**Title page**

**Working 9 to 5: not the way to make an academic living? An observational analysis of submission and peer reviewer data over time**

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**Abstract**

**Objective** Are researchers submitting papers and peer reviews to BMJ journals out-of-hours, and has this changed over time?

**Design** An observational study of submitted research papers and peer reviews between 2012 and 2019 where an author’s address could be geocoded.

**Setting** The online BMJ submission systems for two large general medical journals

**Main outcome measures** Submissions or peer reviews on weekends or national holidays. Between-, .

**Methods Logistic regression to estimate the probability of submissions and peer reviews on weekends or holidays. The regression model had a linear trend over time with a country-specific intercept, and country-specific trend over time if this improved model fit. The hour of day analysis modelled an overall pattern over the 24-hour clock with smooth differences from the overall pattern for each country.**

**Results** The analyses included over 49,000 submissions and 76,000 peer reviews. There was little change over time in the average probability of submissions or peer reviews out-of-hours. The levels of out-of-hours work were high, with average probabilities of over 0.14 for work on the weekends. There were clear and consistent differences between countries with Chinese researchers most often working weekends and late nights, whilst Scandinavian countries were amongst the most likely to submit during standard working hours.

**Conclusion** The great differences between countries that are persistent over time show that a “culture of overwork” is a literal thing, not just a figure of speech.

**Introduction**

The “publish or perish” mantra is well established in research circles, but do academics and doctors have to sacrifice leisure time to achieve this ideal?

fear of thean explosion over time in the number of health and medical journal articles with early career researchers publishing more since 1980 and a general increase in the number of authors per paper (ref)

Anecdotally at least, academics and medical students are working longer hours to accommodate the demands of research and publishing (2 refs). Critics of higher education have long complained that research is being pushed to the margins by teaching and administrative tasks. Hang around in any academic department kitchen and you will hear complaints about over-flowing inboxes, demanding students and requests from administrators. A casual glance at the so called “Academic Quit lit” (ref), where a departing academic lists all the reasons they don’t want to stay in the profession, suggests that some academics are drowning under administrative tasks.

The constant connectivity of our digital world leads to what Gregg (2014) called the “presence bleed” where there is not much difference between home and work in the capacity to do work. The ability to work anytime, anywhere, can make it difficult to set boundaries. The temptation to overwork is exacerbated in many countries by the precarious nature of academic labour and the accompanying anxiety people feel to produce or lose their job (ref). The academic overwork problem has consequences for individuals, but also the publishing system as a whole. Erickson suggests that academic overwork is eroding the “gift economy” of peer reviewing that is necessary to keep the publishing system moving (1). For all this talk, there has been little empirical research on whether academics are actually working longer hours or not, what does exist so far is only retrospective self-report, via interview or survey (ref). This paper sets out to start to fill this gap by looking at the timing of paper and peer review submissions to *the BMJ* and *BMJ Open*. If research writing is being squeezed into leisure time, we would expect to see an increase over time in submissions on weekends, late nights and holidays.

## Methods

This is an observational study using data from the journal submission systems of *The BMJ* and *BMJ Open*, two large international general medical journals based in London. We analysed the submission dates and times of both research manuscripts and peer reviewers’ reports. The data were from 1 January 2012 (when the current *ScholarOne* system was implemented) to 5 April 2019 (2,651 days).

The included articles types were: research, research methods and reporting articles for *The BMJ*, and all article types for *BMJ Open* which only publishes research. The submissions were limited to first version manuscript submissions, and so exclude resubmissions. We excluded papers transferred from other *BMJ* journals in the *ScholarOne* system (2.0% for submissions and 1.7% for peer reviews). For the peer reviewers’ data the included articles types were: research and research methods and reporting articles. The *BMJ*’s statistical advisers were excluded as they are paid and so may have a different working hours pattern (1.2%). They were excluded by SS using their names before the data were anonymised. Patient and public reviews were excluded (0.4%).

