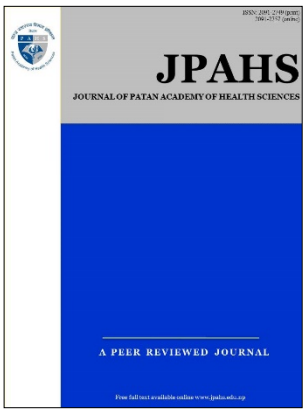

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Validation of mental agility test and personal qualities assessment tools for selecting medical students in Nepal

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Abstract

Introduction: Patan Academy of Health Sciences (PAHS) decided to test mental agility and personal qualities to select undergraduate medical students, different than the conventional approaches used to test for physics, chemistry, and biology contents in other universities in Nepal.

Method: Personal Qualities Assessment (PQA) test batteries used to select medical students in twelve different countries were pilot tested with 10+2 non-sciences, 10+2 science, and 10+3 health science students. The PQA tools were forward translated into Nepali and back-translated in English by bilingual experts independently. The face and content validity of these tools in the Nepali language was established through discussions and consensus with the PAHS admission team and PQA team in Australia.

Result: The PQA tools assessing non-cognitive qualities in the Nepali language were found to be internally consistent in the first pre-test with science and non-science students. PQA tool assessing mental agility in the English language showed acceptable internal consistency in the second pre-test with science and health science students.

Conclusion: Mental agility test in the English language was found to be a suitable cognitive test for selecting medical students. Non-cognitive tests in the Nepali language were found to be reliable and valid to identify applicants with unusual personal traits, leading to deselection. These tests can be considered for selecting undergraduate medical students.

Keywords: cognitive, mental agility test- MAT, Nepal, non-cognitive, Patan Academy of Health Sciences- PAHS, personal qualities assessment- PQA

Introduction

Most medical schools across the globe use academic achievement as the primary selection criteria for admission into medical school.[1] This also applies to all medical schools in Nepal where entrance examinations conducted by the universities or Academies are based on general science subjects.[2,3] However, academic achievement alone as the predictor of someone becoming a 'good' physician has been questioned by many.[3-8] Certainly, personal qualities play an immense role in medical practice, which in itself is a complex phenomenon.[9-10]

Patan Academy of Health Sciences (PAHS) is an autonomous, health sciences institute established in 2008 in Nepal with a mandate to improve the health of people in rural Nepal by producing health professionals who were competent, compassionate, and willing to serve in rural Nepal. It was clear from the outset that academic attainment alone among the aspirants for medical school was not going to be enough as admission criteria for the School of Medicine of PAHS. Further, PAHS also determined the desired characteristics/attributes of its graduates involving all the stakeholders *a priori.*[11]

In this respect, a psychometric test battery (Personal Qualities Assessment, PQA[9-10]) and an Admission OSCE[12-13] procedures were explored to see if they could be used to select medical students for PAHS. This paper reports the validation of the PQA test battery using science and health sciences students as they represented the majority of prospective applicants for the PAHS undergraduate medical education program commonly known as Bachelor in Medicine and Bachelor in Surgery (MBBS) in Nepal/South Asia, as well as non-science students of public/community schools.[14]

Method

The Personal Qualities Assessment (PQA) test battery is used commercially to select health science students in many countries around the world (http://www.pqa.net.au/research.html) and found to be valid, reliable and predictive across different population.[9-10] The PQA test battery tests the cognitive ability through PQA Test A1 or Mental Agility Test (MAT) and a range of non-cognitive qualities though PQA Test A2 (Moral Orientation for Justice and Care: MOJAC) and PQA Test A3 (Empathy, Confidence, Aloofness and Narcissism: ECAN).[15] PAHS, Nepal and PQA Innovation, Australia collaborated to locally validate and use PQA test for selecting medical students of School of Medicine, PAHS in early 2008. PAHS conducted the pilot tests of PQA test batteries using Optical Mark Reader (OMR) sheets, scanned them, created raw file and, sent it as secured spreadsheet file to PQA team after the test. The PQA team then scored the tests using pre-defined keys and rules and, send them back as secured spreadsheet and report files to PAHS for further processing.

