

## Association of entrance examination marks with physiology academic performance in medical students

Namrata Upadhayay<sup>1\*</sup>, Rita Khadka<sup>1</sup>, Dhana Ratna Shakya<sup>2</sup> and Bishnu Hari Paudel<sup>1</sup>

<sup>1</sup>Department of Basic and Clinical Physiology, BP Koirala Institute of Health Sciences, Buddha Chowk, Dharan, Nepal and <sup>2</sup>Department of Psychiatry, BP Koirala Institute of Health Sciences, Buddha Chowk, Dharan, Nepal

**Abstract:** *Objective:* To determine the relationship of academic stress with the cognitive function, entrance examination marks, and physiology academic performance in first year medical students (n=83). *Methods:* Cognitive function and degree of stress were assessed in all the participating students. Their entrance examination marks, and internal and annual examination marks on physiology were documented. Spearman correlation was used for data analysis, at significance  $p < 0.05$ . *Results:* The occurrence of emotional disorders in the beginning, middle and end of the year are 33.33%, 28.98%, 14.5%, respectively. The marks obtained in multiple choice questions have positive association with academic (ARS) [ $r=0.27$ ] and intra-and-interpersonal (IPL) [ $r=0.32$ ] related stressors. In addition to ARS [ $r=0.31$ ], and IPL [ $r=0.3$ ] the marks obtained in short answer questions have positive association with teaching-learning-related stressors (TLRS) [ $r=0.3$ ]. Additionally, physiology practical examination marks have positive association with even more stressors; i.e. ARS [ $r=0.34$ ], IPL [ $r=0.32$ ], TLRS [ $r=0.33$ ] and social related stressors [ $r=0.32$ ]. Further, the physiology academic performance have positive association with the entrance examination marks ( $r= 0.76$ ) and cognitive function scores [ $r= 0.4$ ]. *Conclusion:* Students having high cognitive functions and securing high in the entrance examination have moderate to high level of academic, inter- and-intrapersonal and teaching learning related stress on entry to the medical course, which seemed to favor their physiology academic performance.

**Keywords:** Physiology, Cognitive Function, Entrance Examination, Stress.

### Introduction

In Nepal as in many other countries, graduates of twelve standard of science stream are eligible for studying medicine if they score high in competitive entrance examination. Almost all medical schools recruit students based on multiple choice questions (MCQ) entrance examination on physics, chemistry and biology. But there are some differences across the medical schools in terms of their students' recruitment, teaching-learning methods (problem based learning, conventional lectures etc.), examination rules and remedial support, obligation to attend classes and obligation to follow academic dismissal policy on failure in the examinations.

Very few medical colleges have adopted cognitive ability (IQ type of questions) and interview to assess aptitude and attitude for recruiting students. Our institute, BP Koirala Institute of Health Sciences (BPKIHS), recruits students on the basis of MCQ entrance examination score, which includes questions

primarily from physics, chemistry and biology. There are questions on English and health issues as well. And for the teaching-learning method, it has adopted structured interactive session (SIS) in which all the discussion topics are provided to the students, weeks prior to the SIS.

There are many factors and stressors that affect the students' study progress [1] and their stress coping ability in the academic environment [2-5]. Some of them are teaching-learning overload [6], examinations [7], obligation to attend classes, incompetence in the study, lack of emotional support and recreation [8-9] and difficulty in making friends (more of adjustment disorder) [10] etc. The reports from our institute [11] and Vietnam [12] have shown that prevalence of depression is high in the first year medical students. Therefore, the aim of this study was to examine the stressors and stress level of medical students during their first year of

study. We also hypothesized that students securing high in the entrance examination may perform better in physiology. Therefore, we also sought to determine the relationship of physiology academic performance with stressors, entrance examination marks and cognitive function scores of the students.

### Material and Methods

This prospective study was conducted in first year medical students (MBBS) after taking ethical approval from the BPKIHS Institute Ethical Review Board (IERB). The informed written consent was taken from all the participating students. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975. All of the participants were aged between 18 and 28 years. Criteria for selecting the subjects were as follows:

1. Both male and female were included in the study.
2. Students having history of any previous diagnosed mental and or systemic illness were excluded from the study.
3. Students with any drug or substance abuse were excluded from the study.