The variables were: the date and time of transmission (in Eastern Standard Time), the author/peer reviewer’s address (city, state and country), and the article type. Dates and times were transformed to local times by geocoding the addresses and then extracting the time zone. The geocoding was done using the Google Geocoding API and the R library “ggap” (4) and the time zones were added using the R library “geonames” (5). We excluded under 0.1% of submissions and 4.2% of reviews with no address data, and a further 0.1% of submissions and 0.8% of reviews with incomplete addresses were excluded as they could not be geocoded.

To have sufficient data to examine differences between countries, we excluded countries with under 100 submissions (3.3%) or peer reviews (2.1%).

We used routinely collected data that was non-identifiable, hence ethics approval was not required.

**Outcome definitions**

The definition of a weekend varied by country, but 98% of the data were from countries where the weekend was Saturday and Sunday. In some Muslim-majority countries the weekend is Friday to Saturday.

We used data on public holidays from *Nager.Date* which has data for 100 countries (6). We only examined national holidays and excluded regional holidays (e.g., the Picnic Day holiday in the Northern Territory of Australia).

**Statistical Methods**

## We wrote a study protocol and had pre-planned analyses (available at https://github.com/agbarnett/weekends). Our primary aim was to examine changes over time and we anticipated that there would be an increase over time in out-of-hours work because of the growing pressure on researchers. We also expected differences between countries.

## We tested for an increase in the probability of weekend submissions and peer reviews over time using logistic regression. The data were grouped by consecutive weeks (Monday to Sunday) and the dependent variable was the number of weekend submissions that week, with a denominator of the total number of papers that week. This approach meant we examined a relative change in the probability of weekend submissions or peer reviews, and not an absolute change which could simply happen because of a change over time in the absolute number of submissions or peer reviews.

## The logistic regression models included country-specific intercepts to model between-country differences in the weekend probability. In alternative models we included country-specific trends to examine between-country differences in trends. The addition of country-specific trends were assessed using the Deviance Information Criterion (DIC), with the best model chosen using the lowest DIC (7).

## For holidays we used a similar approach to the weekend analysis, but compared holidays to other days in the same week that were not holidays. Weeks without holidays were excluded from this analysis.

## Models were run separately for *The BMJ* and *BMJ Open* because we thought there could be important differences between the characteristics of researchers, e.g., more clinical researchers for *The BMJ*, which could have influenced typical working hours.

## To examine early mornings and late nights we originally used a dichotomous approach with out-of-hours defined as 6 pm to 7 am. However, this simple dichotomous approach could miss important differences between countries with differing work hours. Hence we instead examined the number of submissions or peer reviews for each hour of the 24-hour clock. We modelled an overall pattern common to all countries plus a smooth difference for each country, an approach that has been successfully applied to time series analysis (8). We used a Poisson regression model of the number of submissions or peer reviews in each hour in each country. The smooth difference for each country was modelled using a sinusoid which allowed a single peak in submissions at any time during the 24-hour clock, with a nadir 12 hours later (ref). We summarise the results across countries by plotting the timing of the peak against the height of the peak expressed as a probability ratio. The full details of this regression model are in the supplement. We did not use a sample size calculation, but instead included all the available data.

## We created an initial set of results using randomly generated submission dates and times, with the aim of making any changes to the statistical methods before viewing the real data.

## The regression models used a Bayesian paradigm because this gives 95% credible intervals which have a 95% probability of containing the true estimate whilst classical 95% confidence intervals do not (8). We used non-informative normal priors for regression estimates and non-informative gamma priors for inverse-variances. The code, data and checks of convergence for the Bayesian estimates are available here: <https://github.com/agbarnett/weekends>. The data management and analyses used R (Version 3.6.0).

## Patient and Public Involvement

## The study was an analysis of routine non-clinical data. Patients were not involved in setting the research question, designing the study, the conduct of the study or the interpretation of the results.

## Results

## The final analyses used over 49,000 submissions and 76,000 peer reviews.

## The overall average probability of submitting a paper on the weekend for both journals was 0.14 and for a review was 0.18 (Table 1). So peer reviews were more often completed on weekends than submissions, and they were also more common on holidays.

