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RESEARCH ARTICLE

EVALUATION OF METACOGNITION LEVELS IN UNDERGRADUATE MEDICAL STUDENTS AND ITS CORRELATION WITH ACADEMIC PERFORMANCE, YEAR OF STUDY, STUDENT'S ACADEMIC BACKGROUND AND GENDER

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ABSTRACT

Introduction: John Flavell in mid-1970s defined Metacognition as thinking about one's own thinking and its regulation. Then in 1985 he further explained that one's metacognitive base comprises what one has learned through various cognitive experiences. Over the past four decades, a considerable amount of work has been done in this field with quite a lot of literature published on the construct of Metacognition. No study has yet been done on evaluation of Metacognition levels among undergraduate medical students in Pakistan.

Aim: The objectives of this study are to: Identify the Metacognition levels of undergraduate medical students in Pakistan; demonstrate the effect of Metacognition levels on academic performance; demonstrate difference in Metacognition levels in 1st year and 2nd year MBBS students with A levels and FSc background and finally to demonstrate the effect of gender on Metacognitive levels.

Methods: A cross sectional study was conducted on 186 undergraduate MBBS (first year and second year) students of UCMD, Lahore. A structured Metacognitive Awareness Inventory (MAI) tool was used.

Results: The results indicate that medical students have high metacognitive levels. Students having better Metacognition have shown significantly better academic performance as compared to those having low Metacognition levels. There is a significant impact of background of study and male gender on Metacognition levels but academic performance is not effected by these two factors. No significant difference was found in Metacognition levels of 1st and 2nd year students due to a small age gap in selected sample population.

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INTRODUCTION

Metacognition is defined most simply as "thinking about thinking" (Livingston, 2003). Metacognition has two components: knowledge and regulation. Metacognitive knowledge component includes knowledge about oneself as a learner and factors that affect performance, knowledge about strategies and when and why to use these techniques (Schraw et al., 1995). Metacognitive regulation is the monitoring of one's knowledge and includes planning of activities, perception of comprehension and task fulfillment, and appraisal of the efficacy of monitoring processes and strategies (Pappleton-louca, 2003). Hartman stressed on the fact that Metacognition is the key to effective learning as metacognitively aware individuals are

competent enough to manage their cognitive skills and also recognize their shortcomings (Hartman, 2001). A number of studies have been carried out which show a strong relationship between Metacognition levels and academic performance(Ford et al., 1998, Garofalo et al., 1985, Bandura et al., 1996, Bouffard et al., 1995). In 1994, Schraw and Dennison developed a 52 item Metacognitive Awareness Inventory (MAI) to measure two main domains of Metacognition, knowledge about cognition and regulation of cognition(Schraw et al., 1994). This inventory has been found to be valid and reliable enough to be used to evaluate Metacognition levels both in students and teachers. Many studies have used MAI as a valid tool to assess metacognitive levels (Mokhtari, 2002, Young et al., 2012, Sperling et al., 2002). Our study can be very useful for both the students as awareness and regulation of cognition can increase success rate of medical students. Also it will help to improve teaching/learning strategies according to international standards.

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MATERIALS AND METHODS

This was a cross-sectional study. Sample size was calculated by using epi info version 7 which came out to be 186. Simple random sampling, a type of probability sampling was used in this study. For maintaining internal validity, study population was not told about the final conclusion of the study as it might effect their results. This study was conducted at UCMD, Lahore. A structured data collection tool Metacognitive Assessment Inventory (MAI) developed by Gregory Schraw and Rayne Sperling Dennison was adopted and used in this study after taking author's consent (Schraw *et al.*, 1994). Cronbach coefficient alpha was calculated to assess the internal consistency aspect of reliability of the instrument which came out to be 0.910 which is close to 1. So our data is highly reliable and can be used for further analysis. Response forms from students were coded. Then data was entered in SPSS 21. For comparison of student population in 1st and 2nd year, a descriptive analysis was carried out. For finding a relationship, Metacognitive score was taken as independent variable while academic performance was the dependent variable.

RESULTS

Metacognition levels of undergraduate medical students

Table 1 has the joint information about the knowledge, regulation and Metacognition score. Knowledge score was computed by adding its three dimensions and regulation score by using its main dimensions. Similarly Metacognition is a concept which was mainly measured through these two sub concepts: knowledge and regulation. Metacognition score was calculated by adding these two scores.

Knowledge score was computed by adding 17 questions related to different dimensions of knowledge of cognition. Its descriptive statistics has shown that it has mean of 65.44 with standard deviation of 8.63 which means sample of this study has more than moderate level of knowledge about cognition. Basically we have range of this concept as 17-85 questions were measured by scaling (1-5). So for this concept they got on average 65 score which was close to upper limit of range. So we can say that students have sufficient knowledge about cognition. Similarly regulation score also show the same pattern and interpretation of results. Metacognition was computed by adding these two score so its score was also showed that students of MBBS had high level of Metacognition.

