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Association of professional identity, gender, teamwork, anxiety and workplace learning with burnout in junior doctors: a longitudinal cohort study

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Association of professional identity, gender, teamwork, anxiety and workplace learning with burnout in junior doctors: a longitudinal cohort study

Running head: Workplace learning alignment longitudinal study

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Data Sharing Statement
No additional unpublished data are available outside the research team.

Author Contribution
LVM and AB contributed to the conception of the study; LVM, AB and SEW designed the work; SEW contributed to the acquisition of the data; HMT and LVM contributed to the analysis of the data and all authors contributed to the interpretation of data; LVM and SEW drafted the manuscript, all authors revised the manuscript critically for important intellectual content; All authors gave their final approval of the version to be published; all authors agree to be accountable for all aspects of the manuscript and will ensure that any questions relating to the accuracy or integrity of any part of the manuscript are appropriately investigated and resolved.

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Ethical Approval
School of Medicine Research Ethics Committee at Cardiff University: SMREC Reference Number: 15/08

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ABSTRACT

Objectives: To examine individual and environmental factors associated with burnout across the stressful transition from medical student to junior doctor.

Design: A longitudinal one-year cohort design. An online questionnaire included: Professional Identity Scale (PI), Team Understanding Scale (TU), modified Hamilton Anxiety Rating Scale (HAM-A) and modified Copenhagen Burnout Inventory (CBI). Data was collected on four occasions: (T1) prior to graduation; (T2) 1-month post transition; (T3) 6-months post transition; and (T4) 10-months post transition.

Setting: Medical schools and postgraduate training in a single UK country.

Intervention: All final year medical students undertake a 6-7 week end-of-year workplace learning placement (assistantship). Undergraduates staying in the country for their first post attended an assistantship aligned (AA) in location and speciality. Outgoing and incoming undergraduates undertook misaligned assistantships (MA).

Participants: All AA (n=351) and MA outgoing/incoming students (n=150) were contacted. n=281 (56%) responded comprising: 68% (n=183) females and 73% (n=206) aged 17-25 at onset (n=129, 46% AA). Completion rates are: aligned 72% (93/129) and misaligned 64% (98/152).

Results: Individual scales by alignment suggests self-reported anxiety and PI stable; Teamwork, personal (PB) and work-related burnout (WRB) increased over time, but no effects of alignment. Linear mixed-effect models of patient-related burnout (PRB), PB and WRB found anxiety significantly positively related to burnout with PI significantly negatively related. Males self-reported significantly lower PB, but higher PRB than females. Age and teamwork did not affect burnout. However, participants experiencing MAs reported higher PB and WRB levels over time.

Conclusions: Our findings bring forth implications for practice including that medical schools consider an end-of-year workplace alignment with first-post, or an extended shadowing period is considered immediately post-graduation. Educators might also consider how best to support undergraduate students' early PI development and support systems should be in place across the transition for individuals with a predilection for anxiety.

Strengths and limitations of this study

1. The use of pre-defined and validated questionnaires enables our data to be considered alongside others' use of these scales.
2. Linear mixed-effect models of burnout sub-scales enabled us to include participants with missing outcomes in the analysis (if sufficient data points), to treat time as continuous rather than a fixed set of points and easily handled time-invariant and time-varying covariates.
3. Although respondents came from a range of UK medical schools, those experiencing an aligned assistantship were all trained and subsequently worked in a single UK country.
4. This study comprises self-reported measures of anxiety, professional identity, teamwork and burnout.

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BACKGROUND

Medical students' transition into clinical practice has long been regarded as a period of high stress. During the first postgraduate year, medical graduates are required to adjust to the increased workload and responsibility of their new role in addition to coping with the challenges of frequently rotating between departments and managing uncertainty concerning their future career.[1-5] Doctors' chronic exposure to workplace stress has been associated with mental health disorders and burnout: feeling mentally and physically exhausted due to work or care-giving undertakings.[6-8] A higher prevalence of mental health disorders such as anxiety, depression, substance misuse and suicide among doctors and medical students is widely reported in the literature.[8-10]. Furthermore, studies conducted in Europe,[1 11-14] North America,[15-17] Australia,[3 7] and South East Asia.[18] have all highlighted burnout to be an area of international concern particularly in relation to its association with increased psychiatric morbidity and negative health behaviours among medical students and early career doctors.[6 11 19] The potential personal and professional consequences of mental health problems and burnout for doctors and their patients can be devastating; resulting in suboptimal patient care, increased medical errors and lapses in professional behaviour.[17 20-22]

Mental health problems and burnout observed at undergraduate level have potential ramifications for graduates' following their transition into clinical practice. For example, perceived stress during medical school has been shown to be a predictor of mental health problems requiring treatment among postgraduates.[23] In addition, doctors at the start of their postgraduate training have been found to be at increased risk of developing burnout compared to their more senior counterparts.[24 25] This in part may be attributable to an *undergraduate burnout hangover,* as a number of studies have suggested that graduates commence their postgraduate training already exhibiting features of burnout.[11 12 16 24] However, a longitudinal prospective cohort study of 117 final year students found a steady increase in burnout over time, rising from 28% prevalence at T1 (six months prior to graduation) to 75% at T5 (11 months post-graduation).[26] This suggests that the workplace learning environment also has an impact. Likewise, a more recent study examining medical interns in an Australian hospital found a 60% overall incidence of burnout and reported similar longitudinal findings whereby high levels of personal and work-related burnout were recorded throughout the year, peaking at six months into the internship.[27]

Individual factors and burnout: Identity, team working and anxiety

It has been argued that burnout in doctors is mainly due to personal factors, including trait measures of personality and individual perceptions of the learning and work environment.[28] The professional socialisation of medical students has been of focus recently.[29-32] Essentially, it has been argued that in order to behave as a fully functioning member of the medical profession, medical students need to develop a strong, sense of themselves as doctors.[30-32] Thus, an essential part of becoming a doctor comprises students' identification of themselves as being part of the medical profession:[29 30 32 33] that is, developing an embodied professional identity. Additionally, identity-threat has been significantly correlated with burnout in doctors.[34] The ability to work well within a team and the opportunity to have a strong sense of belonging to the group (e.g. working in teams during work-based learning placements) have been highlighted as facilitating factors for group identification.[29] Anxiety can be generated by virtue of the situation or event in which we might find ourselves (so once the source of 'threat' goes away, so does the experience of anxiety).[35] Anxiety can also be a more generalised attribution of an individual.[36] Research has demonstrated an association between generalised anxiety and burnout in doctors and other healthcare professionals.[37-39]

Moving from individual to institutional factors for burnout

There have been calls for increased interventions targeted to address wellbeing, mental health problems and burnout at both the undergraduate and the postgraduate level.[6 24] Moreover, there has been a call to focus on both individual and organisational factors that might contribute to wellbeing,

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rather than purely constructing burnout as a personal failing.[40] The most commonly studied interventions for physicians involve mindfulness, stress management and the use of small group discussions.[41] Although such interventions have been shown to be beneficial for reducing physician burnout,[41] they all continue to focus the problem solely at the individual level.

In terms of the environmental level, research has found that students experiencing hospital rotations are more likely to report burnout than those experiencing outpatient, consult services, intensive care or research rotations.[42] Students on rotations requiring overnight call were also significantly more likely to report burnout (55% versus 45%) than students not on rotations requiring overnight call.[42] A recent systematic review, however, has focused on learning environment interventions and their impact on medical students' emotional wellbeing.[43] A total of 28 articles were identified with interventions targeted at both individual and institutional levels, including: mental health programs, mind-body skills training, wellness programmes, mentoring, program reform and curriculum structure.[43] Regarding curricula structure, one study reported that students whose clinical contact hours comprised a greater percentage of their overall learning experiences were less likely to experience burnout or to have seriously considered leaving medical school.[44] This suggests that work-based experience might be a mitigating factor for burnout as students transition into practice.

Curricula intervention

In 2009, the UK General Medical Council introduced a compulsory new addition to the undergraduate curricula in the form a work-based transitional intervention; *the assistantship programme*.[45] Assistantships are designed to address preparedness for practice concerns and the peak in patient safety-related incidences as final year students transition into becoming junior doctors[46-48] and are defined as placements in which final year medical students "act as assistant to a junior doctor, undertaking defined duties under appropriate supervision".[49] Thus they comprise end-of-course work-based experiences with the specific aim of smoothing students' transition into practice.

There is growing evidence that supports the efficacy of these placements in: improving graduates' preparedness for practice across a range of clinical and non-clinical skills domains,[50 51] facilitating a graduated increase in responsibility,[52-55] and providing opportunities for gradual, low-stress workplace acclimatisation and integration within clinical teams facilitated by assistantship alignment.[47 54] However, much of the data to support these assertions lacks rigour. For example, in the case of questionnaire studies, each one utilises a different questionnaire with slightly different foci of enquiry: student anxiety,[54] learning opportunities,[55 56] and specific skills' confidence.[50 51] Additionally, there is a general tendency for relatively low respondent numbers; as low as n=37 and n=43 at time one,[51 56] with none of the analyses matching participant data longitudinally from Time 1 (T1) and Time 2 (T2). In some qualitative studies, participant numbers are also relatively low (i.e. n=15 and n=20).[54 55] Finally, there is no single model of assistantship: each programme has a different duration (2 weeks, 4 weeks, 8 weeks, and so on), placements are provided at different times in the curricula (before, after final exams) and different configurations (aligned to the first post on graduation or misaligned).

Taken together this makes it difficult to draw any strong conclusions regarding the efficacy of the assistantship period. No one study builds on another. Moreover, to date, there has been a limited exploration of the longer-term consequences of assistantship alignment on graduates' psychological wellbeing, namely whether assistantship alignment serves as an existing curriculum intervention to reduce levels of anxiety and burnout in newly qualified doctors. We therefore aim to fill these gaps in the literature through our mixed-methods longitudinal programme of research. Specifically, this study focuses on the following research questions:

RESEARCH QUESTIONS

RQ 1: Do self-reported professional identity, anxiety, teamwork and burnout levels change over time as final year students transition into clinical practice?

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RQ 2: Are there any associations between assistantship alignment and self-reported professional identity, anxiety and teamwork on burnout scores over time?

METHODS

A longitudinal one-year cohort design was used with data being collected via an online questionnaire. The questionnaire included the Professional Identity Scale (PI),[29 57] the Team Understanding Scale (TU),[29] the modified Hamilton Anxiety Rating Scale (HAM-A)[58] and the modified Copenhagen Burnout Inventory (CBI).[59] The PI scale comprises nine questions relating to an individuals' perception of their group identification, the TU measures students' understanding of team working and willingness to engage. The PI and TU scales have been successfully validated with a health and social care student population, including medical students.[29] The HAM-A scale includes a series of statements concerning individuals' experience of anxiety-related symptoms and is essentially a measurement of a person's general anxiety responsiveness, rather than a measure of context-specific anxiety. We utilised this scale to understand how an individuals' level of anxiety impacts on burnout thus facilitating a better understanding of the impact of the assistantship (as an environmental factor) on burnout levels. The CBI comprises questions in three domains: Personal Burnout (PB), Work-Related Burnout (WRB) and Patient-Related Burnout (PRB) and has been validated for the assessment of burnout in hospital doctors[59] and undergraduate students.[60] The versions of the HAM-A and CBI included in the questionnaire were slightly modified by the addition of personal prefixes e.g. "I feel…/I experience…". Owing to a transcription error in the process of generating the online questionnaire, one PB question ("I feel weak and susceptible to illness") was not included in the questionnaire (see Appendix A for the full version of all scales used). The questionnaire comprised 16 pages including 1 introduction, 3 demographic/background pages, a 'your story' page, a 'prize draw' page and a final summary page. Participants could not move forward without completing sections (apart from the final 'you story' section) but could move backwards. This study was conducted as part of a wider, longitudinal, mixed-methods programme of research to examine emotional issues around graduates' transition into practice.[47]

Context

All medical students in Wales undertake a 6-7 week student assistantship with both medical schools co-operating to provide a countrywide joined-up approach. For undergraduates who will commence their postgraduate training in Wales, their assistantship is aligned in location and speciality with their first post-graduate role as a junior doctor (intern) post. In contrast, Welsh undergraduates who will commence their first post in another UK region and undergraduates from other UK medical schools who will commence their first post within Wales undertake misaligned assistantships. This context provides us with a *natural experiment* situation.

Procedure

Following ethical approval, all 2015 graduates of the two medical schools in Wales were invited to participate (n=351) along with graduates from other medical schools who would commence working as a doctor within Wales (n=150). Within this cohort, participants fell into two groups (1) Aligned Assistantship [AA]: individuals who experienced the student assistantship aligned with their first post and (2) Misaligned Assistantship [MA]: individuals who experienced the student assistantship in a different place to their first post. In the UK, the first post is the start of Foundation training, Foundation Year 1 (FY1).

Questionnaires were hosted and administered via the Bristol Online Survey (BOS). Undergraduate assistants tested the questionnaire prior to administration (see Acknowledgements). Participant consent was obtained through the opening pages and subsequent participation. At T1, a link emailed to students in Wales by school administrators,

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and by foundation school administrators to non-Welsh UK graduates undertaking their first post in Wales. Participants were invited to provide an email address for participation into a prize draw. Consent to use this to match data longitudinally was also provided. SEW alone has access to this identifying data. Participants were invited to complete the online questionnaire on four occasions between June 2015 and June 2016: (T1) prior to graduation from medical school and in the middle of their assistantship period (8th June- 6th July 2015); (T2) 1 month following their transition into clinical practice (1st-30th September 2015); (T3) 6 months after their transition into clinical practice (4th January-4th February 2016); and (T4) 10 months following transition (23rd May-24th June 2016). These time periods were purposively designed to capture other transitions in the junior doctor first year (i.e. transitioning into new specialties).

Invitations to participate in the study were sent to graduates via email with the assistance of undergraduate (T1) and postgraduate (T2-T4) administrators. Participants who had not completed the questionnaire were sent weekly reminder emails. A link to the questionnaire was posted on targeted social media pages: e.g. undergraduate year group/junior doctor Facebook pages. As an incentive for participation, individuals were offered the chance to be entered into a prize draw (thirty £20 vouchers were available for each questionnaire). To facilitate delivery of the vouchers, participants wishing to enter the draw were asked to provide an email address. With participants' consent, their email address was utilised as a data identifier allowing participants' responses to be paired over time and analysed longitudinally. After the data had been aligned, all identifiers were removed, and statistical analysis was performed anonymously.

Data analysis and stability assessment

Multivariate regression analyses were performed by fitting the data to a mixed-effect model.[61] The majority of the results were analyzed using R[62] and lme4.[63] We performed linear mixed-effect models on the three factors of burnout to assess the effect of alignment, phase and interaction on burnout. The mixed-effect model was chosen as it offered a better fit of the data than the repeated measures ANOVA for these data sets. Mixed-effect models allow individual variability to be accounted for by computing a random slope and a random intercept for each participant. In this way, individual differences in subjective burnout levels were accounted for. The random effect components comprised: (1) intra-individual variation on burnout throughout the different time points; and (2) measurement error (i.e. the remaining "noise" in the model that represents unexplained variations not captured by the model).

We hypothesized that the degrees of burnout change over time could be partly predicted by participants' experiences of assistantship alignment as well as their personal characteristics of anxiety responsiveness, professional identity (PI), and perceived support from team work (TM). To assess the impact of other factors on the participants' burnout, confounding factors such as participants' age and gender were included in the fixed effect components. As these factors may cause the burnout to be higher or lower or they may cause the burnout to change at a faster or slower rate across different phases, such variation was modelled with a random intercept and slope, respectively, for each participant. The notations in the model are as follows:

$$Burnout_{ij} = \mu + \beta_g Group_j + \beta_t Time_i + \beta_{gt} Group_j \times Time_i + \beta_s sex_j + \beta_a Age_j + \beta_x Anxiety_j + \beta_p PI_j + \beta_w TeamWork_j + \gamma_j^0 + \gamma_j^1 Time_i + \varepsilon_{ij}$$

where i indexes the time phase and j indexes the individual. With respect to effect size of linear mixed models, we employed the method for obtaining R^2 from generalized linear mixed-effects models developed by Nakagawa, Schielzeth.[64] This method yields two r squared, a marginal R_m^2 that accounts for the variance explained by the fixed factors and a conditional R_m^2 for the variance explained by both fixed and random factors.

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RESULTS

Characteristics of Respondents

An total of n=281 (56% response rate aggregated over time) participated in this study, comprising: 68% (n=183) females and 73% (n=206) aged 17-25. Among these, n=129 (46%) experienced the aligned assistantship. Ninety respondents completed the questionnaire on only one occasion. Given this is a longitudinal study, the criteria for inclusion was participation at more than one time. The data from these 90 participants were therefore excluded from the analysis. The number and characteristics of respondents that fulfilled the inclusion criteria at each time point are outlined in Table 1. Completion rates of 72% (93 of 129) and 64% (98 of 152) were observed for aligned and misaligned participants, respectively. Incomplete data were accounted for in the analysis via maximum likelihood estimation. This difference in study completion did not differ significantly between the two groups, $X^2(1) = 1.53$, $p = .22$. The percentages of female by the time phase were 65%, 69%, 69%, and 70% respectively ($X^2(3) = 1.1$, $p = .22$).

