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ORIGINAL ARTICLE

Self-perceived Mate Value is Predicted by Biological and self-reported Indices of Health in Young Adults

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Abstract

Immunocompetence can influence an organism's reproductive fitness, and thus presumably their desirability as a mate (i.e., mate value). In humans, the link between immunocompetence and mate value has found circumstantial support by way of both expressed mate preferences for healthy partners, and via preferences for attractive phenotypes that are ostensibly linked to immune functioning. We examined whether a biological marker of immunocompetence, salivary immunoglobulin A (sIgA), along with self-reported frequency and severity of symptoms of poor health predicted individuals' reported mate value and mating behavior in a sample of 691 young adults. Our measures of immunocompetence (sIgA and symptoms of poor health) correlated significantly with one another, suggesting sIgA is a viable marker of general immune function in young adults. We then examined the independent contributions of these variables to mate value, controlling for age, sex, and body mass index (BMI). Results showed that sIgA (positively) and poor health (negatively) predicted mate value, but not lifetime number of sex partners or current romantic relationship status. These findings suggest that those with better health and immune function report being more desirable as mating partners but support past research showing null links to reported mating behavior. Together, these findings suggest that more comprehensive work on links between immunocompetence and mating is required.

Keywords Salivary Immunoglobulin A (sIgA) · Mate Value · Mating Success · Sexual History · Good Genes Hypothesis · Health · Self-reported Health · Mate Preferences for Health

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Introduction

Immunocompetence can influence an organism's mating success (Georgiev et al., 2015; Stoehr & Kokko, 2006). Those who are more resistant to pathogens and diseases can enhance offspring survival and fitness via reduced risk of transferring pathogens to both their mate and offspring, as well as by passing on disease-resistant genes and antibodies (Grindstaff et al., 2003; Hamilton & Zuk, 1982; Heller et al., 1990; Tybur & Gangestad, 2011; Warner et al., 1987). Thus, it is generally accepted that those who are healthier should be more desirable as mates (i.e., higher in mate value) than their less-healthy conspecifics (Gangestad et al., 2006; Hamilton & Zuk, 1982). This preference appears to be robust to opportunity and search costs as well as potential trade-offs with other mate value traits (Tybur & Gangestad, 2011).

Yet little research has directly considered whether human immunocompetence predicts individual differences in self-reported mate value, defined as the degree to which an individual possesses a constellation of traits or resources deemed desirable by potential mates (Fisher, 2008). Circumstantial evidence drawn from the mate preference literature suggests that: (1) humans consistently prefer healthy mates and are attracted to phenotypic traits which are putatively linked to underlying immunocompetence or compatible genes (e.g., Folstad & Karter 1992; Neff & Pitcher, 2005), (2) these preferences may be expressed more strongly under conditions of pathogen threat, and (3) individuals who report being unhealthy sometimes behave in ways consistent with lower mate value (see Arnocky et al., 2015 for a review). Conversely, one study found no evidence for direct links between some markers of immunocompetence and sexual history variables that might indicate higher mate value (Foo et al., 2017b). The present research addressed these inconsistencies by examining whether self-reported physical health symptom frequency and severity, along with a biological marker of immunocompetence (salivary immunoglobulin A; sIgA), predicted self-reported mate value and sexual history in a large sample of young adults.

Human Preferences for Immunocompetent Mates

Both men and women overtly prefer healthy mates. Across 37 countries, "good health" was ranked by participants, on average, as the fourth most important characteristic in a mate (Buss et al., 1990; Schmitt & International Sexuality Description Project, 2003; Shackelford et al., 2005). Whereas many other mate preferences varied as a function of either culture or sex, the preference for a healthy mate was stable across countries. In another study, good health was rated third in importance (of 18 traits) for sons/daughters-in-law and fourth for spouses (Apostolou, 2008). In addition to a preference for healthier mates, individuals exhibit psychological and behavioral tendencies to avoid infectious mates (Curtis et al., 2011; Hlay et al., 2021; Lieberman et al., 2018; Murray et al., 2013; Schaller & Park, 2011; Tybur et al., 2009, 2013; Tybur & Gangestad, 2011). For example, Schaller (2011) described a stronger preference for less-promiscuous mates (conferring lower risk of sexually transmitted infection) among those who felt vulnerable to infection, particularly when the threat of infectious diseases was salient.