Correlation of academic performance and Metacognition level

Metacognition, its dimensions and its relationship with evaluation or performance score was assessed. Knowledge score has positive correlation with performance or evaluation score. Correlation value is 0.587 with p-value is 0.000. Correlation value has **, it shows that correlation is highly significant or it is significant at 0.01 level of significance. Here positive correlation means if a student has high cognition knowledge score he/she has high evaluation or good performance score and vice versa. Similarly evaluation has high positive correlation with regulation score as compared to knowledge score. Because regulation score has value of correlation, 0.706 and p-value 0.000. Again this correlation value is significant at 0.01 level of significance. Metacognition score is made up of both (knowledge and regulation score) so it also has high correlation with performance or evaluation score.

Table 1. Description of Knowledge, Regulation and Metacognition

		Knowledge Score	Regulation Score	Metacognition Score
N		186	186	186
Mean		65.4409	111.6828	177.1237
Median		66.0000	113.0000	180.0000
Std. Deviation		8.63552	13.90203	21.01353
Variance		74.572	193.266	441.568
Range		49.00	88.00	133.00
Minimum		34.00	53.00	87.00
Maximum		83.00	141.00	220.00
Percentiles	25	61.0000	102.0000	163.0000
	50	66.0000	113.0000	180.0000
	75	71.0000	122.0000	192.0000

Table 2. Correlations

		Evaluation	Knowledge Score	Regulation Score	Metacognition Score
Evaluation	Pearson Correlation	1	.587**	.706**	.708**
	Sig. (2-tailed)		.000	.000	.000
	N	186	186	186	186
Knowledge Score	Pearson Correlation	.587**	1	.724**	.890**
	Sig. (2-tailed)	.000		.000	.000
	N	186	186	186	186
Regulation Score	Pearson Correlation	.706**	.724**	1	.959**
	Sig. (2-tailed)	.000	.000		.000
	N	186	186	186	186
Metacognition Score	Pearson Correlation	.708**	.890**	.959**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	186	186	186	186

**. Correlation is significant at the 0.01 level (2-tailed).

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Overall we can say that if a student has high Metacognition score then there are chances of good performance or evaluation score for a student. Knowledge and regulation score also has strong correlation with Metacognition score. Table 2

Mean comparison of Metacognition, Knowledge and Regulation between 1st year and 2nd year medical students

We made a comparison between 1st and 2nd year students on the basis of Metacognition score and its dimensions. For making a comparison, independent sample t-test was used. Table 3 has the descriptive portion regarding these three compared variables. Metacognition score mean showed that first year students have more score as compared to second year. Knowledge score has no difference in the first and second year students. But regulation score has some difference as 1st year student have more average score as compared to 2nd year students. But as a researcher we have to believe on p-values as compared to descriptive statistics.

insignificant. Because there is only difference of 1.774 in mean scores which can be neglected and statistically insignificant. So we can say that there is no difference between 1st and 2nd year students according to Metacognition score Table 4.

Comparison of Metacognition and evaluation score according to background of study

Next comparison which we have in our study is on the basis of academic background. This research showed that students who have A Level background have more metacognitive abilities and score as compared to who have done FSc in their past. But on the other side their evaluation score are almost same Table 5. Results of independent sample t-test have shown that students of A-Level background have high level of Metacognition score as compared to other group of students. These results have got significant p-value of (0.037) which is significantly less than 0.05.

Table 3. Group Statistics

	Study Year	N	Mean	Std. Deviation	Std. Error Mean
Metacognition Score	1st Year	9	178.01	19.38931	2.01058
		3	08		
Knowledge Score	1st Year	9	176.23	22.59203	2.34268
		3	66		
Regulation Score	1st Year	9	65.344	8.88268	.92109
		3	1		
	2nd Year	9	65.537	8.42816	.87396
		3	6		
	1st Year	9	112.66	12.29646	1.27508
		3	67		
	2nd Year	9	110.69	15.34515	1.59122
		3	89		

Table 4. Independent Samples Test

	t-test	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Metacognition Score	.575	184	.566	1.77419	3.08717
	.575	179.861	.566	1.77419	3.08717
Knowledge Score	-.152	184	.879	-.19355	1.26973
	-.152	183.495	.879	-.19355	1.26973
Regulation Score	.965	184	.336	1.96774	2.03907
	.965	175.657	.336	1.96774	2.03907