Anxiety, Professional Identity, Teamwork And Burnout Over Time

We begin by considering RQ1: do self-reported professional identity, anxiety, teamwork and burnout levels change over time as final year students transition into clinical practice? The changes in self-reports of anxiety, professional identity (PI), teamwork and burnout (PB, WRB and PRB) by assistantship alignment group over time are displayed in Table 2. Briefly, self-reported anxiety levels and professional identity remained stable throughout the four-time points. Teamwork scores increased significantly over time. Concerning the measures of burnout, all three subscales (PB, WRB, PRB) increased sequentially across the four-time points, although this did not reach significance for PRB. We found no significant differences for any of the measures taken by alignment group not any interactions between time and alignment group for these measures.

Linear mixed-effect model of alignment on burnout longitudinally

We now consider RQ2: Are there any associations between assistantship alignment, self-reported PI, anxiety scores and teamwork on self-reported burnout scores over time? Table 3 shows the results of the mixed effect model with the parameter estimates for factors affecting components of modified CBI (i.e. PB, WRB, and PRB). By looking at the random effect components, similar patterns were observed for all three subscales of burnout. The intercepts for three components of burnout are significant while the slopes were insignificant. That is, the variance in change in burnout by time points (as indicated by slope) is relatively small while the variation in each component of overall burnout between individuals (as indicated by intercepts) is quite large. Thus, the size of the intecepts is likely to be due to the measurement characteristics of burnout. This pattern is not uncommon for self-report questionnaires aiming at stable characteristics such as burnout.

From the parameter estimates of the fixed effect components, similar patterns were again observed for all three components of burnout. Over time, burnout scores increased as indicated by increasing trend in the time parameter estimates at subsequent time points, which is significant for WRB ($\beta=1.62$, $p< 0.01$). For personal characteristics, the significant main effects were found for anxiety and perceived PI. The significant main effect for anxiety (PB: $\beta=1.01$, WRB: $\beta=1.02$, PRB: $\beta=0.64$, all $p < 0.001$) indicates that individuals with high self-reported anxiety levels reported greater burnout than did those with low self-reported anxiety levels. However, the reverse relationships were found for perceived PI and burnout (PB: $\beta=-0.41$ [$p < 0.01$], WRB: $\beta=-0.62$, PRB: $\beta=-0.41$, [both $p < 0.001$]). Gender also had a significant effect on PB ($\beta=-5.8$, $p<0.001$) and PRB ($\beta=3.97$, $p<0.05$), but not significant for WRB ($\beta=-2.14$, $p=0.15$): Males self-reported significantly lower PB, but higher PRB scores than females. Age and teamwork did not affect burnout scores.

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The main effect of alignment group is superseded by the significant interaction between alignment and time for PB (β=1.92, $p<0.05$) and WRB (β=1.66, $p<0.05$). The AA participant group, the reference group, self-reported PB scores increased and an average of 1.01 per time point (see Figure 1). For the MA group, self-reported PB scores increased 2.93 (1.01+1.92) per time point on average. Similarly, self-reported WRB scores increased an average of 1.62 per time point for the AA group and an average of 3.28 per time point for the MA group: However, when the actual scores by phase are plotted, we can see how the AA respondent group demonstrated asymptote, peaking at Time 3 (6-months post-transition) whereas the MA group demonstrated asymptote at Time 4.

DISCUSSION

To our knowledge this is the first study to have examined how both individual and environmental factors affect junior doctors' burnout over time. Our longitudinal cohort study used a range of validated questionnaires designed to examine whether medical students' participation in an end-of-year placement (assistantships aligned or misaligned with their first junior doctor post), along with their self-reported PI, teamwork and anxiety, related to their self-reported burnout over time. Looking at the questionnaires individually by alignment group, we found that teamwork, PB and WRB increased significantly over time irrespective of respondents' alignment experience, but no increase in PRB. This finding has some similarity with other research. For example, a longitudinal cohort study of medical graduates in Australia found that PB and WRB rose significantly over their first year, although unlike our study these peaked at 6-months.[27] Furthermore, PRB remained at significantly lower levels than PB and WRB, although it demonstrated a significant increase at 12-months from the 'no-change' earlier time periods.[27] PI and anxiety did not change significantly across the four time periods in our study, again, irrespective of assistantship alignment.

The findings around PI, teamwork and burnout suggests that assistantship alignment appears to provide no absolute beneficial effect on these factors for individuals whose work-based placements are intimately associated with their first role as a junior doctor. This runs counter to our expectation that an aligned assistantship would be beneficial in these areas. However, employing a linear mixed-effect model, we found a significant relationship between alignment group and time for PB and WRB. Respondents experiencing a misaligned assistantship (MA) reported a sharper rise (three-fold) in PB across all four time-points than those experiencing an aligned assistantship (AA) with neither group showing evidence of reaching asymptote. A similar rise was found for the MA group and WRB, although WRB reached asymptote for the AA group immediately on transition into practice. This suggests a slightly delayed beneficial effect regarding work-related burnout for aligning work-based placements to students' first post as a junior doctor. Furthermore, this beneficial effect continues beyond junior doctors' first post and throughout subsequent transitions in the first year.

Our linear mixed-effect model also identified an association between anxiety and burnout: respondents reporting high anxiety levels also reported higher burnout scores as compared to those reporting low anxiety levels. This finding resonates with other research examining the relationship between anxiety and burnout in healthcare professionals.[38 65] Taken together with our finding, it suggests that individuals with a predilection for anxiety are more likely to self-report burnout. Interestingly, the reverse relationship was found for perceived PI in our study: higher levels of self-reported PI were related to significantly lower self-reported burnout across all three factors. As such, our finding relates to other studies examining the relationship between identity and burnout in healthcare workers, teaching professionals, the general population as well as experimental research on members of the general population undertaken by social psychologists.[66-69] Indeed, such research has suggested that a strong sense of social identity (i.e. a feeling of belonging to the group) facilitates an increased capacity to cope under stress, and that a failure to develop such a shared identity is associated with a reduced ability to deal with stressors effectively.[66] That identity did not change over

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time in our study, suggests this shared identity might have been already sufficiently formed prior to students' transition into practice, and that any protective effect it has is not diminished (or enhanced) by the assistantship alignment experience.

Participant gender was also related to burnout scores in our study. Males reported significantly lower PB, but higher PRB scores than their female counterparts. For WRB, both groups demonstrated an increase over time. Regarding PB, previous research suggests that the prevalence of mental health problems is higher in female doctors than their male counterparts.[70] It has been postulated that this may be in part a reflection of the gender specific stresses women encounter in the workplace.[71] However, evidence concerning the relationship between burnout and gender to date is inconclusive. While some studies have reported the prevalence of burnout to be higher in female doctors,[7 72] other studies have reported no gender differences[1] or a higher prevalence in males.[11 73] However, our findings resonate with Hillhouse et al's model of work stress, burnout, affect, health and clinical competence regarding the higher level of PRB identified in male medical residents.[74] Finally, in the wider literature, the commonly held assertion that females are at higher risk of burnout than their male counterparts in the labour market generally has been challenged in a recent meta-analysis.[73]

Despite having strong findings, our research has limitations that need to be taken into account when considering the implications of these findings for practice. Firstly, although the respondents come from a wide range of medical schools across the UK, those experiencing an aligned assistantship were all trained and subsequently worked in a single UK country, Wales. This could be a potential confounding factor, whereby the interaction between burnout and alignment might purely be due to the change in location, and the subsequent disruption to support networks and homes, rather than the work-based placement. However, this is unlikely as students' first posts in Wales were not necessarily located in the same place in which their undergraduate learning occurred. For example, those learning in one University hospital might have their first post in an entirely different one, even differing between city and rural locations across the country. Secondly, respondents were not randomised to the aligned or misaligned work-based placements, and it might be that this "natural experiment" has within it some further confounding factors. For example, there might be some similarities between those individuals who trained in Wales and who wish to stay there, which are very different to those who chose to work elsewhere or to those who trained elsewhere but wished to work in Wales. Thirdly, our study respondents comprised a much higher ratio of females than males (2:1). This ratio, although generally reflecting the higher proportion of females than males in the UK graduate population, is rather exaggerated: the average percentage of female to graduates over the past few years has been 56%, which is lower than our study average (68%).[75]

Despite these limitations, our research has notable strengths. The joined up nature of the assistantship programme in Wales has provided us with a unique opportunity to examine the effects of learning alignment to graduates' first post across a range of personal and environmental factors that are important for the wellbeing of our clinical workforce. We have been able to utilize a general linear mixed regression model, which has proved a useful approach for analysing our repeated measures data in this longitudinal cohort study. Although the model is similar in many respects to ordinary multiple regression, using the mixed regression analysis allows us more flexibility than an ordinary multiple regression: it enables us to include participants with missing outcomes in the analysis (so long as there are sufficient data points); it has permitted us to treat time as continuous, rather than a fixed set of points; and it can easily handle both time-invariant and time-varying covariates. As such we have been able to unpack the nuances to understand how these factors interact over time.

Our findings bring forth some implications for practice and future research suggestions. Given that graduates experiencing an aligned assistantship demonstrate a lower rise in PB over the transition period and a stabilized WRB as compared with those whose assistantship was misaligned, we suggest that medical schools consider organizing students' final-year placements with their first-post on

transition, or that an extended shadowing period is explored immediately on graduation. Furthermore, given that possessing a strong professional identity appears to mitigate burnout, and that identity does not appear to develop over the transition period, we suggest that educators might consider how best to support the professional identity of undergraduate students early on in their programme to ensure this is fully embodied at the time of graduation.[76] It is important to note that such an identity appears to be associated with their feeling of belonging to the profession in general – rather than just to the specialty in which they are studying and will be working in. Therefore educational considerations need to focus on this aspect of affiliation. Finally, given the strong relationship between anxiety and burnout that has been identified in ours, and other studies, we suggest that support systems are in place for individuals who have a predilection for anxiety. Such support systems should be operations during students' undergraduate years and should be made available to them as they transition into practice and beyond.

Following our study we have suggestions for future research. The majority of research in medical education to date has focused on individual factors responsible for burnout, yet we have identified a strong relationship between burnout and environmental factors (assistantship alignment). However, our research tells us little about what it is in the alignment/misalignment experience that has facilitating/mitigating effects. As such we suggest that future research considers these 'black box' issues and tries to unpack the nuances within. For this, qualitative methods (e.g. interviews, diaries, video ethnography) as well as validated questionnaires alongside appropriate approaches to understanding the intricacies of the mechanisms that might be at play (e.g. realist research, structural equation modeling, factor analysis). Furthermore, a concerted effort towards undertaking a systematic programme of research, where each study adds to and builds upon, the other is required. Without such research our knowledge about the factors that increase and mitigate burnout in junior doctors will continue to be unnecessarily fragmented.

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TABLE 1: NUMBER (AND %) OF RESPONDENTS' DEMOGRAPHICS ACROSS EACH OF THE 4 DATA COLLECTION PHASES

	T1	T2	T3	T4
Group	208	175	135	125
Aligned	99	79	64	65
Misaligned	109	96	71	60
Gender				
Female	135 (64.9)	120 (68.57)	93 (68.89)	87 (69.6)
Male	73 (35.1)	55 (31.43)	42 (31.11)	38 (30.4)
Age				
17-25	155 (74.52)	129 (73.71)	96 (71.11)	98 (78.4)
26-30	45 (21.63)	40 (22.86)	36 (26.67)	24 (19.2)
31-35	4 (1.92)	4 (2.29)	2 (1.48)	3 (2.4)
36-40	4 (1.92)	2 (1.14)	1 (0.74)	0 (0)

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TABLE 2: DISTRIBUTION OF MEASUREMENT SCORES BY GROUP AND PHASE

	Phase				
Measures	T1	T2	T3	T4	Wald X^2
HAM-A	11.42±8.02	11.32±8.65	10.72±8.59	10.86±9.28	$X^2_{Group} = .43$
Aligned	10.99±7.29	11.61±8.59	10.66±8.36	11.25±8.47	$X^2_{Time} = .87$
Misaligned	11.81±8.65	11.08±8.75	10.77±8.85	10.45±10.14	$X^2_{Int} = .67$
PI	37.02±4.89	37.11±4.67	37.16±4.84	37.81±4.87	$X^2_{Group} = .57$
Aligned	37.85±4.55	37.05±4.71	37.22±4.95	37.62±4.57	$X^2_{Time} = 2.18$
Misaligned	36.28±5.1	37.17±4.66	37.11±4.78	38.02±5.2	$X^2_{Int} = 6.24$
Teamwork	38.05±3.37	38.97±3.5	40.41±3.24	39.58±3.31	$X^2_{Group} = .97$
Aligned	38.37±3.76	39.06±3.17	40.34±2.75	39.66±3.13	$X^2_{Time} = 46.82^{***}$
Misaligned	37.76±2.95	38.9±3.77	40.48±3.64	39.5±3.52	$X^2_{Int} = 1.81$
PB	42.64±16.28	47.66±18.69	47.33±18.19	48.2±17.07	$X^2_{Group} = .70$
Aligned	41.26±17.35	48.04±18.78	46.02±16.93	46.46±15.58	$X^2_{Time} = 17.29^{**}$
Misaligned	43.9±15.2	47.34±18.71	48.52±19.3	50.08±18.49	$X^2_{Int} = 2.53$
WRB	36.76±13.44	40.94±16.89	41.9±16.04	42.69±15.78	$X^2_{Group} = .33$
Aligned	35.82±14.59	41.37±17.72	41.69±14.79	41.7±14.2	$X^2_{Time} = 34.1^{***}$
Misaligned	37.61±12.31	40.59±16.27	42.1±17.2	43.75±17.38	$X^2_{Int} = .97$
PRB	22.46±12.79	23.36±13.41	23.4±12.98	25.1±14.1	$X^2_{Group} = 1.43$
Aligned	21.09±12.41	23.05±14.48	22.72±13.13	25.51±13.37	$X^2_{Time} = 5.84$
Misaligned	23.7±13.05	23.61±12.53	24±12.9	24.65±14.96	$X^2_{Int} = 1.56$

NOTE: The significance of the main (Group and Time) and the interaction effects was assessed with the Wald chi-square test using GEE estimation. Significance level * p<.05, ** p<0.01 *** p<0.001

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TABLE 3: RESULTS OF MIXED EFFECT MODELS

	Burnout					
Parameters	Personal		Work-related		Patient-related	
Fixed effect	estimate	(SE)	estimate	(SE)	estimate	(SE)
Intercept	42.16***	(8.07)	43.32***	(6.80)	33.09***	(6.68)
Time	1.01	(0.62)	1.62**	(0.52)	0.53	(0.59)
Anxiety	1.01***	(0.08)	1.02***	(0.07)	0.64***	(0.07)
PI	-0.41**	(0.15)	-0.62***	(0.12)	-0.41***	(0.12)
Gender (ref: female)	-5.80***	(1.72)	-2.14	(1.48)	3.97*	(1.52)
Age	0.45	(1.44)	2.34	(1.23)	-1.43	(1.27)
Teamwork	0.17	(0.18)	0.08	(0.15)	-0.10	(0.15)
Group (ref.: Aligned)	-2.68	(2.61)	-4.60*	(2.04)	-0.76	(2.09)
Group * Time	1.92*	(0.88)	1.66*	(0.72)	0.66	(0.73)
Random effect	Variance	(SD)	Variance	(SD)	Variance	(SD)
Intercept	81.02***	(9.0)	30.49***	(5.52)	57.63***	(7.59)
Time (slope)	2.06	(1.43)	0.81	(0.9)	3.37	(1.84)
Residual (error)	106.77	(10.33)	75.07	(8.66)	63.75	(7.98)
R^2 marginal (fixed)	0.39		0.46		0.24	
R^2 conditional (fixed and random)	0.65		0.70		0.64	

NOTE: The significance of the fixed effect was assessed with the Wald test conducted on the full model, whereas the significance of the random intercept and slope effects was assessed with likelihood testing using REML estimation. For each components of burnout, the corresponding marginal and conditional R^2_{GLMM} values were computed based on the method developed by Nakagawa and Schielzeth.[64] Significance level * p<.05, ** p<0.01 *** p<0.001

