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"10% of your medical students will cause 90% of your problems": a prospective correlational study

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Title: "10% of your medical students will cause 90% of your problems": a prospective correlational study

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Keywords

Conscientiousness, professionalism, predictive validity, clinical performance

ABSTRACT

• **Objectives** Our aim was to explore the relationship between medical student Conscientiousness Index scores and indicators of later clinical performance held in the UK Medical Education Database. Objectives were to determine whether conscientiousness in first and second year medical students predicts later performance in medical school and in early practice. Policy implications would permit targeted remediation where necessary or aid in selection.
• **Design** Prospective correlational study
• **Setting** A single UK medical school and early years of practice, 2005-2018.
• **Participants** Data were obtained from the UK Medical Education Database (UKMED) on 858 students. Full outcome data was available for variable numbers of participants, as described in the text.
• **Main outcome measures** Scores on the UK Foundation Programme Office's Situational Judgement Test (SJT) and Educational Performance Measure (EPM), the Prescribing Safety Assessment (PSA), and Annual Review of Competency Progression (ARCP) outcomes.
• **Results** Linear regression analysis shows Conscientiousness Index scores significantly correlate with pre- and postgraduate performance variables,: SJT scores ($R=0.373$, $R^2=0.139$, $B=0.066$, $p<0.001$, $n=539$); PSA scores ($R=0.249$, $R^2=0.062$, $B=0.343$, $p<0.001$, $n=462$); EPM decile scores for the 1st (lowest) decile are significantly lower than the remaining 90% ($P=0.003$, $n=539$), as are PSA scores ($p<0.001$, $n=463$), and ARCP Year 2 scores ($p=0.019$, $n=517$). The Odds Ratio that students in the 1st decile fail to achieve the optimum ARCP outcome is 1.6126 (CI 1.1400 to 2.2809, $p=0.0069$, $n=618$).
• **Conclusions** Conscientiousness Index scores in Year 1 and 2 of medical school have predictive value for later performance in knowledge, skills and clinical practice. This trait could be used either for selection, or for targeted remediation to avoid potential problems in the future.

STRENGTHS AND LIMITATIONS OF THIS STUDY

The study was carried out using data on undergraduate students from a single medical school.

We have explored the impact of a single predictor variable – the underlying causative factor – on a number of dependent variables, and the data structure of the predictor variable is unlikely to be continuous.

The EPM decile ranking is calculated based on the assumption that all medical schools are equivalent, which we know not to be the case.

The ARCP data contains a very high proportion of Outcome 1 candidates that reduces the discrimination.

Our measure of conscientiousness in routine tasks appear to be most valid as a predictor of professional outcomes in later academic and clinical practice at the lower end of the scale. Therefore, this method is most likely to be useful where there is a high applicant/placement ratio, such as during selection.

INTRODUCTION

In 2002 Wright and Tanner published an article in the BMJ indicating that students who failed to bring passport photographs as requested on induction were significantly more likely (48%, as opposed to 8% for those who brought a photograph) to fail second year exams[1]. This observation was greeted with wry amusement by many of those in close contact with medical students, who clearly recognised the general phenomenon corresponds with the folk wisdom in medical schools that '10% of students will cause 90% of your problems'.

In a rather more substantial study[2], Papadakis *et al* found that negative student evaluations by tutors predicted the likelihood of disciplinary action. However, they also found that written exam scores predicted the likelihood of later sanctions even though such sanctions are rarely directly related to skills or knowledge. Papadakis summarised this finding as "It's good to be good, and it's good to be smart", though this seems to contradict common experience: we do not normally observe that virtue is directly related to intelligence. Nor is disciplinary censure normally simply related to lack of knowledge: rather it seems to reflect much more complex underlying characteristics. We hypothesize that there is a common factor underlying both examination success and the probability of fitness to practice sanctions in later practice, namely the trait of conscientiousness. Conscientiousness is one of the 'Big 5' personality factors[3], the others being Openness to new experience, Extraversion, Agreeableness and Neuroticism. The work psychology literature generally identifies conscientiousness as the biggest single predictor of work place performance[4].

Between the years of 2006 and 2014, we measured the conscientiousness in routine tasks of a number of cohorts of first and second year UK medical students in a single UK medical school, as described in the Methods section. A 'Conscientiousness Index' (CI) score, based on many observations, was calculated for each student on this basis. We have previously shown that the CI correlates strongly with staff and student estimates of professionalism[5,6,7,8]. However, the CI can now be related to data held in the UK Medical Education Database (UKMED), "a platform for collating data on the performance of UK medical students and trainee doctors across their education and future career". (https://www.ukmed.ac.uk/),so that the subsequent performance of these students can be studied, and correlations between their earlier conscientiousness and their later performance on a number of measures can be explored.

METHODS

Patient and Public involvement

This was not a patient-related study; therefore, this research was done without patient involvement. This study involved collecting and collating data on medical students in a single medical school and relating it to later performance.

For our predictor variable, we calculated the 'Conscientiousness Index' (CI) for first and second year undergraduate medical students[5]. The Index included: having brought required 'Induction' information (photographs, criminal records information, immunisation status), attendance at

compulsory sessions (unless a good reason had been notified), submission of assignments on time, fulfilling essential administrative requirements (e.g. attending Base Unit allocation meetings), and completion of course evaluations. One point was awarded for each positive activity fulfilled. Typically, well over one hundred points could be awarded each year, but all results are recorded as percentages. Students were aware of the collection of the CI data. Typically, the CI distribution for a year is kurtotic, negatively skewed, with a long tail.