In order to validate the PQA tools in local context, they were forward-translated to Nepali by a professional bilingual person and was back-translated to English by another bilingual professional under the aegis of PAHS Admission team formed in 2008. The original PQA and back-translated PQA tools were then discussed iteratively among PAHS Admission and PQA teams before finalizing the Nepali version with consensus.

The Personal Qualities Assessment tests in Nepali language was pretested with volunteer 10+2 non-science students of public/community schools located inside (n=75) and outside of Kathmandu valley (n=95) and volunteer 10+2 science students of a public school located outskirts of Kathmandu (n=35). As per PQA norm, only the volunteer students completing 80% and above items on Test A2 and Test A3 were included in the final analysis, whereas data of all the volunteer students on Test A1 was included in the final analysis. These tests were scored using the pre-defined keys and rules in Australia by the PQA team. Ethical approval was obtained from the Institutional Review Committee of PAHS (Ref: phs2204081608).

The Personal Qualities Assessment Test A1 (48 items with complex verbal, numerical, spatial, and abstract reasoning) and PQA Test A4 (90 items with simple verbal, numerical, spatial, and abstract reasoning) in English and Nepali languages were trailed again with the larger pool of volunteer 10+2 science students (n=131) of two community colleges and 10+3 health science students (n=56) of a Government College, both located outside of Kathmandu valley. Descriptive statistics were used to describe the test scores whereas the t-test was used to compare the test scores between groups. A p-value less than 0.05 was taken as a statistically significant result.

Result

The Personal Qualities Assessment tests in Nepali were pre-tested first with 205 (110 males and 95 females) 10+2 non-science students in 2008, and Test A1 and Test A4 in English and Nepali were pre-tested again with 187(141 males and 46 females) 10+2 science and 10+3 health science students in 2009. The mean±standard deviation (range) of students' age (in years) in the first and second samples were 20.3±1.3 (17-24) and 18.5±3.4 (15-42).

The cognitive ability test (PQA Test A1/MAT) had lower mean±SD scores 15.3±3.7 than the norm 27.6±5.6 (multinational pool of 1187 applicants to medical schools). The range revealed the minimum and maximum scores as 7 and 25 with a median of 15. The internal consistency reliability coefficient (Cronbach's Alpha) was very low (0.27) for the first pre-test samples.

On the other hand, the non-cognitive personality tests had comparable mean±SD scores of 109.4±13.9 for Test A2 and 259.5± 20.1 for Test A3 with the multinational norms. Most importantly, the Coefficient alpha or the internal consistency reliability of Test A2 and Test A3 were greater than 0.80 (higher than the minimum value of 0.70) for both the tests. Further, a significant and low degree of negative correlation (r=-0.153, p=0.028) was found between Test A1 and Test A3 whereas a non-significant low negative correlation was observed between Test A1 and Test A2 (r=-0.125, p=0.074). As Personal Qualities Assessment Test A1/MAT score in Pre-Test I followed a normal distribution (Shapiro-Wilk=0.987, p-value=0.068) and both science and non-science groups had equal variance (Levene's F=0.421, p-value=0.517), independent samples t-test was used to compare Test A1 score between science and non-science students, Table 2. Test A1 scores were found to be higher for science students and the result was highly significant statistically (t-test=-3.963, p-value<0.0001). The scatterplot of the standardized scores (z-scores) of Test A2/MOJAC and Test A3/ECAN in Nepal language from non-science students shows that most of these students' LibCom (total of MOJAC) and ECAN z-scores lie between -2 and +2 SD and few students' scores were outside of this range, Figure 1.