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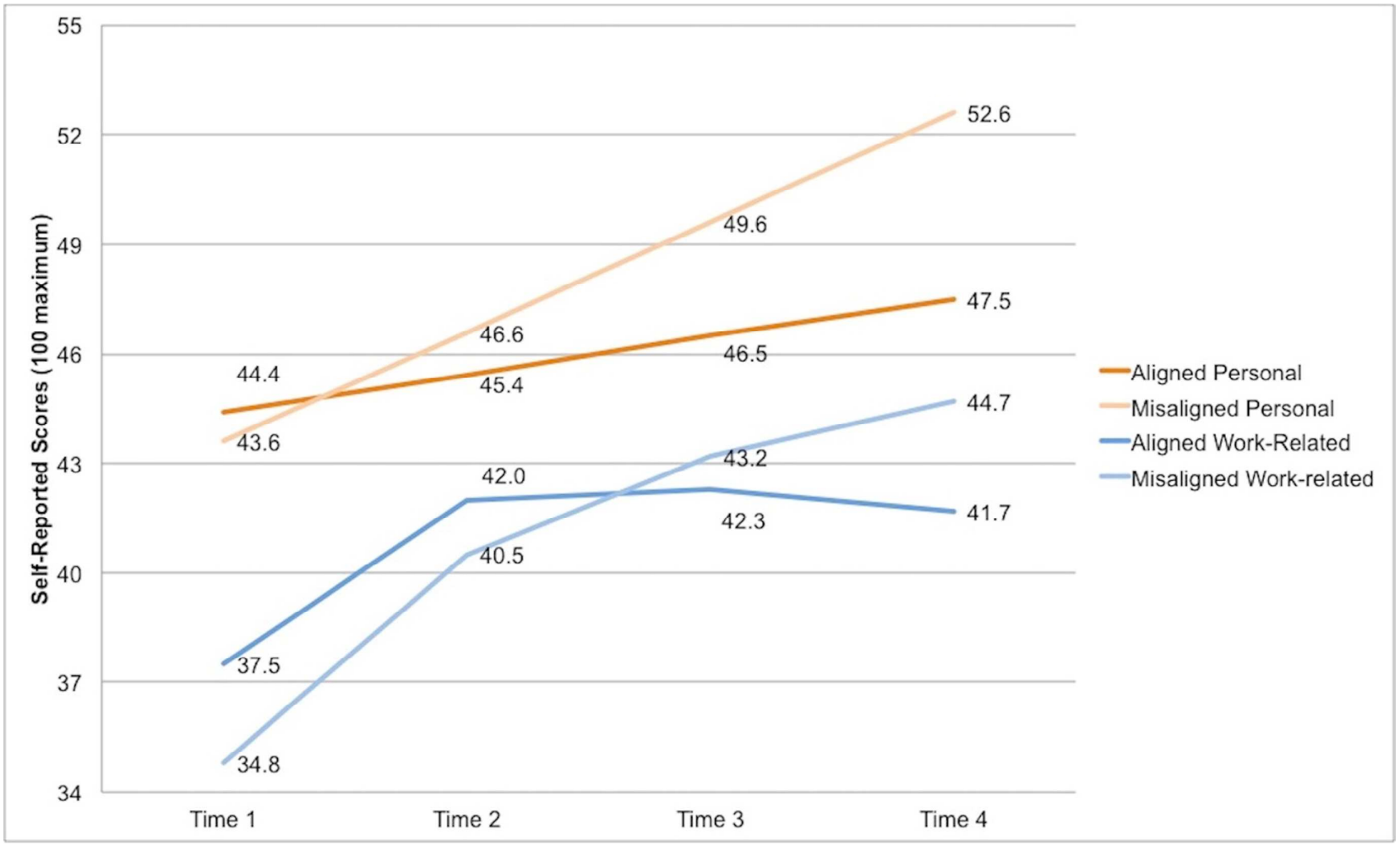
FIGURE 1: ASSISTANTSHIP ALIGNEMENT AND TIME: ASSOCIATION WITH PERSONAL AND WORK-RELATED BURNOUT



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Appendix A: Scales used in the questionnaire

THE MODIFIED HAMILTON ANXIETY RATING SCALE

1. I feel worried, irritable or anticipate the worst
2. I experience feelings of tension such as an inability to relax, started responses or being moved to tears easily
3. I experience fears of the dark, strangers, crowds or being left alone
4. I experience difficulty in falling asleep, unsatisfying sleep or nightmares
5. I experience difficulty in concentrating or experience poor memory
6. I experience low mood or a decreased interest and pleasure in hobbies
7. I experience aches and pains, teeth grinding or twitching and stiffness
8. I experience blurring of vision, hot and cold flushes or feelings of weakness
9. I experience tachycardia, palpitations, chest pain or fainting
10. I experience a sensation of a tight chest, dyspnoea or sighing
11. I experience difficulty swallowing, wind, abdominal pain, weight loss, nausea, vomiting or a change in bowel habit
12. I experience urgency of micturition, loss of libido (or a change in my monthly cycle if I am a woman).
13. I experience a dry mouth, flushing, tendency to sweat or a headache
14. I experience fidgeting, tremor of hands, restlessness, sighing or rapid respiration in stressful moments

PROFESSIONAL IDENTITY SCALE

1. I feel like I am a member of this profession
2. I feel like I have strong ties with members of this profession
3. I am often ashamed to admit I am studying for this profession
4. I find myself making excuses for belonging to this profession
5. I try to hide that I am studying to be part of this profession
6. I am pleased to belong to this profession
7. I can identify positively with members of this profession
8. Being a member of this profession is important to me
9. I feel like I share characteristics with members of the profession

THE MODIFIED COPENHAGEN BURNOUT INVENTORY

Personal Burnout: *"The degree of physical and psychological fatigue and exhaustion experienced by the person"*

1. I feel tired
2. I am physically exhausted
3. I am emotionally exhausted
4. I think "I can't take it anymore"
5. I feel worn out
6. I feel weak and susceptible to illness*

*Omitted from questionnaire due to transcription error

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Work-Related Burnout: *"The degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work"*

1. I feel worn out at the end of the working day
2. I am exhausted in the morning at the thought of another day of work
3. I feel that every working hour is tiring for me
4. I have enough energy for family and friends during leisure time*
5. My work is emotionally exhausting
6. My work frustrates me
7. I feel burnout because of my work

Patient-Related Burnout: *"The degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work with patients*

1. I find it hard to work with patients
2. It drains my energy to work with patients
3. I find it frustrating to work with patients
4. I feel that I give more than I get back when I work with patients
5. I am tired of working with patients
6. I sometimes wonder how long I will be able to continue working with patients

TEAMWORK SCALE

1. I am/have been an active member of some form of team
2. I enjoy working in a team
3. I observed many teams of which I am not a member
4. My participation in a team is facilitated how members of the team work together
5. I know how to make teams more effective
6. I frequently interact with (i.e. work with, train). teams of which I am not a member
7. I understand how people should work together as a team
8. I contribute to teams of which I am a member
9. I understand why some teams are ineffective
10. I contribute more than my fare share to the teams I am a member

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Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

	Date/Time	Procedure, p6.
	Randomization of items	None
	Adaptive questioning	None
	Number of screens	16, see p6.
	Completeness check	Participants could not move forward without completing sections (apart from the final 'your story' section). P6.
	Review check	Yes, participants could move backwards.
Response rates	Unique site visitor	Via email address which enabled us to link data longitudinally
	View rates	None recorded
	Participation rate	Not recorded
	Completion rate	Attrition was not recorded
Preventing multiple entries from single individual	Cookies used	Respondent anonymity and Bristol Online Survey (BOS). BOS is designed to protect respondent anonymity. BOS does not use cookies for survey completion and external tracking software such as Google Analytics is not supported on BOS surveys. Additionally, we cannot access any information about respondents' IP addresses.
Design	Describe survey design	p6.
IRB review	IRB approval	Yes, detailed
	Informed consent	Yes, including additional 1 page information on the survey itself.
	Data protection	BOS Security Physical security All data is stored on servers located at the University of Bristol, United Kingdom. Administrative security Access to sensitive data via BOS is strictly limited to BOS's support and technical teams. This access is only permitted when it is at the request of the client concerned or necessary for the investigation of operational issues (or when required by law). The BOS servers and backups are accessible only by members of the BOS technical team and other authorised members of IT Services within the University of Bristol (such as systems administrators or those responsible

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		for maintaining the backup service). User authentication New users choose their own passwords and will need to enter a username and password each time they log in. BOS issues a cookie to store session information when registered users log in. The session cookie does not include user information and is not retained once the browser is closed. No cookies are used when survey respondents complete surveys. BOS employees All new staff at the University of Bristol, including casual staff, are given a contract of employment containing a confidentiality clause and are made aware of their responsibilities toward restricted university data and personal data as part of their induction process. All University of Bristol IT staff are provided with data security training. Encryption All survey responses are collected over encrypted SSL (TLS) connections. SSL is the standard technology for establishing an encrypted link between a web server and a browser. It ensures that sensitive information can be transmitted securely. All communications within onlinesurveys.ac.uk are also sent over SSL encrypted connections. BOS user passwords are encrypted using PBKDF2 with a SHA256 hash and a random salt. Backups BOS's data stores are backed up daily. University of Bristol has a data retention policy that means that backups are only held for three months. Backups are stored

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		securely in a separate location from the data centres, but still on the University of Bristol's campus. After three months the tapes are either recycled or destroyed. BOS enables users to export survey response data in a number of popular formats (see FAQ for details) so that it can be backed up or used with other software. User responsibilities Users must not share accounts – by this we mean that each person who has access to a BOS account must use a unique username and password. You must not allow other people to use your username and password and multiple users must not log in using a single set of shared credentials (such as a 'group account'). Users' passwords should be sufficiently complicated, stored securely (if stored at all) and not be the same as used on any other system. You should ensure that you have appropriate levels of security on your own systems should you choose to export sensitive data. You and/or your institution are the Data Controller for any information collected using surveys run through BOS. If you are not sure of the implications of being a Data Controller please consult the data protection officer (or equivalent) at your institution.
Development and testing		Questionnaire was tested by undergraduate volunteers prior to the launch (see Acknowledgements) and p6.
Recruitment	Open vs closed	Open
	Contact mode	p6.
	Advertising survey	p6.
Survey administration	Web/email	Bristol Online Survey (p6)
	Context	Bristol Online Survey (p6)
	Mandatory/Voluntary	Voluntary
	Incentives	p7. We offered a prize draw.
Duplicate entries	IP check	Not used
	Log file analysis	Detailed on p 7.
	Registration	Not used

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Analysis	Handling of incomplete questionnaires	maximum likelihood estimation was used – see p7-8.
	Questionnaires with atypical timestamp	n/a
	Statistical correction	none

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Association of professional identity, gender, team understanding, anxiety and workplace learning alignment with burnout in junior doctors: a longitudinal cohort study

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Association of professional identity, gender, team understanding, anxiety and workplace learning alignment with burnout in junior doctors: a longitudinal cohort study

Running head: Workplace learning alignment longitudinal study

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We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Data Sharing Statement
No additional unpublished data are available outside the research team.

Author Contribution
LVM and AB contributed to the conception of the study; LVM, AB and SEW designed the work; SEW contributed to the acquisition of the data; HMT and LVM contributed to the analysis of the data and all authors contributed to the interpretation of data; LVM and SEW drafted the manuscript, all authors revised the manuscript critically for important intellectual content; all authors gave their final approval of the version to be published; all authors agree to be accountable for all aspects of the manuscript and will ensure that any questions relating to the accuracy or integrity of any part of the manuscript are appropriately investigated and resolved.

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Ethical Approval
School of Medicine Research Ethics Committee at Cardiff University: SMREC Reference Number: 15/08

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ABSTRACT

Objectives: To examine how burnout across medical student to junior doctor transition relates to: measures of professional identity, team understanding and anxiety; gender; age; and workplace learning (assistantship) alignment to first post.

Design: A longitudinal one-year cohort design. Two groups of final-year medical students: (1) those undertaking end-of-year assistantships aligned in location and specialty with their first post; and (2) those undertaking assistantships non-aligned. An online questionnaire included: Professional Identity Scale, Team Understanding Scale, modified Hamilton Anxiety Rating Scale and modified Copenhagen Burnout Inventory. Data were collected on four occasions: (T1) prior to graduation; (T2) 1-month post-transition; (T3) 6-months post-transition; and (T4) 10-months post-transition. Questionnaires were analysed individually and using linear mixed-effect models.

Setting: Medical schools and postgraduate training in one UK country.

Participants: All aligned assistantship (n=182) and non-aligned assistantship students (n=319) were contacted; n=281 (56%) responded: 68% (n=183) females, 73% (n=206) 22-30yrs, 46% aligned (n=129). Completion rates: aligned 72% (93/129) and non-aligned 64% (98/152).

Results: Analyses of individual scales revealed self-reported anxiety, professional identity and patient-related burnout were stable, while team understanding, personal and work-related burnout increased, all irrespective of alignment. Three linear mixed-effect models (personal, patient-related and work-related burnout as outcome measures; age and gender as confounding variables) found that males self-reported significantly lower personal, but higher patient-related burnout, than females. Age and team understanding had no effect. Anxiety was significantly positively related and professional identity was significantly negatively related to burnout. Participants experiencing non-aligned assistantships reported higher personal and work-related burnout over time.

Conclusions: Implications for practice include medical schools' consideration of an end-of-year workplace alignment with first-post before graduation, or an extended shadowing period immediately post-graduation. How best to support undergraduate students' early professional identity development should be examined. Support systems should be in place across the transition for individuals with a predisposition for anxiety.

Strengths and limitations of this study

1. The use of pre-defined and validated questionnaires enables our data to be considered alongside others' use of these scales.
2. Linear mixed-effect models of burnout sub-scales enabled us to include participants with missing outcomes in the analysis (if sufficient data points), to treat time as continuous rather than a fixed set of points and easily handled time-invariant and time-varying covariates.
3. Although respondents came from a range of UK medical schools, those experiencing an aligned assistantship were all trained and subsequently worked in a single UK country.
4. This study comprises self-reported measures of anxiety, professional identity, team understanding and burnout.

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BACKGROUND

Medical students' transition into clinical practice has long been regarded as a period of high stress. During the first postgraduate year, medical graduates are required to adjust to the increased workload and responsibility of their new role in addition to coping with the challenges of frequently rotating between departments and managing uncertainty concerning their future career.[1-5] Doctors' chronic exposure to workplace stress has been associated with mental health disorders and burnout: feeling mentally and physically exhausted due to work or care-giving undertakings.[6-8] A higher prevalence of mental health disorders such as anxiety, depression, substance misuse and suicide among doctors and medical students is widely reported in the literature.[8-10]. Furthermore, studies conducted in Europe,[1 11-14] North America,[15-17] Australia,[3 7] and South East Asia.[18] have all highlighted burnout to be an area of international concern particularly in relation to its association with increased psychiatric morbidity and negative health behaviours among medical students and early career doctors.[6 11 19] The potential personal and professional consequences of mental health problems and burnout for doctors and their patients can be devastating; resulting in suboptimal patient care, increased medical errors and lapses in professional behaviour.[17 20-22]

Mental health problems and burnout observed at undergraduate level have potential implications for graduates' following their transition into clinical practice. For example, perceived stress during medical school has been shown to be a predictor of mental health problems requiring treatment among postgraduates.[23] In addition, doctors at the start of their postgraduate training have been found to be at increased risk of developing burnout compared to their more senior counterparts.[24 25] This in part may be attributable to an *undergraduate burnout hangover,* as a number of studies have suggested that graduates commence their postgraduate training already exhibiting features of burnout.[11 12 16 24] However, a longitudinal prospective cohort study of 117 final year students found a steady increase in burnout over time, rising from 28% prevalence at T1 (six months prior to graduation) to 75% at T5 (11 months post-graduation).[26] This suggests that the workplace learning environment also has an impact. Likewise, a more recent study examining medical interns in an Australian hospital found a 60% overall incidence of burnout and reported similar longitudinal findings whereby high levels of personal and work-related burnout were recorded throughout the year, peaking at six months into the internship.[27]

Individual factors and burnout: Identity, team understanding and anxiety

It has been argued that burnout in doctors is mainly due to personal factors, including trait measures of personality and individual perceptions of the learning and work environment.[28] The professional socialisation of medical students has been the focus of much study recently.[29-32] Essentially, it has been argued that in order to behave as a fully functioning member of the medical profession, medical students need to develop a strong sense of themselves as doctors.[30-32] Thus, an essential part of becoming a doctor comprises students' identification of themselves as being part of the medical profession:[29 30 32 33] that is, developing an embodied professional identity that links them with the group. Additionally, identity-threat has been significantly correlated with burnout in doctors.[34] Given that the group is part of our identity, and we are part of the group, identity-threats can include feeling that the group we identify with is threatened in some way or feeling alienated from the group (disrupting our sense of belonging).[35] The ability to work well within a team and the opportunity to have a strong sense of belonging to the group (e.g. working in teams during work-based learning placements) have been highlighted as facilitating factors for group identification.[29] Anxiety can be generated by virtue of the situation or event in which we might find ourselves (so once the source of 'threat' goes away, so does the experience of anxiety).[36] Anxiety can also be a more generalised attribution of an individual.[37] Research has demonstrated an association between generalised anxiety and burnout in doctors and other healthcare professionals.[38-40]

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Moving from individual to institutional factors for burnout

There have been calls for increased interventions targeted to address wellbeing, mental health problems and burnout at both the undergraduate and the postgraduate level.[6 24] Moreover, there has been a call to focus on both individual and organisational factors that might contribute to wellbeing, rather than purely constructing burnout as a personal failing.[41] The most commonly studied interventions for physicians involve mindfulness, stress management and the use of small group discussions.[42] Although such interventions have been shown to be beneficial for reducing physician burnout,[42] they all continue to focus the problem solely at the individual level.

In terms of the environmental level, research has found that students experiencing hospital rotations are more likely to report burnout than those experiencing outpatient, consult services, intensive care or research rotations.[43] Students on rotations requiring overnight call were also significantly more likely to report burnout (55% versus 45%) than students not on rotations requiring overnight call.[43] A recent systematic review, however, has focused on learning environment interventions and their impact on medical students' emotional wellbeing.[44] A total of 28 articles were identified with interventions targeted at both individual and institutional levels, including: mental health programs, mind-body skills training, wellness programmes, mentoring, program reform and curriculum structure.[44] Regarding curricula structure, one study reported that students whose clinical contact hours comprised a greater percentage of their overall learning experiences were less likely to experience burnout or to have seriously considered leaving medical school.[45] This suggests that work-based experience might be a mitigating factor for burnout as students transition into practice.

Curricula intervention

In 2009, the UK General Medical Council introduced a compulsory new addition to the undergraduate curricula in the form a work-based transitional intervention; *the assistantship programme*.[46] Assistantships are designed to address preparedness for practice concerns and the peak in patient safety-related incidents as final year students transition into becoming junior doctors[47-49] and are defined as placements in which final year medical students "act as assistant to a junior doctor, undertaking defined duties under appropriate supervision".[50] Thus they comprise end-of-course work-based experiences with the specific aim of smoothing students' transition into practice.

