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Research Article

GENDER DIFFERENCES AND MASK WEARING: AN OBSERVATIONAL STUDY ON A UNIVERSITY CAMPUS AND A MINI-META-ANALYSIS

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ABSTRACT
Research informed by evolutionary theory has suggested that, all else being equal, men are expected to take greater risks than women. This has been evidenced in a range of domains, including health prevention behaviours. In this study, gender differences in mask wearing were recorded at three locations on a University campus (n = 1,435). Logistic regression and Bayes Factor analyses demonstrated that the data do not support a gender difference in mask wearing. This led us to supplement our findings with a mini-meta-analyis, synthesising the gender difference reported in ten papers (n = 73,493) observing mask wearing during the COVID-19 pandemic. This analysis is supportive of a weak effect whereby women are more inclined to wear a mask than men (OR = 1.54, 95% CI = 1.26 to 1.88). However, the mini-meta-analysis also suggested a considerable amount of heterogeneity. Our research calls for further work assessing the factors explaining this heterogeneity in the observed gender difference in mask wearing.

Keywords: *Risk Taking; Observation; Health behaviour; COVID-19; Gender*

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INTRODUCTION

Evolutionary research has put forward that there are evolved differences between men and women (e.g., Buss, 2019), including in the behavioural tendency to take risks (e.g., Daly & Wilson, 2001; Wilson & Daly, 1985). While the size of this difference can vary based on age, culture and contextual factors, research from a range of domains supports the existence of a difference in risk taking (e.g., Finance: Olsen & Cox, 2001; Economic games: Charness & Gneezy, 2012; Psychological scales: Weber, Blais, & Betz, 2002). Meta-analyses on risk taking attitudes also provide support for the existence of a gender difference, though the size of the effect varies between domains (e.g., Byrnes, Miller, & Schafer, 1999). These gender differences in risk taking also play out in every day decisions. This is clear in traffic behaviour: men are less likely to wear a seat belt than women (e.g., Calisir & Lehto, 2002; Lerner et al., 2001). Men are also less likely to use lights on their bicycle at night than women (Cobey, Laan, Stulp, Buunk, & Pollet, 2013). Men are also more likely to unsafely cross the road than women (e.g., Pawlowski, Atwal, & Dunbar, 2008; Pollet & O'Dowd, 2018).

Gender differences are also evident in both health risk taking behaviour and preventative behaviours. For example, all else being equal, Pinkhasov et al. (2010) found that American men are more likely to be regular and heavy alcohol drinkers, heavier smokers, and illegal drug users, compared to American women. Men were also found to be less likely to utilize health care than women: for example, visiting doctor's offices or going to emergency departments. Men were also less likely to make use of preventative care or dental care visits than women. In a wide variety of domains, these gender differences in preventative health behaviours have been documented (for example: screening for skin cancer: Evans, Brotherstone, Miles, & Wardle, 2005; diabetes management: Shalev, Chodick, Heymann, & Kokia, 2005), but note that exceptions do exist (for example: methods for colorectal screening: McMahon Jr et al., 1999). All else being equal, it is therefore no surprise that the health prevention literature leads to argue that men and women will behave differently when it comes to prevention during a pandemic (e.g., review in context of H1N1: Bish & Michie, 2010).

In the context of the COVID-19 pandemic, gender differences in preventative behaviours have indeed been consistently documented. Even though data suggest that men are at greater risk than women (e.g., Rushovich et al., 2021), men appear to be less inclined to protect themselves from COVID-19 than women. For example, multiple studies using surveys indicated that men are less likely to take preventative measures against COVID-19 than women (e.g., Hearne & Niño, 2022; Latkin et al., 2021; Padidar et al., 2021). These measures including willingness to wear a mask and thus whether or not to wear a mask is an every day decision in a health context entailing risk. Systematic reviews provide evidence that, physical barriers, i.e. masks, reduce the risk of transmission of airborne viruses (e.g., Chu et al., 2020; Jefferson et al., 2009; Liang et al., 2020). When COVID-19 took hold of countries, governments, under the advice public health officials, therefore implemented mask requirements (e.g., in Belgium, France, United Kingdom, Badillo-Goicoechea et al., 2021). When the 'Omicron' variant became dominant in the UK, masks became a requirement for public transport, shops, and were also recommended for universities.