For outcome variables, we obtained anonymised data from the UKMED on:

(a) The UKFPO Situational Judgement Test (SJT) scores, used by the UK Foundation Programme Office (UKFPO)[9] in allocating graduating medical students to their Foundation Year 1 post. The SJT represents a 70-item selected-response test, which has predictive validity for post graduate performance[10,11]. The content domains are coping with pressure, working effectively as part of a team, effective communication, problem solving and commitment to professionalism[12].
(b) The Educational Performance Measure (EPM), also used by the UK Foundation Programme Office (UKFPO) in allocating graduating medical students to their Foundation Year 1 post, in conjunction with the SJT. The EPM represents the Decile each medical student is placed in, based on their academic performance over the first four years of their undergraduate medical programme.
(c) Scores on the Prescribing Safety Assessment (PSA)[13] relative to the pass mark. The PSA is a 60 Item written multi-format test on prescribing accuracy, required to be taken by all UK final year medical students.
(d) Annual Review of Competence Progression (ARCP) outcomes. These represent the considered judgement of a panel of experts on the readiness of trainee doctors to progress to the next level of training, on the basis of evidence provided by the trainee and other sources. A numeric score is used to describe the outcomes, as shown in Table 1, for all the outcomes coded in our database extract.

Table 1. Annual Review of Competence Progression Outcomes

Outcome	Meaning
1	Satisfactory Progress. Competencies achieved as expected.
2	May progress but requires specific targeted training to achieve certain competencies
3	Has not achieved competencies required to progress. Additional training required
4	Released from training with or without specific competencies
5	Incomplete evidence provided

Analysis

All statistical analyses were carried out securely within a 'safe haven' set up by UKMED, using SPSS v25.

Since the relationship between CI scores and all of these outcomes is likely to be complex and possibly non-linear, we made no advance assumptions about the nature of these relationship. Instead, we inspected the data graphically prior to assessing what the nature of the relationships, if any, might be.

RESULTS

As in a previous study[14], we observed that the CI is stable between years 1 and 2; analysis using a Pearson's correlation test of the combined CI scores for 3 cohorts of students showed a high degree of correlation (P = 0.001, with R = 0.54), and we therefore used the average value of both years, so that observations were based on the maximum number of data points.

Our first observation was that the 1st decile of CI scorers appears markedly different from the other deciles. Figure 1 shows the spread of CI scores in each decile, against the average score in that decile. ANOVA indicates that the deciles do not all belong to the same group [$F(9, 848) = 935.66$, $p<0.001$], and a post-hoc t-test reveals that the 1st decile differs from all other deciles ($p<0.001$, n=858).

This corresponds to a more general observation that in measurements of undergraduate student performance (for instance the UKFPO SJT), the distribution is kurtotic and negatively skewed, but with a long tail of low scorers.

Due to this initial observation, then methods such as factor analysis were considered inappropriate.

(a) Relationship of the CI with UKFPO SJT.

Figure 2 shows the relationship between CI Scores and the UKFPO SJT. Linear regression analysis shows a relationship between these two parameters ($R=0.373$, $R^2=0.139$, $B=0.066$, $p<0.001$, n=539). T-test showed a statistically significant difference between SJT scores of students scoring in the 1st decile of the CI and the other 9 deciles, ($p<0.001$).

(b) The Educational Performance Measure (EPM)

Similarly, for the EPM, the difference between the 1st decile and the other 9 deciles by t-test was calculated, ($p=0.003$, n=539). (See Figure 3)

It should be noted that the EPM decile ranking is calculated based on the assumption that all medical schools are equivalent, which we know not to be the case. This will be a significant contribution to error on the part of the EPM.

(c) The Prescribing Safety Assessment (PSA)

Figure 4 shows the scatter plot for CI scores versus PSA scores relative to the pass mark. Linear regression analysis shows $R=0.249$, $R^2=0.062$, $B=0.343$, $p<0.001$, n=462. T-test showed a statistically significant difference between PSA scores of students scoring in the 1st decile of the CI and the other 9 deciles ($p<0.001$, n=463).

(d) ARCP

ARCP scores are difficult to interpret[15]. However, Tiffin et al[16] demonstrated that PLAB scores correlate with subsequent ARCP scores, and that the relationship is at least ordinal. We compared the number of candidates with an ARCP score of 1 (which indicates that they can progress to the subsequent year of training) in the first decile with all other categories. First decile candidates had a higher average score (indicating more outcomes other than 1), as shown by t-test in Year 2 of training ($p=0.019$, n=517), but not in Year 1.

Since the probability that a student in the 1st decile is likely to fail to achieve the optimum ARCP outcome is of key importance to the predictive validity of the CI, we calculated the Odds Ratio for this outcome. Calculation of the Odds ratio in these circumstances is usual in studies of predictive

validity[16]. The Odds Ratio that students in the 1st decile of the CI score failed to achieve the optimum ARCP outcome was 1.6126 (CI 1.1400 to 2.2809, p=0.0069, n=618).

DISCUSSION

We found that there is a relationship between conscientiousness as measured in a single UK medical school by the Conscientiousness Index (CI) in an objective and scalar manner, and subsequent performance as measured by outcomes such as exam scores and OSCE scores (EPM), SJT performance, and later clinical practice, including professionalism as measured by ARCP. The results show that those scoring in the lowest decile are more likely to perform low later in their education and in clinical practice. However, these results are tentative and further research is required to fully establish the nature of the relationships.

