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Personality factors and medical training : a review of the literature

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Abstract

Context: It has been acknowledged that certain personality characteristics influence both medical students' and doctors' performance. With regard to medical students, studies have been concerned with the role of personality and performance indicators such as academic results and clinical competence. In addition the link between personality and vulnerability to stress, which has implications for performance, has been investigated at both the undergraduate and postgraduate level. Most studies that are cited in the literature have been published before the year 2000. The authors therefore decided to undertake a literature search to determine whether there have been any prospective systematic studies published since 2000.

Methods: A review of the literature was performed from 2000 – 2009, using the databases – Medline, PsychINFO, CINAHL. The search terms used were 'personality', 'performance' 'stress' and 'medical student'. Specific inclusion criteria were cohort studies carried out over a minimum period of two years that measured medical student scores on valid and reliable personality tests and also used objective measures of performance and stress.

Results: The authors identified seven suitable studies. Four of these looked at personality factors and academic success, one looked at personality factors and clinical competence and two looked at personality factors and stress. From the literature the main personality characteristic that was repeatedly identified was conscientiousness.

Conclusion: The personality trait known as conscientiousness has been found to be a significant predictor of performance in medical school. The relationship between personality and performance becomes increasingly significant with advancement through medical training. Additional traits concerning sociability i.e. extraversion, openness, self-esteem and neuroticism

have been identified to be also relevant particularly in the applied medical environment. A prospective national study with the collaboration of all medical schools would offer the possibility of further investigating these important but initial findings.

Introduction

This review seeks to investigate whether evidence exists that the personality of the medical student is an important predictor of long-term success. A number of recent studies have shown that issues relevant to performance such as professional misconduct in doctors can be traced back to evidence of performance concerns regarding both unprofessional behaviour and poor academic achievement while still in medical school[1-3]. Performance difficulties can also be traced back to clinical skills scores in licensing examinations[4] and to professionalism ratings obtained during residency training[5]. Hodgson et al [6]provide an interesting insight into the personalities of their sample of unprofessional doctors who were a sub sample of the group of doctors studied by Papadakis and colleagues[1-3]. Hodgson et al were able to obtain the personality profiles of 26 of the total group of 264 individuals in the Papadakis studies. By chance, as part of a test validation study, these individuals had completed a measure of personality (the California Personality Inventory (CPI)) when they entered medical school between the years 1951-1970 for the test authors. Significant unprofessional behaviour was demonstrated by seven of these individuals while in medical school and 19 of them had never demonstrated unprofessional behaviour. Significant differences between the individuals in the unprofessional behaviour group versus those who had not demonstrated any unprofessional behaviour were found on the following CPI

subscales; responsibility, communality, well-being, rule-respecting and total score. The possibility that the personality of the medical student at entry to medical school could have long-standing implications for postgraduate clinical performance is suggested by the findings of this study. In addition, it appears that even certain medical schools may have their own 'personality' as certain schools have been found to be significantly associated with a higher number of graduates who are subsequently sued for malpractice[7]. Other literature points to the possibility that permanent characteristics of individuals and even of certain cohorts of medical students from certain medical schools may be significant predictors of performance[8, 9]. Ensuring optimal and professional performance in the medical student has been the focus of particular attention of medical educators since the publication of *Tomorrows Doctors* in 1993[10,11]. However, little attention is paid to the relevance of personality factors either in selection procedures or in personal and professional development courses in medical schools[12-13].

The role of personality and doctors' performance has received some attention in the postgraduate arena. Mitchell et al describe a number of studies which investigated the role of personality and physicians' performance during residency training[14]. They conducted a systematic review of personal factors contributing to residents' performance and located five studies which measured personality. The studies demonstrated significant associations between certain profiles and poor performance and stress. All of the studies were published prior to the year 2000. None of these studies measured personality while the individuals were still in medical school.

A consistent finding is that 28% of doctors report above threshold levels of stress[15]. Performance and patient care has been shown to be affected by such high levels of stress[16].