The initial sample consisted of 98 students of whom 15 did not complete all of the three visits. Some of them failed in the examination so did not respond whereas few of them were sick and could not complete all the visits. The variables assessed were anthropometric (age, height, weight, body mass index), cardio-respiratory (heart rate, respiratory rate, blood pressure), degree of stress and stressors, and cognitive function scores.

The cardio-respiratory variables, degree of stress and stressors of the students were assessed thrice in the first year of their studies. First visit data were recorded after the two months of their enrollment in the medical institute, second visit recording was done after eight months of their study (i.e. six months after the first visit) and the third visit recording was done after their annual examination (i.e. six months after the second visit). The medical student stressor questionnaire (MSSQ) [13] and emotion and other related stressors (EOS) questionnaire [14] were used to assess their stress. The 'psychiatric caseness' was screened with the general health

questionnaire 28 (GHQ28). It indicates possible mental/emotional disorders. It can be scored from 0 to 3 for each response with a total possible score on the ranging 0-84. A total score of 23/24 is a threshold for the presence of psychiatric caseness or mental disorder [15]. And, their presence of distress (emotional disorder) was determined. The data of three visits on cardio-respiratory, and stressors of the students were compared by Wilcoxon Sign Rank test.

Cognitive function score of the students was assessed in the first visit by using standardized questionnaire prepared from: Gamezo and Domashenko, 1986 [16]. The maximum score that can be secured in cognitive function assessment was forty. The reliability coefficient alpha of the cognitive test is 0.69, which was tested as a pilot study in a separate group of the students.

Students' entrance examination marks (basically on physics, chemistry, biology, English, and health) were documented. And, their internal and annual examinations marks on physiology (theory and practical) were also documented. The marks on physiology were documented from the following organ-system blocks (units) that they study in first year: basic concepts, genetics, growth and development, aging, immunity, blood, respiratory, cardiovascular and environmental physiology. In both, either internal or annual examination, there were five theory papers [which include multiple choice (MCQ) and short answer questions (SAQ)] and three practical examinations (which include objective structured practical examination and viva). Therefore, altogether there were ten theory papers and six practical examinations in the first year of their studies. In MCQ, there were single best response, reason assertion, problem based and multiple response type of questions. To maintain the data homogeneity, five theory papers MCQ marks obtained in internal or annual examinations were summed and converted into the percentage. Similarly, five theory papers SAQ marks obtained in internal or annual examinations were also summed and converted into the percentage. Similarly, three practical examinations marks in internal or annual examinations were also

summed and converted into the percentage. The marks obtained in percentage were compared between internal and annual examinations by using Wilcoxon-Sign Rank test.

Spearman correlation was used to find the relationship among cognitive function scores, entrance examination marks, and internal and annual examinations marks of the students. In addition, all internal and annual marks obtained by each student in MCQ were averaged. Similarly, total marks on SAQ and total marks on the practical examination were also averaged separately. Similarly, averaging of first, second and third visit MSSQ scores and that of GHQ28 scores were also done separately. Then; Spearman correlation was applied to find out the relationship among total physiology academic performance (total MCQ, total SAQ and total practical marks), stressors and GHQ28 scores. Data are expressed as median (quartile1-quartile3) or mean ± standard deviation, considering p value significant at ≤0.05.

**Results**

Table 1 displays the anthropometric variables of the students. Table 2 displays cardio-respiratory variables of the students in all the three visits.

Heart rate is significantly different across the visits. Whereas, systolic and diastolic blood pressures are significantly decreased in second and third visits on comparison to first visit.

