Intercalation predicts improved academic performance across the medical undergraduate curriculum

Seethalakshmi Muthalagappan[2], India Wheeler[3], Rachel Bruton[4], Paul Stewart[5], Lesley Roberts[6]

Corresponding author: Prof Lesley Roberts Lesley.m.roberts@warwick.ac.uk
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Abstract

Introduction: Intercalation has significant costs and students need to balance these with information about potential benefit. Thus this study sought to identify whether undertaking an intercalated degree impacted upon exam performance in the primary medical qualification.

Methods: Retrospective case-matched data analyses of anonymised student databases from the University of Birmingham Medical School. 171 students who intercalated, were matched for MBChB performance with students from the same cohort who did not intercalate. Individual student change in overall year mark (percentage), between two consecutive years of the MBChB, was compared between groups.

Results: There was a significant difference (t(170)=4.095, p<0.001) in change in mark in the intercalation group (mean improvement = 4.48, SD = 6.16) compared with the non-intercalation group (mean improvement = 2.11, SD = 5.04). Intercalation within the home institution, earlier in the MBChB degree and female gender also had positive effects on change in mark.

Conclusion: Students from the University of Birmingham who undertook an intercalated degree demonstrated significant improvements in academic performance. This finding supports evidence from other single institution studies and confirms positive impact of intercalation. Threats to financial support for intercalated degrees may therefore be detrimental in the education of tomorrow’s doctors.

Keywords: Intercalated; Performance
Introduction

Traditionally, it has been estimated that approximately one-third of medical students in the UK undertake an intercalated degree. (Nicholson et al. 2010) (Cleland et al. 2009) This additional year may be optional or an integral part of a six year course. (McManus et al. 1999) (Morrison 2004)

The decision of whether to undertake an intercalated degree is an important dilemma for medical students in the face of rising education costs and associated student debt. Amongst students who chose not to intercalate primary the main reasons expressed relate to the additional time and cost. (Mahesan et al. 2011) There is increasing focus on the importance of this decision as competition for foundation year jobs heightens and students perceive a need to balance the addition of points which may secure a preferred foundation post with the additional cost (both actual and via an additional unsalaried year). Intercalated students are over represented in academic pathways (e.g. Academic Clinical Fellowships, external peer reviewed clinical training fellowships) but this may represent a selection issue. Despite this, research remains in equipoise regarding the potential benefits of undertaking an intercalated degree as part of undergraduate medical training. (Cleland et al. 2009) (McManus et al. 1999) (Mahesan et al. 2011) (Tait and Marshall 1995) Moreover, students have eluded that the absence of this clear evidence base was a contributing factor leading to the decision to not undertake an intercalated degree (Nicholson et al. 2010).

The potential benefits of completing an intercalated degree have been emphasised by prior research which has focused on both the long term advantages (McManus et al. 1999) (Wyllie and Currie 1986) as well as the short term academic rewards (Cleland et al. 2009) (Mahesan et al. 2011). McManus at al's (1999) large scale prospective study investigating the learning styles and career interests of final year medical students, concluded that the undertaking of an intercalated degree resulted in a decreased tendency to memorise facts for examinations, and improved integrated learning strategies across different clinical specialities. Interestingly, these authors also suggested that those students who intercalated had an increased motivation to be successful rather than an overriding fear of failure that was observed in their non-intercalating colleagues. These findings are supported by studies conducted in Aberdeen (Cleland et al. 2009) and Kings College London (Mahesan et al. 2011) which assessed the impact of intercalation on short term academic performance and identified that the addition of an intercalated year resulted in improved overall exam results in the years subsequent to intercalation. This improved performance has been highlighted as an indication of improved future career progression (Nicholson et al. 2010), not only due to an increase in clinical knowledge but also due to elevated ranking in the United Kingdom Foundation Programme (UKFPO) (Mahesan et al. 2011). Not only do the points allocated to the intercalation degree (up to 4 points are currently awarded) elevate UKFPO ranking, but research success such as publication outputs that occur often alongside intercalation also increase UKFPO ranking (Nicholson et al. 2010). Thus successful intercalation may significantly boost a student’s application. Skills obtained through the intercalated degree may further support those students choosing to apply for an Academic Foundation Programme (Woolliscroft 2004) (Greenhalgh 2003).