Although use of ARCP data as an outcome measure has been challenged[17], and it certainly contains a very high proportion of Outcome 1 candidates that reduces the discrimination, (and therefore may be seen as a limitation of this study) the fact that there is a relationship between the CI and ARCP outcomes (in the same way as a relationship between assessment data and ARCP was observed by Tiffin *et al*[16]) indicates that ARCP outcomes are non-random. We therefore consider that continued use of ARCP outcomes is justifiable.

The results show predictive validity for low performance later in education and as junior doctors but do not extend to later events such as sanctions by the GMC. A limitation of this study is that it was necessarily carried out in single medical school; however, we look forward to other colleagues generalising these approaches. Indeed, future studies on a larger data set will be able to indicate if the Conscientiousness Index predicts Fitness to Practice events in the UK, in the way that Papadakis[2] observed for exam scores.

A further limitation of this study is that it is possible that students were aware that a conscientiousness measure was being applied, and as a result of this, responded by changing their behaviour, however, we did not find any evidence of this.

Conclusion and implications for clinicians and policymakers

We have already demonstrated that the CI predicts staff ratings of student professionalism and the likelihood of them receiving an adverse 'critical incident' report[5]. We have also demonstrated that the CI predicts estimates of professionalism by fellow students[6], that the CI predicts scores on knowledge tests[18] and student performance in clinical settings[7]. It is also a predictor of SJT performance, which is itself a predictor of later clinical performance[10]. Here we extend these findings to a wider range of settings, including, for the first time, postgraduate performance.

Why should conscientiousness as a student be predictive of later professionalism in clinical practice, both as senior students and as junior doctors? We postulate that this is through behaviour patterns such as good note and record keeping, good hand overs, following up patients, keeping up to date with developments, and so on. Measurement of conscientiousness in early years will then identify candidates for targeted remediation, and, if this fails, may in the ultimate case be used as a deselection tool.

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UK Medical Education Database ("UKMED") project number P77, extract generated on 05/07/2019 We are grateful to UKMED for the use of these data. However, UKMED bears no responsibility for their analysis or interpretation. The data includes information derived from that collected by the Higher Education Statistics Agency Limited ("HESA") and provided to the GMC ("HESA Data"). Source: HESA Student Record 2005/2006 to 2014/2015 Copyright Higher Education Statistics Agency Limited. The Higher Education Statistics Agency Limited makes no warranty as to the accuracy of the HESA Data, cannot accept responsibility for any inferences or conclusions derived by third parties from data or other information supplied by it.

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FOOTNOTES

Contributors:
JMcL designed the original study. MS collated the data. Both MS and JMcL contributed equally to the analysis and interpretation of the data, the drafting of the manuscript and the revision of the manuscript. Both authors approved the final version to be published; and both agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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The study was granted ethical clearance by the Ethics Committee of a UK Medical School, approval reference ESC2/2017/PP02. All UKMED projects that use solely UKMED-held data have a blanket exemption from ethics application. This exemption has been confirmed by Queen Mary University of London Research Ethics Committee, on behalf of all UK medical schools.

Competing interests statement:
None declared.

Author contributions:
The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. Both authors made substantial contributions to the conception or design of the work, the acquisition, analysis, and interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Patient consent for publication:
Not required.

Data sharing statement:
Upon reasonable request in writing, the authors are willing to share the Contentiousness Index data however, as the outcome data was analysed in a safe haven, authors no longer have access to this data from the UK Medical Education Database (UKMED). Requests for this data must be made to the UKMED research subgroup.