**Table-1: Anthropometric variables of the medical students, n=83**

Anthropometric variables	Mean ± SD
Age (Years)	20.10 ± 1.77
Height (m)	1.66 ± 0.09
Weight (Kg)	60.47 ± 11.04
BMI (Kg/m <sup>2</sup> )	21.69 ± 2.64

The occurrence of ‘psychiatric caseness, (emotional disorders) as determined by GHQ28 in first, second and third visits were 33.33%, 28.98%, 14.5%, respectively. Academic related stressor and ‘psychiatric caseness’ (assessed by GHQ 28) of the students were significantly different across the visits as shown in Table 3. And, on comparing the stressors (MSSQ scores) of the students from first to third visits, there is a trend of decrease in stress level and stressors, which is also supported by the evidence that cardiovascular variables (HR, SBP, and DBP) values are significantly less on subsequent visits as compared to the first visit (table 2).

**Table-2: Comparison of cardio-respiratory variables of medical students in three visits, n=83**

Cardio-respiratory variables	First visit	Second visit	Third visit	p1	p2	p3
	Mean ± SD	Mean ± SD	Mean ± SD			
Heart Rate	74.43 ± 10.39	68.62 ± 9.496	72.72 ± 9.16	<0.0001	0.002	0.044
Respiratory Rate	18.43 ± 2.63	18.34 ± 3.49	18.22 ± 3.88	NS	NS	NS
Systolic Blood Pressure	117.20 ± 8.66	111.05 ± 9.09	111.93 ± 9.52	<0.0001	NS	<0.0001
Diastolic Blood Pressure	76.19 ± 8.21	73.08 ± 9.17	70.94 ± 9.28	0.027	NS	<0.001

Footnote: p1= p value on comparing first and second visits; p2= p value on comparing second and third visits and p3= p value on comparing first and third visits.

**Table-3: Comparison of students stressors in all the three visits, n=83**

Variables	First visit	Second visits	Third visits	p1	p2	p3
	Median (q1-q3)	Median (q1-q3)	Median (q1- q3)			
ARS	2 (1.6-2.5)	1.66 (1.23-2.07)	1.41 (1.07-1.91)	<0.0001	0.0017	<0.0001
IPL	2 (1.58-2.43)	1.57 (1.14-2.28)	1.43 (1-2.13)	0.0005	NS	0.00014
TLRS	1.6 (1.29-2.1)	1.14 (0.86-1.71)	1.14 (0.71-1.58)	<0.0001	NS	<0.0001
SRS	1.5 (1.17-2)	1.16 (0.83-1.66)	1.16 (0.83-1.66)	0.001	NS	0.0001
DDRS	1 (0.67-1.67)	1 (0.33-1.33)	1 (0.66-1.33)	0.0006	NS	0.00014
GARS	1.5 (1.25-2)	1 (0.75-1.5)	1 (0.75-1.5)	<0.0001	NS	<0.0001
EOS	1.6 (1.1-2)	1.2 (1-1.7)	1.3 (0.9-1.6)	0.0009	NS	0.0002
GHQ 28	18 (12-27)	15 (10.5-23)	13 (8-20)	0.0127	0.039	<0.0001

Footnote: p1: p value on comparing first and second visits; p2: p value on comparing second and third visits and p3: p value on comparing first and third visits. ARS: Academic related stressor, IPL: Intra-and-interpersonal-related stressor, TLRS: Teaching and learning related stressor, SRS: Social related stressor, DDRS: Drive and desire related stressor, GARS: Group activities related stressor, EOS: Emotion and other related stressor.

**Table-4: Comparison of marks obtained by the students in the internal and annual examinations, n=83**

Variables	Internal examination	Annual examination	p value
	Median (q1- q3)	Median (q1- q3)	
Multiple choice questions	71.42 % (60.26-79.017)	69.512% (58.53-80.48)	NS
Short answer questions	63.46 % (53.26-71.346)	71.315 % (63.157-77.36)	<0.0001
Practical examination (OSPE and viva-voice)	65.62 % (51.625-75.062)	70.97 % (63.26-78.33)	<0.0001

On comparing marks obtained in internal and annual examinations, there is no significant difference in multiple choice questions, but students performed short answer questions and practical examination better in the annual examination than in the internal examination as shown in table 4.