Despite this evidence, recent studies have documented a fall in the number of students that are intercalating in certain medical schools in the UK (Nicholson et al. 2010). This decrease could be explained by a number of factors. Firstly, there is evidence, disputing the previous data that have been presented, which questions the short term academic advantages of undertaking the intercalated degree. Research carried out at University College London (Howman and Jones 2011) compared subsequent academic performance in students who intercalated after year 2 to peers who did not intercalate at this point (but would have done later as the intercalated year is compulsory), looking particularly at exam grades after their 3rd year of study. After adjusting for potential confounders such as baseline academic performance in the 2nd year of study, researchers concluded that intercalating had no influence on the third year exam results. This could be explained by the difference in learning environment at UCL where intercalation is
integral to the medical course, a fact which itself may attract students with academic focus. Hence the results from an institution where intercalation is compulsory, may not be comparable to institutions where students voluntarily opt to intercalate.

In addition, much of the previous research on intercalation has focussed on the progression of intercalated students into an academic career post (Wyllie and Currie 1986) (Howman and Jones 2011) (Nguyen-Van-Tam et al. 2001), which may deter some individuals who do not have such aspirations. Despite this previous focus, more recent studies have highlighted the benefits of an intercalated degree in routine clinical medicine perhaps suggesting a more rigorous approach to clinical research, resulting in an increased tendency to practice evidence based medicine (Cleland et al. 2009).

The current evidence base for the benefits of intercalated degrees highlights a level of indecision that remains within the medical education community regarding intercalation. The only evidence to date relating specifically to the University of Birmingham is inconclusive due to a small sample (Tait and Marshall 1995). The medical school at the University is one of the largest in the country and provides an integrated learning environment combining problem based learning (PBL) with traditional lecture techniques. Intercalated degrees offered by the University are highly research-focused. Given the unique nature of intercalated programmes there is a need for local evaluation of impact. Furthermore, although the studies highlighted in this literature review, have commented on the effect of an intercalated degree on short term academic performance (Cleland et al. 2009) (Mahesan et al. 2011) as well as future impact on career pathways (McManus et al. 1999), little research has been reported which considers whether the intercalated subject chosen has any additional influence.

Further studies utilising heterogeneous institutions are needed in order to gain a better understanding of the impact of intercalation on subsequent academic performance (Cleland et al 2009). In the face of potential threats to Health Education England/ NHS support for intercalation and later proposals to replace bursaries and fees with student loans (Stubbs 2016), the primary aim of this study was to analyse the effect of intercalation upon academic performance of students, addressing their concerns regarding the concept they may be disadvantaged through intercalation, but also to inform student choice in intercalation. This was done through comparison of academic performance on the core medical course of medical students who opted to undertake an intercalated degree as part of the traditional MBChB programme to those who did not. The primary focus was on change in overall year mark between consecutive years of the MBChB which either were or were not separated by an intercalated year. Secondary objectives included determining whether intercalation subject impacts on performance change, and determining whether any identified differences hold true for both students intercalating in their home institution and those who did an intercalated degree at an external institution.

Methods

Type of study

Retrospective case-matched analysis of anonymised student academic performance as recorded in databases held by the University of Birmingham Medical School.

Place of study

The University of Birmingham Medical School offers experience of the largest health region in the United Kingdom, with a correspondingly large annual intake of around 360 to the core 5-year programme; including applicants from
home and abroad.

Applicants who intercalate internally, at the University of Birmingham, are able to choose from several programmes of study which can loosely be termed under three broad intercalation disciplines; Clinical Sciences, Biological Sciences and Population Sciences and Humanities. Approximately 25% of students currently opt to intercalate either internally or through the process of an academic leave of absence and the completion of an intercalation in another UK institution.

**Study population**

All medical students in the 2000-2010 intercalation cohorts inclusive were eligible for recruitment to this study. This included students who intercalated after years 2, 3 or 4 as all options were permitted. Only those records where full recording of intercalation option was available were utilised; where data were missing, no identified pattern was determined.

**Inclusion criteria**

A case-match was achieved using year records and by selecting a student from the same initial year cohort who had an identical academic performance (mean year mark) but who did not intercalate. Matching was undertaken on the basis of:

1. Mean Academic Score (MAS). A student with an identical mark was selected where possible but where no such student existed those students who score 1% above or below were eligible for selection as the control.
2. Gender was matched when possible.

