Cross-cultural variation in men's beardedness.

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Word count: 11162.
Conflict of interest statement: The authors have no competing interests.

This is a post-peer-review, pre-copyedit version of an article published in *Adaptive Human Behavior and Physiology*. The final authenticated version is available online at: https://doi.org/10.1007/s40750-020-00150-4

Abstract

Objectives:
To test whether cross-cultural variation in men's facial hair conforms to patterns predicted by processes of inter-sexual and intra-sexual selection.

Methods:
Data were taken from the PEW Research Center's World's Muslims' project that collected information from 14,032 men from 25 countries. An Independent Factor Analysis was used to analyse how suites of demographic factors predict men's beardedness.

Results:
Analyses replicated those from past research using the PEW data, showing that beardedness was more frequent under prevailing conditions of lower health and higher economic disparity.

Conclusions:
These findings contribute to evidence that men's decision to augment their masculinity via full beardedness occurs under conditions characterised by stronger inter-sexual and intra-sexual selection.

Key words: Sexual selection; pathogen stress; economics; health; facial hair.

1. Introduction

Explaining the maintenance in variation of sexually dimorphic ornamentation is a complex challenge in evolutionary biology (Kokko et al., 2006). In humans, this issue is further complicated as physical characters can be culturally modified (Luoto, 2019). A striking example of sexual dimorphism at the intersection of biological underpinnings and cultural modification is facial hair (Dixson, 2019). Beardedness is a genetically determined androgen-dependent secondary sexual characteristic (Randall, 2008). Experimental studies consistently find that facial hair augments ratings of men's age (Neave & Shields, 2008), masculinity (Addison, 1989; Dixson & Brooks, 2013) social status (Dixson & Vasey, 2012), physical dominance (Gray et al., 2020; Saxton et al., 2016) and aggressiveness (Geniole & McCormick, 2015; Muscarella & Cunningham, 1996; Nelson et al., 2019). Beards may increase perceived intra-sexual formidability by enhancing the prominence of the jaw (Dixson et al., 2017a; Mefodeva et al., 2020; Sherlock et al., 2017) and saliency of angry facial expressions (Craig et al., 2019; Dixson & Vasey, 2012).

Yet men groom and remove their beards at little cost to their health. While men's grooming reflects cultural trends (Peterkin, 2001), the decision to cultivate a more masculine bearded appearance may coincide with demographic factors that would be expected under sexual selection (Janif et al., 2014). Thus, men's facial hair in London from 1842-1971 was higher in years when men outnumbered women in the mating pool (Barber, 2001). Beards were also more frequent in cities with larger populations, where women's preferences for beards were highest and average incomes were lower (Dixson et al., 2017b). Women's preferences for beards and body hair are also strongest in countries with male-biased sex ratios, lower education and higher urbanisation (Dixson et al., 2019), all of which are conditions of higher intra-sexual competition. Recently, Pazhoohi and Kingstone (2020) tested whether country-level factors influence prevalence of beardedness in 14,032 men from 25 countries. The GINI coefficient, which reflects national wealth distribution and may indicate intrasexual competition, was positively associated with men's beardedness. Parasite load also positively predicted men's beardedness, which may reflect men advertising aspects of underlying genetic quality under high pathogen stress (Hamilton and Zuk, 1982).

The statistical analyses employed in cross-cultural studies of mate preferences have impacted on their interpretations (Pollet et al., 2014). Thus, women's preferences for masculine facial shape were shown to be stronger lower national health (DeBruine et al., 2010, 2011) and higher pathogen stress (DeBruine et al., 2012; Moore et al., 2013), while men's preferences for female facial femininity followed the opposite pattern (Marcinkowska et al., 2014). However, these studies used data aggregated at the national level, limiting interpretations of individual-level preferences (Pollet et al., 2014). When employing mixed-effect models, women's preferences for facial masculinity are strongest among countries with greater urban development and not health or income inequality (Scott et al., 2014). An issue when conducting cross-national research concerns country level factors being highly inter-correlated (Pollet et al., 2014). This is particularly the case with demographics associated with health and inequality, which tend to be highly correlated with economic factors, level of development, and level of violence. Marcinkowska et al (2019) addressed this issue using an Independent Factors Analysis (IFA) to reduce 11 country-level predictors to two factors that capture health/development and inequality, and found women's facial masculinity preferences were positively related to health and human development indices but not indices relating to male-male competition.