Beyond direct preferences for health, indirect evidence for desired immunocompetence in mates comes by way of parasite models of good genes sexual selection (Hamilton & Zuk, 1982; Neff & Pitcher, 2005). Although debate exists about the underlying mechanisms driving good genes sexual selection (Davis & Arnocky, 2022; Penn & Számadó, 2020; Prum, 2012), these models broadly suggest that some phenotypic traits are preferred because they signal genetic immunocompetence. For instance, some attractive secondary sex characteristics, such as vocal masculinity in men (Arnocky et al., 2018) and breast symmetry in women (Locke & Arnocky, 2021), have been found to correlate positively with sIgA, the most abundant antibody in the human immune system (Macpherson et al., 2008). Additionally, traits associated with greater mate value (e.g., facial sexual dimorphism, symmetry, and rated attractiveness) have been associated with measures of underlying health and longevity in men and women (Foo et al., 2020; Jones et al., 2001; Little et al., 2011; Mengelkoch et al., 2022; Phalane et al., 2017; Thornhill & Gangestad, 2006; cf. Pound et al., 2014). Finally, observers' ratings of others' health are sometimes associated with phenotypic mate-value traits (Roberts et al., 2017), such as homogeneous and carotenoid skin coloration (Fink et al., 2001, 2006; Henderson et al., 2017; Jones, 2018), a more masculine voice (Albert et al., 2021), and facial averageness (Jones, 2018), whereas other studies have found weak or inconsistent links (e.g., Foo et al., 2017a).

Preferences for mates' phenotypic traits have also been found to vary as a function of pathogen threat. For instance, men and women higher in pathogen disgust (a measure of perceived pathogen threat; Hlay et al., 2021) prefer more sexually dimorphic faces (Jones, Feinberg, et al., 2013; Jones, Fincher, et al., 2013; cf. Tybur et al., 2022). Gangestad and Buss (1993) found a link between higher objective levels of pathogen threat and preference for putative indicators of health; across 29 countries, physical attractiveness was rated as more important in a mate when parasites were more prevalent, and that this was not a function of gender inequality (Gangestad et al., 2006). In nations where poor health is common, women show a greater preference for masculinized male faces (Debruine et al., 2010). In spite of challenges to this finding (Brooks et al., 2011; Marcinkowska et al., 2019), experimental evidence appears to support the link between infection threat and desirability of a mate's health. Individuals primed with pathogen threats tend to exhibit preferences for phenotypic indicators of mate value, such as symmetrical and sexually dimorphic faces (Ainsworth & Maner, 2019; Watkins et al., 2012; Young et al., 2011; cf. Tybur et al., 2022). Moreover, phenotypes that are commonly associated with poor health, such as high body mass index (BMI) have been negatively associated with self-perceived mate value (Brierley et al., 2016; Fernandez et al., 2014; Frederick et al., 2022; cf. Frederick & Jenkins, 2015).

Evidence for the potential link between health and mate value has also been observed in studies of mating psychology and relationship behavior. Arnocky and colleagues (2015) found that young adults who reported more frequent and severe physical health problems (e.g., fatigue, muscle aches, and sleep problems) over the past year were more jealous in their romantic relationships, and that this link was mediated by an increased belief that their partner would commit infidelity. Similarly, Davis and colleagues (2022) found that individuals experiencing more frequent and severe health problems engaged in more cost-inflicting mate retention behaviors

(e.g., inducing jealousy, threatening same-sex rivals, and monopolizing a partner's time), which was mediated by a greater expression of hostility. Together these findings suggest that those in poor health behave in a manner reflective of being at a mating disadvantage.