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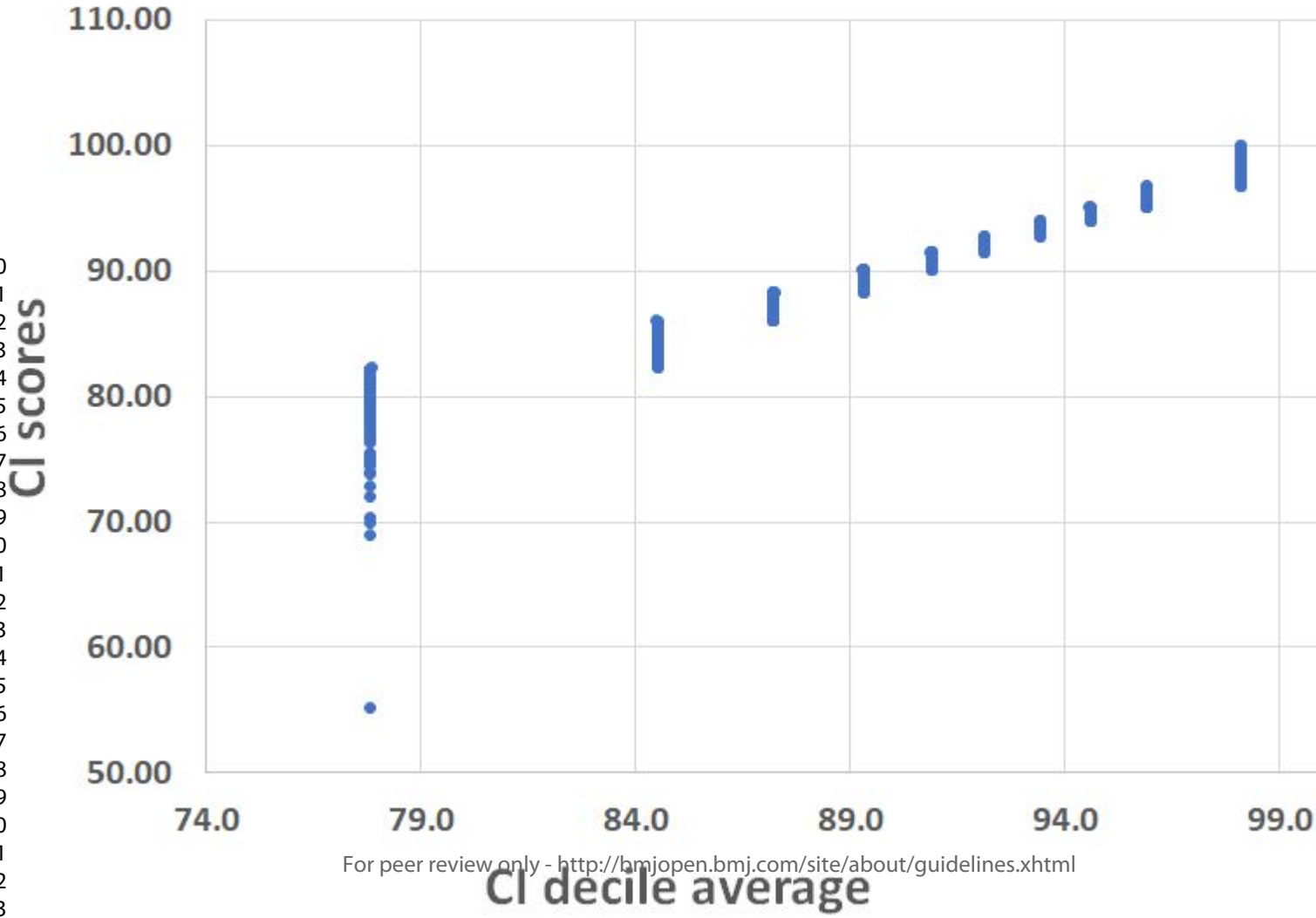
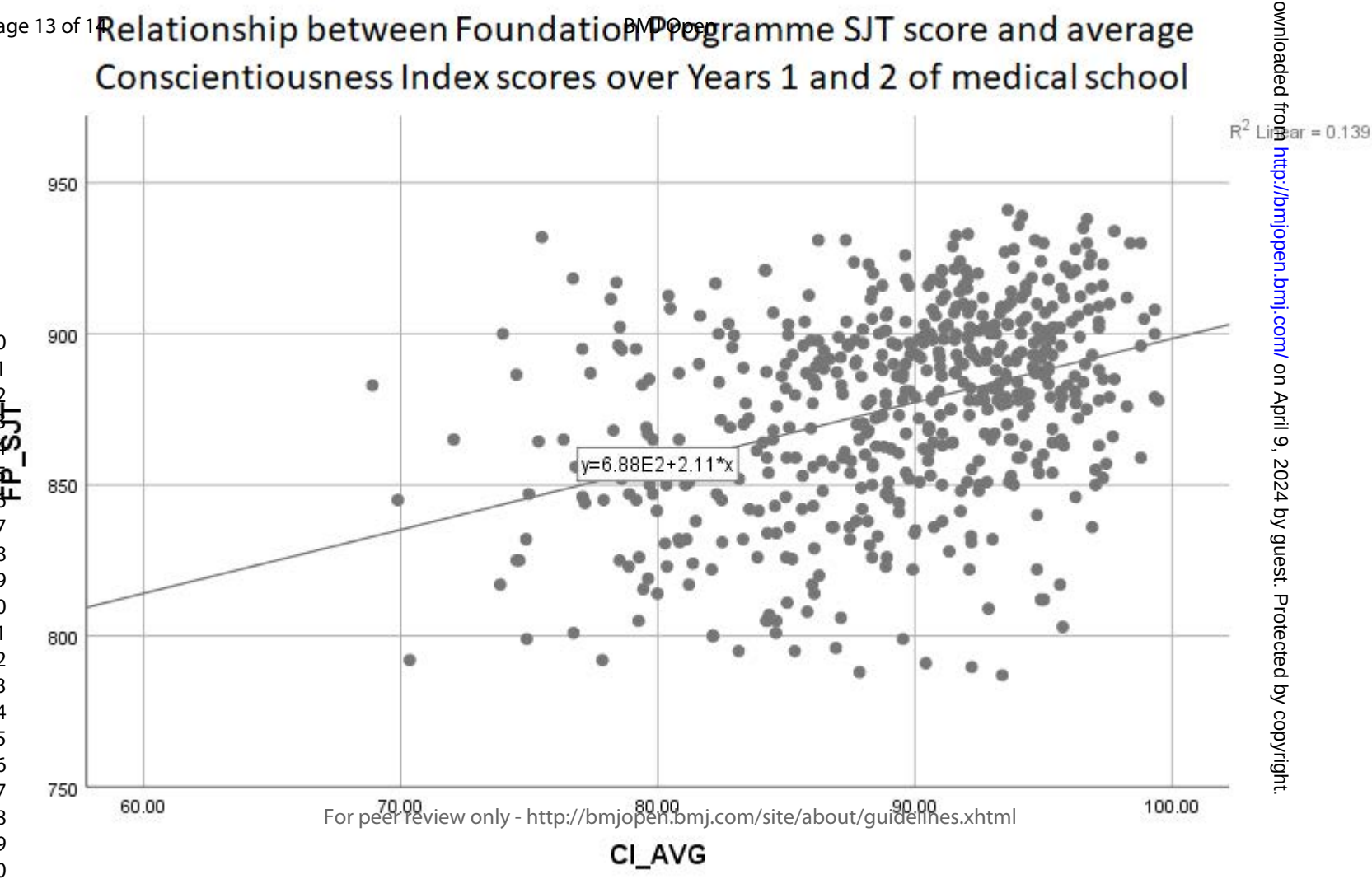
Figure 1 The spread of Conscientiousness Index scores in each decile, against the average score in that decile. ANOVA indicates that the deciles do not all belong to the same group [$F(9, 848) = 935.66$, $p<0.001$], and a post-hoc t-test reveals that the 1st decile differs from all other deciles ($p<0.001$, $n=858$).