Pazhoohi and Kingstone (2020) (hereafter P and K) appropriately employed a binomial mixed effects model to explore the demographic factors influencing men's beardedness. The current study expands upon the results reported in P and K to consider a wider range of demographics. There are a four principle differences between our analyses and that conducted in P and K. First, P and K used the latest estimates of GINI and sex-ratio available at the time (i.e. data for 2019), rather than the GINI and sex-ratio values for the year the data was collected (i.e., 2012). While country level demographics may not change substantially from year to year, using data from 2012 is more appropriate. Second, they included country sex-ratio as a predictor in the model. Sex-ratio provides an index of level of intra-sexual competition, as a higher number of males compared to females likely means that men have greater competition for access to mates and resources (Kokko and Jennions, 2008, Stone, Shackelford, and Buss, 2007). However, P and K used the sex-ratio at birth (i.e., the number of male births compared to female births), rather than adult sex-ratio that reflects the number of sexually active men compared to women and potentially provides a more appropriate indicator of levels of intrasexual competition than the sex-ratio at birth. Third, the mixed model reported in P and K only included random intercepts for country and region, but did not include random slopes. Intercept-only models can inflate the false-positive rate compared to models that specify both random intercepts and random slopes (Barr, Levy, Scheepers, and Tily, 2013). A more conservative model would include both random intercepts and random slopes. Finally, P and K standardised country-level variables at the participant level, rather than the country level, which weights country-level data more heavily towards countries with a larger number of observations when sample sizes between countries are uneven. As sample sizes between countries varies in this dataset, we ran analyses with country-level predictors standardised at the country level.

Statistical Analyses

To determine whether the above considerations have a substantial influence on the results, we first replicate the analysis in Pazhoohi and Kingstone (2020) with the above adjustments. Data was acquired from The World's Muslims' dataset, created and maintained by the Pew Research Centre. We applied the same exclusion criteria as Pazhoohi and Kingstone (2020), which resulted in 14,032 men from 25 countries. We conducted a binomial mixed effects model using R, using the *lme4* (Bates, Mächler, Bolker and Walker, 2015) and *lmerTest* (Kuznetsova, Brockhoff, and Christensen, 2015) packages. The key differences between the analysis reported below and that reported in Pazhoohi and Kingstone (2020) are that 1) country demographic information were taken for the year that the data was collected; 2) overall sex-ratio was included instead of sex-ratio at birth; and 3) random slopes were specified maximally following Barr et al. (2013) and Barr (2013); and 4) country-level variables are standardised at the country level.

Results

Fixed effects are reported in Table 1 (for full model results, see the supplementary materials). While the overall pattern remains the same as that reported in Pazhoohi and Kingstone (2020), the key associations with GINI and pathogen stress are no longer significant (note, beardedness was coded as 0 = clean shaven, 1 = bearded). Visualisation of the associations between the GINI coefficient and pathogen stress are included in Figures 1 and 2 respectively. While a strict interpretation of null hypothesis significance testing may conclude that these results do not replicate, we note that the pattern of results is in the same direction as that reported in Pazhoohi and Kingstone (2020), and estimate sizes are comparable. As such, it is unclear whether any associations in fact do not exist, or perhaps with more statistical power (e.g., including participants from more than 25 countries), such an association would be significant.

Table 1. Estimated fixed effects for the model with GINI and parasite stress predicting beardedness.