Compared to the volume of survey research on preventative behaviours toward COVID-19, there have been relatively few studies of mask wearing relying on direct observation. A study capturing data from live streaming of high school graduations in 5 US high schools (n = 1,152), found that nearly 70% of students wore a mask, but did not find a gender difference. A small study, covering three locations in North-East of the U.S., found that women were more inclined to wear masks than men (n= 300, Okten, Gollwitzer, & Oettingen, 2020). Haischer et al. (2020) conducted observations at retail locations in Milwaukee (US) in June/July 2020 (n = 9,935). These authors found that the odds of mask wearing was greater for women than for men by around a factor of 1.5. An observational study of 1,004 people in Vermont (US) also found that women were more inclined to wear masks than men (Beckage, Buckley, & Beckage, 2021), as did a study in New York city (US) parks (n = 1,453, Hitch et al., 2022). Data from a range of non-Western countries similarly support a gender difference in mask wearing, for example data from Argentina (n = 15,507, Freidin, Acera Martini, Senci, Duarte, & Carballo, 2022), Taiwan (n = 11,680, Chuang & Liu, 2020) and Ethiopia (n = 632, Woldearegay, 2022).

Current study

Given that the majority of research suggests a gender difference in mask wearing, the predictions are that women would be more likely to wear masks (1) and more likely to use hand sanitiser (2) than men. The hand sanitiser was available from a stand at each building but during our study not a single participant was observed using hand sanitiser. Therefore this measure does not feature in this paper. No predictions were made about location on campus or the interaction between gender and location on mask use. These analyses are thus exploratory.

METHODS

Observations

The observation schedule and analysis plan was preregistered. The sample size was determined by the time allocated to the first author for this project (data collected between Feb. 1st and Feb. 25th). There were three locations: Library, Student union, Gym, at a large university campus in England. Two data collection sessions were planned at each location. One session was rescheduled due to inclement weather. The procedure was approved by the local ethics committee where the study was carried out. The University had a non-enforced requirement for staff and students to wear a face mask when moving in buildings on campus. Two raters coded perceived gender (male/female), mask use (yes/no) and hand sanitation use (yes/no) when entering or exiting a campus building. Any type of face covering, and regardless of how it was worn, was coded as mask use. Groups of individuals were coded individually and great care was taken not to code the same individual twice, if they were, for example, to exit after a short stay. The first twenty observations were used to trial the procedure and discarded. There was perfect agreement between the raters on mask wearing but three cases where the codes did not correspond for gender. These were likely coding errors and were excluded. This leads to a final sample of 1,435 observations. It should be noted that just prior to the study, on January 26th, the UK government announced the removal of the requirement for wearing masks indoors. However, the Mayor for London announced that they would still be required for the London metro. This continued requirement to wear a mask also applied to the University where the work was carried out: mask wearing remained compulsory when navigating through any campus building and this was communicated to staff and students..

Data analysis

All the analyses were conducted in R 4.2.1 (R Development Core Team, 2008). The data, code, and analysis document are available from the Open Science Framework. The key hypothesis test is evaluated with a logistic regression model. An *a priori* power analysis via G*Power 3.1, suggested that a sample size of n = 192 is required to detect a weak effect (Odds Ratio of 1.68, Chen, Cohen, & Sophie Chen, 2010) at 80% power and a two-tailed significance level of 5% (Faul, Erdfelder, Lang, & Buchner, 2007). Next to frequentist statistics, Bayes Factors (BF) which allow comparing models are presented (Makowski, Ben-Shachar, & Lüdecke, 2019). Many rules of thumb for the interpretation of BFs exist (Jarosz & Wiley, 2014). Here, the qualifications for evidence by Jeffreys (1961) were used (BF = 1 - No evidence, 1 < BF <= 3 -

Anecdotal, 3 < BF <= 10 - Moderate, 10 < BF <= 30 - Strong, 30 < BF <= 100 - Very strong, BF > 100 - Extreme).