Despite extant research linking immune markers to specific phenotypic traits and studies demonstrating individuals' preferences for healthy mates, we are aware of only one study to date that has directly examined links between immunocompetence and actual human mating behavior. In a sample of 181 men and women (80 females), Foo et al., (2017b) examined the relationship between sexual behavior (age at first intercourse and number of lifetime sex partners) as a proxy for mating success in relation to physiological indicators of health. The authors measured salivary lysosomes and bacterial killing capacity as markers of innate immune function as well as 8-OHdG and 8-isoprostane levels as markers of oxidative stress, along with sperm concentration and motility as a marker of semen quality in men. Together these reflected indices of both innate immunity and reproductive viability. There was no relationship between mating success and health. The authors cautioned that using physiological measures that only examine current health and innate immune function rather than long-term health with adaptive immune function may have impacted their results. Another limitation of this work was the use of lifetime number of sex partners and the date of first sexual intercourse as an index of mating success, given that other demographic and individual difference factors beyond one's mate value can influence these sexual outcomes. Furthermore, age at first intercourse may not indicate female mate value considering an early age of first sexual intercourse is correlated to early substance use (i.e., drinking and smoking) and lower socioeconomic status (Paul et al., 2000; Rosenthal, 1999).

The Present Study

We extended upon Foo et al., (2017b) and employed a marker of mucosal immunocompetence (salivary immunoglobulin A; sIgA). Immunoglobulins play an important role in bridging innate and adaptive immunity (Nathan, 2002). IgA is the most common antibody in human secretory fluids including mucus, saliva, and tears. sIgA is synthesized by plasma B cells in salivary glands, which are transferred through secretory epithelia in mucosal surfaces and provide an initial defence against pathogens entering the body through mucosal surfaces (Macpherson et al., 2008). It inhibits the attachment and replication of pathogens, which prevents colonization while also being capable of neutralizing toxins and viruses (see Strugnell & Wijburg, 2010; Woof & Mestecky, 2015 for reviews). sIgA has been found to correlate negatively with several illnesses, including influenza (Klentrou et al., 2002), risk of mortality in cancer patients (Phillips et al., 2015), upper respiratory tract infections (Neville et al., 2008), and increased risk of infections in diabetic patients (Oikawa et al., 2015). In addition to sIgA, we examined body mass index (BMI) as a covariate which has been linked to lower self-reported mate value in some previous research in industrialized populations (Brierley et al., 2016; Fernandez et al., 2014; Frederick et al., 2022; cf. Frederick & Jenkins, 2015). We also administered a self-report measure of longer-term health symptoms experienced over a one-year period.

In line with Foo et al., (2017b), we examined lifetime number of sex partners. However, we replaced Foo et al.'s (2017b) second dependent variable, age at first sexual intercourse, with current relationship status. Participants also completed a reliable measure of self-reported mate value.

We advanced the hypothesis that sIgA (positively) and physical health problem frequency and severity (negatively) would predict mate value scores (H1), controlling for age, sex, and BMI. Given the importance of immunocompetence to both male and female mate value (Tybur & Gangestad, 2011), we did not anticipate a sex difference and examined these links in the combined male and female sample. Nevertheless, given that some research has linked women's sIgA to certain attractive phenotypic traits such as breast symmetry (Locke & Arnocky, 2021), whereas others have shown null links between sIgA and health surveys with rated facial attractiveness (Cai et al., 2019), we also examined links between health and mate value separately for men and women in a follow-up exploratory analysis.

We further set out to test the hypothesis that sIgA (positively) and health problem frequency and severity (negatively) would predict number of sex partners and current relationship status (H2), again controlling for age, sex, and BMI. Because number of sex partners could be more indicative of male rather than female mate value, whereas number of established romantic relationships may be more indicative of female relative to male mate value, we further examined these relationships separately across sex.