There is growing evidence that supports the efficacy of these placements in: improving graduates' preparedness for practice across a range of clinical and non-clinical skills domains,[51 52] facilitating a graduated increase in responsibility,[53-56] and providing opportunities for gradual, low-stress workplace acclimatisation and integration within clinical teams facilitated by assistantship alignment.[48 55] However, much of the data to support these assertions lacks rigour. For example, in the case of questionnaire studies, each one utilises a different questionnaire with slightly different foci of enquiry: student anxiety,[55] learning opportunities,[56 57] and specific skills' confidence.[51 52] Additionally, respondent numbers are generally low (e.g. n=37 and n=43 at Time 1),[52 57] with none of the analyses matching participant data longitudinally from Time 1 (T1) and Time 2 (T2). Finally, there is no single model of assistantship: each programme has a different duration (2 weeks, 4 weeks, 8 weeks, and so on), placements are provided at different times in the curricula (before, after final exams) and different in configurations (aligned to the first post on graduation or non-aligned).

Taken together this makes it difficult to draw any strong conclusions regarding the efficacy of the assistantship period. No one study builds on another. Moreover, to date, there has been a limited exploration of the longer-term consequences of assistantship alignment on graduates' psychological wellbeing, namely whether assistantship alignment serves as an existing curriculum intervention to reduce levels of anxiety and burnout in newly qualified doctors. We therefore aim to fill these gaps in the literature through our mixed-methods longitudinal programme of research. Specifically, this study focuses on the following research questions:

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RESEARCH QUESTIONS

RQ 1: Do self-reported professional identity, anxiety, team understanding and burnout levels change over time as final year students transition into clinical practice?

RQ 2: Are there any associations between assistantship alignment and self-reported professional identity, anxiety and team understanding on burnout scores over time?

METHODS

A longitudinal one-year cohort design was used with data being collected via an online questionnaire. The questionnaire included the Professional Identity Scale,[29 58] the Team Understanding Scale,[29] the modified Hamilton Anxiety Rating Scale[59] and the modified Copenhagen Burnout Inventory.[60] The professional identity scale comprises nine questions relating to an individuals' perception of their group identification, the team understanding scale measures students' understanding of team working and willingness to engage. The professional identity and team understanding scales have been successfully validated with a health and social care student population, including medical students.[29] The Hamilton Anxiety Rating scale includes a series of statements concerning individuals' experience of anxiety-related symptoms and is essentially a measurement of a person's general anxiety responsiveness, rather than a measure of context-specific anxiety. We utilised this scale to understand how an individuals' level of anxiety impacts on burnout thus facilitating a better understanding of the impact of the assistantship (as an environmental factor) on burnout levels. The Copenhagen Burnout Inventory comprises questions in three domains: Personal Burnout, Patient-Related Burnout and Work-Related Burnout and has been validated for the assessment of burnout in hospital doctors[60] and undergraduate students.[61] The versions of the Hamilton Anxiety Rating Scale and Copenhagen Burnout Inventory included in the questionnaire were slightly modified by the addition of personal prefixes e.g. "I feel…/I experience…". Owing to a transcription error in the process of generating the online questionnaire, one personal burnout question ("I feel weak and susceptible to illness") was not included in the questionnaire (see Appendix A for the full version of all scales used). The questionnaire comprised 16 pages including 1 introduction, 3 demographic/background pages, a 'your story' page, a 'prize draw' page and a final summary page. Participants could not move forward without completing sections (apart from the final 'your story' section) but could move backwards. This study was conducted as part of a wider, longitudinal, mixed-methods programme of research to examine emotional issues around graduates' transition into practice.[48]

Context

All medical students in Wales undertake a 6-7 week student assistantship with both medical schools co-operating to provide a countrywide joined-up approach. For undergraduates who will commence their postgraduate training in Wales, their assistantship is aligned in location and speciality with their first post-graduate role as a junior doctor (intern) post. This first post is not necessarily in the same location within the country. For example, the graduate could be starting their new junior doctor post in a remote northern Wales setting despite them undertaking the majority of their studies in a southern city setting. Welsh undergraduates who will commence their first post in another UK region and undergraduates from other UK medical schools who will commence their first post within Wales undertake non-aligned assistantships. Some of these graduates might be returning to their home country, Wales. This context provides us with a *natural experiment* situation, with both groups of participants likely experiencing some form of disruption to their social setting.

Procedure

Following ethical approval, all 2015 graduates of the two medical schools in Wales were invited to participate (n=351) along with graduates from other medical schools who would commence working as a doctor within Wales (n=150). Within this cohort, participants fell into two groups (1) Aligned

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Assistantship: individuals who experienced the student assistantship aligned with their first post and (2) Non-aligned Assistantship: individuals who experienced the student assistantship in a different place to their first post. In the UK, the first post is the start of Foundation training, Foundation Year 1 (FY1).

Questionnaires were hosted and administered via the Bristol Online Survey (BOS). Undergraduate assistants tested the questionnaire prior to administration (see Acknowledgements). Invitations to participate in the study were sent to graduates via email with the assistance of undergraduate (T1) and postgraduate (T2-T4) administrators. Weekly reminder emails were sent. A link to the questionnaire was posted on targeted social media pages: e.g. undergraduate year group/junior doctor Facebook pages. As an incentive for participation, individuals were offered the chance to be entered into a prize draw (thirty £20 vouchers were available for each questionnaire). To facilitate delivery of the vouchers, participants wishing to enter the draw were asked to provide an email address. With participants' consent, their email address was utilised as a data identifier allowing participants' responses to be paired over time and analysed longitudinally. After the data had been aligned, all identifiers were removed, and statistical analysis was performed anonymously (SEW only had access to this data). Participants were invited to complete the online questionnaire on four occasions between June 2015 and June 2016: (T1) prior to graduation from medical school and in the middle of their assistantship period (8th June- 6th July 2015); (T2) 1 month following their transition into clinical practice (1st-30th September 2015); (T3) 6 months after their initial transition into clinical practice and 2 months after their second post (4th January-4th February 2016); and (T4) 10 months following their initial transition and 2 months after their third post (23rd May-24th June 2016). These time periods were purposively designed to capture these other transitions in the junior doctor first year (i.e. transitioning into new specialties).

Data analysis and stability assessment

Analysis comprised two stages. Stage 1 analysis was undertaken to answer RQ1 in terms of whether self-reported professional identity, anxiety, team understanding and burnout levels changed over the time of our study as final year students transitioned into their clinical practice. Here, the individual scales were examined (for the Copenhagen Burnout Inventory the three sub-scales of burnout were examined separately: personal, patient-related and work-related). The significance of the main effects (alignment group and time) and the interaction effects for aligned/non-aligned groups over time were assessed with the Wald chi-square test using GEE estimation.

Stage 2 analyses were undertaken to answer RQ2 by examining the associations between assistantship alignment, self-reported professional identity, anxiety and team understanding on burnout scores over time. Multivariate regression analyses were performed by fitting the data to a mixed-effect model.[62] The majority of the results were analyzed using R[63] and lme4.[64] We performed linear mixed-effect models on the three factors of burnout (personal, patient-related and work-related) to assess the effect of alignment, phase and interaction on burnout. The mixed-effect model was chosen as it offered a better fit of the data than the repeated measures ANOVA for these data sets. Mixed-effect models allow individual variability to be accounted for by computing a random slope and a random intercept for each participant. In this way, individual differences in subjective burnout levels were accounted for. The random effect components comprised: (1) intra-individual variation on burnout throughout the different time points; and (2) measurement error (i.e. the remaining “noise” in the model that represents unexplained variations not captured by the model).

We treat time as a continuous variable. We hypothesized that the degrees of burnout change over time could be partly predicted by participants’ experiences of assistantship alignment as well as their personal characteristics of anxiety responsiveness, professional identity, and perceived support from team understanding. To assess the impact of other factors on the participants’ burnout, confounding factors such as participants’ age and gender were included in the fixed effect components. As these

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factors may cause the burnout to be higher or lower or they may cause the burnout to change at a faster or slower rate across time, such variation was modelled with a random intercept and slope, respectively, for each participant. Although it is interesting to see the interaction between these factors and time, we do not include these interaction terms in our model for simplicity purpose. The notations in the model are as follows:

$$Burnout_{ij} = \mu + \beta_g Group_j + \beta_t Time_i + \beta_{gt} Group_j \times Time_i + \beta_s sex_j + \beta_a Age_j + \beta_x Anxiety_j + \beta_p PI_j + \beta_w TeamUnderstanding_j + \gamma_j^0 + \gamma_j^1 Time_i + \varepsilon_{ij}$$

where i indexes the time phase and j indexes the individual. With respect to effect size of linear mixed models, we employed the method for obtaining R^2 from generalized linear mixed-effects models developed by Nakagawa, Schielzeth.[65] This method yields two r squared, a marginal R_m^2 that accounts for the variance explained by the fixed factors and a conditional R_m^2 for the variance explained by both fixed and random factors.

RESULTS

Characteristics of Respondents

The response rates for the four time points were as follows: T1 n=251 (50%), T2 n=179 (34%), T3 n=141 (28%) and T4 n=125 (25%). The response rate aggregated over time was 56% (n=281), of whom 68% (n=183) were female and 73% (n=206) were aged 12-30. Among these, n=129 (46%) experienced the aligned assistantship. Ninety respondents completed the questionnaire on only one occasion. Given this is a longitudinal study, the criteria for inclusion was participation at more than one time. The data from these 90 participants were therefore excluded from the analysis. The number and characteristics of respondents that fulfilled the inclusion criteria at each time point are outlined in Table 1. Completion rates of 72% (93 of 129) and 64% (98 of 152) were observed for aligned and non-aligned participants, respectively. Incomplete data were accounted for in the analysis via maximum likelihood estimation. This difference in study completion did not differ significantly between the two groups, $X^2(1) = 1.53$, p = .22. The percentages of female by time phase were 65%, 69%, 69%, and 70% respectively ($X^2(3) = 1.1$, p = .22).

Anxiety, Professional Identity, Team Understanding And Burnout Over Time

We begin by considering RQ1: do self-reported professional identity, anxiety, team understanding and burnout levels change over time as final year students transition into clinical practice? The changes in self-reports of anxiety, professional identity, team understanding and burnout (personal, patient-related and work-related burnout) by assistantship alignment group over time are displayed in Table 2. Briefly, self-reported anxiety levels and professional identity remained stable throughout the four-time points. Team understanding scores increased significantly over time. Concerning the measures of burnout, all three subscales (personal, patient-related and work-related burnout) increased sequentially across the four-time points, although this did not reach significance for patient-related burnout. We found no significant differences for any of the measures taken by alignment group nor any interactions between time and alignment group for these measures.

Linear mixed-effect model of alignment on burnout longitudinally

We now consider RQ2: Are there any associations between assistantship alignment, self-reported professional identity, anxiety scores and team understanding on self-reported burnout scores over time? Table 3 shows the results of the mixed effect model with the parameter estimates for factors affecting components of modified Copenhagen Burnout Inventory (i.e. personal, patient-related and work-related burnout). By looking at the random effect components, similar patterns were observed for all three subscales of burnout. The intercepts for three components of burnout are significant while the

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slopes were insignificant. That is, the variance in change in burnout by time points (as indicated by slope) is relatively small while the variation in each component of overall burnout between individuals (as indicated by intercepts) is quite large. Thus, the size of the intecepts is likely to be due to individual differences in burnout. This pattern is not uncommon for self-report questionnaires aiming at stable characteristics such as burnout.

From the parameter estimates of the fixed effect components, similar patterns were again observed for all three components of burnout. Over time, burnout scores increased as indicated by increasing trend in the time parameter estimates at subsequent time points, which is significant for work-related burnout (β=1.62, p< 0.01). For personal characteristics, the significant main effects were found for anxiety and perceived professional identity. The significant main effect for anxiety (personal burnout: β=1.01, work-related burnout: β=1.02, patient-related burnout: β=0.64, all p < 0.001) indicates that individuals with high self-reported anxiety levels reported greater burnout than did those with low self-reported anxiety levels. However, the reverse relationships were found for perceived professional identity and burnout (PB: β=-0.41 [p < 0.01], work-related burnout: β=-0.62, patient-related burnout: β=-0.41, [both p < 0.001]). Gender also had a significant effect on personal burnout (β=-5.8, p<0.001) and patient-related burnout (β=3.97, p<0.05), but not significant for work-related burnout (β=-2.14, p=0.15): Males self-reported significantly lower personal burnout, but higher patient-related burnout scores than females. Age and team understanding did not affect burnout scores.

The main effect of alignment group is superseded by the significant interaction between alignment and time for personal burnout (β=1.92, p<0.05) and work-related burnout (β=1.66, p<0.05). The aligned assistantship participant group, the reference group, self-reported personal burnout scores increased and an average of 1.01 per time point (see Figure 1). For the non-aligned assistantship group, self-reported personal burnout scores increased 2.93 (1.01+1.92) per time point on average. Similarly, self-reported work-related burnout scores increased an average of 1.62 per time point for the aligned assistantship group and an average of 3.28 per time point for the non-aligned assistantship group: However, when the actual scores by phase are plotted, we can see how the aligned assistantship respondent group demonstrated asymptote, peaking at Time 3 (6-months post-transition) whereas the non-aligned assistantship group demonstrated asymptote at Time 4.

DISCUSSION

To our knowledge this is the first study to have examined how both individual and environmental factors affect junior doctors' burnout over time. Our longitudinal cohort study used a range of validated questionnaires designed to examine whether medical students' participation in an end-of-year placement (assistantships aligned or non-aligned with their first junior doctor post), along with their self-reported professional identity, team understanding and anxiety, related to their self-reported burnout over time. Looking at the questionnaires individually, we found that team understanding, personal burnout and work-related burnout increased significantly over time irrespective of respondents' alignment experience, but no increase in patient-related burnout. This finding has some similarity with other research. For example, a longitudinal cohort study of medical graduates in Australia found that personal burnout and work-related burnout rose significantly over their first year, although unlike our study these peaked at 6-months.[27] Furthermore, patient-related burnout remained at significantly lower levels than personal burnout and work-related burnout, although it demonstrated a significant increase at 12-months from the 'no-change' earlier time periods.[27] Professional identity and anxiety did not change significantly across the four time periods in our study, again, irrespective of assistantship alignment.

The findings around professional identity, team understanding and burnout suggests that assistantship alignment appears to provide no absolute beneficial effect on these factors for individuals whose

work-based placements are intimately associated with their first role as a junior doctor. This runs counter to our expectation that an aligned assistantship would be beneficial in these areas. However, employing a linear mixed-effect model using burnout as the outcome variable, we found a significant relationship between alignment group and time for personal burnout and work-related burnout. Respondents experiencing a non-aligned assistantship reported a sharper rise (three-fold) in personal burnout across all four time-points than those experiencing an aligned assistantship with neither group showing evidence of reaching asymptote. A similar rise was found for the non-aligned assistantship group and work-related burnout, although work-related burnout reached asymptote for the aligned assistantship group immediately on transition into practice. This suggests a slightly delayed beneficial effect regarding work-related burnout for aligning work-based placements to students' first post as a junior doctor. Furthermore, this beneficial effect continues beyond junior doctors' first post and throughout subsequent transitions in the first year. That the aligned group demonstrated an initial rise in work-related burnout on their first transition to being a junior doctor is not unexpected. Indeed, the sharp rise in responsibility as perceived by new graduates is well documented[48 53] and it is highly possible that students undertaking an aligned assistantship might feel more protected prior to their first post beginning.[48] As such, there might be an initial 'shock' at first, followed by a period of greater stability.

Our linear mixed-effect model also identified an association between anxiety and burnout: respondents reporting high anxiety levels also reported higher burnout scores as compared to those reporting low anxiety levels. This finding resonates with other research examining the relationship between anxiety and burnout in healthcare professionals.[39 66] Taken together with our finding, it suggests that individuals with a predisposition for anxiety are more likely to self-report burnout. Interestingly, the reverse relationship was found for perceived professional identity in our study: higher levels of self-reported professional identity were related to significantly lower self-reported burnout across all three factors. As such, our finding relates to other studies examining the relationship between identity and burnout in healthcare workers, teaching professionals, the general population as well as experimental research on members of the general population undertaken by social psychologists.[67-70] Indeed, such research has suggested that a strong sense of social identity (i.e. a feeling of belonging to the group) facilitates an increased capacity to cope under stress, and that a failure to develop such a shared identity is associated with a reduced ability to deal with stressors effectively.[67] That self-reported identity did not change over time in our study, suggests that for some, this shared identity might have been already sufficiently formed prior to students' transition into practice, and that any protective effect that it provides has not been diminished (or enhanced) by the assistantship alignment experience and their subsequent junior doctor role. For those participants whose shared identity was insufficiently formed prior to their transition, it appears that such identities, likewise, are nether diminished or enhanced over time leaving them vulnerable to experiencing burnout. However, as we did not measure individuals' perceptions of their professional identities *prior to* the assistantship programme (T1 being in the middle of it), we cannot be fully sure that the early weeks did not have an impact on professional identity.