Table 5. Group Statistics

	Study Background	N	Mean	Std. Deviation	Std. Error Mean
Metacognition Score	FSc	167	170.0108	15.38931	2.01058
	A-Level	19	182.2366	22.59203	2.34268
Evaluation Score	FSc	167	23.1935	3.21768	.33366
	A-Level	19	23.0538	4.00099	.41488

Table 6. Independent Samples Test

t-test for Equality of Means					
	t-test	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Metacognition Score	2.38	184	0.037	12.024	2.08717
	2.21	179.861	0.041	12.024	2.08717
Evaluation	1.17	184	0.479	0.145	1.26973
	1.31	183.495	0.457	0.145	1.26973

Like in Metacognition score, t-statistic is 0.575 and p-value is 0.566 which shows that the difference between first year and second year students with respect to metacognition score was

insignificant. Because there is only difference of 1.774 in mean scores which can be neglected and statistically insignificant. So we can say that there is no difference between 1st and 2nd year students according to Metacognition score Table 4.

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	2.21	179.861	0.041	12.024	2.08717
Evaluation	1.17	184	0.479	0.145	1.26973
	1.31	183.495	0.457	0.145	1.26973

But both groups have same performance in their evaluation score. Because results are insignificant here, it means both groups show same performance Table 6.

Table 7. Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Metacognition Score	Male	97	180.0108	15.38931	2.01058
	Female	89	170.2366	22.59203	2.34268
Evaluation Score	Male	97	23.1935	3.21768	.33366
	Female	89	22.0538	4.00099	.41488

Table 8. Independent Samples Test

t-test for Equality of Means					
	t-test	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Metacognition Score	1.98	184	0.047	9.7824	3.08717
	1.97	179.861	0.049	9.7824	3.08717
Evaluation	1.07	184	0.479	1.1575	1.26973
	1.11	183.495	0.457	1.1575	1.26973

Comparison of Metacognition and evaluation score according to Gender

An effort was made to find out the effect of gender on Metacognition score and evaluation. Descriptive statistics showed that males have more Metacognition score and perform better than females Table 7.

Independent sample t-test showed that males have more Metacognition score as compared to females. These results are significant at 0.05 level because p-value (0.047) is less than 0.05. But on the other side evaluation score are slightly higher in males but not significantly different from females Table 8.

DISCUSSION

By using Metacognition Awareness Inventory (MAI), we found that students who participated in this study have high level of Metacognition score. A study conducted in 2010 concluded similar type of findings in medical university students that they have more than moderate level of Metacognition score due to their learning styles and academic achievements (Turan *et al.*, 2010). Correlation analysis in this study clearly indicates that students having high Metacognition score show better academic performance and achieve high evaluation score and vice versa. This correlation is also proved in some other studies done worldwide (Peklaj *et al.*, 2002, Sternberg., 1998, Vrugt., 2008). These studies also proved that Metacognition score and its dimensions are correlated with each other and evaluation score of students. Certain studies have concluded that if one wants to improve the evaluation score or academic performance, certain measures need to be adopted to enhance the level of Metacognition in the students. (Pintrich., 1990, Zimmerman., 1989, Wolters., 1999) In our study similar type of conclusion can be drawn on the basis of Regression analysis.

The results of this study have shown that Metacognition, knowledge and regulation score have equal averages in 1st year and 2nd year medical students. There might be many reasons behind these findings. Previous researches have shown that age has significant impact on the level of Metacognition (Veenman *et al.*, 2005). Our study participants belonged to almost the same age group, with a difference of 1 year in both compared groups.

So this age difference did not create a significant difference in Metacognition levels. A-Level students have more score on Metacognition as compared to F.Sc students because A-Level students have their curriculum which is very different in nature as compared to F.Sc curriculum. A-Level syllabus has more practical, general and analytical knowledge based as compared to F.Sc students. This practice has developed more metacognitive abilities in them, so the study results indicate that they have more Metacognition score as compared to F.Sc students. Current study findings also have shown that Metacognition score varies in males and female. Males have more metacognitive abilities and score as compared to females (Carr *et al.*, 1997).

Conclusion

Metacognitive evaluation is a very useful tool for both teachers and students for effective teaching/learning process. It is clear from the results of current study that students who are aware of their learning process and its effective regulation can produce better results as compared to their peers who have lower Metacognition levels. Also male students showed better Metacognition as compared to females due to their better exposure and interaction with the changing world trends. Student's academic background effects their Metacognition as those who did A-levels had a better understanding of their learning process and its regulation. Hence, with the advent of Medical Education, it is imperative to impart knowledge in an effective manner to facilitate and enhance Metacognition among students. Teachers should be aware about the strategies and practices in the class room environment which prove helpful in enhancing the Metacognition levels of students, hence enabling them to achieve high aims in their lives.

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