Method

Participants

A priori sample size calculation using G*Power version 3.1.9.7 (Faul et al., 2007) for regression analysis with five predictor variables, an alpha of 0.05, an anticipated small effect size of 0.15, and 95% power requires a sample size of 138 participants. As part of four larger studies on immunity and mating, participants were recruited from a small university and college (shared campus) in Northern Ontario using the online research participation system over the span of five years. Sample 1 comprised 108 males and 100 females collected between September 2016 and April 2017; Sample 2 included 162 males collected between October 2017 and April 2018; Sample 3 involved 132 females collected between October 2018 and September 2019; and Sample 4 comprised 189 females collected between September 2019 and February 2020 (pre-covid-19, with data collection ending prior to the initial provincial/institutional shutdown). Our combined sample included 691 participants (421 female) between the ages of 17 and 39 (M_{age} = 20.65, SD = 3.25). Participants were primarily Caucasian (96.5%) and heterosexual (90.5%). Missing data were minimal (< 5%) and were excluded listwise within analyses (n for each analysis reported in results).

Materials and Procedures

In each study, participants were instructed not to eat, drink (except water), smoke, or exercise for at least one hour before their appointment and to reschedule if they were sick. Participants provided informed consent and then were led to a quiet, private testing room. As part of more extensive protocols, they provided a saliva sample via passive drool into a transparent 5ml polystyrene culture tube. Height and weight were then measured, and participants subsequently completed self-report questionnaires on mate value, severity and frequency of symptoms of poor health, the number of sexual partners, and relationship status within larger survey packages.

Salivary Immunoglobulin-A (sIgA)

In each study, saliva samples were stored at -60ºC until assayed using commercially available enzyme immunoassay (ELISA) kits (DRG International, NJ, USA). Samples were assayed in duplicate, and the average of the duplicates was used to create a concentration value. In each of the four data sets, the inter-and intra-assay coefficients of variation for sIgA were below 5%. Previous research has shown that salivary flow rate corresponds to measurable sIgA levels (Arnocky, 2018; Eliasson et al., 2006). Accordingly, flow rate (µg/ml) was controlled by multiplying the concentration by flow rate to create a flow rate-adjusted concentration (µg/s) and then log-transforming this value to adjust for non-normality. Although we used the same kit manufacturer across studies, lot numbers and protocols varied. We therefore standardized our log-flow rate controlled sIgA variables within the study using a *z*-transformation prior to combining the data sets. Given some studies have observed circadian changes in sIgA, we also controlled for the time-of-day saliva was provided.

Symptoms of Physical Health Problems

The Health Symptoms Survey by Knack et al., (2011), is a 56-item scale that assesses the frequency and severity of poor health-related symptoms. 28 Likert-type questions range from 1 (not at all) to 4 (all the time) to determine the symptoms' frequency. An additional 28 Likert-type questions assess the severity of the symptoms and range from 1 (does not hurt at all) to 4 (unbearable pain). Participants are asked to rate the severity and frequency for 28 symptoms (e.g., "extreme fatigue," "fever," and "stomach-aches"). Higher scores indicate greater severity and frequency of poor health symptoms. The Health Symptoms Survey was reliable and valid in the study conducted by Knack (2009). Health symptom scores were internally consistent across studies: Study 1 ($\alpha = 0.93$), Study 2 ($\alpha = 0.85$), Study 3 ($\alpha = 0.90$), and Study 4 ($\alpha = 0.91$).

BMI, Number of Sexual Partners, and Relationship Status

BMI was calculated by dividing weight in kilograms by squared height in meters (kg/m^2). In Study 1, participants self-reported their height and weight. Recent research has reported that young North American adults' self reports of height and weight

are strongly correlated with objective measures, with the researchers concluding that self-report measures are sufficient for calculating BMI in this population (Olfert et al., 2018). In Studies 2–4, height and weight were measured using a Detecto APEX medical scale with sonar height rod, which calculated BMI automatically. Number of sexual partners and relationship status were obtained from participants through questions in the demographic sections of each respective survey package.