The marks obtained by the students in cognitive function assessment out of forty is 25 (20-28) and in the entrance examination out of two hundred they have obtained 152.5 (125-161). There is positive association of cognitive function scores with the entrance, internal and annual examination marks (table 5). Similarly, there is positive association of entrance examination marks with the internal and annual examination marks (table 6).

**Table-5: The relationship of cognitive function score with the internal, annual and entrance examination marks, n=83**

Variables	Cognitive function score	
	Correlation Coefficient (rho)	p
Internal-MCQ	0.351	0.0013
Annual-MCQ	0.39	0.0004
Internal-SAQ	0.433	<0.0001
Annual-SAQ	0.342	0.0018
Internal assessment practical marks	0.47	<0.0001
Annual examination practical marks	0.4	0.0002
Entrance examination marks	0.33	0.003

**Table-6: The relationship of the entrance examination marks with internal and annual examination marks, n=83**

Variables	Examination	Entrance examination marks	
		Correlation coefficient (rho)	p
Multiple choice questions	Internal	0.71	<0.0001
	Annual	0.74	<0.0001
Short answer questions	Internal	0.73	<0.0001
	Annual	0.66	<0.0001
Practical examination marks	Internal	0.72	<0.0001
	Annual	0.76	<0.0001

Table 7 displays the positive association of stressors with academic performance (total MCQ, total SAQ and total practical marks). Where total MCQ, total SAQ and total practical marks were obtained by averaging marks obtained in the internal and annual examination on MCQ, SAQ and practical examination, respectively.

It shows that scores of MCQs and SAQs are positively associated with academic and inter-and-intrapersonal related stressors. In addition, SAQ score is related to teaching learning related stressors too. It also shows that the practical examination is most stressful. The achievement in it is correlated to academic, intra-and-interpersonal, teaching-learning, and social related stressors.

**Table-7: The relationship of the physiology academic performance with stressors and neuropsychological state of the students, n=83**

Variables	Correlation coefficient (r) & p value	ARS	IPL	TLRS	SRS	DDRS	GARS	EOS	GHQ 28 score
Total MCQ marks	r	0.27	0.32	0.23	0.25	0.07	0.11	0.1	0.18
	p	0.049*	0.017*	0.058	0.06	0.6	0.42	0.45	0.17
Total SAQ marks	r	0.31	0.3	0.3	0.17	0.16	0.11	0.051	0.23
	p	0.02*	0.032*	0.035*	0.21	0.21	0.39	0.71	0.085
Total Practical marks	r	0.34	0.32	0.33	0.32	0.15	0.089	0.20	0.31
	p	0.01**	0.018*	0.016*	0.018*	0.27	0.517	0.13	0.02*

Footnote: \*\* p value significant at  $\leq 0.01$  and \* p value significant at  $\leq 0.05$ . ARS: Academic related stressor, IPL: Intra- and-interpersonal-related stressor, TLRS: Teaching and learning related stressor, SRS: Social related stressor, DDRS: Drive and desire related stressor, GARS: Group activities related stressor, EOS: Emotion and other related stressor

### Discussion

Performance in any formal professional education including medicine is associated with many factors. Reports show that medical education is stressful. The medical students face many stressors during their medical course. Therefore, this study was conducted to find out stressors in first year medical students after their recruitment in the MBBS course. In addition, students' physiology academic performance was also documented to find out its relationship with their stressors, entrance examination marks, and cognitive function scores.

In our result, the occurrence of mental/emotional disorders as determined by GHQ28 in first, second and third visits were 33.33%, 28.98%, 14.5%, respectively. In over all, this occurrence is a bit less than in a more intensive study done among medical students of different years at BPKIHS [10], possibly because of its exclusion of already diagnosed subjects. This is in decreasing order as the medical students undergo medical education training in their first year of studies.