	Estimate (Std. Error)	*z* value	*p* value
Intercept	-1.53 (.23)	-6.55	< .001
Age	.42 (.03)	15.32	< .001
Marital Status	.25 (.07)	3.87	< .001
Income Level	-.01 (.03)	-.43	.667
Importance of Religion	-.14 (.03)	-4.90	< .001
Parasite Stress	.49 (.32)	1.52	.127
Legal Restriction	.19 (.40)	.48	.633
GINI	.28 (.17)	1.64	.102
Sex Ratio	-.03 (.17)	-.19	.851

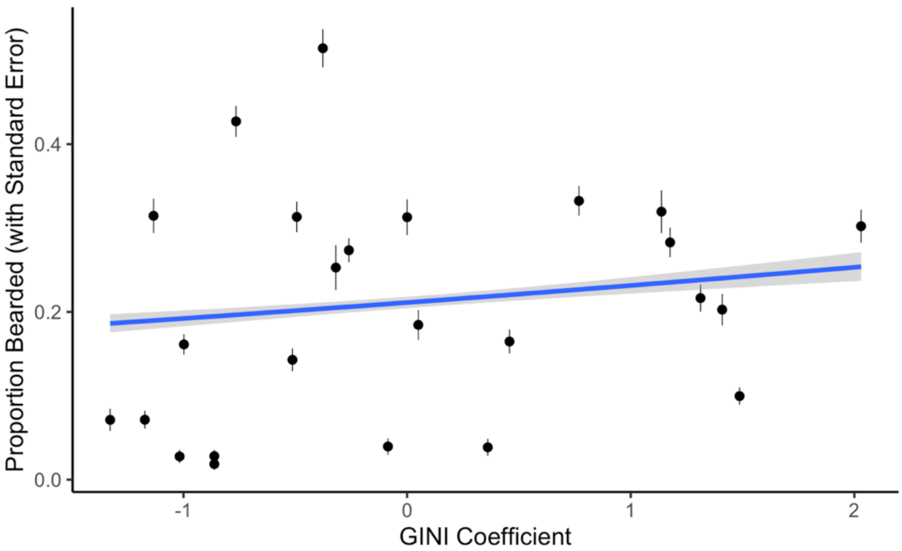

Figure 1. The association between the proportion of men with beards (+/- 1SE) and the proportion of beardedness for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals.

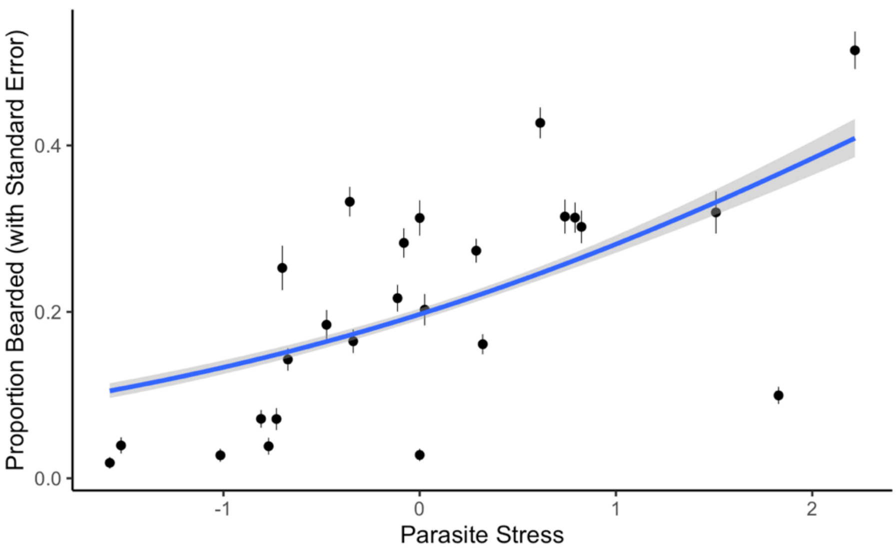

Figure 2. The association between the proportion of men with beards (+/- 1SE) and the proportion of beardedness for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals.