## There was a strong diurnal pattern in submissions and peer reviews (Figure 1). The peak time for submissions was the end of the working day (3 to 5 pm). There was a small local peak at midday, which could be people working during lunch. People in China and Japan were the most likely to submit late at night (Figure 2). Submissions from China were 86% higher than the average during the hours of midnight to just before 1am, and reviews were 57% higher during the same time. The three Mediterranean countries of France, Italy and Spain together with Brazil had relatively late peak times (mostly after 6 pm), but with probability ratios much smaller than those in Japan and China (all under a 25% increase). Denmark had a relatively high probability of submitting during the middle of the day (57% higher than the average).

## There was almost no difference over time in the probability of submitting or peer reviewing papers on weekends or holidays (Table 2). Most of the differences were close to zero with narrow credible intervals, indicating little change over time.

## The differences between countries in probabilities for weekend submissions to *The BMJ* and *BMJ Open* are in Figure 3, and shows a large variation between countries for both journals. The lowest mean probabilities were in India and the highest in China. The credible intervals are narrower for countries with more data.

## The differences between countries are summarised for the combinations of the two journals, submissions or peer reviews, and weekends or holidays in Figure 4. China had high probabilities of submissions and peer reviews on weekends (0.22 or higher), but lower probabilities on holidays (0.08 to 0.12). The Scandinavian countries of Norway, Denmark, Finland and Sweden had some of the lowest probabilities of working on weekends (0.10 to 0.17). Italy had relatively high probabilities of working on the weekends (0.12 to 0.20), but low probabilities for the holidays (0.08 to 0.12). Belgium had the highest average probability of working during the holidays (0.09 to 0.18).

## Discussion

Our primary aim was to examine a change over time in out-of-hours work. We hypothesised that a growing pressure on researchers would mean a growing trend in unsociable work hours. However, the lack of any trends over time was remarkably consistent, indicating stable working patterns since 2012.

The levels of out-of-hours work were high, with average probabilities of 0.14 or higher for work on the weekends. Digital technology enables academic writing to happen anywhere, anytime, meaning that work can easily invade leisure time. The constant ability to work may be contributing to burn-out (ref).

A positive side to being able to work at home is that researchers may be time shifting important tasks to quieter times and spaces, away from their noisy office, as a recent study of academic work suggests (9). The creative work of writing a paper may be easier to do on the weekend, and may be something that many researchers enjoy. A recent study found doctors in Germany often did continuing medical education on weekends, early mornings and late nights (ref)

*Differences between countries*

There were large and interesting differences between countries (Figures 2 and 4). The country you live in is the strongest predictor of whether you will work out-of-hours, suggesting a “culture of overwork” is a literal thing, not just a figure of speech. Countries known to have family friendly working conditions and unionised academic workforces were less likely to work out-of-hours. China was a clear outlier in terms of out-of-hours work, and is known to have a hard working academic culture (10). There are clear incentives for researchers to “publish or perish” in China, as hiring and promotion is based on the quantity of papers in journals with high impact factors, and there are financial bonuses for published papers (11). At a national level there are targets for international league tables which are largely driven by research quantity not quality (11).

*Implications for policy and practice*

The higher probability of peer reviews (compared with submissions) on weekends and holidays suggest that some researchers feel unable to complete peer reviews at work. Research institutes and universities should acknowledge that peer reviewing papers is an expected part of a researcher’s job and not something that researchers need to do in their own time. The assessment and reward structures at universities should include peer review as a key measure (12).

Although journals have less responsibility towards researchers than employers, they should recognise their part in the culture of overwork. Journals could state that there is no expectation for peer reviews and submissions to occur out-of-hours, and this message would apply equally to authors, reviewers and editors. We are not convinced that such a solution would be effective, but we suggest it because if peer review is something that becomes measured and acknowledged, this task is likely to become yet another metric for academics to try to achieve.

*Limitations*

Submitting a paper or peer review is the final step in an often long process, and even when submitting out-of-hours, the bulk of the thinking and writing may have been done during working hours.