Participant gender was also related to burnout scores in our study. Males reported significantly lower personal burnout, but higher patient-related burnout scores than their female counterparts. For work-related burnout, both groups demonstrated an increase over time. Regarding personal burnout, previous research suggests that the prevalence of mental health problems is higher in female doctors than their male counterparts,[71] and other research on a graduate cohort have found females reporting greater personal burnout than males.[27] It has been postulated that the vulnerability of females to burnout and mental health problems may be in part a reflection of the gender specific stresses women encounter in the workplace.[72] However, evidence concerning the relationship between burnout and gender to date is inconclusive. While some studies have reported the prevalence of burnout to be higher in female doctors,[7 73] other studies have reported no gender differences[1] or a higher prevalence in males.[11 74]

Our findings resonate with Hillhouse et al's model of work stress, burnout, affect, health and clinical competence regarding the higher level of patient-related burnout identified in male medical residents,[75] although other research has not found this.[27] Indeed, in the wider literature, the commonly held assertion that females are at higher risk of burnout than their male counterparts in the labour market generally has been challenged in a recent meta-analysis.[74] One factor that might impact on these gender-specific findings might be that respondents are acting according to their gendered expectations. Thus males might downplay distress due to a social expectation that they should appear tough and resilient.[76] Thus, in our study we find that males report greater patient-related burnout but females reporting greater personal burnout. In terms of the social expectations explanation, it could be that males are downplaying their personal burnout (subconsciously acting out a tough male role) but up playing patient-related burnout (i.e. subconsciously shifting from self to 'other'), and vice-versa for females (i.e. subconsciously due to societal expectations around their nurturing role). However, we remain agnostic on this interpretation, as it is impossible to really understand what is happening. Importantly, if it is that males are downplaying their experiences of personal burnout, they might be at greater risk of experiencing negative emotional wellbeing. As such we should not necessarily accept the findings in terms of gender at face value.

Despite having strong findings, our research has limitations that need to be taken into account when considering the implications of these findings for practice. Firstly, although the respondents come from a wide range of medical schools across the UK, those experiencing an aligned assistantship were all trained and subsequently worked in a single UK country, Wales. This could be a potential confounding factor, whereby the interaction between burnout and alignment might purely be due to the change in location, and the subsequent disruption to support networks and homes, rather than the work-based placement. However, this is unlikely as students' first posts in Wales were not necessarily located in the same place in which their undergraduate learning occurred. For example, those learning in one University hospital might have their first post in an entirely different one, even differing between city and rural locations across the country. Secondly, respondents were not randomised to the aligned or non-aligned work-based placements, and it might be that this "natural experiment" has within it some further confounding factors. For example, there might be some similarities between those individuals who trained in Wales and who wish to stay there, which are very different to those who chose to work elsewhere or to those who trained elsewhere but wished to work in Wales. Thirdly, our study respondents comprised a much higher ratio of females than males (2:1). This ratio, although generally reflecting the higher proportion of females than males in the UK graduate population, is rather exaggerated: the average percentage of female to graduates over the past few years has been 56%, which is lower than our study average (68%).[77]

Despite these limitations, our research has notable strengths. The joined up nature of the assistantship programme in Wales has provided us with a unique opportunity to examine the effects of learning alignment to graduates' first post across a range of personal and environmental factors that are important for the wellbeing of our clinical workforce. We have been able to utilize a general linear mixed regression model, which has proved a useful approach for analysing our repeated measures data in this longitudinal cohort study. Although the model is similar in many respects to ordinary multiple regression, using the mixed regression analysis allows us more flexibility than an ordinary multiple regression: it enables us to include participants with missing outcomes in the analysis (so long as there are sufficient data points); it has permitted us to treat time as continuous, rather than a fixed set of points; and it can easily handle both time-invariant and time-varying covariates. As such we have been able to unpack the nuances to understand how these factors interact over time.

Our findings bring forth some implications for practice and future research suggestions. Given that graduates experiencing an aligned assistantship demonstrate a lower rise in personal burnout over the transition period and a stabilized work-related burnout as compared with those whose assistantship was non-aligned, we suggest that medical schools consider organizing students' final-year placements

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with their first-post on transition, or that an extended shadowing period is explored immediately on graduation. Although this suggestion might seem out of reach, we believe that it is not impossible. For example, in 2016 across the UK an average of 40.5% of graduating medical students selected their local foundation school (the organisation which provides postgraduate training) as their first preference for postgraduate studies (with Northern Ireland and Scotland having over 60% of graduates applying locally), the vast majority of which were successful.[78] This means that potentially around 40% of UK graduates could experience an aligned assistantship prior to their transition into practice. Such a move would enable further research on the potential benefits of alignment to be examined on a much wider scale.

Furthermore, given that possessing a strong professional identity appears to mitigate burnout, and that identity does not appear to develop over the transition period, we suggest that educators might consider how best to support the professional identity of undergraduate students early on in their programme to ensure this is fully embodied at the time of graduation.[79] It is important to note that such an identity appears to be associated with their feeling of belonging to the profession in general – rather than just to the specialty in which they are studying and will be working in. Therefore educational considerations need to focus on this aspect of affiliation. Finally, given the strong relationship between anxiety and burnout that has been identified in ours, and other studies, we suggest that support systems are in place for individuals who have a predisposition for anxiety. Such support systems should be operations during students' undergraduate years and should be made available to them as they transition into practice and beyond.

Following our study we have suggestions for future research. The majority of research in medical education to date has focused on individual factors responsible for burnout, yet we have identified a strong relationship between burnout and environmental factors (assistantship alignment). However, our research tells us little about what it is in the alignment/non-alignment experience that has facilitating/mitigating effects. As such we suggest that future research considers these 'black box' issues and tries to unpack the nuances within. For this, qualitative methods (e.g. interviews, diaries, video ethnography) as well as validated questionnaires alongside appropriate approaches to understanding the intricacies of the mechanisms that might be at play (e.g. realist research, structural equation modeling, factor analysis). Furthermore, a concerted effort towards undertaking a systematic programme of research, where each study adds to and builds upon, the other is required. Without such research our knowledge about the factors that increase and mitigate burnout in junior doctors will continue to be unnecessarily fragmented.

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TABLE 1: NUMBER (AND %) OF RESPONDENTS' DEMOGRAPHICS ACROSS EACH OF THE 4 DATA COLLECTION TIMES

	T1	T2	T3	T4
Group	208	175	135	125
Aligned	99	79	64	65
Non-aligned	109	96	71	60
Gender				
Female	135 (64.9)	120 (68.57)	93 (68.89)	87 (69.6)
Male	73 (35.1)	55 (31.43)	42 (31.11)	38 (30.4)
Age				
17-25	155 (74.52)	129 (73.71)	96 (71.11)	98 (78.4)
26-30	45 (21.63)	40 (22.86)	36 (26.67)	24 (19.2)
31-35	4 (1.92)	4 (2.29)	2 (1.48)	3 (2.4)
36-40	4 (1.92)	2 (1.14)	1 (0.74)	0 (0)

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TABLE 2: DISTRIBUTION OF MEASUREMENT SCORES BY GROUP AND TIME

	Phase				
Measures	T1	T2	T3	T4	Wald X^2
HAM-A	11.42±8.02	11.32±8.65	10.72±8.59	10.86±9.28	$X^2_{Group} = .43$
Aligned	10.99±7.29	11.61±8.59	10.66±8.36	11.25±8.47	$X^2_{Time} = .87$
Non-aligned	11.81±8.65	11.08±8.75	10.77±8.85	10.45±10.14	$X^2_{Int} = .67$
Professional identity	37.02±4.89	37.11±4.67	37.16±4.84	37.81±4.87	$X^2_{Group} = .57$
Aligned	37.85±4.55	37.05±4.71	37.22±4.95	37.62±4.57	$X^2_{Time} = 2.18$
Non-aligned	36.28±5.1	37.17±4.66	37.11±4.78	38.02±5.2	$X^2_{Int} = 6.24$
Teamwork	38.05±3.37	38.97±3.5	40.41±3.24	39.58±3.31	$X^2_{Group} = .97$
Aligned	38.37±3.76	39.06±3.17	40.34±2.75	39.66±3.13	$X^2_{Time} = 46.82^{***}$
Non-aligned	37.76±2.95	38.9±3.77	40.48±3.64	39.5±3.52	$X^2_{Int} = 1.81$
Personal burnout	42.64±16.28	47.66±18.69	47.33±18.19	48.2±17.07	$X^2_{Group} = .70$
Aligned	41.26±17.35	48.04±18.78	46.02±16.93	46.46±15.58	$X^2_{Time} = 17.29^{**}$
Non-aligned	43.9±15.2	47.34±18.71	48.52±19.3	50.08±18.49	$X^2_{Int} = 2.53$
Work-related burnout	36.76±13.44	40.94±16.89	41.9±16.04	42.69±15.78	$X^2_{Group} = .33$
Aligned	35.82±14.59	41.37±17.72	41.69±14.79	41.7±14.2	$X^2_{Time} = 34.1^{***}$
Non-aligned	37.61±12.31	40.59±16.27	42.1±17.2	43.75±17.38	$X^2_{Int} = .97$
Patient-related burnout	22.46±12.79	23.36±13.41	23.4±12.98	25.1±14.1	$X^2_{Group} = 1.43$
Aligned	21.09±12.41	23.05±14.48	22.72±13.13	25.51±13.37	$X^2_{Time} = 5.84$
Non-aligned	23.7±13.05	23.61±12.53	24±12.9	24.65±14.96	$X^2_{Int} = 1.56$

NOTE: The significance of the main (Group and Time) and the interaction effects was assessed with the Wald chi-square test using GEE estimation. Significance level * p<.05, ** p<0.01 *** p<0.001

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TABLE 3: RESULTS OF MIXED EFFECT MODELS

	Burnout					
Parameters	Personal		Work-related		Patient-related	
Fixed effect	estimate	(SE)	estimate	(SE)	estimate	(SE)
Intercept	42.16***	(8.07)	43.32***	(6.80)	33.09***	(6.68)
Time	1.01	(0.62)	1.62**	(0.52)	0.53	(0.59)
Anxiety	1.01***	(0.08)	1.02***	(0.07)	0.64***	(0.07)
Professional identity	-0.41**	(0.15)	-0.62***	(0.12)	-0.41***	(0.12)
Gender (ref: female)	-5.80***	(1.72)	-2.14	(1.48)	3.97*	(1.52)
Age	0.45	(1.44)	2.34	(1.23)	-1.43	(1.27)
Team understanding	0.17	(0.18)	0.08	(0.15)	-0.10	(0.15)
Group (ref: Aligned)	-2.68	(2.61)	-4.60*	(2.04)	-0.76	(2.09)
Group * Time	1.92*	(0.88)	1.66*	(0.72)	0.66	(0.73)
Random effect	Variance	(SD)	Variance	(SD)	Variance	(SD)
Intercept	81.02***	(9.0)	30.49***	(5.52)	57.63***	(7.59)
Time (slope)	2.06	(1.43)	0.81	(0.9)	3.37	(1.84)
Residual (error)	106.77	(10.33)	75.07	(8.66)	63.75	(7.98)
R^2 marginal (fixed)	0.39		0.46		0.24	
R^2 conditional (fixed and random)	0.65		0.70		0.64	

NOTE: The significance of the fixed effect was assessed with the Wald test conducted on the full model, whereas the significance of the random intercept and slope effects was assessed with likelihood testing using REML estimation. For each components of burnout, the corresponding marginal and conditional R^2_{GLMM} values were computed based on the method developed by Nakagawa and Schielzeth.[65] Significance level * p<.05, ** p<0.01 *** p<0.001

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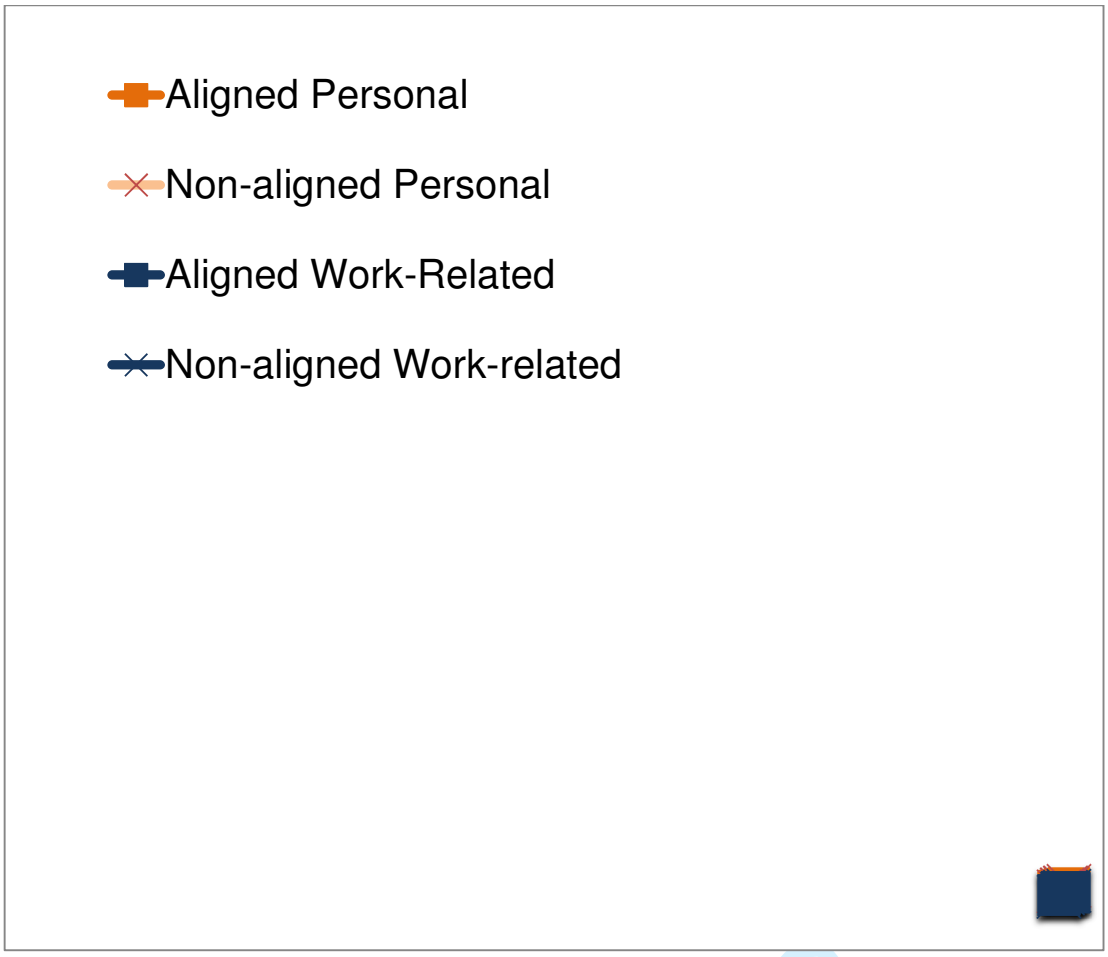
FIGURE 1: ASSISTANTSHIP ALIGNMENT AND TIME: ASSOCIATION WITH PERSONAL AND WORK-RELATED BURNOUT

Legend:



NOTE: The slope demonstrated the increase for the fixed effect of Time and is akin to the beta in a regression line.

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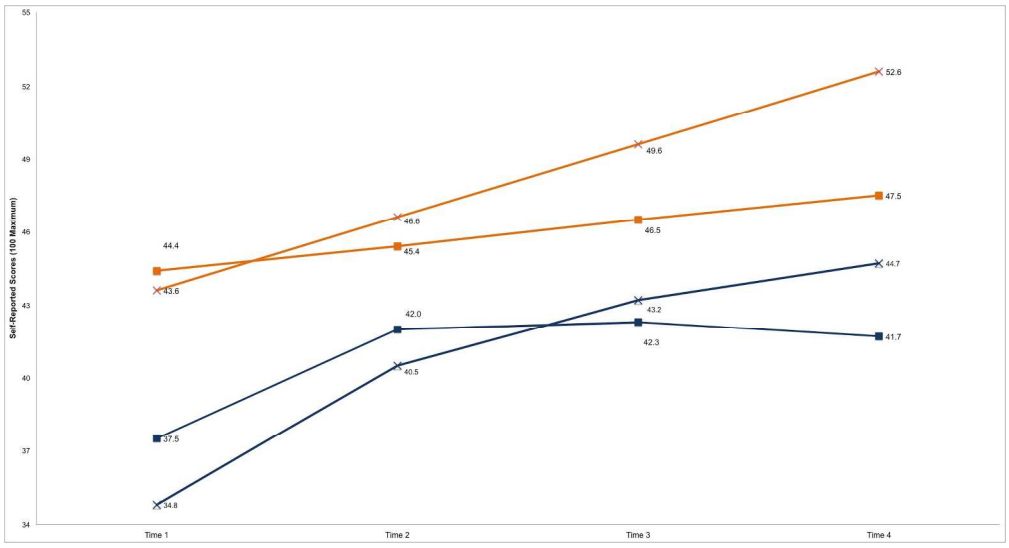

FIGURE 1: ASSISTANTSHIP ALIGNMENT AND TIME: ASSOCIATION WITH PERSONAL AND WORK-RELATED BURNOUT

677x363mm (300 x 300 DPI)

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Appendix A: Scales used in the questionnaire

NOTE: All questions for all scales were rated using a 5-point likert scale.