These results highlight the importance of considering numerous country level demographics concurrently. One issue with cross-national studies is that demographic variables reflecting health, violence, and economic factors are highly inter-correlated. To address this, we conducted an Independent Factors Analysis (IFA) to reduce 11 country-level predictors to two factors. We followed the procedure in Marcinkowska et al (2019), with the exception that, instead of only including the countries in the sample of interest, we included data for all available countries. Countries with missing data for more than two of the country statistics were excluded from analysis, while we imputed the mean value for countries with missing data for two or less statistics. This resulted in an IFA with 121 countries. From this, we took the factor scores for 23 of the countries in the current dataset (country factor scores were not available for Kosovo or Palestinian Territories and were therefore removed from analysis).

Table 2. Factor loadings from the Independent Factors Analysis

	Factor 1: Health/Development	Factor 2: Inequality
HDI	**-.97**	-.01
Life Expectancy	**-.97**	.04
Years Lost to Disease	**.95**	.01
Fertility Rate	**.92**	-.08
GII	**.86**	.22
Urbanisation	**-.76**	.16
Historical Pathogen Prevalence	**.63**	.26
Mortality Rate	.38	**-.47**
Homicide Rate	-.05	**.84**
GINI	.22	**.76**
GDP	-.29	.05

The country level demographics included in the IFA, and the factor loadings for the IFA are reported in Table 2. Consistent with Marcinkowska et al. (2019), Factor 1 appears to capture country health and development and explains 51% of the total variance in country-level statistics. Also, Factor 2 appears to capture country inequality and explain 15% of the total variance. Factor scores were coded such that higher scores on Factor 1 represent better health/development, while higher scores on Factor indicate greater equality. The two factors were positively correlated (r = .31, p = .001).

Table 3. Estimated fixed effects for the model predicting beardedness from country health/development and inequality factors.

	Estimate (Std. Error)	*z* value	*p* value
Intercept	-1.66 (.14)	-11.44	< .001
Age	.42 (.03)	14.81	< .001
Marital Status	-.26 (.07)	-3.84	< .001
Income Level	.00 (.02)	.01	.992
Importance of Religion	-.13 (.03)	-4.33	< .001
Health/Development Factor	-1.08 (.22)	-4.87	< .001
Inequality Factor	-1.67 (.35)	-4.77	< .001

We conducted a binomial mixed effects model with beardedness as the outcome variable, and the two factor scores as predictors. We also included the same individual level covariates (age, marital status, income level, and importance of religion) as Pahzoohi and Kingstone (2020). Fixed effects from the binomial mixed effects model are reported in Table 3. We found a significant association between beardedness and the health/development factor, such that men were more likely to be bearded in countries with lower health/development (Fig. 3). We also found a significant association between the inequality factor and beardedness, such that men were more likely to be bearded in countries with lower equality (Fig. 4).