There are potential sources of measurement error for the submission and peer review times that we cannot quantify. Some authors may have been outside their country when they submitted their paper or peer review (e.g., at a conference), meaning they would be out of their time zone. Researchers may have inaccurately completed their address, or may not have updated their address after moving country. Some researchers have multiple affiliations and their primary time zone may be different to the one they are working in.

We did not find an increase over time, but it is possible that a large increase in weekend work may have occurred prior to 2012, during the time of the exponential increase in paper numbers (2). We examined a relative increase in out-of-hours work and we would expect an increase in the absolute number of out-of-hours peer reviews and submissions if the total number of papers continues to increase over time.

We did not have the age or gender of the researchers or peer reviewers, and so cannot examine differences by these characteristics. We did not have the researchers’ names, so we could not examine a within-researcher change over time in out-of-hours work.

The *BMJ* and *BMJ Open* are large general medical journals, but will not be representative of all researchers or all researchers in health and medicine. Hence we should be careful about generalising to other areas of research.

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| What is already known on this topic:  * University ranking tables are being used as a management tool to encourage researchers to “publish or perish” * Researchers are working longer hours to accommodate the demands of research and publishing * There are many complaints about academic and clinical overwork   *What this study adds:*   * The “weekend” is a misnomer for many researchers * There were large differences between countries in working hours, with China as a clear outlier of working long hours |

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**Contributorship statements**

AGB had the original idea, performed the analysis, wrote the first draft of the article and is the guarantor. SS and IM gave input into the study design, helped interpret the results, and wrote sections of the paper. SS sourced the data.

**Transparency declaration**

AGB affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

**Dissemination declaration**

Dissemination to participants is not applicable.

**Data sharing statement**

The data are fully available at <https://github.com/agbarnett/weekends>.

**Competing interests declaration**

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi\_disclosure.pdf and declare: no support from any organisation for the submitted work; AGB has received research grants from the Australian National Health and Medical Research Council, SS works for BMJ; no other relationships or activities that could appear to have influenced the submitted work. We have reviewed for and submitted articles to The BMJ and BMJ Open, often out-of-hours.

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**Table 1**: Mean probabilities (and 95% CIs) of submissions and peer reviews on weekends and holidays. The holiday probabilities are relative to other days in a week with at least one holiday.

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| Outcome | Type | Journal | Mean | 95% CI |
| Weekend | Submissions | BMJ | 0.14 | 0.12 to 0.15 |
|  | Submissions | BMJ Open | 0.14 | 0.13 to 0.15 |
|  | Reviews | BMJ | 0.18 | 0.16 to 0.20 |
|  | Reviews | BMJ Open | 0.18 | 0.17 to 0.19 |
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| Holidays | Submissions | BMJ | 0.08 | 0.07 to 0.10 |
|  | Submissions | BMJ Open | 0.10 | 0.08 to 0.11 |
|  | Reviews | BMJ | 0.13 | 0.11 to 0.15 |
|  | Reviews | BMJ Open | 0.12 | 0.11 to 0.13 |

**Table 2**: Estimated changes per year in the probability of submissions on weekends and holidays. The results are the absolute probability difference (current year minus previous year) and 95% credible interval.

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| --- | --- | --- | --- |
| Outcome | Data | Journal | Mean difference (95% CI) |
| Weekend | Submission | BMJ | –0.2 (–1.3, 0.9) |
|  | Submission | BMJ Open | 0.1 (–1.0, 1.2) |
|  | Reviews | BMJ | 0.3 (–1.4, 1.9) |
|  | Reviews | BMJ Open | 0.2 (–0.0, 0.4) |
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| Holidays | Submission | BMJ | –0.0 (–0.3, 0.2) |
|  | Submission | BMJ Open | –0.0 (–0.3, 0.2) |
|  | Reviews | BMJ | –0.0 (–0.3, 0.3) |
|  | Reviews | BMJ Open | 0.0 (–0.2, 0.2) |