THE MODIFIED HAMILTON ANXIETY RATING SCALE

1. I feel worried, irritable or anticipate the worst
2. I experience feelings of tension such as an inability to relax, started responses or being moved to tears easily
3. I experience fears of the dark, strangers, crowds or being left alone
4. I experience difficulty in falling asleep, unsatisfying sleep or nightmares
5. I experience difficulty in concentrating or experience poor memory
6. I experience low mood or a decreased interest and pleasure in hobbies
7. I experience aches and pains, teeth grinding or twitching and stiffness
8. I experience blurring of vision, hot and cold flushes or feelings of weakness
9. I experience tachycardia, palpitations, chest pain or fainting
10. I experience a sensation of a tight chest, dyspnoea or sighing
11. I experience difficulty swallowing, wind, abdominal pain, weight loss, nausea, vomiting or a change in bowel habit
12. I experience urgency of micturition, loss of libido (or a change in my monthly cycle if I am a woman).
13. I experience a dry mouth, flushing, tendency to sweat or a headache
14. I experience fidgeting, tremor of hands, restlessness, sighing or rapid respiration in stressful moments

PROFESSIONAL IDENTITY SCALE

1. I feel like I am a member of this profession
2. I feel like I have strong ties with members of this profession
3. I am often ashamed to admit I am studying for this profession (R)
4. I find myself making excuses for belonging to this profession (R)
5. I try to hide that I am studying to be part of this profession (R)
6. I am pleased to belong to this profession
7. I can identify positively with members of this profession
8. Being a member of this profession is important to me
9. I feel like I share characteristics with members of the profession

(R) = items that are reversed scored.

THE MODIFIED COPENHAGEN BURNOUT INVENTORY

Personal Burnout: *"The degree of physical and psychological fatigue and exhaustion experienced by the person"*

1. I feel tired
2. I am physically exhausted
3. I am emotionally exhausted
4. I think "I can't take it anymore"
5. I feel worn out
6. I feel weak and susceptible to illness*

*Omitted from questionnaire due to transcription error

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Work-Related Burnout: *"The degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work"*

1. I feel worn out at the end of the working day
2. I am exhausted in the morning at the thought of another day of work
3. I feel that every working hour is tiring for me
4. I have enough energy for family and friends during leisure time*
5. My work is emotionally exhausting
6. My work frustrates me
7. I feel burnout because of my work

Patient-Related Burnout: *"The degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work with patients*

1. I find it hard to work with patients
2. It drains my energy to work with patients
3. I find it frustrating to work with patients
4. I feel that I give more than I get back when I work with patients
5. I am tired of working with patients
6. I sometimes wonder how long I will be able to continue working with patients

TEAM UNDERSTANDING SCALE

1. I am/have been an active member of some form of team
2. I enjoy working in a team
3. I observed many teams of which I am not a member
4. My participation in a team has facilitated how members of the team work together
5. I know how to make teams more effective
6. I frequently interact with (i.e. work with, train) teams of which I am not a member
7. I understand how people should work together as a team
8. I contribute to teams of which I am a member
9. I understand why some teams are ineffective
10. I contribute more than my fare share to the teams I am a member

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Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

	Date/Time	Procedure, p6.
	Randomization of items	None
	Adaptive questioning	None
	Number of screens	16, see p6.
	Completeness check	Participants could not move forward without completing sections (apart from the final 'your story' section). P6.
	Review check	Yes, participants could move backwards.
Response rates	Unique site visitor	Via email address which enabled us to link data longitudinally
	View rates	None recorded
	Participation rate	"All aligned assistantship (n=182) and non-aligned assistantship students (n=319) were contacted; n=281 (56%) responded: 68% (n=183) females, 73% (n=206) 22-30yrs, 46% aligned (n=129). Completion rates: aligned 72% (93/129) and non-aligned 64% (98/152)." p3.
	Completion rate	Attrition was not recorded
Preventing multiple entries from single individual	Cookies used	Respondent anonymity and Bristol Online Survey (BOS). BOS is designed to protect respondent anonymity. BOS does not use cookies for survey completion and external tracking software such as Google Analytics is not supported on BOS surveys. Additionally, we cannot access any information about respondents' IP addresses.
Design	Describe survey design	p6.
IRB review	IRB approval	Yes, detailed
	Informed consent	Yes, including additional 1 page information on the survey itself.
	Data protection	BOS Security Physical security All data is stored on servers located at the University of Bristol, United Kingdom. Administrative security Access to sensitive data via BOS is strictly limited to BOS's support and technical teams. This access is only permitted when it is at the request of the client concerned or necessary for the investigation of operational issues (or

		when required by law). The BOS servers and backups are accessible only by members of the BOS technical team and other authorised members of IT Services within the University of Bristol (such as systems administrators or those responsible for maintaining the backup service). User authentication New users choose their own passwords and will need to enter a username and password each time they log in. BOS issues a cookie to store session information when registered users log in. The session cookie does not include user information and is not retained once the browser is closed. No cookies are used when survey respondents complete surveys. BOS employees All new staff at the University of Bristol, including casual staff, are given a contract of employment containing a confidentiality clause and are made aware of their responsibilities toward restricted university data and personal data as part of their induction process. All University of Bristol IT staff are provided with data security training. Encryption All survey responses are collected over encrypted SSL (TLS) connections. SSL is the standard technology for establishing an encrypted link between a web server and a browser. It ensures that sensitive information can be transmitted securely. All communications within onlinesurveys.ac.uk are also sent over SSL encrypted connections. BOS user passwords are encrypted using PBKDF2 with a SHA256 hash and a random salt.

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		Backups BOS's data stores are backed up daily. University of Bristol has a data retention policy that means that backups are only held for three months. Backups are stored securely in a separate location from the data centres, but still on the University of Bristol's campus. After three months the tapes are either recycled or destroyed. BOS enables users to export survey response data in a number of popular formats (see FAQ for details) so that it can be backed up or used with other software. User responsibilities Users must not share accounts – by this we mean that each person who has access to a BOS account must use a unique username and password. You must not allow other people to use your username and password and multiple users must not log in using a single set of shared credentials (such as a 'group account'). Users' passwords should be sufficiently complicated, stored securely (if stored at all) and not be the same as used on any other system. You should ensure that you have appropriate levels of security on your own systems should you choose to export sensitive data. You and/or your institution are the Data Controller for any information collected using surveys run through BOS. If you are not sure of the implications of being a Data Controller please consult the data protection officer (or equivalent) at your institution.
Development and testing		Questionnaire was tested by undergraduate volunteers prior to the launch (see Acknowledgements) and p6.
Recruitment	Open vs closed	Open
	Contact mode	p6.
	Advertising survey	p6.
Survey	Web/email	Bristol Online Survey (p6)

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administration		
	Context	Bristol Online Survey (p6)
	Mandatory/Voluntary	Voluntary
	Incentives	p7. We offered a prize draw.
Duplicate entries	IP check	Not used
	Log file analysis	Detailed on p 7.
	Registration	Not used
Analysis	Handling of incomplete questionnaires	maximum likelihood estimation was used – see p7-8.
	Questionnaires with atypical timestamp	n/a
	Statistical correction	none

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BMJ Open

Association of professional identity, gender, team understanding, anxiety and workplace learning alignment with burnout in junior doctors: a longitudinal cohort study

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BACKGROUND

Medical students' transition into clinical practice has long been regarded as a period of high stress. During the first postgraduate year, medical graduates are required to adjust to the increased workload and responsibility of their new role in addition to coping with the challenges of frequently rotating between departments and managing uncertainty concerning their future career.[1-5] Doctors' chronic exposure to workplace stress has been associated with mental health disorders and burnout: feeling mentally and physically exhausted due to work or care-giving undertakings.[6-8] A higher prevalence of mental health disorders such as anxiety, depression, substance misuse and suicide among doctors and medical students is widely reported in the literature.[8-10]. Furthermore, studies conducted in Europe,[1 11-14] North America,[15-17] Australia,[3 7] and South East Asia.[18] have all highlighted burnout to be an area of international concern particularly in relation to its association with increased psychiatric morbidity and negative health behaviours among medical students and early career doctors.[6 11 19] The potential personal and professional consequences of mental health problems and burnout for doctors and their patients can be devastating; resulting in suboptimal patient care, increased medical errors and lapses in professional behaviour.[17 20-22]

Mental health problems and burnout observed at undergraduate level have potential implications for graduates' following their transition into clinical practice. For example, perceived stress during medical school has been shown to be a predictor of mental health problems requiring treatment among postgraduates.[23] In addition, doctors at the start of their postgraduate training have been found to be at increased risk of developing burnout compared to their more senior counterparts.[24 25] This in part may be attributable to an *undergraduate burnout hangover,* as a number of studies have suggested that graduates commence their postgraduate training already exhibiting features of burnout.[11 12 16 24] However, a longitudinal prospective cohort study of 117 final year students found a steady increase in burnout over time, rising from 28% prevalence at T1 (six months prior to graduation) to 75% at T5 (11 months post-graduation).[26] This suggests that the workplace learning environment also has an impact. Likewise, a more recent study examining medical interns in an Australian hospital found a 60% overall incidence of burnout and reported similar longitudinal findings whereby high levels of personal and work-related burnout were recorded throughout the year, peaking at six months into the internship.[27]

Individual factors and burnout: Identity, team understanding and anxiety

It has been argued that burnout in doctors is mainly due to personal factors, including trait measures of personality and individual perceptions of the learning and work environment.[28] The professional socialisation of medical students has been the focus of much study recently.[29-32] Essentially, it has been argued that in order to behave as a fully functioning member of the medical profession, medical students need to develop a strong sense of themselves as doctors.[30-32] Thus, an essential part of becoming a doctor comprises students' identification of themselves as being part of the medical profession:[29 30 32 33] that is, developing an embodied professional identity that links them with the group. Additionally, identity-threat has been significantly correlated with burnout in doctors.[34] Given that the group is part of our identity, and we are part of the group, identity-threats can include feeling that the group we identify with is threatened in some way or feeling alienated from the group (disrupting our sense of belonging).[35] The ability to work well within a team and the opportunity to have a strong sense of belonging to the group (e.g. working in teams during work-based learning placements) have been highlighted as facilitating factors for group identification.[29] Anxiety can be generated by virtue of the situation or event in which we might find ourselves (so once the source of 'threat' goes away, so does the experience of anxiety).[36] Anxiety can also be a more generalised attribution of an individual.[37] Research has demonstrated an association between generalised anxiety and burnout in doctors and other healthcare professionals.[38-40]

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Moving from individual to institutional factors for burnout

There have been calls for increased interventions targeted to address wellbeing, mental health problems and burnout at both the undergraduate and the postgraduate level.[6 24] Moreover, there has been a call to focus on both individual and organisational factors that might contribute to wellbeing, rather than purely constructing burnout as a personal failing.[41] The most commonly studied interventions for physicians involve mindfulness, stress management and the use of small group discussions.[42] Although such interventions have been shown to be beneficial for reducing physician burnout,[42] they all continue to focus the problem solely at the individual level.

In terms of the environmental level, research has found that students experiencing hospital rotations are more likely to report burnout than those experiencing outpatient, consult services, intensive care or research rotations.[43] Students on rotations requiring overnight call were also significantly more likely to report burnout (55% versus 45%) than students not on rotations requiring overnight call.[43] A recent systematic review, however, has focused on learning environment interventions and their impact on medical students' emotional wellbeing.[44] A total of 28 articles were identified with interventions targeted at both individual and institutional levels, including: mental health programs, mind-body skills training, wellness programmes, mentoring, program reform and curriculum structure.[44] Regarding curricula structure, one study reported that students whose clinical contact hours comprised a greater percentage of their overall learning experiences were less likely to experience burnout or to have seriously considered leaving medical school.[45] This suggests that work-based experience might be a mitigating factor for burnout as students transition into practice.

Curricula intervention

In 2009, the UK General Medical Council introduced a compulsory new addition to the undergraduate curricula in the form a work-based transitional intervention; *the assistantship programme*.[46] Assistantships are designed to address preparedness for practice concerns and the peak in patient safety-related incidents as final year students transition into becoming junior doctors[47-49] and are defined as placements in which final year medical students "act as assistant to a junior doctor, undertaking defined duties under appropriate supervision".[50] Thus they comprise end-of-course work-based experiences with the specific aim of smoothing students' transition into practice.

There is growing evidence that supports the efficacy of these placements in: improving graduates' preparedness for practice across a range of clinical and non-clinical skills domains,[51 52] facilitating a graduated increase in responsibility,[53-56] and providing opportunities for gradual, low-stress workplace acclimatisation and integration within clinical teams facilitated by assistantship alignment.[48 55] However, much of the data to support these assertions lacks rigour. For example, in the case of questionnaire studies, each one utilises a different questionnaire with slightly different foci of enquiry: student anxiety,[55] learning opportunities,[56 57] and specific skills' confidence.[51 52] Additionally, respondent numbers are generally low (e.g. n=37 and n=43 at Time 1),[52 57] with none of the analyses matching participant data longitudinally from Time 1 (T1) and Time 2 (T2). Finally, there is no single model of assistantship: each programme has a different duration (2 weeks, 4 weeks, 8 weeks, and so on), placements are provided at different times in the curricula (before, after final exams) and different in configurations (aligned to the first post on graduation or non-aligned).

Taken together this makes it difficult to draw any strong conclusions regarding the efficacy of the assistantship period. No one study builds on another. Moreover, to date, there has been a limited exploration of the longer-term consequences of assistantship alignment on graduates' psychological wellbeing, namely whether assistantship alignment serves as an existing curriculum intervention to reduce levels of anxiety and burnout in newly qualified doctors. We therefore aim to fill these gaps in the literature through our mixed-methods longitudinal programme of research. Specifically, this study focuses on the following research questions:

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RESEARCH QUESTIONS

RQ 1: Do self-reported professional identity, anxiety, team understanding and burnout levels change over time as final year students transition into clinical practice?

RQ 2: Are there any associations between assistantship alignment and self-reported professional identity, anxiety and team understanding on burnout scores over time?

METHODS

A longitudinal one-year cohort design was used with data being collected via an online questionnaire. The questionnaire included the Professional Identity Scale,[29 58] the Team Understanding Scale,[29] the modified Hamilton Anxiety Rating Scale[59] and the modified Copenhagen Burnout Inventory.[60] The professional identity scale comprises nine questions relating to an individuals' perception of their group identification, the team understanding scale measures students' understanding of team working and willingness to engage. The professional identity and team understanding scales have been successfully validated with a health and social care student population, including medical students.[29] The Hamilton Anxiety Rating scale includes a series of statements concerning individuals' experience of anxiety-related symptoms and is essentially a measurement of a person's general anxiety responsiveness, rather than a measure of context-specific anxiety. We utilised this scale to understand how an individuals' level of anxiety impacts on burnout thus facilitating a better understanding of the impact of the assistantship (as an environmental factor) on burnout levels. The Copenhagen Burnout Inventory comprises questions in three domains: Personal Burnout, Patient-Related Burnout and Work-Related Burnout and has been validated for the assessment of burnout in hospital doctors[60] and undergraduate students.[61] The versions of the Hamilton Anxiety Rating Scale and Copenhagen Burnout Inventory included in the questionnaire were slightly modified by the addition of personal prefixes e.g. "I feel…/I experience…". Owing to a transcription error in the process of generating the online questionnaire, one personal burnout question ("I feel weak and susceptible to illness") was not included in the questionnaire (see Appendix A for the full version of all scales used). The questionnaire comprised 16 pages including 1 introduction, 3 demographic/background pages, a 'your story' page, a 'prize draw' page and a final summary page. Participants could not move forward without completing sections (apart from the final 'your story' section) but could move backwards. This study was conducted as part of a wider, longitudinal, mixed-methods programme of research to examine emotional issues around graduates' transition into practice.[48]

Context

All medical students in Wales undertake a 6-7 week student assistantship with both medical schools co-operating to provide a countrywide joined-up approach. For undergraduates who will commence their postgraduate training in Wales, their assistantship is aligned in location and speciality with their first post-graduate role as a junior doctor (intern) post. This first post is not necessarily in the same location within the country. For example, the graduate could be starting their new junior doctor post in a remote northern Wales setting despite them undertaking the majority of their studies in a southern city setting. Welsh undergraduates who will commence their first post in another UK region and undergraduates from other UK medical schools who will commence their first post within Wales undertake non-aligned assistantships. Some of these graduates might be returning to their home country, Wales. This context provides us with a *natural experiment* situation, with both groups of participants likely experiencing some form of disruption to their social setting.

Procedure

Following ethical approval, all 2015 graduates of the two medical schools in Wales were invited to participate (n=351) along with graduates from other medical schools who would commence working as a doctor within Wales (n=150). Within this cohort, participants fell into two groups (1) Aligned

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Assistantship: individuals who experienced the student assistantship aligned with their first post and (2) Non-aligned Assistantship: individuals who experienced the student assistantship in a different place to their first post. In the UK, the first post is the start of Foundation training, Foundation Year 1 (FY1).

Questionnaires were hosted and administered via the Bristol Online Survey (BOS). Undergraduate assistants tested the questionnaire prior to administration (see Acknowledgements). Invitations to participate in the study were sent to graduates via email with the assistance of undergraduate (T1) and postgraduate (T2-T4) administrators. Weekly reminder emails were sent. A link to the questionnaire was posted on targeted social media pages: e.g. undergraduate year group/junior doctor Facebook pages. As an incentive for participation, individuals were offered the chance to be entered into a prize draw (thirty £20 vouchers were available for each questionnaire). To facilitate delivery of the vouchers, participants wishing to enter the draw were asked to provide an email address. With participants' consent, their email address was utilised as a data identifier allowing participants' responses to be paired over time and analysed longitudinally. After the data had been aligned, all identifiers were removed, and statistical analysis was performed anonymously (SEW only had access to this data). Participants were invited to complete the online questionnaire on four occasions between June 2015 and June 2016: (T1) prior to graduation from medical school and in the middle of their assistantship period (8th June- 6th July 2015); (T2) 1 month following their transition into clinical practice (1st-30th September 2015); (T3) 6 months after their initial transition into clinical practice and 2 months after their second post (4th January-4th February 2016); and (T4) 10 months following their initial transition and 2 months after their third post (23rd May-24th June 2016). These time periods were purposively designed to capture these other transitions in the junior doctor first year (i.e. transitioning into new specialties). We did not use the facility within the BOS to enable individuals to 'save responses and complete later', so we are unable to know how many people started, but did not finish, the questionnaires.