Mate Value

In Study 1, participants completed the Components of Mate Value Scale (CMVS; Fisher, 2008), which consists of 22 items with response options ranging from 1 (strongly disagree) to 7 = (strongly agree). The CMVS incorporates items from a diverse set of mate-value dimensions including sociality (e.g., "I run into friends wherever I go"), how the respondent is viewed by members of the opposite sex (e.g., "Members of the opposite sex are attracted to me"), parenting (e.g., "I would make a good parent"), wealth (e.g., "I want people to think that I am wealthy"), physical attractiveness (e.g., "I would like members of the opposite sex to consider me sexy"), relationship history (e.g., "After I date someone they often want to date me again"), and fear of romantic failure (e.g., "I often worry about not having a date"). In the present study, the measure showed good internal consistency ($\alpha = 0.85$).

Studies 2 through 4 employed the 4-item Mate Value Scale (MVS; Edlund & Sagarin, 2014), Participants responded to items 1 ("Overall, how would you rate your level of desirability as a partner on the following scale?") and 2 ("Overall, how would members of the opposite sex rate your level of desirability as a partner on the following scale?") using a 7-point Likert-type scale ranging from 1 (extremely undesirable) to 7 (extremely desirable). Item 3 ("Overall, how do you believe you compare to other people in desirability as a partner on the following scale?") had response options ranging from 1 (very much lower than average) to 7 (very much higher than average), whereas item 4 ("Overall how good of a catch are you?") included response options ranging from 1 (very bad catch) to 7 (very good catch). The measure showed good internal consistency across studies: Study 2 ($\alpha = 0.90$), Study 3 ($\alpha = 0.91$), and Study 4 ($\alpha = 0.88$). Scores for each mate value scale were averaged and standardized within each study using a *z*-transformation.

Results

Immunocompetence Predicting Mate Value

Descriptive statistics and Pearson bivariate correlations were first generated (see Table 1). Results showed that, consistent with previous literature, sIgA was higher in men than in women, and that sIgA was negatively correlated with frequency and severity of symptoms of poor health. sIgA, BMI, and symptoms of poor health correlated in expected directions with mate value, but not with lifetime number of sex partners or relationship status. Women reported more overall symptoms of poor health, and men reported higher self-perceived mate value and more lifetime sex partners.

Table 1 Pearson Bivariate Correlations Among Variables and Descriptive Statistics

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Z-sIgA	-----								
2. Poor health	−0.08*	-----							
3. Z-Mate value	0.08*	−0.10*	-----						
4. Log # of sex partn.	0.04	−0.05	0.14**	-----					
5. Relationship status	0.04	−0.05	−0.06	−0.04	-----				
6. BMI	0.02	0.12**	−0.21***	0.09*	0.01	-----			
7. Age	0.03	−0.18***	−0.03	0.30***	0.08*	0.12**	-----		
8. Sex	0.08*	−0.44***	0.03	0.20***	0.07†	−0.01	0.30***	-----	
9. Saliva T.O.D.	−0.01	−0.01	0.01	0.01	0.05	−0.10*	0.02	0.11**	-----
n	682	684	678	530	688	634	687	691	682
M	0.00	1.61	0.00	0.66	-----	24.81	20.64	-----	741.81
SD	0.10	0.30	0.10	0.46	-----	5.21	3.25	-----	139.00
Minimum	-3.85	1.00	-3.29	0.00	-----	16.00	17.00	-----	154.00
Maximum	3.40	3.04	2.51	2.08	-----	64.00	39.00	-----	1240.08

Note. † = $p<.10$, *$p<.05$, ** $p<.01$, ***$p<.001$; Sex coded: 1=male, 0=female. Relationship status coded: 1=currently in romantic relationship, 0=single; Log-sIgA and mate value reflect *z*-transformed scores. Saliva T.O.D. (time of day) is provided in minutes (from 12:00)