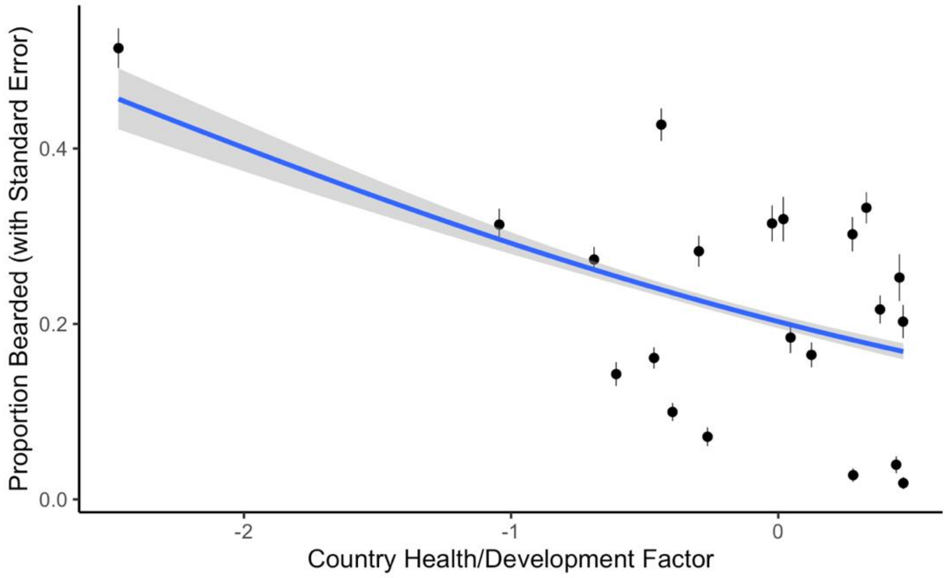

Figure 3. The association between the proportion of men with beards (+/- 1SE) and country health/development for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals.

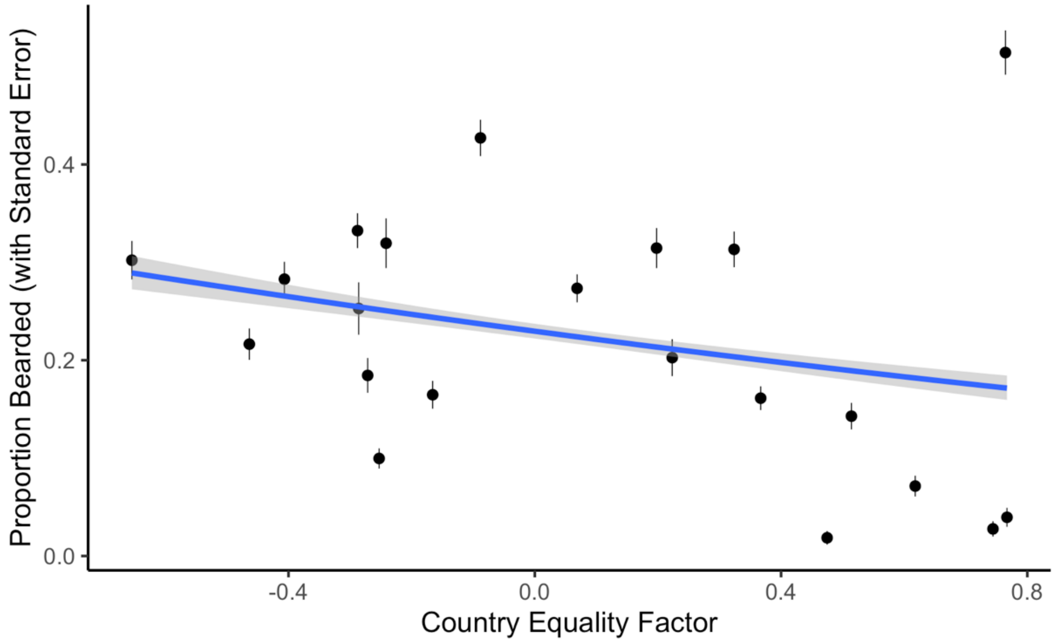

Figure 4. The association between the proportion of men with beards (+/- 1SE) and the country equality factor for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals.

Discussion

Our findings provide additional evidence that men’s decisions to augment their masculinity through keeping a full beard occurs under conditions of high intra-sexual competition and supports recent evidence that beardedness may be more common when health is compromised (Dixson, 2020). We revisited the data and analyses from a recent study that employed a binomial mixed effects model to uncover the demographic factors influencing men's beardedness across 25 countries (Pazhoohi and Kingstone, 2020). We replicated the positive associations between beardedness, parasite stress and the income inequality, although the associations were no longer statistically significant (p = 0.127 and p = 0.102, respectively). This may reflect a lack of statistical power to uncover a significant association with the sample size of 25 countries. Further, these countries were surveyed as part of the World's Muslims study by the PEW Research Centre and some locations occur in close geographic proximity (e.g. Iraq, Iran, Jordan, Azerbaijan, and Turkey), which may have resulted in a restriction of range on the demographic factors, potentially further attenuating any possible association.