Personality traits have long been recognised as strong predictors of subjective well-being[17]. The traits that comprise 'mental toughness' have been shown to correlate positively with all the traits of the Big Five except neuroticism[18]. So it follows that studies which investigate the predictive value of personality factors and stress in the medical student or medical trainee population are relevant to this discussion. A recent systematic review found similar levels of stress among medical students to that found in doctors[19]. The review identified 15 studies which measured personality all of which, except one, were published prior to the year 2000. A number of significant protective personality factors were identified, self actualisation, self-awareness, and a sense of fulfilment, whereas perfectionism, Type A personality, and anger suppression were associated with an increased vulnerability to stress.

Ferguson et al conducted a systematic review of individual factors associated with academic success in medical school[20]. The review covered 13 studies published before the year 2000 of previous academic performance, personality, sex, ethnicity and learning styles, selection interviews, personal statements and references as possible predictors of academic success in medical school. Meta-analysis was only possible on the studies of previous academic success and the authors concluded that 23% of the variance in medical school performance was explained by previous academic performance. While evidence for the impact of personality on academic success was identified in the review, the authors concluded that a systematic, prospective study is needed before a firm conclusion can be drawn. There were no studies identified which compared personality factors with subsequent postgraduate medical performance or competence.

All of the studies in the three systematic reviews described above were published before the year 2000. Therefore it is of interest to investigate whether or not prospective systematic studies have been conducted since then and what the findings are. If sufficient convincing evidence exists which indicates that personality factors are capable of predicting medical student performance then medical schools should consider including a measure of these personality factors in their selection process. This review of the literature conducted a search for cohort studies published since the year 2000 which investigated medical students' scores on valid personality tests and objective measures of performance and stress.

Search Strategy - Method

A number of library catalogues were searched for books and government publications on the topic of personality and success in medical school published since the year 2000. The databases PsychINFO, CINAHL and MEDLINE were searched for full text articles published between 2000-2009 using the search terms 'personality', 'performance' 'stress' and 'medical student'. Only longitudinal studies conducted across a minimum period of two years were included. Objective measures of academic performance and stress were additional criteria for inclusion as was the use of personality measures with proven reliability and validity. The results of the database searches led to key articles which led to links with other databases such as Web of Science and PubMed for related articles. The British Medical Journal was hand searched electronically. The reference lists of all key articles and books were searched to identify articles not already located.

Results

Seventeen full-text articles were identified which measured the personalities of medical students. Of these, ten were excluded from the review, either because they did not compare personality scores to measures of academic performance or did not use objective measures of personality or because they used a cross-sectional design rather than a longitudinal one[8, 21-29]. The remaining seven studies are described below (See table 1; Description of longitudinal studies of personality and medical students' and doctors' performance, for a summary).

Study One

Lievens et al present details of both a cross-sectional study and a longitudinal study of a large cohort of medical students in the five medical schools in Belgium[30]. In the longitudinal study, a group of 607 students were assessed over three years. They administered the authorised Flemish translation of the NEO-PI-R (a measure of the 'Big Five' domains of personality [31]) to 80.4% of the total number of registered medical students for 1997. The domain of conscientiousness was identified by means of both multiple regression analysis and by Pearson correlations to be a significant predictor of academic success. High levels of conscientiousness predicted success. One possible source of bias came from the significant rate of attrition from year one to year three such that the final group comprised of 341 students which was only 43.4% of the total student population registered for the year of entry. However the authors conducted a number of statistical analyses to counteract this possible source of selection bias. A logistic regression analysis with 'passing the three years successfully' as a dependent variable and

the ‘Big Five’ domains as independent variables revealed that conscientiousness was the only domain that had a significant regression weight. This finding reassures the reader that conscientiousness is a reliable predictor of academic success in this group of students. T-tests demonstrated that other personality domains were also significantly associated with academic success but the authors warn about the possibility of Type-1 error resulting from multiple analyses and most of the associations disappeared after applying the Bonferroni correction. In the authors’ concluding statements they direct our attention to the finding that personality accounted for six percent of the variance in year one, three percent of the variance in year two and five percent of the variance in year three. While this might seem to be very little, they conclude that the percentages of variance explained by personality should be considered to be incremental variance accounting for over and above the stringent selection procedure. Notwithstanding the methodological difficulties in this longitudinal study in that it is only representative of approximately half of the class who may have been the most conscientiousness and most persevering in the first place, nevertheless the domain of conscientiousness emerged as an important personality attribute.

