between 3.67–4.00.

Variables such as gender (p = 0.060), material well-being (p = 0.057), family relationships (p = 0.080), social interaction (p = 0.084), and positive life changes (p = 0.054) demonstrated borderline significance. This suggests possible associations with academic performance and highlights the need for further research. In this study, female students were more likely to achieve GPA 3.67–4.00 compared to males. Higher GPA was also associated with greater self-assessment of material well-being and social interaction. Conversely, higher scores for "family relationships" and "positive life changes" were linked to a decreased likelihood of high GPA, which may reflect a shift of focus away from academics toward family, social, or personal activities. Further research is needed to clarify these associations.

Table 2 – Predictors associated with GPA among medical students

Variables (step 18)	B	Wald	p	Exp(B)
School performance (self-assessment 1–5)	0.783	3.936	0.047	2.188
Gender (1=male, 2=female)	-1.308	3.529	0.060	0.270
Material well-being (1–5)	0.905	3.622	0.057	2.472
Family relationships (1–5)	-0.969	3.065	0.080	0.379
Communication with friends (1–5)	0.829	2.994	0.084	2.291
Sleep quality (1–5)	-1.288	9.345	0.002	0.276
Positive life changes (1–5)	-0.909	3.727	0.054	0.403
No major problems this year (1–5)	0.708	4.527	0.033	2.030
Constant	2.547	1.182	0.277	12.766

DISCUSSION

The results of this study confirm the importance of several factors influencing medical students' academic performance, consistent with previous research. The primary predictor of high GPA was school performance, supporting findings that emphasize the role of foundational education in later academic achievement (Chan LJ et al., 2022)[9]. High school grades

and participation in educational clubs are predictors of success in higher education, highlighting the need for early identification and support of talented students during secondary education.

Sleep quality was also a significant predictor of GPA, consistent with findings from other studies. For example, Maheshwari G. et al. (2019)[10] found that poor sleep reduced cognitive abilities and academic performance. Similar conclusions were drawn by Gupta S. et al. (2023)[11], emphasizing the role of regular and adequate sleep in learning efficiency. This points to the need for educational and psychological programs focused on improving students' sleep patterns.

A sense of stability and absence of major life difficulties were also identified as important predictors in this study, consistent with findings from Datu JAD et al. (2018) [12], who demonstrated that higher subjective well-being contributes to improved academic performance. These results suggest that supporting students in difficult life situations and fostering a favorable educational environment play a critical role in student success.

Notably, factors like material well-being and social interaction demonstrated borderline significance. This is consistent with Rahman S. (2023)[i3], indicating that socioeconomic conditions may indirectly influence academic performance through individual characteristics. Further research is required to gain a more comprehensive understanding of these relationships.

Other factors such as satisfaction with the educational process and availability of free time have been discussed in prior research. For example, Jian Z. (2022) [13] emphasized that student engagement in the learning process is closely linked to academic performance.Our results confirm this but also highlight the importance of balancing academic workload with rest opportunities, consistent with Alyami A. et al. (2021) [(15-17)].

Thus, this study contributes to the literature by emphasizing a comprehensive approach to studying predictors of academic performance. The findings can inform programs to support students, aiming to enhance their learning experience and achieve better academic outcomes.

CONCLUSION

This study identified key factors influencing the academic performance of medical students. The main predictors of high GPA were school performance, sleep quality, a sense of stability, and satisfaction with the educational process. These findings highlight the importance of both objective and subjective factors in students' academic success.

The results can be applied to improve the educational process and to develop support programs aimed at enhancing students' physical and emotional well-being. Further studies are recommended to examine additional variables and clarify borderline associations. The findings provide a basis for developing recommendations to improve academic success and the learning conditions of medical students at Al-Farabi Kazakh National University (Kazakhstan).

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