Learning in practice

A levels and intelligence as predictors of medical careers in UK doctors: 20 year prospective study

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Abstract

Objective To assess whether A level grades (achievement) and intelligence (ability) predict doctors' careers.
Design Prospective cohort study with follow up after 20 years by postal questionnaire.
Setting A UK medical school in London.
Participants 511 doctors who had entered Westminster Medical School as clinical students between 1975 and 1982 were followed up in January 2002.
Main outcome measures Time taken to reach different career grades in hospital or general practice, postgraduate qualifications obtained (membership/fellowships, diplomas, higher academic degrees), number of research publications, and measures of stress and burnout related to A level grades and intelligence (result of AH5 intelligence test) at entry to clinical school. General health questionnaire, Maslach burnout inventory, and questionnaire on satisfaction with career at follow up.
Results 47 (9%) doctors were no longer on the Medical Register. They had lower A level grades than those who were still on the register ($P < 0.001$). A levels also predicted performance in undergraduate training, performance in postregistration house officer posts, and time to achieve membership qualifications (Cox regression, $P < 0.001$; b=0.376, SE=0.098, exp(b)=1.457). Intelligence did not independently predict dropping off the register, career outcome, or other measures. A levels did not predict diploma or higher academic qualifications, research publications, or stress or burnout. Diplomas, higher academic degrees, and research publications did, however, significantly correlate with personality measures.
Conclusions Results of achievement tests, in this case A level grades, which are particularly used for selection of students in the United Kingdom, have long term predictive validity for undergraduate and postgraduate careers. In contrast, a test of ability or aptitude (AH5) was of little predictive validity for subsequent medical careers.

Introduction

Selection of UK medical students depends mainly on grades achieved in school leaving examinations, such as A levels.[1] Few long term studies have validated such selection measures,[2] and their theoretical underpinning is unclear. Examinations measure achievement, accomplishment, or attainment and assess whether students have mastered an academic subject. In contrast, measures of ability or aptitude assess cognitive ability independently of cultural content and educational experience and are typified by measures of intelligence (general mental ability[3]) (see www.bmj.com). Whereas intelligence shows stability through life,[4] achievement tests depend mainly on recent educational experience.

Although seldom articulated, three arguments underpin selection with achievement tests:

- The achievement argument—A levels ensure a minimum competence in the sciences basic to medicine, such as chemistry and biology
- The ability argument—Academic success depends mainly on intellectual ability,[2] and achievement tests indirectly assess intelligence. Because achievement tests can be biased or inaccurate, due to poor schooling, absent role models, low expectations, or inappropriate motivation, there is a case for replacing A levels with measures of aptitude or ability[5 6]
- The motivation argument—A levels are effective because university education requires not only intellectual ability but also good study skills and motivation. High A level grades indicate both satisfactory intellectual ability and learning style. The content of the course therefore matters less than the fact of success.

To distinguish such positions we need to relate career outcomes to achievement and intellectual ability. In 2002 we followed up a cohort of clinical students who had taken a standard intelligence test when they entered Westminster Medical School between 1975 and 1982. We had four outcome measures:

- Dropout—Whatever the problems of defining success in a medical career, doctors not on the Medical Register are not successful as practising doctors, albeit that non-clinicians provide much benefit to medicine and society
- Career progression— Medical careers are hierarchical. Speed of progression and of attaining postgraduate qualifications therefore indicate success. Although exceptions occur, doctors who take longer to reach the top realise their potential less

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Supplementary definitions, more detailed results, three extra tables, and three extra figures are on bmj.com

Effects of mean A level grade, total AH5 score, and AH5 verbal and spatial subscores on various outcome measures. All effects are simple effects that do not take other variables into account; all analyses, however, take differences in general practice/hospital into account. Analyses for time to event use Cox regression and other analyses use multiple regression. Figures are regression b (SE) and P values