PAHS Admission committee conducted the second Pre-Test of Test A1 and Test A4 in Nepali and English languages with the large (187) volunteer 10+2 science students and 10+3 health science students in public school/college outside of Kathmandu valley as Nepali Test A1 results were not promising with the non-science and the science students. The Mental Agility Test (Test A1) had lower mean±SD scores for English 18.4±5.0 language and Nepali 16.8±4.3 language than the multinational norm of 27.6±5.6. Yet, Test A1 in the English language's mean score of 18.4 was different from Test A1 in Nepali's mean score of 16.8, which was also statistically significant (t=2.3348, p-value=0.0206). Although the mean of Test A1 in the English language (18.4) done in 2009 was found to be higher than Test A1 in the Nepali language (17.51) for the 10+2 science students in 2008, they were not significantly different (t=0.9769, p-value=0.3304), Table 2 & 3. The internal consistency reliability (coefficient alpha), a proxy for construct validity, was found to be 0.63 for Test A1 in the English language and 0.49 for the Nepali language for the second pre-test samples. On the other hand, the mean percentage score of the General Ability Test (Test A4) in English language and Nepali

language were 50.0 and 47.6 respectively, which was higher than the mean percentage score of Test A1 in the English language (38.3) and Nepali language (35.0). The mean percentage scores were statistically different for English and Nepali versions of Test A4 (t=2.310, p-value=0.022) but it was not statistically different for English and Nepali versions of Test A1 (t=1.367, p-value=0.171). Further analysis of Test A1 and Test A4 scores in English and Nepali languages with the sex of the applicants was not found to be statistically different. However, Test A1 and Test A4 showed statistically significant negative correlations with the age of the students for English (r=-0.226, p-value=0.025; r=-0.395, p-value<0.001) and Nepali (r=-0.261, p-value=0.011; r=-0.211, p-value=0.047) languages.

The Test A1 (English language) scores for 10+3 health science students and 10+2 science students were not significantly different but Test A4 (English language) scores for 10+3 health science students and 10+2 science students were statistically different in the second pre-test, Table 4.

Table 1. Personal qualities assessment pre-test I with non-science major students, 2008, Nepal

Test (Language)	Nepali candidates						International candidates		
	N	Mean	SD	Median	Range	Alpha	N	Mean	SD
Test A1-NEPALI	205	15.3	3.7	15.0	7 – 25	0.27	1811	27.6	5.6
Test A2-NEPALI	205	109.4	13.9	108.0	79 – 147	0.82	9762	116.0	15.3
Test A3-NEPALI	205	259.6	20.1	259.0	216 – 320	0.81	7032	283.0	22.8

Table 2. Test A1 (Nepali) score of 10+2 science and non-science students, 2008

Stream	N	Mean	SD	Median	Min	Max	t	p-value
Non-sciences – NEPALI (48 items)	170	14.87	3.643	15.00	7	24		
Science – NEPALI (48 items)	35	17.51	3.338	17.00	12	25	3.963	<0.0001
Total	205	15.32	3.721	15.00	7	25		

