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ORIGINAL ARTICLE

Cross-Cultural Variation in Men's Beardedness

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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.

Keywords Sexual selection · Pathogen stress · Economics · Health · Facial hair

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

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genetically determined androgen-dependent secondary sexual characteristic (Randall 2008). Experimental studies report that facial hair augments ratings of men's age (Neave and Shields 2008), masculinity (Addison 1989; Dixson and Brooks 2013) social status (Dixson and Vasey 2012), physical dominance (Gray et al. 2020; Saxton et al., 2016) and aggressiveness (Geniole and McCormick 2015; Muscarella and 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 the saliency of angry facial expressions (Craig et al. 2019; Dixson and Vasey 2012).

Yet men groom and remove their beards at little cost to their health. While men's grooming reflects cultural trends (Oldstone-Moore 2015), 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 to 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. 2019b), which are conditions of higher intra-sexual competition. Recently, Pazhoohi and Kingstone (2020) tested whether country-level factors are associated with beardedness in 14,032 men from 25 countries. The GINI coefficient, which reflects national wealth distribution and may indicate intra-sexual 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 in countries with lower national health (DeBruine et al. 2010) 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 (Kuppens and Pollet 2014; Pollet et al. 2014; Robinson 1950). 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, levels of development, and levels 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, our reading of the open source data set suggests 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 were 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 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 et al. 2007). However, our reading of the open source data set suggested 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, which may provide a more appropriate indicator of levels of intra-sexual 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 et al. 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.

Method

Participants

Data was acquired from The World's Muslims' dataset, created and maintained by the Pew Research Centre. Face to face surveys were conducted among 32,604 people in 26 countries, which are stated to reflect national level data. In Pazhoohi and Kingstone (2020), participants were removed if they were not male and did not report on their beardedness. Further, participants were excluded if their sexual orientation was not reported, which included participants reporting being divorced, separated and widowed. All participants were older than 18 years of age and were split into six age blocks reflecting; 18–25, 26–35, 36–45, 46–55, 56–65 and over 66 years. Data from Afghanistan were not included in the analyses due to the possibility that governmental rules underpinned the high proportion of beardedness among men. The final analyses included 14,032 male participants from 25 countries (Albania, Algeria, Azerbaijan, Bangladesh, Bosnia-Herzegovina, Egypt, Indonesia, Iran, Iraq, Jordan, Kazakhstan, Kosovo, Kyrgyzstan, Lebanon, Malaysia, Morocco, Niger, Pakistan, Palestine, Russia, Tajikistan, Thailand, Tunisia, Turkey, Uzbekistan).

Statistical Analyses

We applied the same exclusion criteria as Pazhoohi and Kingstone (2020), which resulted in 14,032 men from 25 countries. To determine whether the considerations we noted in the introduction have a substantial influence on the results, we first replicate the analysis in Pazhoohi and Kingstone (2020) with the adjustments stated in the final paragraph of the introduction. We conducted a binomial mixed effects model using R, using the *lme4* (Bates et al. 2015) and *lmerTest* (Kuznetsova et al. 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), Barr (2013) and Heisig and Schaeffer (2019); 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 Figs. 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.

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

Table 1 Estimated fixed effects in 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

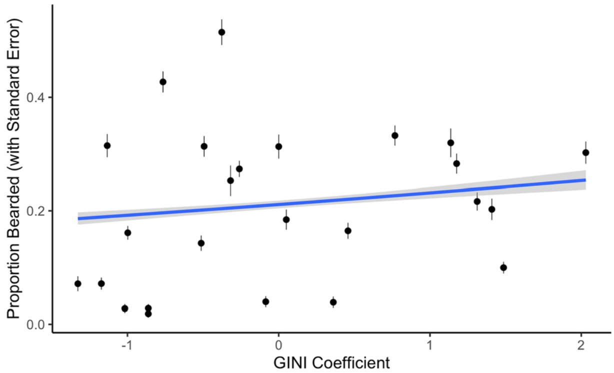

Fig. 1 The association between the proportion of men with beards (± 1SE) and the GINI coefficient for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals

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).

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 ($r = .31$, $p = .001$).

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 Pazhoohi and Kingstone (2020). Fixed effects from the binomial mixed effects model are reported in Table 3. We found a significant association between beardedness and

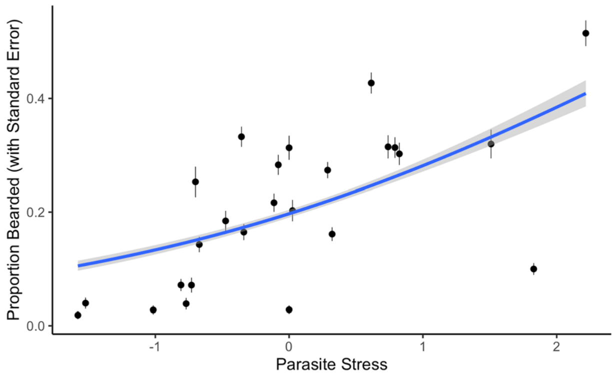

Fig. 2 The association between the proportion of men with beards (± 1SE) and the parasite stress for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals

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 boldface represents factor loadings rather than statistical significance

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).