Study Two

Ferguson et al also measured the ‘Big Five’ dimensions of personality of 176 students attending Nottingham medical school (UK) [32]. Goldberg’s markers or facet dimensions was used instead of the NEO-PI-R. The authors do not adequately describe the reasons why they did not use the NEO-PI-R as their measure of the ‘Big Five’. In a previous

article, one of the ten studies listed above, the same authors present details of the internal reliability and construct validity of the Goldberg scales[8]. Nevertheless, they do not present numerical values and this is an unfortunate weakness in the present study and so comparison with the results of the Flemish study is not straightforward. Furthermore, in the aforementioned paper, the authors go to some length to criticise much of the previous studies of personality on the grounds of their cross-sectional methodology and poorly focussed hypotheses[8]. It is thus somewhat surprising that this paper lacks a focussed question from the outset leading to the very real possibility of spurious correlations.

Sixty-seven percent of the medical school entrants gave their consent to participate. Comparisons were made between personality scores and the results of four academic assessments in years one and two, four assessments in year three and ten assessments in years four and five. An extensive statistical analysis was carried out using univariate (zero-order correlations, t-test, chi square test) and multivariate methods (hierarchical multiple linear regression, multivariate analysis of variance, structural equation modelling). Once more, the conscientiousness dimension was found to be a significant predictor of academic performance in the preclinical years but not of the clinical years (years four and five) where it was linked with worse performance. No other trait emerged as a significant predictor of performance. However the comparison with the preclinical years has to be considered as somewhat retrospective in that the students completed the personality assessment, not at the beginning of the programme but two and a half years into their training. Nevertheless the possibility that conscientiousness is a personality trait capable of predicting academic performance in the preclinical but not in the clinical years

is intriguing and suggests caution regarding the selection of medical students on the basis of only one trait.

Study Three

Multiple estimates of personality were employed by Hojat et al[33] .Their study was conducted with 1,710 students attending the Jefferson Medical College in Philadelphia (USA) over nine intake years. They used abridged versions of six personality measures and the rationale and associated psychometrics for these abridged versions among medical students and other health profession students is reported previously[34].The sample studied represented 82% of the total student population. In addition to personality measures, they asked the groups questions about their relationships with their parents during their childhoods and a single question on general health. They compared these assessments taken in year one (with the exception of the 1987 year entrants who were assessed in year two) with faculty global ratings of competence in six third- year clerkships. While data on the validity and reliability of this method of ratings are not provided, they are provided elsewhere[34]. On consultation of this article, it is evident that the measurement ratings are considerably detailed and that their validity and reliability has been demonstrated in a number of studies. It is for this reason then that this study was allowed to remain in the final selected group of seven studies for description and appraisal in this review.

The authors do not provide any null hypotheses for their study. The medical school faculty's global ratings of students' clinical competence in six third-year core clerkships

(family medicine, internal medicine, obstetrics/gynaecology, paediatrics, psychiatry and surgery) were used. These ratings were completed in each clerkship by faculty, using a four-point scale ('High Honours', 'Excellent', 'Good', and 'Marginal Competence'). Data on the psychometrics of these ratings have been reported [34]. Students' personality scores and parental relationship ratings were compared to whether students were allocated to a high/moderate/low level of clinical competence. The students in the low competency group demonstrated significantly poorer levels of self-esteem and sociability, were lonelier and reported less satisfactory relationships with parents than the two other groups of students. In addition to multivariate and univariate analyses of variance, multivariate analysis of covariance was conducted to control for the effect of gender and they also replicated the analyses on two halves of the total sample (i.e. the first half, 1987,1992-1995 and the second half,1996-1999), to demonstrate that timing was not a confounding factor. The authors admit to the possibility that a halo effect may have been a confounding factor in that the more sociable student with higher levels of self-esteem may have received higher ratings by faculty. However they dismiss this by referring to a previous study with the same rating method which demonstrated that these ratings are capable of predicting students' scores a number of years later on in licensing examinations and on residency performance ratings and thus demonstrate good reliability and validity[34].