	A level grade	Total AH5 score	Verbal AH5 score	Spatial AH5 score
Time measures (Cox regression)				
Time to consultant/GP principal	0.041 (0.087), 0.638	0.002 (0.008), 0.800	0.002 (0.014), 0.866	0.003 (0.014), 0.798
Time to membership	0.376 (0.098), <0.001*	0.016 (0.008), 0.049*	0.028 (0.014), 0.048*	0.019 (0.014), 0.170
Time to diploma	0.187 (0.126), 0.139	0.022 (0.011), 0.050*	0.020 (0.020), 0.308	0.046 (0.020), 0.020*
Time to academic degree (hospital doctors only)	0.316 (0.195), 0.104	0.004 (0.015), 0.787	0.013 (0.025), 0.612	–0.001 (0.026), 0.954
Research publications (multiple regression)				
Research papers	–0.002 (0.048), 0.967	0.002 (0.004), 0.710	0.008 (0.008), 0.267	–0.003 (0.007), 0.645
Stress, burnout, and satisfaction with medicine as career (multiple regression)				
Stress (GHQ-12, 0-1-2-3 scoring)	0.383 (0.376), 0.308	0.026 (0.035), 0.445	0.031 (0.059), 0.598	0.045 (0.058), 0.444
Emotional exhaustion (aMBI)	0.060 (0.325), 0.853	0.018 (0.030), 0.553	–0.004 (0.051), 0.948	0.054 (0.051), 0.287
Depersonalisation (aMBI)	0.116 (0.300), 0.699	012 (0.028), 0.674	0.007 (0.047), 0.879	0.026 (0.047), 0.575
Personal accomplishment (aMBI)	264 (0.227), 0.245	0.017 (0.021), 0.937	–0.021 (0.036), 0.553	0.026 (0.035), 0.471
Satisfaction with medicine as career	–0.267 (0.280), 0.341	–0.003 (0.026), 0.918	–0.005 (0.044), 0.902	–0.003 (0.043), 0.958

GHQ=general health questionnaire; aMBI=abbreviated Maslach burnout inventory.
*Results significant at P<0.05.

- Research output—Many doctors publish research and some publish a lot. The implicit presumption is that productive research is the prerogative of the brightest and the best (and typically is the basis for MB-PhD selection)
- Stress, burnout, and satisfaction with medicine as a career—A successful doctor is a happy doctor, with low stress and burnout and high career satisfaction. Although less intellectually able doctors may suffer stress due to difficulties in keeping up to date as practice changes, a more subtle converse argument suggests that stressed doctors are those with highest ability, day to day practice providing insufficient variation for adequate intellectual stimulation.[7]

For practical reasons we could not assess doctor-patient interaction.

Method

PRF administered the AH5 (a timed "high grade" intelligence test[8]) to clinical students entering the Westminster Medical School from 1975 to 1982. The test has measures of verbal and reasoning ability (part I, "verbal") and spatial ability (part II, "spatial"). Students were informed that the test was confidential and for research and that results would not be available to teachers or examiners.

In 1988, PRF and ICM collated the results with date of birth, sex, A levels, intercalated degree results, finals performance, and performance in preregistration posts.[9] A levels were scored as A=5 to E=1 and O/F=0, and summarised as the mean. Performance at finals was recorded as 4=distinction, 3=pass all first time, 2=pass after resits, 1=fail. Preregistration performance was the average consultant rating (4=outstanding, 3=good, 2=satisfactory, 1=inadequate).

In 2001 we used the Medical Register and Directory to trace the graduates. In January 2002 we sent a questionnaire to those on the 2001 UK Medical Register; non-respondents were sent two reminders. The questionnaire asked about career, qualifications, interests, and personality.[10 11] We assessed stress with the general health questionnaire (GHQ-12) and an abbreviated Maslach burnout inventory (aMBI),[12] with additional questions on satisfaction with medicine (see www.bmj.com). Statistical analysis used SPSS 10.0 and LISREL 8.51.

Results

The mean total AH5 score (fig A, bmj.com) of 40.4 was similar to norms,[8] as were verbal and spatial scores (table A, bmj.com). The mean A level score (fig A, bmj.com) was 4.00, equivalent to grade BBB. AH5 score and A level grade were correlated (Pearson r=0.285, P<0.001; fig B, bmj.com).

Dropouts from Medical Register—All 511 students registered with the General Medical Council, but only 464 were on the 2001 Medical Register. The 47 doctors who left the register (a mean of 11.1 years after qualifying; SD 5.9; range 2-23) had lower A level grades but not lower AH5 scores (table A, bmj.com); see www.bmj.com for ROC analysis. Two doctors subsequently returned to the register. Of the remainder, three had died, contact details were available for 35, and no information was available for seven.

Questionnaire response—Of the 464 doctors on the register, 349 (73%) replied to the questionnaire. Non-respondents had lower AH5 scores but did not have different A levels results (table A, bmj.com).