We also conducted Bayesian analysis of our re-analysis of the model in Pazhoohi and Kingstone (2020), as well as the model that employed the IFA. These models were conducted with uninformative priors. The estimates from the posterior distributions are in line with the estimates provided using the frequentist approach reported in the manuscript. We have included the Bayesian analyses in the electronic supplementary materials (ESM).

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 (Dixson et al. 2017a) and supports recent evidence that beardedness may

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

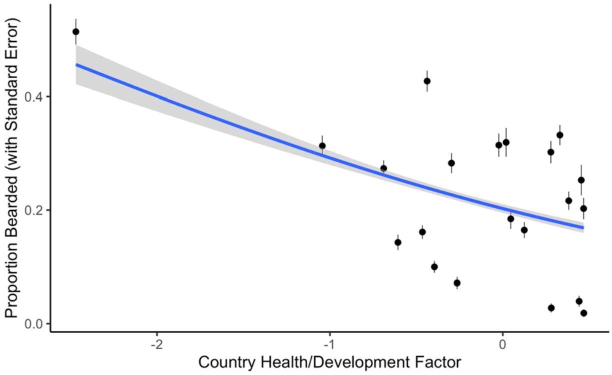

Fig. 3 The association between the proportion of men with beards (± 1SE) and country health/development for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals

be more common when health is compromised (Pazhoohi and Kingstone 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 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. 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 restricted the range of the demographic factors, potentially further attenuating any possible associations.

One way to overcome issues of range restriction and multicollinearity of cross-national data is to perform Independent Factors Analysis (IFA) with data from a larger sample of countries, which reduces multiple country-level predictors to a smaller number of factors. Marcinkowska et al. (2019) used this approach and reported that

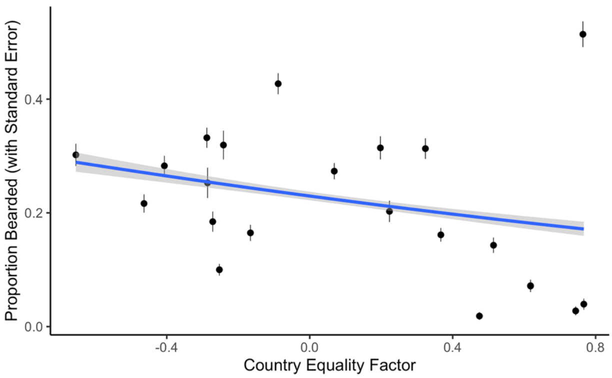

Fig. 4 The association between the proportion of men with beards (± 1SE) and the country equality factor for the 25 countries in the study. The grey regions around the blue line regression line are 95% confidence intervals

women's facial masculinity preferences were stronger in countries with higher health and greater economic development. In the current study, we used IFA to reduce 11 country-level predictors from 121 countries 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) and past research reporting men were more likely to be bearded under conditions favouring greater intra-sexual competition (Dixson et al. 2017b). These findings are also supported by experimental studies suggesting that beards communicate masculinity, dominance and aggressiveness to other men in static (Mefodeva et al. 2020) and dynamic stimuli (Craig et al. 2019; Dixson and Vasey 2012). The lack of association between men's beardedness and fighting ability reported in previous research (Dixson et al. 2018b) and its possible role in protecting the jaw from strikes (Beseris et al. 2020) highlights that facial hair may operate as a badge of age, masculinity and status (Dixson et al. 2005; Grueter et al. 2015) as in males of many species of nonhuman primates (Petersen and Higham 2020).

Our analyses also found men were more likely to be bearded in countries with lower health/development. These findings support those reported in Pazhoohi and Kingstone (2020) and potentially parasite stress models of sexual selection. 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 and Rantala 2016) and exposure to visual cues of pathogens does not causatively alter the direction of women's mate preferences for male facial hair (McIntosh et al. 2017). Moreover, other cross-cultural studies have not found 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 and 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 from these data and the reported association between female scarcity in the mating market and men being more bearded (Barber 2001), may reflect status communicated intra-sexually via beardedness that, in turn, positively impacts on mate preferences. 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, b; Gray et al. 2020; Stower et al. 2020), beardedness is preferred among older women (Dixson et al. 2013, 2019a), women judge facial hair as more attractive for long-term than short-term relationships (Clarkson et al. 2020; Neave and Shields 2008; Stower et al. 2020) and bearded men receive higher ratings for parenting abilities than sexual attractiveness (Dixson and 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 (Dixson et al. 2019a) 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 success, but we acknowledge this cannot be confirmed using the current data. An additional limitation of the current study is that cultural, historical and political views might have contributed to variation in beardedness between populations. Finally, participants only reported their beardedness as either fully bearded or clean-shaven. Future research employing a wider range of facial hair styles would be beneficial (Dixson et al. 2017b; Gray et al. 2020). For now, our results compliment the findings in Pazhoohi and Kingstone (2020), and suggest that beardedness is more prevalent under ecological conditions associated with poor health/development and higher inequality.

Compliance with Ethical Standards

Conflict of Interest The authors have no competing interests.

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