Study Four

McManus et al have published the results of their analysis of personality factors and stress in their 12 year longitudinal study of medical students who attended five medical schools in the UK[35]. The personality assessment point was at the time of internship. Measures of stress were administered at five years post graduation. An abbreviated version of the

NEO-PI-R was used which is not described in detail. References to previous use of this abbreviated version of the measure did not yield any further information[36] .The final sample size was 1,668 which represented 63.3% of the total sample initially assessed at the time of application to medical school. There was no evidence of response bias. Similar to previous research on stress and doctors, 20% of the sample was identified as cases on the General Health Questionnaire. The authors used path analysis to investigate whether personality factors could be identified as causes of stress mediating between the doctors' approaches to work practices and learning styles. Results revealed that stress could indeed be concluded to be caused by personality factors, specifically by high levels of neuroticism, low levels of extraversion and also low levels of conscientiousness. The proposed model of causation and path diagram was confirmed, indicating that these personality factors mediate between the doctors' approaches to work and learning styles which in turn lead to stress. Although the present study did not look at competency ratings, it has long been known that doctors under stress are at risk of underperforming and making mistakes[37, 38]. The findings are further supported by a recent Swedish study which demonstrated that impulsivity (the opposing correlate of conscientiousness), measured at the beginning of the first year in medical school predicted elevated stress levels in medical students in their third year[28]. Although this study was conducted over three years and thus could have been included in this review, unfortunately, only two facets (eight items) of a measure of the 'Big Five' was used without an adequate description of validity and reliability and so was not deemed suitable for inclusion.

Study Five

The concept of a 'Big Three' is investigated in a longitudinal study of 421 students who were accepted into the four medical schools in Norway reported by Tyssen et al[39]. The 'Big Three' was combined into eight typologies according to prevalidated methods. The student sample was assessed over the six years of training and their perceived level of stress was measured twice using a recognised validated instrument. Univariate and multivariate analyses were conducted. The findings indicate that 'brooders' who are high on neuroticism and conscientiousness and low on extraversion demonstrate high levels of perceived stress whereas 'hedonists' who are low on neuroticism and conscientiousness and high on extraversion demonstrate low levels of perceived stress.

Conscientiousness, neuroticism and extraversion emerge as significant personality factors whereby low levels of conscientiousness combine with high levels of neuroticism along with low levels of extraversion to increase susceptibility to stress. Thus far in this review there are indications that conscientiousness may be advantageous during the early years of medical training but perhaps disadvantageous later on unless the protective effects of extraversion are present.

Study Six

In this study, the authors investigated whether personality characteristics are associated with the academic performance of medical students over three years[40].The study was conducted in Queensland Australia and used the Hogan Developmental Survey (HDS) as the measure of personality which was compared with end-of –year examination grades for years one to three in a sample of 139 students. The students represented three years of students who entered medical school in the years 2000, 2001 and 2002.Statistical analysis

used Pearson's bivariate correlation analysis and found that borderline/schizoid and narcissistic/antisocial characteristics were negatively correlated with academic success. Scores on one of the subsections of the HDS, the 'Diligent' syndrome was found to be positively related to academic success. The 'Diligent' syndrome is associated with a tendency to be attentive and good with details, orderly, rational, careful and well-organised. The authors acknowledge a number of limitations including but not limited to different personality assessment points across the years, the lack of control for other situational variables and particular characteristics of the medical curriculum which may have accentuated the relevant personality factors. Nevertheless, the study adds to the evidence demonstrating that once more personality factors are significantly associated with measures of academic success over time and in particular identifies a significant syndrome 'Diligent', whose description encompasses characteristics reminiscent of what is usually understood by conscientiousness.