RESULTS

Figure 1 represents the data. Even though masks were compulsory based on university guidelines, in only 28.6% of the observations the person was wearing a mask.

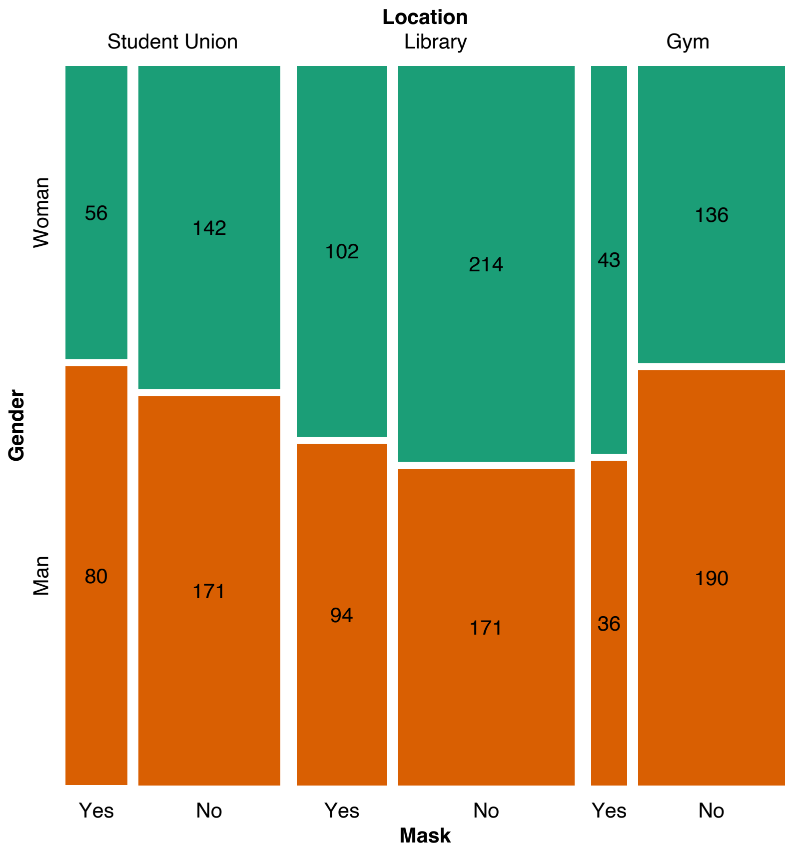


Figure 1: Mosaic plot for gender, location and mask wearing.

Table 1 shows the results from logistic regression models. Model 1 contains Gender, Model 2 contains Location, Model 3 contains Gender and Location, Model 4 contains the main effects of Gender and Location and an interaction effect. Model 1 showed that there is no support for gender differences in mask wearing ($\chi^2(1) = .086$, $p = .769$). Model 2 showed that individuals were more likely to wear a mask when entering or exiting the library and student union compared to the gym. For the Library 33.73% of individuals were recorded to be wearing a mask, for the Student union 30.28% , as opposed to 19.51% for the gym. Model 3 showed that the location effect is upheld, when including gender in the model. Model 4 suggested an interaction effect between gender and location on mask use. As demonstrated in Figure 1, women were more likely than men to wear a mask at the gym. However, while some of the individual coefficients were statistically significant, the likelihood ratio test for the interaction effect was not ($\chi^2(2) = 5.47$, $p = .065$). As this result could be considered on the cusp, and given that there was not an *a priori* predicted interaction effect, Bayes Factors which allow quantifying the evidence for one model versus another were also used.

Table 1: Odds Ratios for logistic regression models predicting mask wearing. Note: Reference categories are: "Man" and "Gym".