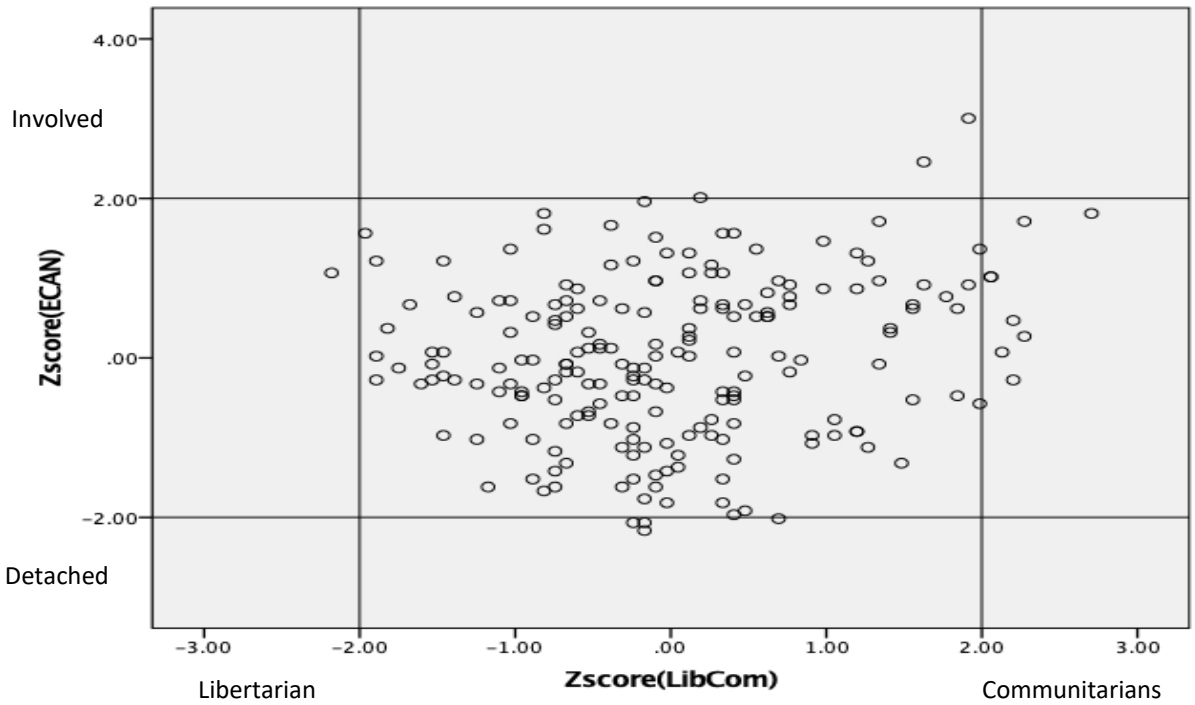

Figure 1. Scatter plot of Z-scores of test A2 and test A3, pre-test I, 2008, Nepal

Table 3. Personal qualities assessment pre-test II with science and health science students, 2009, Nepal

Test (Language)	Nepali candidates						International candidates		
	N	Mean	SD	Median	Range	Alpha	N	Mean	SD
Test A1-ENGLISH (48 items)	98	18.4	5.0	18.0	8 – 30	0.63	1811	27.6	5.6
Test A1-NEPALI (48 items)	89	16.8	4.3	17.0	8 – 25	0.49			NA
Test A4-ENGLISH (90 items)	98	45.0	11.3	44.5	18 – 77	0.88			NA
Test A4-NEPALI (90 items)	89	42.8	10.1	43.0	12 – 60	NA			NA

NA=Not Available

Table 4. Comparison of mental agility test (test A1) and general ability test (test A4) (English version) scores among science and health sciences students, pre-test II, 2009, Nepal

Test and Stream (Test: Discipline)	**Nepal Candidates**							
	N	Mean	SD	SEM	Median	Range	T	p-value
Test A1-ENGLISH: 10+3 Health Sciences	56	18.3	4.5	0.61	17.0	12 – 29	0.342	0.772
Test A1-ENGLISH: 10+2 Sciences	42	18.6	5.6	0.87	18.5	8 – 30		
Test A4-ENGLISH: 10+3 Health Sciences	56	41.77	9.3	1.25	42.5	18 – 60	3.292	0.002
Test A4-ENGLISH: 10+2 Sciences	42	49.24	12.3	1.90	51.5	24 – 77		

SEM = Standard error of the measurement

Discussion

The MAT (Test A1) score was found to be lower than the international norms for both 10+2 science as well as non-science students, which suggests unfamiliarity with this form of test, differences in schooling, general cultural differences in approach to tests, etc. among these public/community school students. As the Test A1 questions were based on complex verbal, numerical, spatial, and abstract reasoning dimensions, it suggests that higher school students of Nepal require more exposure and practice on these types of aptitude tests as they are used widely to select students, screen recruits for military/police forces, and test job applicants.[16,17]

The MAT (Test A1) in Nepali language scores were found to be significantly higher among higher secondary level science students compared to non-science students, possibly due to mathematical intuition leading to plausible numerical and abstract reasoning as part of their courses rather than higher verbal and spatial reasoning abilities. The MAT in the Nepali language had a low internal consistency reliability coefficient in the first pre-test, indicating that the different types of items i.e., verbal, numerical, spatial, and abstract reasoning items included in the test were of differing difficulties for this group, who may have guessed many of their answers. Also, possibly the volunteers felt that since their future was not at stake, they did not feel the need to fully exercise their intellectual ability in answering the questions, as most of them (170 out of 205) were non-science students. It may also be true that Test A1 in the Nepali language is not a suitable cognitive ability test for the 10+2 science as well as 10+2 non-science students.