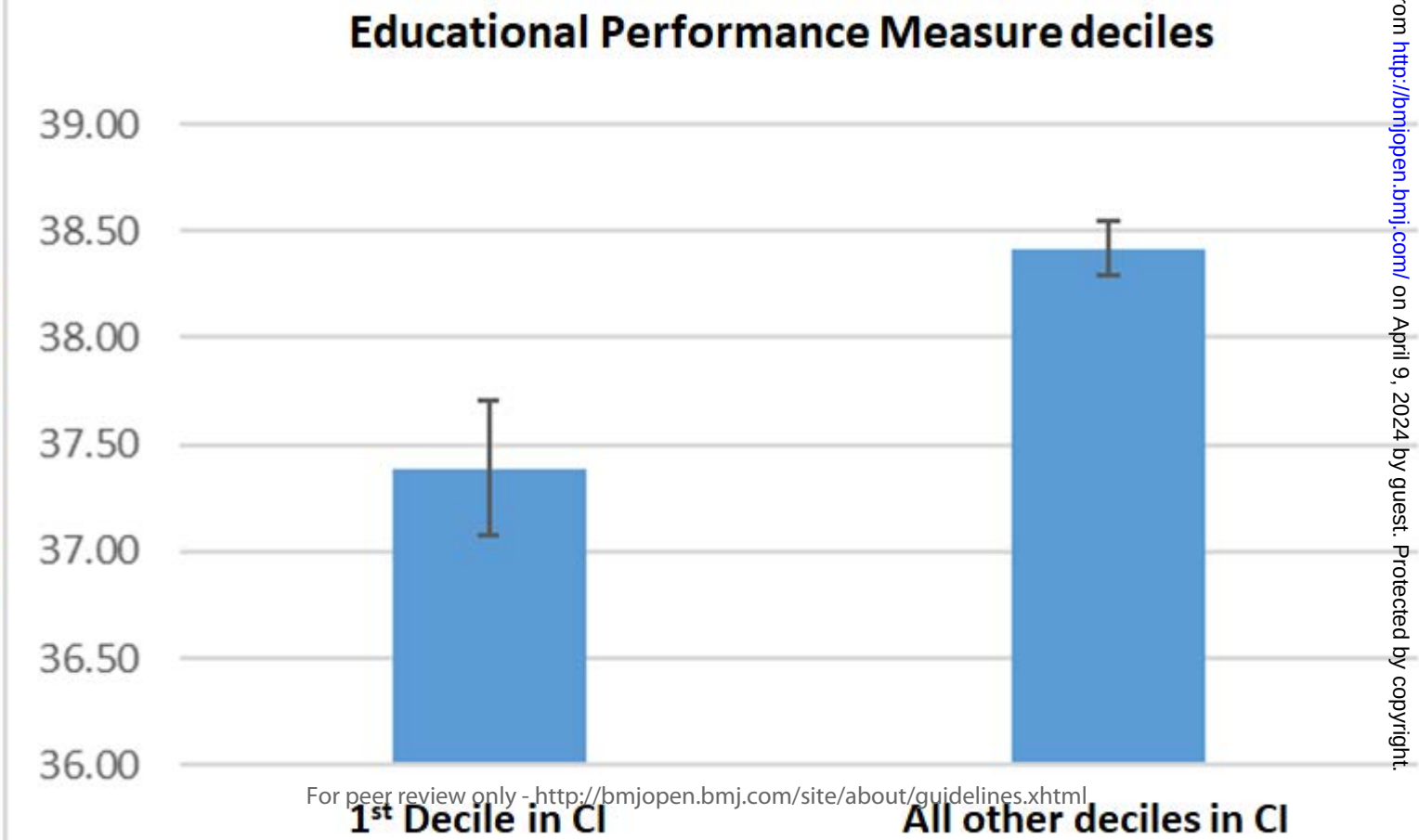
Figure 2 Scatter plot of Conscientiousness Index scores against Situational Judgement Test (SJT) scores. Linear regression analysis shows a statistically significant positive relationship ($R=0.373$, $R^2=0.139$, $B=0.066$, $p<0.001$, $n=539$).