Study Seven

Lievens and others present further analyses of their longitudinal investigation of the same cohort of students from study one a number of years later [41]. In this analysis, the authors have collected additional data not previously available and have conducted more robust statistical analyses. Specifically they compare the personality assessment results taken at college entry with the students' Grade Point Average (GPA) scores over the seven years of medical school. To correct for possible bias, they included in their analyses, range restriction correlation (μ values) while allowing for the reduction in variability in GPAs over the seven years of medical training. Multiple regression analyses demonstrated that personality factors became increasingly able to predict academic success with

advancement through the medical curriculum (R^2 for year one = 0.22, R^2 for year seven = 0.56). Conscientiousness, extraversion and openness became increasingly significant contributors to the relationship over the years of medical training. Finally they calculated effect sizes for the differences between personality and GPA scores for the 'persisters' versus the 'leavers'(i.e. the students who dropped out of medical school versus the students who continued on to year seven). Large effect sizes were demonstrated for GPAs (e.g. *d*=0.97) in year one.Small effect sizes were obtained for personality factors for the 'persisters' compared to the 'leavers' across the years .Conscientiousness was the personality factor which achieved the largest of these (all *d*s for conscientiousness ranged from 0.18 to 0.27). The authors conclude that while in the first year, GPAs rather than personality factors are the most crucial factors determining student attrition. However certain personality factors (ie conscientiousness, extraversion and openness) become increasingly important predictors of academic success as the student progresses through medical school.

Conclusion

This review of the literature on prospective longitudinal studies of personality factors and medical student performance published between the years 2000-2009 has identified seven studies. Four studies investigated personality factors and academic success, one looked at personality factors and clinical competence and two investigated the relationship between personality and stress. Study four and Study seven have been assessed to be the most rigorous and therefore the most convincing. Taken together and supported by the less

rigorous but still significant findings of the other five studies, we conclude that conscientiousness, as measured by the NEO-PI-R is an important personality factor which has been found to predict long term success in medical training. The conscientiousness personality factor has emerged as an important predictor not only of academic success but also as a predictor of vulnerability to stress if present with high neuroticism and low extraversion. The conscientiousness factor has long been recognised in psychology literature to be an important predictor of job performance and so the conclusions of this review add further to this evidence[42-44]. Furthermore the evidence from these seven studies also suggests that social traits such as the extraversion factor and in other studies the level of self esteem and sociability may be important mediating factors in the clinical years. Lievens et al have coined the phrases "getting ahead" i.e. conscientiousness, which has been identified to be important for the early years and the phrase "getting along" i.e. extraversion and openness which may be the additional critical personality factors which are predictors of success in the applied settings of the later years ([41] p. 1527). This review goes some way towards addressing the concerns expressed recently about the lack of recognition of the importance of personality factors and success in medical school[45]. A large scale national prospective study involving all medical schools is now required to confirm these preliminary but important findings.

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Reference List

1. Papadakis MA, Hodgson CS, Teherani A & Kohatsu ND. Unprofessional behaviour in medical school is associated with subsequent disciplinary action by a state medical board. *Acad Med*. 2004; **79** (3): 244-249.
2. Papadakis MA, Teherani A, Banach MA, Knettler TR, Rattner SL, Stern DT et al. Disciplinary action by medical boards and prior behaviour in medical school. *New Eng J Med*. 2005; **353**(25):2673-2682.
3. Teherani A, Hodgson CS, Banach M, & Papadakis MA. Domains of unprofessional behaviour during medical school associated with future disciplinary action by a state medical board. *Acad Med*. 2005; **80**(10 suppl): S17-20.
4. Tamblyn R, Abrahamowicz M, Dauphinee D, Wenghofer E, Jacques A, Klass D, Smee S, Blackmore D, Winslade N, Girard N, Duberger R, Bartman I, Buckeridge DL, Hanley J. Physician scores on a national clinical skills examination as predictors of complaints to medical regulatory authorities. *JAMA*. 2007; **298**: 993-1001.
5. Papadakis MA, Arnold G, Blank L, Holmboe RS. Performance during internal medicine residency training and subsequent disciplinary action by state licensing boards. *Ann Intern Med*. 2008; **148**:869-876.