Career choice and career progression—Of 332 doctors for whom we had usable information, 173 worked in hospital (149 were consultants) and 131 in general practice (116 were principals). Of the remainder, four were not working, five had non-medical posts, and 19 had other medical posts. Hospital doctors had higher A level grades and AH5 scores (see table A on bmj.com), each effect being significant after we accounted for the other (A levels: Student's t test, t_{299} = 2.674, P=0.008; AH5: t_{299} = 2.059, P=0.040). Remaining analyses therefore took differences in speciality into account. Figure 1 shows the career progression of hospital doctors and general practitioners. Qualifications are grouped into memberships (MRCP, FRCS, etc), diplomas (or equivalent, often offered by Royal Colleges), and academic degrees (PhD, MD, masters, or bachelors degree). A levels had a highly significant effect on years to membership (table, Cox regression, P<0.001; fig 2), even after we accounted for AH5 (P=0.001). AH5 had a significant simple effect on years

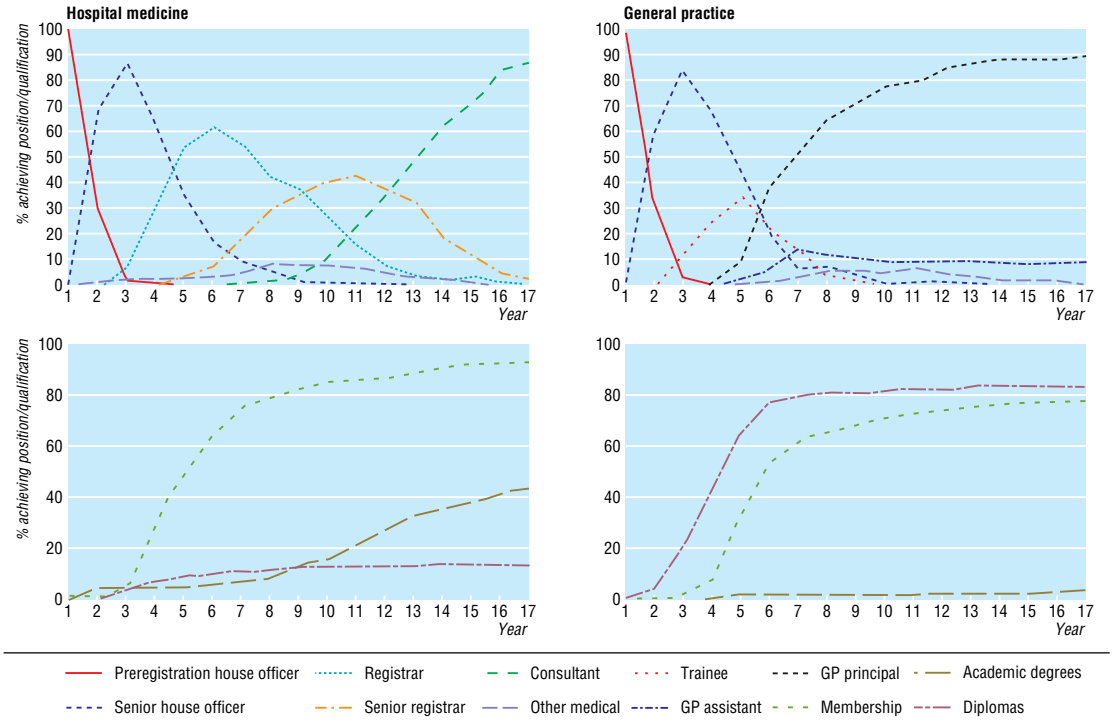

Fig 1 Careers of doctors in hospital medicine and general practice (career grade above and acquisition of memberships, diplomas, and academic degrees below)

to membership (P=0.049) but not after we accounted for A levels (P=0.401). Other effects of A levels and AH5 were not significant after we accounted for multiple testing.

Structural modelling of educational achievement—We modelled academic and professional achievement using structural equation modelling with causal order mainly determined by temporal order, except that we regarded AH5 score before A levels. Goodness of fit was excellent (χ^2=4.90, df=8, P=0.768; GFI (goodness of fit index)=0.995; AGFI (adjusted goodness of fit index)=0.988). Each stage predicted the subsequent stage, and A level grade and finals performance had additional direct effects on time to membership (fig 3).

Research publications—In total 138 doctors (40%) had not published any research papers, 44 (13%) had published 1-2 papers, 36 (11%) 3-5 papers, 30 (9%) 6-10 papers, 39 (11%) 11-20 papers, 29 (9%) 21-50 papers, 18 (5%) 51-100 papers, and 8 (2%) had published more than 100 papers. Regression of normal scores (ranked normal deviates; normal order statistics) showed differences between hospital doctors and general practitioners (P < 0.001) but no effect of A levels or AH5 score (table).

Stress, burnout, and satisfaction with medicine as a career—Sixty two doctors (18%) scored ≥4 on the general health questionnaire, indicating "caseness" for stress. General practitioners scored higher than hospital doctors on measures of emotional exhaustion, depersonalisation, and personal accomplishment in the Maslach burnout inventory but did not differ on the general health questionnaire (0-1-2-3 scoring) or on satisfaction with a medical career. No measure showed any association with A level grades or AH5 score (table).