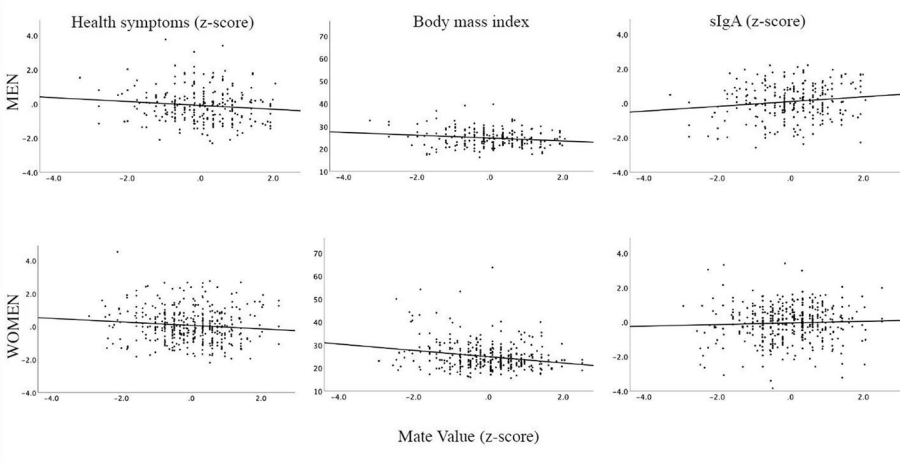

Fig. 1 Associations between Mate Value and Immunocompetence (sIgA and Symptoms of poor health). *Note*: Mate value and sIgA variables are standardized using *z*-scores

Table 2 Multiple Regression Models Predicting Mate Value, Sex Partners, and Partnered Relationship Status

	Predicting mate value (n=602)			
Predictors	*b*	*SE*	β	*t*
sIgA	0.09	0.04	0.10	2.39*
Symptoms of poor health	-0.37	0.14	−0.14	-2.56*
BMI	-0.03	0.01	−0.18	-4.47***
Age	-0.01	0.01	−0.04	-0.87
Sex	-0.01	0.05	−0.01	-0.07
Saliva T.O.D.	0.00	0.00	0.01	0.122
	Predicting lifetime # of sexual partners (n=612)			
Predictors	*b*	*SE*	β	*t*
sIgA	0.22	0.40	0.02	0.54
Symptoms of poor health	1.82	1.45	0.05	1.26
BMI	0.04	0.08	0.02	0.45
Age	0.86	0.12	0.30	6.89***
Sex	1.50	0.47	0.14	3.22**
Saliva T.O.D.	0.00	0.00	-0.02	-0.39
	Predicting partnered relationship status (n=616)			
Predictors	*B*	*SE*	Wald	*Exp(B)*
sIgA	0.44	0.08	0.29	1.05
Symptoms of poor health	-0.04	0.30	0.01	0.97
BMI	-0.01	0.02	0.04	1.00
Age	0.05	0.03	0.36	1.06†
Sex	0.06	0.02	0.04	0.82
Saliva T.O.D.	0.00	0.00	0.19	1.00

Note. † p<.10, *p<.05, ** p<.01, ***p<.001. b=unstandardized beta coefficient, SE=standard error, β=standardized beta coefficient for linear regression analyses. B=log odds units, *Exp(B)*=odds ratio for predictors

Older participants reported higher BMI, more sex partners, and being in a romantic relationship.

We next examined the relationship between symptoms of poor health, sIgA as predictors of self-reported mate value controlling for BMI, age, sex, and saliva provision time using multiple regression. Results showed that there was a collective significant effect of the model predictors on mate value (F[6, 601]=6.61, p<.001, R^2adj=0.05). BMI, sIgA, and symptoms of poor health each uniquely predicted variance in mate value, whereas sex, age, and saliva provision time did not. Together these findings suggest that poor health indicators and BMI predict lower reported mate value. When we split the file by sex, results showed that higher BMI predicted lower mate value among both sexes, albeit more strongly among women (b = -0.04, β = −0.25, SE=0.01, p<.001) than men (b = -0.05, β = −0.19, SE=0.02, p<.02). Higher sIgA predicted higher mate value among men (b=0.21, β=0.22, SE=0.08, p=.01) but not women (b=0.04, β=0.04, SE=0.06, p=.44). Symptoms of poor health approached but did not meet thresholds for statistical significance among women (b = -0.34, β = −0.10, SE=0.20, p=.08), or men (b = -0.50, β = −0.13, SE=0.32, p=.12) (see Table 2).