On the other hand, MOJAC (Test A2) and NACE (Test A3) scores in Pre-Test I were similar to the international norm and had very high internal construct reliability (>0.80) suggesting they are satisfactory tests for Nepali applicants at 10+2 level or equivalent in both science and non-science streams. These tests could be used to deselect outliers, i.e., students with potential behavior problems where outliers were

defined statistically as below -2 SD and above +2 SD for the standardized total MOJAC (LibCom) and ECAN scores.[15]

Tests A2 and Test A3 had small negative but statistically insignificant correlations with Test A1, showing that they measured different traits (Test A1 measuring cognitive abilities and Test A2 and A3 measure non-cognitive traits) and thus are both potentially useful for selecting students for all the undergraduate level health-related programs in Nepal. Ironically, the small negative correlation further indicates that there is a slight tendency for those who are stronger in cognitive skills to be weaker in interpersonal skills, but there were still a substantial proportion of applicants who are strong in both.

During the second pre-test done to check the consistency of the first pre-test results, Test A1 in Nepali was again found to have a slightly low internal reliability coefficient (Alpha < 0.50) for a larger pool of n=89 of volunteer science and health science students whereas the original MAT/Test A1 in the English language had a slightly more acceptable internal construct reliability (Alpha>0.60) for n=98 volunteer science and health science students. This result is similar to 2003 Scottish medical school applicants[10] though it is lower than the PQA international norm student sample average of 0.73.[15] Coefficient alpha of 0.60 and above is considered good and 0.70 and above is considered very good for tests with complex items i.e., MAT (Test A1) in the English language used in Nepal.[18]

Further, Test A4 in the English language showed statistically different and higher results for science and health sciences students compared to Test A4 in the Nepali language whereas Test A1 in the English language showed higher but statistically insignificant results compared to Test A1 in the Nepali language. So, Test A4 containing simple verbal, numerical, spatial, and abstract reasoning items is found to be easy whereas Test A1 containing complex verbal, numerical, spatial, and abstract reasoning items is found to be difficult for both groups of students, Figure 1.

When the Test A1 and Test A4 test scores in the English language were analyzed separately for the science and health science students, Test A1 scores were not found to be statistically different indicating a fair test to select undergraduate medical students compared to Test A4 which produced a statistically different score. Thus, MAT (Test A1) in the English version was chosen to select MBBS students of the School of Medicine, Patan Academy of Health Sciences as it had sufficient internal consistency reliability and was fair to both science and health science students, despite being a bit difficult test of verbal, numerical, spatial and abstract reasoning aptitude required for the course. Recent studies confirmed the predictive validity of PQA tests among medical students in the UK, which remains to be done at PAHS.[18-20]

Conclusion

The MAT (PQA Test A1) in English was found to be a reliable test to select medical students for PAHS and similar institutions in Nepal as it was also found to be fair among 10+2 science/10+3 health science students. Also, PQA Test A2 and Test A3 in Nepali were found to be fair and reliable tests to identify unusual personality traits and to deselect such candidates for all the undergraduate level health science programs in Nepal and beyond.

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Conflict of Interest

None

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Author Contribution

Concept, design, planning: SB, RNG; Literature review: SB; Data collection: SB, KPB, RNG; Data analysis: SB, Draft manuscript: SB; Revision of draft: KPB, RNG; Final manuscript: SB, KPB, RNG; Accountability of the work: SB, KPB, RNG.