**Exclusion criteria**

Graduate entry students were not included in this study. Students who came from other institutions to undertake the intercalated course at Birmingham were also not included. Students who did not return to study on the MBChB programme after completion of an intercalated degree were excluded.

**Data collection**

**Primary outcome**

Individual academic mark change (improvement or decrease) from initial year (the year prior to intercalation for cases and the matched year for controls) to subsequent MBChB year (the year after intercalation for cases and matched year for controls)

**Calculation of academic improvement**

Individual change in overall year mark, between two consecutive years of the MBChB, were compared across groups. This study used exam result matching to allow meaningful comparison between students without the confounding effect of prior academic ability.

The overall academic marks used in this comparison contain the results of all forms of degree assessment, including Extended Matching Questions (EMQs), Multiple Choice Questions (MCQ), Objective Structures Clinical Exams (OSCEs), essay projects and professional presentations. For this analysis, only the overall academic marks were compared as it is these which contribute to ranking and UKFPO application. In all cases the mark used was the mark
obtained during the ‘first sit’ of the assessment - in cases where extenuating circumstances confirmed a student should have a further first sit (rather than resit) opportunity this mark was included as the first attempt at the assessment.

**Clarification of Co-Variables**

Intercalation location was categorised as internal if the student stayed within the University of Birmingham to intercalate, or external if they intercalated outside the University of Birmingham.

Intercalation discipline was grouped depending on whether focus was best defined as biological sciences, clinical sciences or population sciences (including humanities).

**Statistical Analysis**

Analysis was undertaken in SPSS (IBM SPSS Statistics 19). The respective cohorts were defined using summary statistics and normal distribution of data confirmed. Paired T-tests were then used to compare the mean academic change in mark between the intercalating and non-intercalating student groups.

Multivariable linear regression analysis was undertaken to explore the relationship between intercalating and subsequent academic performance using a forward stepwise approach. Primary analysis explored the impact of intercalation and gender on associated performance change. Secondary analyses explored factors relating to intercalation such as degree discipline, year and location in those who choose to intercalate.

As this was a retrospective analysis of an anonymised database, ethical approval was not deemed to be required. The study was instigated and supported by the Dean’s management team.

**Results**

**Demographics**

The final sample included 342 students. Of these 342, 171 were cases (i.e. had completed an intercalated degree after the end of year 2, 3 or 4 of their MBChB degree), and 171 were control subjects who had not intercalated. Gender matching was not possible in all cases after academic mark had been matched, resulting in an overall gender distribution of 121 males and 221 females.

Of the 171 intercalating students, 103 (60.2%) were female and 68 (39.8%) were male, which reflects the intake of medical school. The intercalation cohort comprised 145 (84.8%) students who intercalated internally (within the University of Birmingham) and 26 (15.2%) students who intercalated externally.

**Intercalation versus Non-intercalation**

There was a significant difference in change in mark (t(170) = 4.095, p<0.001), between the intercalation group (mean improvement = 4.48 percentage points, SD = 6.16, and non-intercalation group (mean improvement = 2.11 percentage points, SD = 5.04). Specifically our results suggest that students who intercalate demonstrate greater improvement in their examinations the following year than those who progress through the MBChB without intercalation.
Given that we were unable to fully match students on the basis of both gender and mean academic mark, sensitivity analyses using only the sub-sample matched on both variables was undertaken which demonstrated findings held true for this group with the intercalation group having a mean improvement of 5.37 percentage points, SD = 6.20 versus 2.01 percentage points, SD = 4.46 in the non-intercalating group (t(83) = 3.913, p < 0.001).

**Effects of co-variables on performance change**

Given failure to fully gender match multiple linear regression was used to predict change in mark with regards to intercalation status when gender has been accounted for (table 1). This model explained only 5.1% of the variance in change in mark suggesting influence of several unmeasured factors, as would be expected and demonstrated that intercalation explains a change in mark of 2.50 percentage points, when variance explained by gender is controlled for.