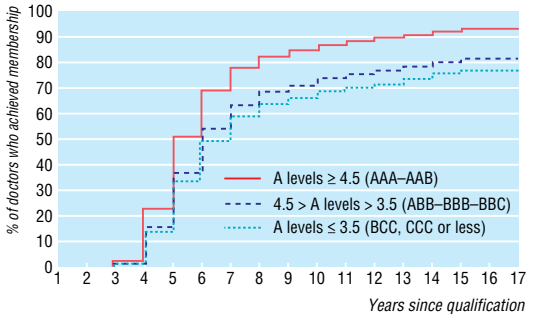

Fig 2 Kaplan-Meier plots for percentage of doctors obtaining membership in relation to A level grade, after taking hospital/general practice differences into account

Discussion

Few studies have attempted to validate the selection procedures for medical students, although in such studies the effect size of academic measures for postgraduate performance is 0.48.[2] Despite A levels being the basis for selection in the United Kingdom,[1] little evaluation has taken place, and although occasional comments suggest that A levels are "completely unpredictive" they actually predict early dropout from medical school.[13 14] For university degrees overall, A levels also predict degree class, dropout, and repeated years, particularly for science.[13 14]

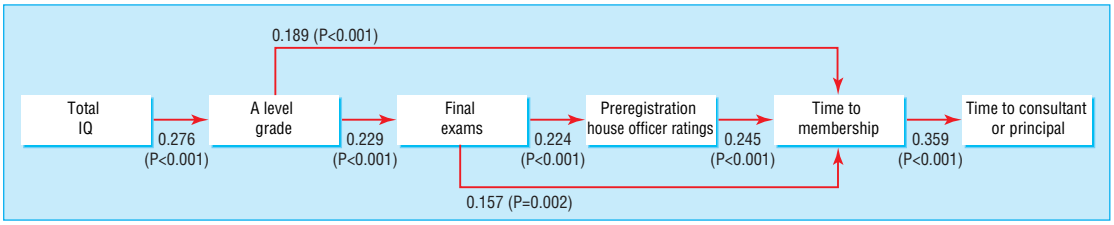

Fig 3 Path model of causal associations between different educational achievements of doctors. Coefficients represent standardised path coefficients (β coefficients) with their associated significance levels

We have shown that A level results, which are measures of achievement, can predict time taken to gain membership qualifications, choosing to become a general practitioner, and leaving the register. In contrast the AH5, which measures ability, cannot independently predict membership qualifications or dropout.

A levels therefore have validity in selection, with a validity coefficient of about 0.3 (see www.bmj.com), although care should be taken in generalising the results to other examinations in other countries. Intelligence does not predict careers, thus rejecting the ability argument. A levels predict because they assess achievement, and the structural model shows how past achievements predict future achievement. Our data cannot distinguish the achievement argument and the motivation argument, although the long term, direct effect of A levels on membership examinations (fig 3) suggests that motivation might be important.

Despite their predictive ability, A levels are probably not the only predictors[2] and should not be the sole basis for selection.[15] Some of our other outcomes were not predicted by A levels but were correlated with measures of personality (see www.bmj.com) and would probably also be predicted by learning styles.[16 17] West answered Smith's editorial question of "Why are doctors so unhappy?"[18] by suggesting that doctors burn out because they are overqualified for a repetitious job.[7] The causes of stress and burnout in doctors are complex,[12] but our data suggest that excess intellectual ability is not one of them.

What is already known on this topic

There are few prospective studies of achievement tests used in student selection, such as A levels, in relation to outcomes in medical careers

It is not clear whether A levels are useful in selection because they assess knowledge, motivation, study habits, or ability (intelligence)

What this study adds

A level results can predict outcome in medical careers

An ability test (the AH5 intelligence test) does not predict outcome

It is not clear yet whether the predictive value of A levels results from assessing knowledge, motivation, or study habits

Other measures such as personality are also probably important in predicting outcome

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Contributors: PRF initiated the study, and was responsible for collecting the original data from 1975 to 1982, and ICMcM and PRF collated those data in 1989. ICMcM, ES, and PP designed the present follow up, and ES and PP traced and contacted the doctors. AK was responsible for data coding and entry. ICMcM, ES, PP, and AK jointly carried out data analysis. The first draft of the paper was written by ICMcM, and ES, PP, AK, and PRF contributed to its revision. ICMcM is guarantor.

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