6. Hodgson CS, Teherani A, Gough HG, Bradley P & Papadakis MA. The relationship between measures of unprofessional behaviour during medical school and indices on the California Psychological Inventory. *Acad Med*. 2007; **82**(10 suppl): S4-7.
7. Waters TM, Lefevre FV, Budetti PP. Medical School attended as a predictor of medical malpractice claims. *Qual Saf Health Care*. 2003; **12**:330-336.
8. Ferguson E, Sanders A, O'Hehir F, James D. Predictive validity of personal statements and the role of the five-factor model of personality in relation to medical training. *J Occup Organ Psychol*. 2000; **73**:321-344.
9. McManus IC, Powis D. Testing medical school selection tests. *Med J Aust*. 2007; **186**(3):118-119.
10. General Medical Council. *Tomorrow's doctors: recommendations on undergraduate medical education issued by the Education Committee of the General Medical Council in pursuance of Section 5 of the Medical Act 1983*: General Medical Council; 1993.
11. Thistlethwaite J & Spencer J. *Professionalism in medicine*. Oxford: Radcliffe; 2008.
12. Stern DT. *Measuring medical professionalism*. New York; Oxford: Oxford University Press; 2006.
13. Wear D & Aultman JM. *Professionalism in medicine: critical perspectives*. New York: Springer; 2006.
14. Mitchell M, Srinivasan M, West DC, Franks P, Keenan C, Henderson M, Wilkes M. Factors affecting resident performance: development of a theoretical model and a focused literature review. *Acad Med*. 2005; **80**(4):376-389.
15. Firth-Cozens J. Doctors, their well-being, and their stress. *BMJ*. 2003; **326**:670-671.

16. Firth-Cozens J. Interventions to improve physicians' wellbeing and patient care. *Soc Sci Med*. 2001; **52**:215-222.

17. Haslam N, Whelan J, Bastian B. Big five traits mediate associations between values and subjective well-being. *Pers Individ Dif*. 2009; **46**:40-42.

18. HorsburghVA, Schermer JA, Veselka L, Vernon PA. A behavioural genetic study of mental toughness and personality. *Pers Individ Dif*. 2009; **46**:100-105.

19. Dyrbye LN, Thomas MR & Shanafelt TD. Systematic Review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med*. 2006; **81**(4):354-373.

20. Ferguson E, James D, Maddeley I. Factors associated with success in medical school and in a medical career. *BMJ*. 2002; **324**:952-957.

21. Jones BJ & Borges NJ. The contribution of non-cognitive characteristics in predicting MCAT scores. *Acad Med*. 2001; **76**(10 suppl):S52-54.

22. Enns MW, Cox BJ, Sareen J & Freeman P. Adaptive and maladaptive perfectionism in medical students: a longitudinal investigation. *Med Educ*. 2001; **35**(11):1034-1034.

23. Rimoldi HJ, Raimondo R, Erdmann JB & Hojat M. Intra- and intercultural comparisons of the personality profiles of medical students in Argentina and the United States. *Adolescence*. 2002; **37**(147):477-477.

24. Lavine E, Regehr G, Garwood K, Ginsburg S. The role of attribution to clerk factors and contextual factors in supervisors' perceptions of clerks' behaviours. *Teach Learn Med*. 2004; **16**(4):317-322.

25. Madill A & Latchford G. Identity change and the human dissection experience over the first year of medical training. *Soc Sci Med*. 2005; **60**(7):1637-1647.

26. Ham BJ, Lee YM, Kim MK, Lee J, Ahn DS, Choi MJ, Lyoo IK, Choi IG, Lee MS. Personality, dopamine receptor D4 Exon III polymorphisms, and academic achievement in medical students. *Neuropsychobiology*. 2006; **53**(4):203-209.

27. Knights JA & Kennedy BJ. Medical school selection: Screening for dysfunctional tendencies. *Med Educ*. 2006; **40**(11):1058-1064.2

28. Hren D, Vujaklija A, Ivanisevic R, Knezevic J, Marusic M & Marusic A. Students' moral reasoning, Machiavellianism and socially desirable responding: implications for teaching ethics and research integrity. *Med Educ*. 2006; **40**(3):269-277.