Reference

1. Patterson F, Knight A, Dowell J, Nicholson S, Cousans F, Cleland J. How effective are selection methods in medical education? A systematic review. Med Educ. 2016 Jan;50(1):36-60. | DOI | PubMed | Google Scholar | Weblink |
2. Maharjan S, Dixit H. MBBS student selection: search for proper criteria. Kathmandu Univ Med J (KUMJ). 2003;2(3):252-259. | PubMed | Google Scholar | Full Text | Weblink |
3. Niraula SR, Khanal SS. Critical Analysis of Performance of Medical Students. Educ Health (Abingdon). 2006;19(1):5-13. | DOI | PubMed | Google Scholar | Full Text | Weblink |
4. McManus C, Powis D. Testing medical school selection tests. Med J Aust. 2007;186(3):118. | DOI | PubMed | Google Scholar | Full Text | Weblink |
5. Sanson-Fisher RW, Williams N, Outram S. Health inequities: the need for action by schools of medicine. Med Teach. 2008;30:389-94. | DOI | PubMed | Google Scholar |Weblink |
6. Powis D. Selecting medical students. Med Educ. 1994;28:443-69. | DOI | PubMed | Google Scholar | Weblink |
7. Powis D. How to do it: select medical students. BMJ. 1998;317:1149-50. | DOI | PubMed | Google Scholar | Full Text | Weblink |
8. Powis D, Hamilton J, McManus IC. Widening access by changing the criteria for selecting medical students. Teaching Teach Educ. 2007;23:1235-45. | DOI | Google Scholar | Weblink |
9. Powis D, Bore M, Munro D, Lumsden MA. Development of the personal qualities assessment as a tool for selecting medical students. J Adult Continuing Education. 2005;11(1):3-14. | DOI | Google Scholar | Weblink |
10. Lumsden MA, Bore M, Millar K, Jack R, Powis D. Assessment of personal qualities in relation to medical school. Med Educ. 2005;39:258-65. | DOI | PubMed | Google Scholar | Weblink |
11. Morgan JHC. Designing an assessment tool for professional attributes of medical graduates from a new medical school in Nepal. SEAJME. 2009;3(1):2-7. | Google Scholar | Full Text |
12. Powis D, Neame RLB, Bristow T, Murphy LB. The objective structured interview for medical student selection. BMJ. 1988;296:765-8. | DOI | PubMed | Google Scholar | Full Text | Weblink |
13. Eva KW, Rosenfield J, Reiter HI, Norman GR. An admissions OSCE: the multiple mini-interview. Med Educ. 2004;38:314-26. | DOI | PubMed | Google Scholar| Weblink |
14. Salvatori P. Reliability and validity of admissions tools used to select students for the health professions. Adv Health Sci Educ. 2001;6(2):159-75. | DOI | PubMed | Google Scholar | Weblink |
15. Bore M, Munro D, Powis D. A comprehensive model for the selection of medical students. Med Teach. 2009;31(12):1066-72. | DOI | PubMed | Google Scholar | Weblink |
16. Batool M, Dahar MA, Ali MI. Role of public and private schools in developing of IQ among elementary students. IJSER. 2017;8(2):248-62. | Weblink | Full Text |
17. Schmitt N, Billington A, Keeney J, Reeder M, Pleskac TJ, Sinha R, et al. Development and validation of measures of noncognitive college student potential. The College Board: Research Report. 2011;1. | Full Text | Weblink |
18. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53-5. | DOI | PubMed | Google Scholar | Full Text | Weblink |
19. Adam J, Bore M, Child R, Dunn J, Mckendree J, Munro D, et al. Predictors of professional behavior and academic outcomes in a UK medical school: A longitudinal cohort study. Med Teach. 2015;37(9):868-80. | DOI | PubMed | Google Scholar | Full Text | Weblink |
20. Prideaux D, Roberts C, Eva K, Centeno A, Mccrorie P, Mcmanus C, et al. Assessment for selection for the health care professions and specialty training: consensus statement and recommendations from the Ottawa 2010 Conference. Med Teach. 2011;33(3):215-23. | DOI | PubMed | Google Scholar | Weblink |
21. Griffin B, Horton GL, Lampe L, Shulruf B, Hu W. The change from UMAT to UCAT for undergraduate medical school applicants: impact on selection outcomes. Med J Aust. 2021;214(2):84-9. | DOI | PubMed | Google Scholar | Full Text | Weblink |