One way to overcome issues of restriction of range, and multicollinearity of cross-national data is to perform Independent Factors Analysis (IFA) with data from 121 countries, which reduces multiple country-level predictors to a smaller number of factors. Marcinkowska et al (2019) used this approach and reported that women's facial masculinity preferences were stronger in countries with higher health and stronger economic development. In the current study, we used IFA to reduce 11 country-level predictors to two factors; an inequality factor and a health/development factor. We found men were more likely to be bearded in countries with lower equality, replicating the results reported in Pazhoohi and Kingstone (2020). Past research has also reported that men are more likely to be bearded under conditions favouring greater intra-sexual competition (Dixson et al., 2017b), supporting experimental studies that suggest that beards communicate masculinity, dominance and aggressiveness to other men in static (Mefodeva et al., 2020) and dynamic stimuli (Craig et al., 2019; Dixson & Vasey, 2012). The lack of association between men's beardedness and fighting ability reported in previous research (Dixson et al., 2018) highlights that facial hair operates as a badge of masculine age, masculinity and status (Dixson et al., 2005; Grueter et al., 2005) as in males of many species of nonhuman primates (Petersen & Higham, 2020).

Our analyses also found men were also more likely to be bearded in countries with lower health/development. Thus, our findings support those reported in Pazhoohi and Kingstone (2020) and potentially parasite stress models of sexual selection for beardedness. Interestingly, previous studies reported women's attractiveness ratings were positively associated with their self-reported pathogen disgust (Clarkson et al., 2020; McIntosh et al., 2017). However, whether or not beardedness is a condition-dependant ornament that impacts on immune response is unknown (Dixson & Rantala, 2016) and exposure to visual cues of pathogens does not alter the direction of women's mate preferences for male facial hair (McIntosh et al., 2017). Moreover, cross-cultural studies did not find positive associations between prevailing pathogens and women's preferences for male beards and body hair (Dixson et al., 2019b). A combination of non-adaptive genetic drift and sexual selection may explain natural variation in masculine hirsutism (Kupfer & Fessler, 2018) and until further replications of the association between beardedness and pathogens are undertaken, we urge caution when interpreting our findings.

A limitation of the current data is a lack of information on men's physical attractiveness and mating or reproductive success. Barber (2001) used data on facial hair frequencies spanning 1842-1971 among men who published their marriage announcements in the *London Illustrated News Magazine*, which were typically only afforded to high status men (Robinson, 1976). Mating success and female choice could be inferred for these data and the reported association between female scarcity in mating market and men being more bearded (Barber, 2001), men may be communicating status intra-sexually via beardedness that, in turn, positively impacts on mate preferences under these demographic conditions. The current analyses of the PEW dataset showed positive associations between men's beardedness and their age and marital status. While women's preferences for men's beards vary considerable across experimental studies (Dixson et al., 2018a; 2018b; Gray et al., 2020; Stower et al., 2020), beardedness is consistently preferred among older women (Dixson et al., 2013; 2019) and that women judge facial hair as more attractive for long-term than short-term relationships (Clarkson et al., 2020; Neave & Shields, 2008; Stower et al., 2020) and receive higher ratings for parenting abilities than sexual attractiveness (Dixson & Brooks, 2013; Dixson et al., 2019). Women's preferences for beards are also associated with their actual mate preferences for beardedness (Dixson et al., 2013; Janif et al., 2014), mothers gave higher parenting skills ratings for bearded men than non-mothers for beards (Dixson et al., 2019) and women in long-term relationships with bearded partners reported higher reproductive success than women in relationships with non-bearded men (Štěrbová et al., 2019). In the current study, the positive associations between men's beardedness, age and marital status may also reflect that bearded men had higher reproductive, but we acknowledge this cannot be confirmed. For now, our results compliment the findings in Pazhoohi and Kingstone (2020), and suggest that beardedness is more prevalent in ecological factors associated with poor health/development and higher inequality.

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