This shows that on entry to the medical course (in the first visit) students perceived moderate to high level of stress in inter-and-intrapersonal, teaching-learning and academic- related stressors, as reported earlier [8-9]. However, subsequently in second (in mid-year) and third visit (after the annual examination) there is a decreasing trend in stress level in the above mentioned stressors

(table 3). Other stressors like social, drive and desire, group activities and emotion and other related stressors were of mild to moderate level [17] in the entire year. It seems stress is process oriented. The students are more stressed on entry to the novel field and they have started to cope up with it as their process of learning continued. In addition, the cardiovascular variables (HR, SBP, and DBP) also show that stress is decreased from initial to the end of their first year studies. Gradual decrease in cardiovascular indicators from first visit to third visit indicates that the first visit values do not represent "white coat" effect and is the effect of overall increased stress. Neither there is effect of season on cardio-vascular variable because first and last visits data were in the same season. This is the best evidence from our results to show that they are coping up with their stress on their own even in the absence of formal coping training or counseling.

A comparative study done in the medical students in India has also shown that academic factors and emotional factors were greater source of perceived stress in first year of students [3]. Similar finding was found in a cross-sectional study where first and second year students perceived high level of stress [5]. We have assessed students' stress level and stressors thrice in a year using GHQ28 and MSSQ tools. On comparing among visits i.e. across the entire year, the stress level and

stressors were in a decreasing trend on subsequent months of their studies. It has been supported by a report that the level of stress decreases as they progress in their year of study [18]. It has been also mentioned that the year of the study could be the best predictor of the stress level [6]. Therefore, it is suggested that to draw proper picture about the students stress, their stress level and stressors should be assessed throughout their medical course.

In the annual examination, students have secured significantly high marks in the short answer questions and practical examination as compared to the internal assessments (Table 4). This shows that students study more for the annual examination. As 30% internal assessment marks are added to the annual examination, students should study regularly to secure better marks even in the internal assessments. Or, probably there should be change in the weight of the internal and annual examinations from current system of 30% and 70%, respectively, into 100% marks over a year equally into 3-4 internal assessments.

An interesting finding of our study is that the entrance examination marks has positive association with the cognitive function score, internal and annual examination marks obtained by the students in physiology. Hence, we accept our hypothesis that students securing high in the entrance examination marks (based on physics, chemistry and biology) may reflect their better performance in physiology subject in the first year of their study. It also shows that the selection of the students using MCQ entrance examination format seems to be good at least in terms of performance in physiology. Moreover, the cognitive function scores (similar to IQ) are reliable to reflect their academic performance (table 5). It is worth exploring the relationship between medical entrance examination scores with the performance in all the medical science disciplines.

The result of the study also shows that the practical marks on physiology has significant positive association with the academic, inter-and intrapersonal, teaching-learning and social related stressors. It also has positive association with GHQ28 (neuropsychological state) scores. This shows that practical examinations are most

stressful. In addition, students securing high in MCQ marks are having moderate level of stress in academic and inter-and-intrapersonal- related stressors. The total SAQ marks obtained by the students have positive association with ARS, IPL and TLR stressors. The result seems that optimal level of stress is enhancing their learning [19] and that is helping them to improve their physiology academic performance. The degree of stress did not cross the 'normal' limits. Otherwise, it is known that higher the level of stress and stressors lower is the academic performance [1].

### Conclusion

In medical students the occurrence of stress is high in the beginning of the year. They have moderate to high level of stress on entry to the medical college but later it decreased as study progressed. The practical examinations were the most stressful. The scores of multiple choice and short answer questions were positively correlated with the degree of stresses related to academic load and intra-and-interpersonal-interaction.

This moderate to high level of stress seems and medical entrance examination score is, to favor the students' physiology academic performance. Along with the assessment of their stress level and stressors, if their coping strategy in each and every year during their medical course is assessed then we may be able to draw a better picture of their stress level. This may help to manage their stress level and stressors according to their academic year. It will also help the administration to plan coping or counseling strategy on year basis to improve the students' performance accordingly. To see the effect of medical education training on the brain electrical activity of the first year medical students when they are under moderate to high level of stress, we are planning to assess electroencephalogram in them.

### Acknowledgements

Authors would like to thank Nepal Academy of Science and Technology (NAST) for providing financial support to conduct the study.