Data analysis and stability assessment

Analysis comprised two stages. Stage 1 analysis was undertaken to answer RQ1 in terms of whether self-reported professional identity, anxiety, team understanding and burnout levels changed over the time of our study as final year students transitioned into their clinical practice. Here, the individual scales were examined (for the Copenhagen Burnout Inventory the three sub-scales of burnout were examined separately: personal, patient-related and work-related). The significance of the main effects (alignment group and time) and the interaction effects for aligned/non-aligned groups over time were assessed with the Wald chi-square test using GEE estimation.

Stage 2 analyses were undertaken to answer RQ2 by examining the associations between assistantship alignment, self-reported professional identity, anxiety and team understanding on burnout scores over time. Multivariate regression analyses were performed by fitting the data to a mixed-effect model.[62] The majority of the results were analyzed using R[63] and lme4.[64] We performed linear mixed-effect models on the three factors of burnout (personal, patient-related and work-related) to assess the effect of alignment, phase and interaction on burnout. The mixed-effect model was chosen as it offered a better fit of the data than the repeated measures ANOVA for these data sets. Mixed-effect models allow individual variability to be accounted for by computing a random slope and a random intercept for each participant. In this way, individual differences in subjective burnout levels were accounted for. The random effect components comprised: (1) intra-individual variation on burnout throughout the different time points; and (2) measurement error (i.e. the remaining "noise" in the model that represents unexplained variations not captured by the model).

We treat time as a continuous variable. We hypothesized that the degrees of burnout change over time could be partly predicted by participants' experiences of assistantship alignment as well as their personal characteristics of anxiety responsiveness, professional identity, and perceived support from

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team understanding. To assess the impact of other factors on the participants' burnout, confounding factors such as participants' age and gender were included in the fixed effect components. As these factors may cause the burnout to be higher or lower or they may cause the burnout to change at a faster or slower rate across time, such variation was modelled with a random intercept and slope, respectively, for each participant. Although it is interesting to see the interaction between these factors and time, we do not include these interaction terms in our model for simplicity purpose. The notations in the model are as follows:

$$Burnout_{ij} = \mu + \beta_g Group_j + \beta_t Time_i + \beta_{gt} Group_j \times Time_i + \beta_s sex_j + \beta_a Age_j + \beta_x Anxiety_j + \beta_p PI_j + \beta_w TeamUnderstanding_j + \gamma_j^0 + \gamma_j^1 Time_i + \varepsilon_{ij}$$

where i indexes the time phase and j indexes the individual. With respect to effect size of linear mixed models, we employed the method for obtaining R^2 from generalized linear mixed-effects models developed by Nakagawa, Schielzeth.[65] This method yields two r squared, a marginal R_m^2 that accounts for the variance explained by the fixed factors and a conditional R_m^2 for the variance explained by both fixed and random factors.

RESULTS

Characteristics of Respondents

The response rates for the four time points were as follows: T1 n=251 (50%), T2 n=179 (34%), T3 n=141 (28%) and T4 n=125 (25%). The response rate aggregated over time was 56% (n=281), of whom 68% (n=183) were female and 73% (n=206) were aged 12-30. Among these, n=129 (46%) experienced the aligned assistantship. Ninety respondents completed the questionnaire on only one occasion. Given this is a longitudinal study, the criteria for inclusion was participation at more than one time. The data from these 90 participants were therefore excluded from the analysis. The number and characteristics of respondents that fulfilled the inclusion criteria at each time point are outlined in Table 1. Completion rates of 72% (93 of 129) and 64% (98 of 152) were observed for aligned and non-aligned participants, respectively. Incomplete data were accounted for in the analysis via maximum likelihood estimation. This difference in study completion did not differ significantly between the two groups, $X^2(1) = 1.53$, p = .22. The percentages of female by time phase were 65%, 69%, 69%, and 70% respectively ($X^2(3) = 1.1$, p = .22).

Anxiety, Professional Identity, Team Understanding And Burnout Over Time

We begin by considering RQ1: do self-reported professional identity, anxiety, team understanding and burnout levels change over time as final year students transition into clinical practice? The changes in self-reports of anxiety, professional identity, team understanding and burnout (personal, patient-related and work-related burnout) by assistantship alignment group over time are displayed in Table 2. Briefly, self-reported anxiety levels and professional identity remained stable throughout the four-time points. Team understanding scores increased significantly over time. Concerning the measures of burnout, all three subscales (personal, patient-related and work-related burnout) increased sequentially across the four-time points, although this did not reach significance for patient-related burnout. We found no significant differences for any of the measures taken by alignment group nor any interactions between time and alignment group for these measures.

Linear mixed-effect model of alignment on burnout longitudinally

We now consider RQ2: Are there any associations between assistantship alignment, self-reported professional identity, anxiety scores and team understanding on self-reported burnout scores over time? Table 3 shows the results of the mixed effect model with the parameter estimates for factors affecting components of modified Copenhagen Burnout Inventory (i.e. personal, patient-related and work-

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related burnout). By looking at the random effect components, similar patterns were observed for all three subscales of burnout. The intercepts for three components of burnout are significant while the slopes were insignificant. That is, the variance in change in burnout by time points (as indicated by slope) is relatively small while the variation in each component of overall burnout between individuals (as indicated by intercepts) is quite large. Thus, the size of the intecepts is likely to be due to individual differences in burnout. This pattern is not uncommon for self-report questionnaires aiming at stable characteristics such as burnout.

From the parameter estimates of the fixed effect components, similar patterns were again observed for all three components of burnout. Over time, burnout scores increased as indicated by increasing trend in the time parameter estimates at subsequent time points, which is significant for work-related burnout (β=1.62, $p< 0.01$). For personal characteristics, the significant main effects were found for anxiety and perceived professional identity. The significant main effect for anxiety (personal burnout: β=1.01, work-related burnout: β=1.02, patient-related burnout: β=0.64, all $p < 0.001$) indicates that individuals with high self-reported anxiety levels reported greater burnout than did those with low self-reported anxiety levels. However, the reverse relationships were found for perceived professional identity and burnout (PB: β=-0.41 [$p < 0.01$], work-related burnout: β=-0.62, patient-related burnout: β=-0.41, [both $p < 0.001$]). Gender also had a significant effect on personal burnout (β=-5.8, $p<0.001$) and patient-related burnout (β=3.97, $p<0.05$), but not significant for work-related burnout (β=-2.14, $p=0.15$): Males self-reported significantly lower personal burnout, but higher patient-related burnout scores than females. Age and team understanding did not affect burnout scores.

The main effect of alignment group is superseded by the significant interaction between alignment and time for personal burnout (β=1.92, $p<0.05$) and work-related burnout (β=1.66, $p<0.05$). The aligned assistantship participant group, the reference group, self-reported personal burnout scores increased and an average of 1.01 per time point (see Figure 1). For the non-aligned assistantship group, self-reported personal burnout scores increased 2.93 (1.01+1.92) per time point on average. Similarly, self-reported work-related burnout scores increased an average of 1.62 per time point for the aligned assistantship group and an average of 3.28 per time point for the non-aligned assistantship group: However, when the actual scores by phase are plotted, we can see how the aligned assistantship respondent group demonstrated asymptote, peaking at Time 3 (6-months post-transition) whereas the non-aligned assistantship group demonstrated asymptote at Time 4.

DISCUSSION

To our knowledge this is the first study to have examined how both individual and environmental factors affect junior doctors' burnout over time. Our longitudinal cohort study used a range of validated questionnaires designed to examine whether medical students' participation in an end-of-year placement (assistantships aligned or non-aligned with their first junior doctor post), along with their self-reported professional identity, team understanding and anxiety, related to their self-reported burnout over time. Looking at the questionnaires individually, we found that team understanding, personal burnout and work-related burnout increased significantly over time irrespective of respondents' alignment experience, but no increase in patient-related burnout. This finding has some similarity with other research. For example, a longitudinal cohort study of medical graduates in Australia found that personal burnout and work-related burnout rose significantly over their first year, although unlike our study these peaked at 6-months.[27] Furthermore, patient-related burnout remained at significantly lower levels than personal burnout and work-related burnout, although it demonstrated a significant increase at 12-months from the 'no-change' earlier time periods.[27] Professional identity and anxiety did not change significantly across the four time periods in our study, again, irrespective of assistantship alignment.

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The findings around professional identity, team understanding and burnout suggests that assistantship alignment appears to provide no absolute beneficial effect on these factors for individuals whose work-based placements are intimately associated with their first role as a junior doctor. This runs counter to our expectation that an aligned assistantship would be beneficial in these areas. However, employing a linear mixed-effect model using burnout as the outcome variable, we found a significant relationship between alignment group and time for personal burnout and work-related burnout. Respondents experiencing a non-aligned assistantship reported a sharper rise (three-fold) in personal burnout across all four time-points than those experiencing an aligned assistantship with neither group showing evidence of reaching asymptote. A similar rise was found for the non-aligned assistantship group and work-related burnout, although work-related burnout reached asymptote for the aligned assistantship group immediately on transition into practice. This suggests a slightly delayed beneficial effect regarding work-related burnout for aligning work-based placements to students' first post as a junior doctor. Furthermore, this beneficial effect continues beyond junior doctors' first post and throughout subsequent transitions in the first year. That the aligned group demonstrated an initial rise in work-related burnout on their first transition to being a junior doctor is not unexpected. Indeed, the sharp rise in responsibility as perceived by new graduates is well documented[48 53] and it is highly possible that students undertaking an aligned assistantship might feel more protected prior to their first post beginning.[48] As such, there might be an initial 'shock' at first, followed by a period of greater stability.

Our linear mixed-effect model also identified an association between anxiety and burnout: respondents reporting high anxiety levels also reported higher burnout scores as compared to those reporting low anxiety levels. This finding resonates with other research examining the relationship between anxiety and burnout in healthcare professionals.[39 66] Taken together with our finding, it suggests that individuals with a predisposition for anxiety are more likely to self-report burnout. Interestingly, the reverse relationship was found for perceived professional identity in our study: higher levels of self-reported professional identity were related to significantly lower self-reported burnout across all three factors. As such, our finding relates to other studies examining the relationship between identity and burnout in healthcare workers, teaching professionals, the general population as well as experimental research on members of the general population undertaken by social psychologists.[67-70] Indeed, such research has suggested that a strong sense of social identity (i.e. a feeling of belonging to the group) facilitates an increased capacity to cope under stress, and that a failure to develop such a shared identity is associated with a reduced ability to deal with stressors effectively.[67] That self-reported identity did not change over time in our study, suggests that for some, this shared identity might have been already sufficiently formed prior to students' transition into practice, and that any protective effect that it provides has not been diminished (or enhanced) by the assistantship alignment experience and their subsequent junior doctor role. For those participants whose shared identity was insufficiently formed prior to their transition, it appears that such identities, likewise, are nether diminished or enhanced over time leaving them vulnerable to experiencing burnout. However, as we did not measure individuals' perceptions of their professional identities *prior to* the assistantship programme (T1 being in the middle of it), we cannot be fully sure that the early weeks did not have an impact on professional identity.

Participant gender was also related to burnout scores in our study. Males reported significantly lower personal burnout, but higher patient-related burnout scores than their female counterparts. For work-related burnout, both groups demonstrated an increase over time. Regarding personal burnout, previous research suggests that the prevalence of mental health problems is higher in female doctors than their male counterparts,[71] and other research on a graduate cohort have found females reporting greater personal burnout than males.[27] It has been postulated that the vulnerability of females to burnout and mental health problems may be in part a reflection of the gender specific stresses women encounter in the workplace.[72] However, evidence concerning the relationship between burnout and gender to date is inconclusive. While some studies have reported the prevalence of burnout to be

higher in female doctors,[7 73] other studies have reported no gender differences[1] or a higher prevalence in males.[11 74]

Our findings resonate with Hillhouse et al's model of work stress, burnout, affect, health and clinical competence regarding the higher level of patient-related burnout identified in male medical residents,[75] although other research has not found this.[27] Indeed, in the wider literature, the commonly held assertion that females are at higher risk of burnout than their male counterparts in the labour market generally has been challenged in a recent meta-analysis.[74] One factor that might impact on these gender-specific findings might be that respondents are acting according to their gendered expectations. Thus males might downplay distress due to a social expectation that they should appear tough and resilient.[76] Thus, in our study we find that males report greater patient-related burnout but females reporting greater personal burnout. In terms of the social expectations explanation, it could be that males are downplaying their personal burnout (subconsciously acting out a tough male role) but up playing patient-related burnout (i.e. subconsciously shifting from self to 'other'), and vice-versa for females (i.e. subconsciously due to societal expectations around their nurturing role). However, we remain agnostic on this interpretation, as it is impossible to really understand what is happening. Importantly, if it is that males are downplaying their experiences of personal burnout, they might be at greater risk of experiencing negative emotional wellbeing. As such we should not necessarily accept the findings in terms of gender at face value.

Despite having strong findings, our research has limitations that need to be taken into account when considering the implications of these findings for practice. Firstly, although the respondents come from a wide range of medical schools across the UK, those experiencing an aligned assistantship were all trained and subsequently worked in a single UK country, Wales. This could be a potential confounding factor, whereby the interaction between burnout and alignment might purely be due to the change in location, and the subsequent disruption to support networks and homes, rather than the work-based placement. However, this is unlikely as students' first posts in Wales were not necessarily located in the same place in which their undergraduate learning occurred. For example, those learning in one University hospital might have their first post in an entirely different one, even differing between city and rural locations across the country. Secondly, respondents were not randomised to the aligned or non-aligned work-based placements, and it might be that this "natural experiment" has within it some further confounding factors. For example, there might be some similarities between those individuals who trained in Wales and who wish to stay there, which are very different to those who chose to work elsewhere or to those who trained elsewhere but wished to work in Wales. Thirdly, our study respondents comprised a much higher ratio of females than males (2:1). This ratio, although generally reflecting the higher proportion of females than males in the UK graduate population, is rather exaggerated: the average percentage of female to graduates over the past few years has been 56%, which is lower than our study average (68%).[77]

Despite these limitations, our research has notable strengths. The joined up nature of the assistantship programme in Wales has provided us with a unique opportunity to examine the effects of learning alignment to graduates' first post across a range of personal and environmental factors that are important for the wellbeing of our clinical workforce. We have been able to utilize a general linear mixed regression model, which has proved a useful approach for analysing our repeated measures data in this longitudinal cohort study. Although the model is similar in many respects to ordinary multiple regression, using the mixed regression analysis allows us more flexibility than an ordinary multiple regression: it enables us to include participants with missing outcomes in the analysis (so long as there are sufficient data points); it has permitted us to treat time as continuous, rather than a fixed set of points; and it can easily handle both time-invariant and time-varying covariates. As such we have been able to unpack the nuances to understand how these factors interact over time.