When considering factors predictive of mark change in individuals who chose to intercalate three independent variables; location, gender and MBChB year made a unique and statistically significant contribution to the final intercalation model (table 2). The final model was able to explain only 7.4% of the variance in change in mark. Intercalation location and gender conferred significant contributions to the change in mark by 3.74 and 3.08 units respectively, with those intercalating within their own institution and females demonstrating greater increase in performance. Independent samples t-test confirmed that the mean change in mark was 5.7 percentage points in females and 2.95 percentage points in males. Choice of intercalation discipline and point at which intercalation occurred within the MBChB did not impact significantly on change in mark although data suggests that intercalating earlier in the MBChB course may confer greater advantage to academic performance the following year.

**Table 1: Multiple Linear Regression Model for determining the effect of intercalation on change in mark the following year in both groups (when gender has been accounted for)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardised Coefficient (Beta Value)</th>
<th>t</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (Change in Mark)</td>
<td>4.764</td>
<td>3.511</td>
<td>0.001</td>
</tr>
<tr>
<td>Gender</td>
<td>1.383</td>
<td>2.177</td>
<td>0.030</td>
</tr>
<tr>
<td>Intercalation Status</td>
<td>2.496</td>
<td>-4.109</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*R squared 0.051*

**Table 2: Multiple Linear Regression Model for determining the effect of variables on change in mark the following year in the Intercalation group**

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardised Coefficient (Beta Value)</th>
<th>t</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (Change in Mark)</td>
<td>8.516</td>
<td>2.478</td>
<td>0.014</td>
</tr>
<tr>
<td>Gender</td>
<td>3.084</td>
<td>3.164</td>
<td>0.002</td>
</tr>
<tr>
<td>MBChB Year</td>
<td>1.452</td>
<td>-1.680</td>
<td>0.095</td>
</tr>
<tr>
<td>Degree Discipline</td>
<td>0.125</td>
<td>-0.212</td>
<td>0.833</td>
</tr>
</tbody>
</table>
Discussion

The decision to intercalate is an ongoing challenge faced by medical students across the country. Whilst it is clear that having the extra points for the Foundation Programme from an intercalated degree is theoretically beneficial, academic ranking in medical school also carries significant importance in securing one's first choice foundation school. In light of contradictory findings from previous studies and in recognition of the need for local evaluation due to difference in intercalated offerings, our study assessed whether intercalation impacted on students’ performance within the MBChB programme the following year, with the aim to provide an evidence base to inform student decisions.

Like similar research done in Kings College London (Mahesan et al. 2011), this study was based on retrospective data analysis of anonymised student records, but assessed the impact of intercalating on exam performance the following year, as opposed to final examination performance and effects on the foundation programme. Our study is unique in controlling for the impact of gender on performance change which is important given differences in performance trajectories for males and females. Additionally our study presents novel findings on the impact of other factors such as type of intercalation degree and external versus internal intercalation, which previous literature has not accounted for.

Our study demonstrates that students who intercalated had a greater change in overall performance during subsequent MBChB study than those who did not intercalate. Multiple linear regression suggests that intercalating earlier in the MBChB course is associated with greater performance improvement, as is intercalating at one's home institution. A plausible explanation for this would be the seamless ability to continue studies post intercalation with little personal transition. Gender was also associated with improvement, with females demonstrating greater levels of performance enhancement. It was notable that intercalation discipline did not impact on performance in the MBChB suggesting that the benefits of intercalation are independent of discipline and are achieved through generic study skill improvement or factors such as greater academic maturity or reflection skills. (Schiefele et al 2003) (Kesici et al 2009) (Virtanen and Nevgi 2010) Organisational, writing and analytical skills are key to future examination success and may be developed during an intercalated year. It is also possible that where application for intercalation is competitive (as was the case at this time), the selection process is itself identifying those with greatest potential. Intercalation encourages higher strategic and deep learning scores, alongside lateral thinking and critical analysis, providing students with skills that they would not have otherwise obtained from the medical degree (Nicholson et al 2010) (Mahesan et al 2011) and it is therefore reasonable to assume that application of critical thinking is beneficial to some of the more demanding examinations in later years.

The positive effects of intercalation may be more prominent in institutions such as the University of Birmingham, where not all students choose to intercalate, unlike institutions where intercalation is compulsory. McManus et al suggest that the effect of intercalation is most powerful when a small proportion of students intercalate (McManus et al 1999).  