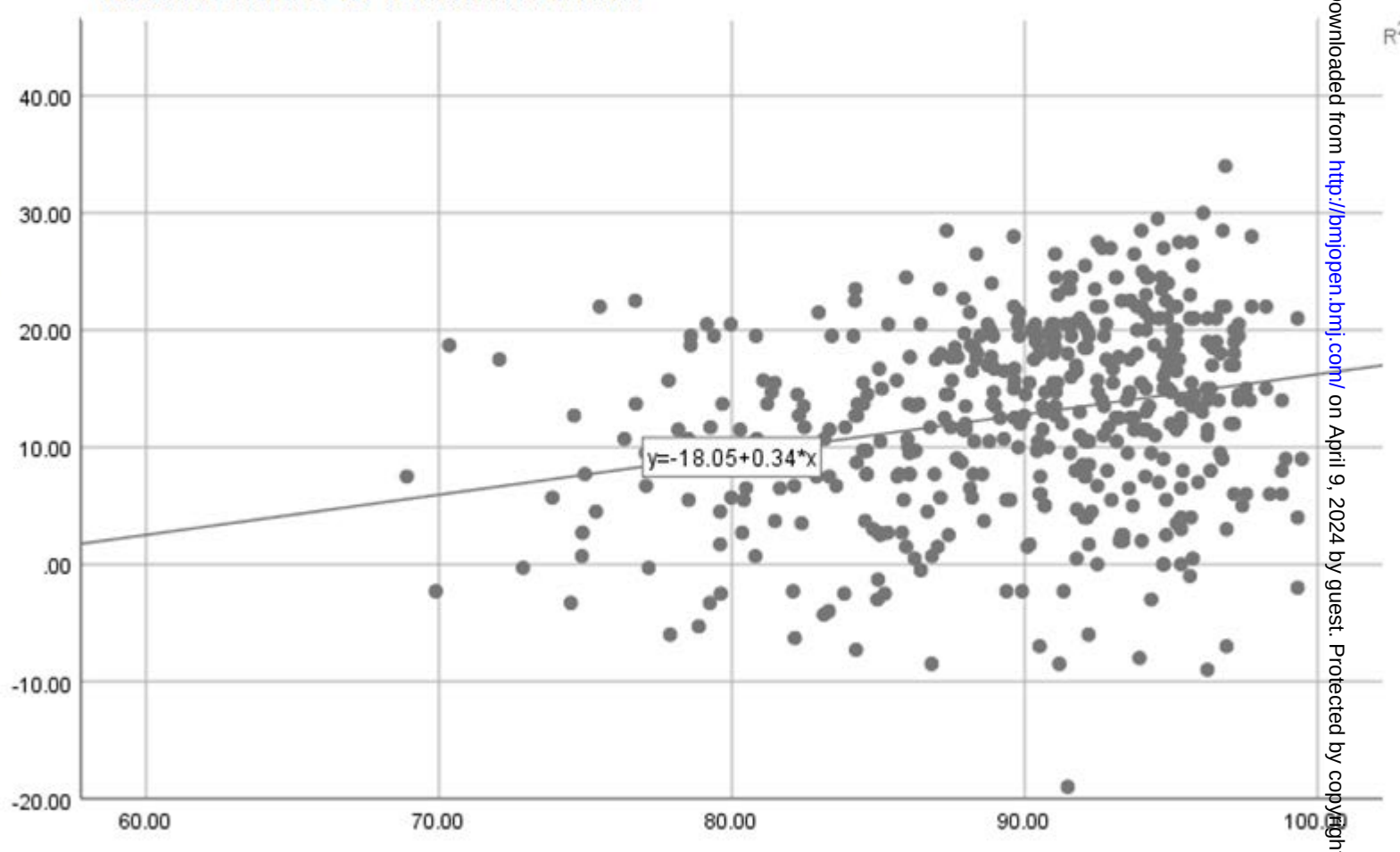
Figure 3 The Educational Performance Measure decile scores for those in 1st decile of the Conscientiousness Index, and the other 9 deciles. Analysis by t-test shows the 1st decile is significantly different to the rest ($p=0.003$, $n=539$).

Figure 4 Scatter plot of Conscientiousness Index scores against Prescribing Safety Assessment scores relative to the pass mark. Linear regression analysis shows a statistically significant positive relationship ($R=0.249$, $R^2=0.062$, $B=0.343$, $p<0.001$, $n=462$).









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Keywords

Conscientiousness, professionalism, predictive validity, clinical performance

ABSTRACT

• **Objectives** Our aim was to explore the relationship between medical student Conscientiousness Index scores and indicators of later clinical performance as held in the UK Medical Education Database. Objectives were to determine whether conscientiousness in first and second year medical students predicts later performance both in medical school and in early practice. Policy implications would permit targeted remediation where necessary or aid in selection.
• **Design** Prospective correlational study
• **Setting** Medical school and early years of practice, 2005-2018.
• **Participants** Data were obtained from the UK Medical Education Database (UKMED) on 858 students. Full outcome data was available for variable numbers of participants, as described in the text.
• **Main outcome measures** Outcomes in the UK Foundation Programme Office's Situational Judgement Test (SJT) and Educational Performance Measure (EPM), the Prescribing Safety Assessment (PSA), and Annual Review of Competency Progression (ARCP) outcomes.
• **Results** Linear regression analysis shows Conscientiousness Index scores significantly correlate with pre- and postgraduate performance variables; Foundation Programme application SJT scores ($R=0.373$, $R^2=0.139$, $B=0.066$, $p<0.001$, effect size=0.70, n=539), PSA scores ($R=0.249$, $R^2=0.062$, $B=0.343$, $p<0.001$, effect size=0.59, n=462). EPM decile scores for the 1st (lowest) decile are significantly lower than the remaining 90% (effect size=0.39, P=0.003, n=539), as are PSA scores (effect size=0.59, p<0.001, n=463), and ARCP Year 2 scores (effect size=0.34, p=0.019, n=517). The Odds Ratio that students in the 1st decile fail to achieve the optimum ARCP outcome is 1.6126 (CI 1.1400 to 2.2809, p=0.0069, n=618).
• **Conclusions** Conscientiousness in Year 1 and 2 of medical school has predictive value for later performance in knowledge, skills and clinical practice. This trait could be used either for selection, or for targeted remediation to avoid potential problems in the future.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Other medical schools use similar approaches to the CI, of which the most straightforward is attendance at compulsory events, so the essence of the methodology used here and relevant data are not confined to this one medical school.