29. Dahlin ME & Runeson B. Burnout and psychiatric morbidity among medical students entering clinical training: a three year prospective questionnaire and interview-based study. *BMC Med Educ*. 2007; **7**:6-6.

30. Lievens F, Coetsier P, De Fruyt F, & De Maeseneer J. Medical students' personality characteristics and academic performance: a five-factor model perspective. *Med Educ*. 2002; **36**(11):1050-1056.

31. Costa PT, McCrae RR. *Revised NEO Personality Inventory (NEO-PI-R) and NEO five-factor inventory (NEO-FFI) professional manual*. Odessa: Psychological assessment Resources, Inc ; 1992.

32. Ferguson E, James D, O'Hehir F, Sanders A & McManus IC. Pilot study of the roles of personality, references, and personal statements in relation to performance over the five years of a medical degree. *BMJ*. 2003; **326**(7386):429-432.

33. Hojat M, Callahan CA & Gonnella JS. Students' personality and ratings of clinical competence in medical school clerkships: a longitudinal study. *Psychol Health Med*. 2004; **9**(2):247-252.

34. Callahan CA, Erdmann JB, Hojat M, Veloski J, Rattner S, Nasca TJ, Gonnella JS. Validity of faculty ratings of students' clinical competence in core clerkships in relation to scores on licensing examinations and supervisors' ratings in residency. *Acad Med*. 2000; **75**(10 suppl): S71-73.

35. McManus IC, Keeling A & Paice E. Stress, burnout and doctors' attitudes to work are determined by personality and learning style: a twelve year longitudinal study of UK medical graduates. *BMC Med*. 2004; **2**:29.

36. McManus IC, Smithers E, Partridge P, Keeling A, Fleming PR. A levels and intelligence as predictors of medical careers in UK doctors: 20 year prospective study. *BMJ*. 2003; **327**:139-142.

37. British Medical Association. *Underlying causes of doctors' disciplinary problems: survey results*. London: BMA; 2004.

38. Fahrenkopf AM,Seetish TC, Barger LK, Sharek PJ, Lewin D, Chiang VW. Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ*. 2008; **336**:488-491.

39. Tyssen R, Dolatowski FC, RÃ vik JO, Thorkildsen RF, Ekeberg O, Hem E et al. Personality traits and types predict medical school stress: a six-year longitudinal and nationwide study. *Med Educ*. 2007; **41**(8):781-787.

40. Knights JA & Kennedy BJ. Medical school selection: impact of dysfunctional tendencies on academic performance. *Med Educ*. 2007; **41**(4):362-368.

41. Lievens P, Ones DS, Dilchert S. Personality scale validities increase throughout medical school. *J Appl Psychol*. 2009; **94**(6): 1514-1535.

42. Behling O. Employee Selection: Will intelligence and conscientiousness do the job? *Academy of Management Executive*. 1998; **12**:77-86.

43. Barrick MR, Mount MK. The Big Five personality dimensions and job performance: A meta-analysis. *Personnel Psychology*. 1991; **44**:1-26.

44. Hurtz GM, Donovan JJ. Personality and job performance: The Big Five revisited. *J Appl Psychol*. 2000; **85**: 869-879.

45. Musson D. Personality and medical education. *Med Educ*. 2009; **43**: 395-397.

Table 1: Description of longitudinal studies of personality and medical students' and doctors' performance