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TABLE 1: NUMBER (AND %) OF RESPONDENTS' DEMOGRAPHICS ACROSS EACH OF THE 4 DATA COLLECTION TIMES

	"	"#	"$	"
%	208	175	135	125
Aligned	99	79	64	65
Non-aligned	109	96	71	60
%				
Female	135 (64.9)	120 (68.57)	93 (68.89)	87 (69.6)
Male	73 (35.1)	55 (31.43)	42 (31.11)	38 (30.4)
&				
17-25	155 (74.52)	129 (73.71)	96 (71.11)	98 (78.4)
26-30	45 (21.63)	40 (22.86)	36 (26.67)	24 (19.2)
31-35	4 (1.92)	4 (2.29)	2 (1.48)	3 (2.4)
36-40	4 (1.92)	2 (1.14)	1 (0.74)	0 (0)

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TABLE 2: DISTRIBUTION OF MEASUREMENT SCORES BY GROUP AND TIME

Measures	T1	T2	T3	T4	Wald X^2
HAM-A	11.42±8.02	11.32±8.65	10.72±8.59	10.86±9.28	$X^2_{Group} = .43$
Aligned	10.99±7.29	11.61±8.59	10.66±8.36	11.25±8.47	$X^2_{Time} = .87$
Non-aligned	11.81±8.65	11.08±8.75	10.77±8.85	10.45±10.14	$X^2_{Int} = .67$
Professional identity	37.02±4.89	37.11±4.67	37.16±4.84	37.81±4.87	$X^2_{Group} = .57$
Aligned	37.85±4.55	37.05±4.71	37.22±4.95	37.62±4.57	$X^2_{Time} = 2.18$
Non-aligned	36.28±5.1	37.17±4.66	37.11±4.78	38.02±5.2	$X^2_{Int} = 6.24$
Teamwork	38.05±3.37	38.97±3.5	40.41±3.24	39.58±3.31	$X^2_{Group} = .97$
Aligned	38.37±3.76	39.06±3.17	40.34±2.75	39.66±3.13	$X^2_{Time} = 46.82^{***}$
Non-aligned	37.76±2.95	38.9±3.77	40.48±3.64	39.5±3.52	$X^2_{Int} = 1.81$
Personal burnout	42.64±16.28	47.66±18.69	47.33±18.19	48.2±17.07	$X^2_{Group} = .70$
Aligned	41.26±17.35	48.04±18.78	46.02±16.93	46.46±15.58	$X^2_{Time} = 17.29^{**}$
Non-aligned	43.9±15.2	47.34±18.71	48.52±19.3	50.08±18.49	$X^2_{Int} = 2.53$
Work-related burnout	36.76±13.44	40.94±16.89	41.9±16.04	42.69±15.78	$X^2_{Group} = .33$
Aligned	35.82±14.59	41.37±17.72	41.69±14.79	41.7±14.2	$X^2_{Time} = 34.1^{***}$
Non-aligned	37.61±12.31	40.59±16.27	42.1±17.2	43.75±17.38	$X^2_{Int} = .97$
Patient-related burnout	22.46±12.79	23.36±13.41	23.4±12.98	25.1±14.1	$X^2_{Group} = 1.43$
Aligned	21.09±12.41	23.05±14.48	22.72±13.13	25.51±13.37	$X^2_{Time} = 5.84$
Non-aligned	23.7±13.05	23.61±12.53	24±12.9	24.65±14.96	$X^2_{Int} = 1.56$

NOTE: The significance of the main (Group and Time) and the interaction effects was assessed with the Wald chi-square test using GEE estimation. Significance level * p<.05, ** p<0.01 *** p<0.001

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TABLE 3: RESULTS OF MIXED EFFECT MODELS

	Burnout					
Parameters	Personal		Work-related		Patient-related	
Fixed effect	estimate	(SE)	estimate	(SE)	estimate	(SE)
Intercept	42.16***	(8.07)	43.32***	(6.80)	33.09***	(6.68)
Time	1.01	(0.62)	1.62**	(0.52)	0.53	(0.59)
Anxiety	1.01***	(0.08)	1.02***	(0.07)	0.64***	(0.07)
Professional identity	-0.41**	(0.15)	-0.62***	(0.12)	-0.41***	(0.12)
Gender (ref: female)	-5.80***	(1.72)	-2.14	(1.48)	3.97*	(1.52)
Age	0.45	(1.44)	2.34	(1.23)	-1.43	(1.27)
Team understanding	0.17	(0.18)	0.08	(0.15)	-0.10	(0.15)
Group (ref: Aligned)	-2.68	(2.61)	-4.60*	(2.04)	-0.76	(2.09)
Group * Time	1.92*	(0.88)	1.66*	(0.72)	0.66	(0.73)
Random effect	Variance	(SD)	Variance	(SD)	Variance	(SD)
Intercept	81.02***	(9.0)	30.49***	(5.52)	57.63***	(7.59)
Time (slope)	2.06	(1.43)	0.81	(0.9)	3.37	(1.84)
Residual (error)	106.77	(10.33)	75.07	(8.66)	63.75	(7.98)
R^2 marginal (fixed)	0.39		0.46		0.24	
R^2 conditional (fixed and random)	0.65		0.70		0.64	

NOTE: The significance of the fixed effect was assessed with the Wald test conducted on the full model, whereas the significance of the random intercept and slope effects was assessed with likelihood testing using REML estimation. For each components of burnout, the corresponding marginal and conditional R^2_{GLMM} values were computed based on the method developed by Nakagawa and Schielzeth.[65] Significance level * p<.05, ** p<0.01 *** p<0.001

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FIGURE 1: ASSISTANTSHIP ALIGNMENT AND TIME: ASSOCIATION WITH PERSONAL AND WORK-RELATED BURNOUT

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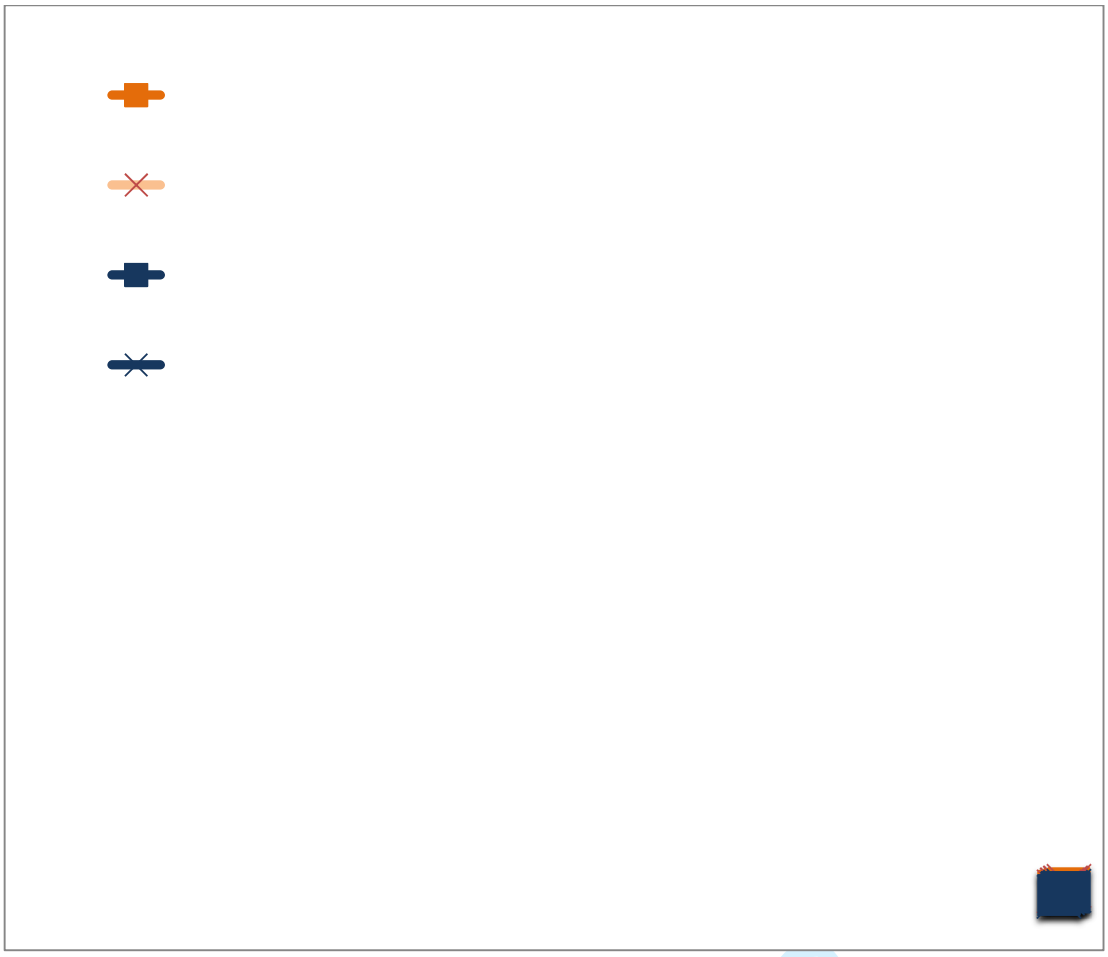

NOTE: The slope demonstrated the increase for the fixed effect of Time and is akin to the beta in a regression line.

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Irish Journal of Medical Science

The Ulster Medical Journal

Medical Journal of Australia

BMJ Open

Advances in health sciences education : theory and practice

The Clinical Teacher

Postgraduate Medical Journal

Clinical Medicine

Public Health

Annals of translational medicine

Medical Education ONline http://dx.doi.org/10.3402/meo.v19.25209

Nordic Journal of Psychiatry

GMS Zeitschrift fur medizinische Ausbildung

Journal of Occupational Medicine and Toxicology

Academic Medicine

Teaching and Learning in Medicine

Annals of Internal Medicine

Psychiatry Investigation

Annals of Internal Medicine

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Medical Education

Postgraduate Medical Journal

Social Science & Medicine

Medical Education

Journal of Graduate Medical Education

Aging Ment Health

The Medical journal of Australia

The Ochsner Journal

BMC Medicine

Learning in Health and Social Care

Medical Education

Med Educ

The Annals of Occupational Hygiene

Identity

Australian Journal of Psychology

Journal of Psychosomatic Research https://doi.org/10.1016/S0022-3999(01)00296-3

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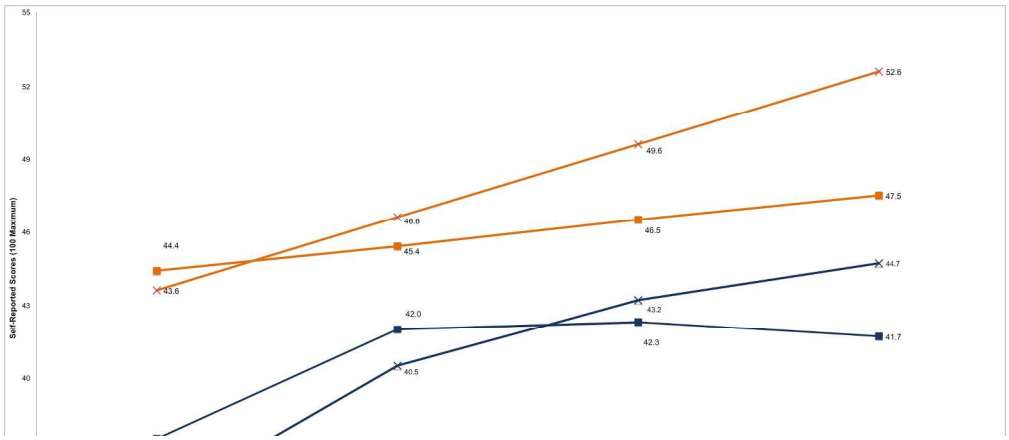

FIGURE 1: ASSISTANTSHIP ALIGNMENT AND TIME: ASSOCIATION WITH PERSONAL AND WORK-RELATED BURNOUT

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NOTE: All questions for all scales were rated using a 5-point likert scale.

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1. I feel worried, irritable or anticipate the worst
2. I experience feelings of tension such as inability to relax, started responses or being moved to tears easily
3. I experience fears of the dark, strangers, crowds or being left alone
4. I experience difficulty in falling asleep, unsatisfying sleep or nightmares
5. I experience difficulty in concentrating or experience poor memory
6. I experience low mood or a decreased interest and pleasure in hobbies
7. I experience aches and pains, teeth grinding or twitching and stiffness
8. I experience blurring of vision, hot and cold flushes or feelings of weakness
9. I experience tachycardia, palpitations, chest pain or fainting
10. I experience a sensation of a tight chest, dyspnoea or sighing
11. I experience difficulty swallowing, wind, abdominal pain, weight loss, nausea, vomiting or a change in bowel habit
12. I experience urgency of micturition, loss of libido (or a change in my monthly cycle if I am a woman).
13. I experience a dry mouth, flushing, tendency to sweat or a headache
14. I experience fidgeting, tremor of hands, restlessness, sighing or rapid respiration in stressful moments

PROFESSIONAL IDENTITY SCALE

1. I feel like I am a member of this profession
2. I feel like I have strong ties with members of this profession
3. I am often ashamed to admit I am studying for this profession (R)
4. I find myself making excuses for belonging to this profession (R)
5. I try to hide that I am studying to be part of this profession (R)
6. I am pleased to belong to this profession
7. I can identify positively with members of this profession
8. Being a member of this profession is important to me
9. I feel like I share characteristics with members of the profession

(R) = items that are reversed scored.

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5#4.3$,-(6/4$3/0)(!"#$%&&$'($$%)*%+#,-./01%02&%+-,/#)1)'./01%*03.'4$%02&%$5#04-3.)2%$5+$(.$2/$&%6,%3#$%+%&(-)27

1. I feel tired
2. I am physically exhausted
3. I am emotionally exhausted
4. I think ÒI canÕt take it anymoreÓ
5. I feel worn out
6. I feel weak and susceptible to illness*

*Omitted from questionnaire due to transcription error

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73489#-,0#%(6/4$3/0(!"#$%&$'($$%)*%+#,-./01%02&%+-,/#)1)'./01%*03.'4$%02&%$5#04-3.)2%
3#03%.-%+$(/$.8$&%6,%3#$%+$(-)2%0-%($103$&%3)%#.-9#$(%:)(;7

1. I feel worn out at the end of the working day
2. I am exhausted in the morning at the thought of another day of work
3. I feel that every working hour is tiring for me
4. I have enough energy for family and friends during leisure time*
5. My work is emotionally exhausting
6. My work frustrates me
7. I feel burnout because of my work

5,0&#$0#-,0#%(6/4$3/0(!"#$%&$'($$%)*%+#,-./01%02&%+-,/#)1)'./01%*03.'4$%02&%$5#04-3.)2%
3#03%.-%+$(/$.8$&%6,%3#$%+$(-)2%0-%($103$&%3)%#.-9#$(%:)(;%%.3#%+03.$23-

1. I find it hard to work with patients
2. It drains my energy to work with patients
3. I find it frustrating to work with patients
4. I feel that I give more than I get back when I work with patients
5. I am tired of working with patients
6. I sometimes wonder how long I will be able to continue working with patients

TEAM UNDERSTANDING SCALE

1. I am/have been an active member of some form of team
2. I enjoy working in a team
3. I observed many teams of which I am not a member
4. My participation in a team has facilitated how members of the team work together
5. I know how to make teams more effective
6. I frequently interact with (i.e. work with, train) teams of which I am not a member
7. I understand how people should work together as a team
8. I contribute to teams of which I am a member
9. I understand why some teams are ineffective
10. I contribute more than my fare share to the teams I am a member

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Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

	Date/Time	Procedure, p6.
	Randomization of items	None
	Adaptive questioning	None
	Number of screens	16, see p6.
	Completeness check	Participants could not move forward without completing sections (apart from the final 'your story' section). P6.
	Review check	Yes, participants could move backwards.
Response rates	Unique site visitor	Via email address which enabled us to link data longitudinally
	View rates	None recorded
	Participation rate	"All aligned assistantship (n=182) and non-aligned assistantship students (n=319) were contacted; n=281 (56%) responded: 68% (n=183) females, 73% (n=206) 22-30yrs, 46% aligned (n=129). Completion rates: aligned 72% (93/129) and non-aligned 64% (98/152)." p3.
	Completion rate	Attrition was not recorded
Preventing multiple entries from single individual	Cookies used	Respondent anonymity and Bristol Online Survey (BOS). BOS is designed to protect respondent anonymity. BOS does not use cookies for survey completion and external tracking software such as Google Analytics is not supported on BOS surveys. Additionally, we cannot access any information about respondents' IP addresses.
Design	Describe survey design	p6.
IRB review	IRB approval	Yes, detailed
	Informed consent	Yes, including additional 1 page information on the survey itself.
	Data protection	BOS Security Physical security All data is stored on servers located at the University of Bristol, United Kingdom. Administrative security Access to sensitive data via BOS is strictly limited to BOS's support and technical teams. This access is only permitted when it is at the request of the client concerned or necessary for the investigation of operational issues (or

		when required by law). The BOS servers and backups are accessible only by members of the BOS technical team and other authorised members of IT Services within the University of Bristol (such as systems administrators or those responsible for maintaining the backup service). User authentication New users choose their own passwords and will need to enter a username and password each time they log in. BOS issues a cookie to store session information when registered users log in. The session cookie does not include user information and is not retained once the browser is closed. No cookies are used when survey respondents complete surveys. BOS employees All new staff at the University of Bristol, including casual staff, are given a contract of employment containing a confidentiality clause and are made aware of their responsibilities toward restricted university data and personal data as part of their induction process. All University of Bristol IT staff are provided with data security training. Encryption All survey responses are collected over encrypted SSL (TLS) connections. SSL is the standard technology for establishing an encrypted link between a web server and a browser. It ensures that sensitive information can be transmitted securely. All communications within onlinesurveys.ac.uk are also sent over SSL encrypted connections. BOS user passwords are encrypted using PBKDF2 with a SHA256 hash and a random salt.

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		Backups BOS's data stores are backed up daily. University of Bristol has a data retention policy that means that backups are only held for three months. Backups are stored securely in a separate location from the data centres, but still on the University of Bristol's campus. After three months the tapes are either recycled or destroyed. BOS enables users to export survey response data in a number of popular formats (see FAQ for details) so that it can be backed up or used with other software. User responsibilities Users must not share accounts – by this we mean that each person who has access to a BOS account must use a unique username and password. You must not allow other people to use your username and password and multiple users must not log in using a single set of shared credentials (such as a 'group account'). Users' passwords should be sufficiently complicated, stored securely (if stored at all) and not be the same as used on any other system. You should ensure that you have appropriate levels of security on your own systems should you choose to export sensitive data. You and/or your institution are the Data Controller for any information collected using surveys run through BOS. If you are not sure of the implications of being a Data Controller please consult the data protection officer (or equivalent) at your institution.
Development and testing		Questionnaire was tested by undergraduate volunteers prior to the launch (see Acknowledgements) and p6.
Recruitment	Open vs closed	Open
	Contact mode	p6.
	Advertising survey	p6.
Survey	Web/email	Bristol Online Survey (p6)

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administration		
	Context	Bristol Online Survey (p6)
	Mandatory/Voluntary	Voluntary
	Incentives	p7. We offered a prize draw.
Duplicate entries	IP check	Not used
	Log file analysis	Detailed on p 7.
	Registration	Not used
Analysis	Handling of incomplete questionnaires	maximum likelihood estimation was used – see p7-8.
	Questionnaires with atypical timestamp	n/a
	Statistical correction	none

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