- Approaches such as the systematic measurement of conscientiousness in routine tasks appear to be strongest at the lower end of the scale as a predictor of professional in later academic and clinical practice, therefore, they are probably best applied with big data sets, and where there is a high applicant/placement ratio.

- We believe the Conscientiousness Index to be sensitive, but not specific, in that those who fail on professionalism are likely to have done badly on the CI and similar metrics, but those who have scored low on the CI will not necessarily fail subsequently.

INTRODUCTION

In 2002 Wright and Tanner published an article in the BMJ indicating that students who failed to bring passport photographs on induction as requested were significantly more likely (48%, as opposed to 8% for those who brought a photograph) to fail second year exams[1]. This observation was greeted with wry amusement by many of those in close contact with medical students, who clearly recognised the general phenomenon and could probably have named individual medical students from their experience who corresponded to this stereotype. It also matches the folk wisdom in medical schools that '10% of your medical students will cause 90% of your problems'.

In a rather more substantial study[2], Papadakis et al found that negative student evaluations by tutors predicted the likelihood of successful disciplinary action, which is unsurprising. However, they also found that written exam scores also predicted the likelihood of later sanction even though such sanctions are rarely directly to do with skills or knowledge. Papadakis summarised this finding as "It's good to be good, and it's good to be smart". On the face of it, this seems to contradict common experience: we do not normally observe that virtue is directly related to intelligence. Nor is disciplinary censure normally simply related to lack of knowledge: rather it seems to reflect much more complex underlying characteristics. We hypothesized instead that there was a common factor underlying both exam scores and the probability of fitness to practice sanctions in later practice. A strong candidate is the trait of conscientiousness. This is one of the 'Big 5' personality factors, where the others are openness to new experience, extraversion, agreeableness and neuroticism. Work psychology literature generally identifies conscientiousness as the biggest single predictor of work place performance, and it seems unlikely that medicine is different.

Between the years of 2006 and 2014, we measured the conscientiousness in routine tasks of a number of cohorts of first and second year UK medical students, as described in the Methods section. A 'Conscientiousness Index' (CI), based on many observations, was calculated for each student on this basis. We have previously shown that the CI correlates strongly with staff and student estimates of professionalism [3,4,5,6]. However, the CI can now be compared with data held in the UK Medical Education Database (UKMED), "a platform for collating data on the performance of UK medical students and trainee doctors across their education and future career". (https://www.ukmed.ac.uk/). With the availability of the UKMED database, the subsequent performance of these students can now be studied, and correlations between their earlier conscientiousness and their later performance on a number of measures can be explored.

METHODS

Patient and Public involvement

This was not a patient-related study; therefore, this research was done without patient involvement.

The study was granted ethical clearance by the Ethics Committee of a UK Medical School, approval reference ESC2/2017/PP02. All UKMED projects that use solely UKMED-held data have a blanket exemption from ethics application. This exemption has been confirmed by Queen Mary University of London Research Ethics Committee, on behalf of all UK medical schools.

For our Predictor Variable, we calculated the 'Conscientiousness Index' (CI) for first and second year undergraduate medical students[3]. The Index included: having brought required 'Induction' information (photographs, criminal records information, immunisation status), attendance at compulsory sessions (unless a good reason had been notified), submission of assignments on time, fulfilling essential administrative requirements (e.g. attending Base Unit allocation meetings), and completing course evaluations. One point was awarded for each positive activity fulfilled. Typically,

well over one hundred points could be awarded each year, and all results are described as percentages. Students were aware of the collection of the CI data. Typically, the CI distribution for a year represented a kurtotic, negatively skewed, normal distribution with a long tail.

For outcome variables, we obtained anonymised data from the UKMED on:

(a) The UKFPO Situational Judgement Test (SJT) scores, used by the UK Foundation Programme Office (UKFPO)[7] in allocating graduating medical students to their Foundation Year 1 post. The SJT represents a 70-item selected-response test.
(b) The Educational Performance Measure (EPM), also used by the UK Foundation Programme Office (UKFPO) in allocating graduating medical students to their Foundation Year 1 post, in conjunction with the SJT. The EPM represents the Decile each medical student is placed in, based on their academic performance over the first four years of their undergraduate medical programme.
(c) Scores on the Prescribing Safety Assessment (PSA)[8] relative to the pass mark. The PSA is a 60 Item written multi-format test on prescribing accuracy, required to be taken by all UK final year medical students.
(d) Annual Review of Competence Progression (ARCP) outcomes. These represent the considered judgement of a panel of experts on the readiness of trainee doctors to progress to the next level of training, on the basis of evidence provided by the trainee and other sources. A numeric score is used to describe the outcomes, as shown in Box 1, for all the outcomes coded in our database extract.

Box 1. Annual Review of Competence Progression Outcomes

Outcome	Meaning
1	Satisfactory Progress. Competencies achieved as expected.
2	May progress but requires specific targeted training to achieve certain competencies
3	Has not achieved competencies required to progress. Additional training required
4	Released from training with or without specific competencies
5	Incomplete evidence provided

Analysis

All statistical analyses were carried out securely within a 'safe haven' set up by UKMED, using SPSS v25.