Authors/Year	Participants	Study type and follow-up period	Measures	Main findings
Study 1 Lievens F,Coetsier P,De Fruyt F,De Maeseneer J. 2002 . [30]	631 medical students (80.4% of total N of medical students in Belgium in 1997)	Prospective study over 3 years(preclinical years)	Personality: Flemish translation of NEO-PI-R. Academic :year end scores	Conscientiousness found to be a significant predictor of year end scores across all 3 years (β = 0.24,$p<0.001$, β = 0.17,$p<0.01$, β = 0.19,$p<0.01$). Extraversion found to be a significant predictor for yr 1 only but negatively (β = -0.12,$p<0.01$)
Study 2 Ferguson E,James D,O'Hehir F,Sanders A.2003, [32]	176 medical students in Nottingham (UK) medical school in 1995	Part prospective and part retrospective study over 5 years .Personality assessment conducted mid medical training.	Personal info: A level grades, teacher's reference, student's personal statement, Personality: Goldbergs adjectives for the big five. Academic: multiple exam results over the preclinical and clinical years	Conscientiousness predicted best performance in preclinical years but worst performance in clinical years. Conscientiousness correlated with A level scores. Higher A level scores related to better preclinical performance. Preclinical scores significantly predicted better clinical performance.
Study 3 Hojat M,Callahan CA,Gonnella JS.(2004). [33]	1,710 medical students enrolled at Thomas Jefferson medical school (USA),1982,1992-1999	Prospective study over 3 years. First year to third year of medical training.	Personality :Abridged versions of : Rosenberg's self-esteem questionnaire; Eysenck personality Questionnaire; UCLA loneliness	Multivariate ANOVA demonstrated that sociability,self-esteem,loneliness and perceptions of early childhood

			scale;Taylor manifest anxiety scale; Test anxiety scale .[34] Questions re perceptions of relationships in childhood with parents and one question re perception of general health. Clinical competence: faculty global ratings of clinical competence on 4 levels from clinical clerkships.	relationships were found to be significantly related to clinical competency ratings. Low to moderate effect sizes stated in text for low vs high competency groups (from 0.19 for self-esteem to 0.42 for loneliness)
Study 4 McManus IC,Keeling A,Paice E.(2004). [35]	1,668 medical students enrolled in 5 UK medical schools in 1991,1992,1993.	Part prospective and part retrospective study over 12 years .Assessed at entry,graduation, internship years and again in 2002.Personality assessment conducted following graduation in internship year.	Stress :General health questionnaire(GHQ); Abbreviated versions of the ;Maslach Burnout Inventory. Personality: Abbreviated questionnaire assessing the 'big five' Others: Happiness with Medical career questionnaire ;Study Process Questionnaire; Approach to work questionnaire; Workplace Climate questionnaire	High neuroticism, low extraversion, low conscientiousness caused stress. Personality factors linked to learning style. Learning style linked to approaches to work. 20% doctors assessed to be experiencing significant stress.
Study 5 Tyssen R,Dolatowski FC,Røvik JO,Thorkildsen RF,Øivind E,Hem E,Gude T,Grønvold NT,Vaglum P.(2007). [39]	421 medical students in all 4 medical schools in Norway,1993.	Prospective study over 6 years with 3 assessments at entry,year 3 and graduation. 236 (56%) completed all assessments.	Personality: Big Three (using Basic character Inventory) Stress: Perceived medical school stress	Neuroticism (β = 0.8,p= 0.002)and conscientiousness (β =0.6,p=0.03) predicted stress inclination. 'Brooders ' showed higher levels of stress than'hedonists'. Personality effect greater for females early on in course.

Study 6 Knights JA,Kennedy BJ.(2007). [40]	139 medical students who entered medical school over 3 years (2000,2001,2002)	Prospective study over 3 years.	Personality: Hogan development Survey(HDS) Academic: average of exam grades obtained at end of each year (yr 1-3).	'Moving away' syndrome (borderline personality characteristics) and 'Moving against' syndrome (schizoid personality characteristics) negatively related to academic grades. 'Diligent'syndrome positively related to academic grades.
Study 7 Lievens F, Ones DS, Dilchert S.(2009). [41]	631 medical students (80.4% of total N of medical students in Belgium in 1997)same sample as study 1.	Prospective study over 7 years.	Personality: Flemish translation of NEO-PI-R. Academic :year end scores GPA for 7 years. Attrition status; 'persisters','leavers'	Personality factors increasingly able to predict academic success over 7 years (R^2 0.22 yr 1 to 0.56 yr 7). Conscientiousness most predictive of attrition status (all *d*s range from 0.18 to 0.27) Extraversion openness also important factors.