Literature on the impact of gender on academic achievement, in disciplines both within and outside medicine, is mixed. Whilst no gender differences in general cognitive ability have been evidenced (Ruffling et al. 2015), Marrs
and Sigler (2012) reported that gender differences do exist in the application of learning strategies. Male students have been found to use critical evaluation and relationships more, whereas females apply a larger variety of learning strategies easily (Kesici et al 2009) (Virtanen and Nevgi 2010), perhaps suggesting a difference in attitude towards academic study within the genders. However research relating specifically to medical student examination performance shows similar findings to our study, suggesting better performance in females than their male counterparts (Haist et al 2012) (Haq et al 2005) (McDonough et al 2000).

The main strength of this study was use of retrospective natural data, which included students who chose to intercalate at different time points with within cohort matching to account for baseline performance. We were inclusive of students intercalating at the ends of years 2, 3 and 4 as opposed to a single year group. Unlike previous studies, we chose not to assess age and maturity as we believe these factors carry extensive homogeneity. As one of many UK medical schools where intercalation is not compulsory, our results may be generalizable to several other institutions, thus enabling the wider student cohort to make informed decisions about intercalation. The lack of any discipline specific impact should provide reassurance to students in selection of an intercalation programme and additionally encourage students to pursue an area of interest.

As a single institution study, this study does carry limitations, although it does provide further strength to the evidence that already exists. The retrospective nature of this work using routine student records means other factors associated with performance enhancement could not be assessed. Improvements in score could be associated with other factors that impacted students to perform to less than their academic potential the previous year and which may also be associated with the decision to intercalate at a specific point e.g. mitigating circumstances or welfare related issues, but we were unable to comment on this.

**Conclusion**

This study confirms that intercalation is associated with benefit to subsequent medical exam results and does not, as is sometimes feared, confer disadvantage to academic performance. Students from the University of Birmingham who undertook an intercalated degree demonstrated an improvement in change in mark the following year which was significantly greater than that exhibited by students progressing without an intercalated year. Furthermore our findings suggest that intercalating earlier in the MBChB programme and staying at one’s home institution, may further support academic benefit. Gender had a significant impact on change in mark, with females demonstrating greater improvement in academic performance. Choice of degree discipline did not make significant contribution to academic improvement post intercalation, and this should encourage students to pursue an area of personal interest for intercalation. The ultimate aim for all Schools is production of high quality clinicians and academic attainment is considered an indicator of this. With this aim in mind, intercalation appears to enhance academic performance and at a time of considerable reform to funding of medical education this study indicates that ongoing support for intercalation should be maintained.

**Take Home Messages**

1. Intercalation is associated with improved performance in subsequent years of primary medical qualification.
2. There was no differential improvement in students studying across different subject disciplines suggesting improvement is accrued via generic improvements to study skills.
3. Students undertaking an intercalated year within their usual medical school accrued greatest performance benefit which may suggest that environment transitioning reduces benefit.
Notes On Contributors

Seetha Muthalagappan is a junior doctor at University Hospital Coventry and Warwick. She undertook analysis, co-drafted the first draft of this manuscript and critically reviewed the final manuscript.

India Wheeler is a junior doctor at the Royal Liverpool Hospital. She undertook an intercalated degree at the University of Birmingham. India worked with LR in the development of the research methods for this study and critically reviewed the final manuscript.

Rachel Bruton is Senior Research Facilitator in the School of Cancer Sciences within the University of Birmingham. She previously worked in the Research and Knowledge Transfer Office within the Medical School supporting the Lead for Clinical Academic Training. She worked with LR in the development of the research methods for this student, undertook data collection and synthesis and critically reviewed the final manuscript.

Paul Stewart is Faculty Dean of Medicine & Health at the University of Leeds. He is Professor of Medicine and a Consultant Endocrinologist and was responsible for conception of this study and critical review of the final manuscript.

Lesley Roberts is Pro Dean Education at Warwick Medical School, University of Medicine and Professor of Medical Education. She previously held the position of College Lead for Intercalation at the College of Medical and Dental Sciences, University of Birmingham. Lesley led on development of research methods, undertook data collection and analysis, co-drafted the first draft of this manuscript and critically reviewed the final manuscript.

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Appendices

Declarations

The author has declared the conflicts of interest below.

LR, PS and RB are employed in Medical Schools which may benefit from increased fee revenue if intercalating student numbers increase, although no personal benefit is identified.

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