## References

- Nudrat S. Stress and Academic Performance among Medical Students. *Journal of the College of Physicians and Surgeons Pakistan* 2013; 23(1):67-71.
- Abouserie R. Sources and levels of stress in relation to locus of control and self esteem in university students. *Educational psychology* 1994; 14(3):323-330.
- Supe AN. A study of stress in medical students at Seth G.S. Medical College. *J Postgrad Med* 1998; 44:1-6.
- Radcliffe C, Lester H. Perceived stress during undergraduate medical training: a qualitative study. *Medical Education* 2003; 37(1):32-38.
- Brahmbhatt KR, Nadeera VP, Prasanna KS, Jayram S. Perceived stress and sources of stress among medical undergraduates in a private medical college in Mangalore, India. *International Journal of Biomedical and Advance Research* 2013; 04 (02):128-136.
- Yusoff MSB, Rahim AFA, Yaacob MJ. Prevalence and Sources of Stress among Universiti Sains Malaysia Medical Students. *Malaysian J Med Sci* 2010; 17(1): 30-37.
- Shah M, Hasan S, Malik S, Sreeramareddy CT. Perceived Stress, Sources and Severity of Stress among medical undergraduates in a Pakistani Medical School. *BMC Med Educ* 2010; 10:2.
- Abraham RR, Zulkifli EMB, Zi Fan ES, Xin GN, Lim JTG. A report on stress among first year students in an Indian medical school. *South East Asian Journal of Medical Education* 2009; 3(2):78-81.
- Sreeramareddy CT, Shankar PR, Binu VS, Mukhopadhyay C, Ray B, Menezes RG. Psychological morbidity, sources of stress and coping strategies among undergraduate medical students of Nepal. *BMC Med Edu* 2007; 7:26.
- Shakya DR, Shangwa PM, Shakya R, Agrawal CS. Mental and behavioral problems in medical students of a health institute in eastern Nepal. *Asian J of Psychiatric* 2011; 4(1):S61.
- Basnet B, Jaiswal M, Adhikari B, Shyangwa PM. Depression among undergraduate medical students. *Kathmandu Univ med J* 2012; 39(3):56-59.
- Dinh Do Q. Depression and stress among the first year medical students in university of medicine and pharmacy Hochiminh city, Vietnam (thesis). 2007; 1-72.
- Yusoff MSB, Rahim AFA and Yaacob MJ. The development and validity of the Medical Student Stressor Questionnaire (MSSQ). *ASEAN Journal of Psychiatry* 2010; 11 (1). Available from: <http://www.aseanjournalofpsychiatry.org/oe11105.htm>.
- Upadhayay N, Khadka R, Paudel BH. Impact of educational stress on cortisol, cardiac autonomic drive and academic performance of medical students. *Asian Journal of Medical Sciences* 2014; 5(4):73-78.
- General health questionnaire-28 (GHQ-28) Michele Sterling, The University of Queensland, Australia, *Journal of Physiotherapy*, 2011; 57:259.
- Gamezo MV and Domashenko IA. Atlas of Psychology. *Moskva Prosveshcheniye* 1986; 24-42.
- Habeeb KA. Prevalence of Stressors among Female Medical Students Taibah University. *J T U Med Sc* 2010; 5(2):110-119.
- Sani M, Mahfouz MS, Bani I, Alsomily AH, Alagi D, Alsomily NY, Madkhaly FM, Madkhali R, Hakami AAM, Hakami A, Shaqraa Shaabi, Al Ebrahim S, Mashiakhi SH, Ageel B, Asiri S. Prevalence of stress among medical students in Jizan University, Kingdom of Saudi Arabia. *Gulf Medical Journal* 2012; 1(1):19-25.
- Kaplan HI, Saddock BJ. Learning Theory. In: Synopsis of Psychiatry: Behavioral Sciences/ClinicalPsychiatry. 8th ed. Philadelphia: Lippincott Williams & Wilkins. 2000; 148-154.

\*All correspondences to: Namrata Upadhayay, PhD student, Department of Basic and Clinical Physiology, BP Koirala Institute of Health Sciences, Buddha Chowk, Dharan, Nepal. E-mail: namrataupadhayay@gmail.com