Since the relationship between CI scores and all of these outcomes is likely to be complex and possibly non-linear, we made no advance assumptions about the nature of these relationship. Instead, we displayed the data graphically prior to assessing what the nature of the relationships, if any, might be.

RESULTS

As in a previous study[9], we observed that the CI is stable between years 1 and 2, and we therefore used the average value of both years, so that observations were based on the maximum number of data points.

Our first observation was that the 1st decile of CI scorers appears markedly different from the other deciles. Figure 1 shows the spread of CI scores in each decile, against the average score in that decile. ANOVA indicates that the deciles do not all belong to the same group, and a post-hoc t-test reveals that the 1st decile differs from all other deciles (p=0.000, effect size=2.90, n=858).

This corresponds to a more general observation that in measurements of undergraduate student performance (for instance the UKFPO SJT), the distribution is kurtotic and negatively skewed, but with a long tail of low scorers.

This initial observation coloured our subsequent analyses markedly: if this is the case, then methods such as factor analysis may well be inappropriate.

(a) Relationship of the CI with UKFPO SJT.

Figure 2 shows the relationship between CI Scores and the UKFPO SJT. Linear regression analysis shows a relationship between these two parameters (R=0.373, R^2=0.139, B=0.066, p<0.001, n=539). We also calculated the difference between the 1st decile and the other 9 deciles by t-test, (p=0.000, effect size=0.70).

(b) The Educational Performance Measure (EPM)

Similarly for the EPM, the difference between the 1st decile and the other 9 deciles by t-test was calculated, (p=0.003, effect size=0.39, n=539). (See Figure 3)

It should be noted that the EPM is calculated based on the assumption that all medical schools are equivalent, which we know not to be the case. This will be a significant contribution to error on the part of the EPM.

(c) The Prescribing Safety Assessment (PSA)

Figure 4 shows the scatter plot for CI scores versus PSA scores relative to the pass mark. Linear regression analysis shows R=0.249, R^2=0.062, B=0.343, p=0.000, n=462. Comparison of the 1st decile with the other deciles indicates an effect size of 0.59, p=0.000, n=463.

(d) ARCP

ARCP scores are difficult to interpret[10]. However, Tiffin et al [11] demonstrated that PLAB scores correlate with subsequent ARCP scores, and that the relationship is at least ordinal. We compared the number of candidates with an ARCP score of 1 (which indicates that they can progress to the subsequent year of training) in the first decile with all other categories. First decile candidates had a higher average score (indicating more outcomes other than 1), as shown by t-test in Year 2 of training (effect size=0.34, p=0.019, n=517), but not in Year 1.

We considered that this data was also suitable for an Odds Ratio calculation. The Odds Ratio that students in the 1st decile failed to achieve the optimum ARCP outcome was 1.6126 (CI 1.1400 to 2.2809, p=0.0069, n=618).

DISCUSSION

We believe that there is a relationship between conscientiousness as measured by the Conscientiousness Index (CI) in an objective and scalar manner, and, as we have observed, subsequent performance as measured by outcomes such as exam scores and OSCE scores (EPM), SJT performance, and later clinical practice, including professionalism as measured by ARCP. Now we have established the nature of the data relationships, more complex studies can undoubtedly be carried out.

Although use of ARCP data has been challenged, and certainly contains a very high proportion of Outcome 1 candidates which reduces the discrimination, the fact that there is a relationship between the CI and ARCP outcomes (in the same way as a relationship between assessment data and ARCP was observed by Tiffin et al[11]) indicates that ARCP outcomes are non-random. We therefore consider that continued use of ARCP outcomes is justifiable.

Future studies will be able to indicate if Conscientiousness predicts Fitness to Practice events in the UK, in the way that Papadakis[2] observed for exam scores.

Conclusion and implications for clinicians and policymakers

We suspect that conscientiousness as a student is related to assessment scores in that a student or trainee who conscientiously engages with training is likely to lead to good assessment scores. But why should conscientiousness as a student be predictive of later professionalism in clinical practice? Perhaps this is through behaviour patterns such as good note and record keeping, good hand overs, following up patients, keeping up to date with developments, and so on. Perhaps such characteristics should be measured early in training programmes or even in selection. Remediation could then be targeted to those who most need it, or indeed, in the ultimate case used as a deselection tool.

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Not required.

Data sharing statement:
Upon reasonable request in writing, the authors are willing to share the Contentiousness Index data however, as the outcome data was analysed in a safe haven, authors no longer have access to this data from the UK Medical Education Database (UKMED). Requests for this data must be made to the UKMED research subgroup.

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Figure 1 The spread of Conscientiousness Index scores in each decile, against the average score in that decile. ANOVA indicates that the deciles do not all belong to the same group, and a post-hoc t-test reveals that the 1st decile differs from all other deciles (p=0.000, effect size=2.90, n=858).

Figure 2 Scatter plot of Conscientiousness Index scores against Situational Judgement Test (SJT) scores. Linear regression analysis shows a statistically significant positive relationship (R=0.373, R^2=0.139, B=0.066, p<0.001, n=539).

Figure 3 The Educational Performance Measure decile scores for those in 1st decile of the Conscientiousness Index, and the other 9 deciles. Analysis by t-test shows the 1st decile is significantly different to the rest (p=0.003, effect size=0.39, n=539).

Figure 4 Scatter plot of Conscientiousness Index scores against Prescribing Safety Assessment scores relative to the pass mark. Linear regression analysis shows a statistically significant positive relationship (R=0.249, R^2=0.062, B=0.343, p=0.000, n=462).