	Outcome			
	(1)	(2)	(3)	(4)
Woman	1.035		0.993	1.669*
Student union		2.101***	2.102***	2.901***
Library		1.793***	1.793***	2.469***
Woman*Student union				0.520*
Woman*Library				0.505*
N	1,435	1,435	1,435	1,435
Log Likelihood	-859.388	-846.641	-846.639	-843904
AIC	1,722.776	1,699.282	1,701.279	1,699.807

*p < .05; **p < .01; ***p < .001

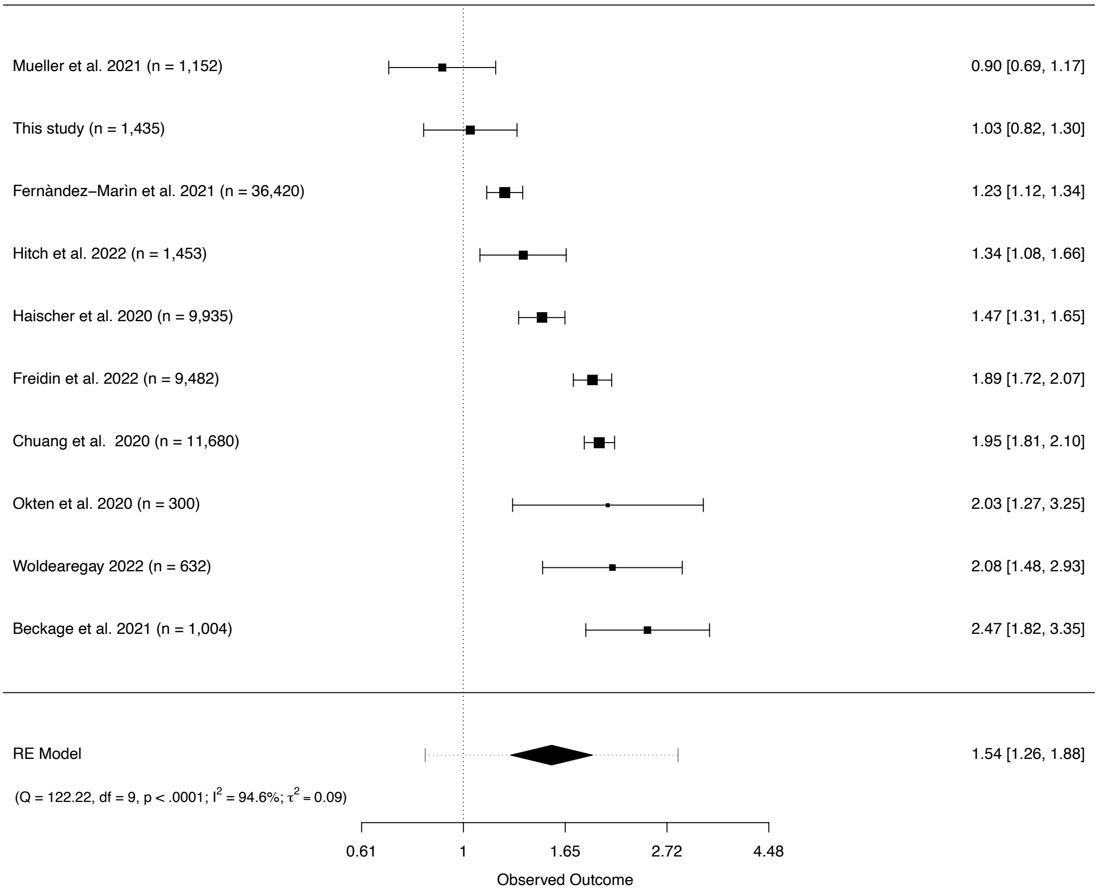
Bayes Factors very strongly favour the null model by a factor of >36 over the model with gender (Model 1). The null model is also strongly favoured over the model with the interaction by a factor >14 (Model 4). In contrast, the location model (Model 2) is favoured by a factor >250 over the null model. Finally, if the analysis is restricted to the Gym location, then the null model is still favoured by a factor of 2.54 over a model with gender included, albeit this is only 'anecdotal' evidence for the null model. In sum, even in a subgroup analysis, the data do not support a gender effect on mask wearing.

Mini-meta-analysis

Effect sizes on the gender difference in mask wearing uncovered in the above literature review were synthesised in a mini-meta-analysis. Only peer-reviewed papers were included. Papers needed to rely on direct observation of (adult) mask wearing during the COVID-19 pandemic and needed to allow for derivation of an odds ratio for gender. The log(odds ratio) was synthesised via a random effects meta-analysis with restricted maximum likelihood (REML, Viechtbauer, 2010). More details and additional analyses can be found on the OSF.

Figure 2 demonstrates that, overall, there is support for a weak effect of gender: an odds ratio of 1.54 (95% CI: 1.26, 1.88). It also demonstrates a very large heterogeneity between the studies, with individual studies ranging from no support to an odds ratio of 2.47 (95% CI: 1.82 to 3.35).

Figure 2: Forest plot of odds ratios (back transformed from meta-analysis for figure). The tips of the diamond present the 95% CI for the pooled effect size estimate, the dashed interval represents the prediction interval.



DISCUSSION AND CONCLUSION

For the observational study, Bayesian analyses actively support the null model: the data did not support the key prediction that women would be more inclined to wear a mask on campus than men. Also the data showed that mask wearing, even though compulsory on University campus, was not the norm. Less than 1 in 3 individuals were observed to be wearing a face covering. This could be one potential reason for why our study did not find a gender difference: Mask wearing was not the norm. However, in the setting were masks were least normative (Gym), the gap between men and women in mask wearing was the largest. Therefore, this explanation is perhaps unlikely.

There are many limitations to the current observational study. First, behaviour was recorded at only one university. However, we would expect similar findings at other universities in the UK. It is unclear how our campus would be (very) different from others, though campuses could vary in gender composition and the degree to which mask wearing was the norm. Second, gender was inferred via observation and, even though there was near perfect agreement on perceived gender, this is a clear limitation of any observational study on gender differences. Though there is bound to be some error in this variable, it seems unlikely that this would overturn the strong evidence in favour of the null model, as opposed to the model containing gender (Bayes Factor >36). Third, as individuals were only observed on campus, and given that social isolation is a risk mitigating strategy, it is possible that men were more likely to come on to campus than women. This is not something that can be ruled out based on the collected data, as it would require estimating the number of individuals which would normally be at the campus locations. Moreover, it is also possible that women were taking additional health protective measures which were not recorded, such as using their own hand sanitiser, keeping their distance, or washing their hands more frequently, compared to men. Therefore, it is possible that if a wider range of preventative behaviours is examined there would be support for a gender difference in preventative behaviours. Fourth, even though our measure of wearing masks is a reasonable proxy for a health preventative behaviour, it is unclear which psychological mechanisms actually influence mask wearing. While mask wearing was not normative in our setting, the motives for wearing or not wearing a mask could be shaped by conformity more so than considerations relating to health risk. Thus, this study does not allow disentangling whether individuals wore masks due to compliance or for health reasons. Conversely, it is unclear if not wearing a mask would constitute non-compliance or risk taking. Further research on behavioural intentions is needed to better understand why individuals choose to wear masks and the potential role which gender might play on the context in which one is worn.

Our mini-meta-analysis demonstrated that across ten observational studies there was some support for a weak gender difference in mask wearing, with women being more inclined to wear a mask than men. Nonetheless, these analyses also demonstrated substantial heterogeneity in this effect (Figure 2). This is evident from the wide prediction interval, for example. The prediction interval includes an odds ratio of 1: a new study could thus still be expected to find an odds ratio of 1, i.e. no difference. Our research calls for more observational work in this area, as well as research into the factors which could explain the observed heterogeneity (e.g., how widespread the norm is of mask wearing, prevalence of risk, culture, overall gender composition of the sample, etc.). As described above, future work is also necessary to examine the mechanisms which could lead to the observed gender difference. For now, even though our individual study did not support a gender difference, we conclude that the available data are consistent with a weak, but heterogeneous, observed gender difference in mask wearing.

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