We next examined health markers in relation to sexual history. There was a collective significant effect of the model predictors on lifetime number of sex partners (F[6, 611]=13.04, p<.001, R^2adj=0.11). Results showed that this effect was driven by the demographic covariates, such that age and sex both predicted number of life-

time sex partners, whereby males relative to females, and older relative to younger participants, had more lifetime sex partners. Conversely, BMI, sIgA, and symptoms of poor health did not. This finding did not change when we split the analyses by sex; age remained the only predictor of lifetime number of sex partners for both males and females. Results also remained consistent when log-transforming the lifetime sex partner variable to adjust for non-normality. This finding aligns with Foo et al., (2017b) to suggest that immunocompetence does not predict lifetime number of sex partners.

We next examined health markers in relation to current relationship status using binary logistic regression. Results showed that the overall model was not statistically significant (Hosmer-Lemeshow: $\chi^2(8)=5.58$, $p=.69$). The prediction success (classification) rate was 52%, Nagelkerke pseudo $R^2=0.01$. Of our control variables, age modestly predicted relationship status, such that for every year increase in age participants were 1.05 times more likely have a romantic partner. Neither BMI, sex, sIgA, symptoms of poor health, or saliva provision time predicted relationship status. These relations did not meaningfully change when examining the sexes separately, suggesting that there is no association between immunocompetence and current relationship status. Results for predictors of mate value and sexual history remained unchanged when removing BMI from the models, suggesting that immunological links to mate value are not merely a function of body fat influencing both health and mate value.

Discussion

Diverse lines of evidence suggest that immunocompetence and health are key elements of self-perceived mate value. Nevertheless, to date no research has directly examined the relationship between immunocompetence and self-reported mate value. Further, only one previous study examined potential links between immunocompetence and putative markers of mating success (Foos et al., 2017b). In the current study, we examined sIgA, frequency and severity of symptoms of poor health, and BMI as three markers of immunocompetence in relation to self-reported mate value, number of sexual partners, and romantic relationship status. We predicted that healthier individuals (i.e., higher levels of sIgA, less frequent and severe symptoms of poor health) would have higher self-perceived mate value than less healthy individuals.

As anticipated, both immunocompetence markers (sIgA, severity and frequency of symptoms of poor health) as well as BMI predicted mate value in the expected directions. Our results provide an important extension to previous literature suggesting that individuals prefer healthy mates (Apostolou, 2008; Buss et al., 1990), by demonstrating that healthier individuals also perceive themselves as more desirable to members of the opposite sex. Our results are consistent with previous findings indicating BMI negatively predicts mate value among industrialized populations (Brierley et al., 2016; Fernandez et al., 2014; Frederick et al., 2022; cf. Frederick & Jenkins, 2015). Post-hoc analysis showed that this relationship held when splitting the file by sex, suggesting that higher BMI predicts lower mate value among both men and women. Although the effect of BMI on mate value appears to be greater among females, follow-up analyses suggested that the effects of BMI on mate value were

not significantly different from one another across the sexes. There is an increased risk of health issues among those with higher BMI, including negative effects on fertility and delivery of offspring in females (see Jungheim et al., 2013; Silvestris et al., 2018 for reviews), and fertility and embryo health among males (Paasch et al., 2010; see Palmer et al., 2012; Shukla et al., 2014 for reviews). Similarly, a greater frequency and severity of symptoms of poor health could signal risk of infection and poor genetic quality to potential mates (see Tybur & Gangestad, 2011). Importantly, because both symptoms of poor health and mate value relied upon self-report, it is possible that unfavorable scores on each could be a function of a response bias. Examining sIgA as a biomarker of broad immunocompetence addresses this issue by providing a more objective index of current immunological function, with findings again supporting a link between low immunocompetence and low mate value.

When splitting the file by sex, results also showed that sIgA was a significant predictor of mate value for men but not women. Nevertheless, follow-up analyses (comparing the regression coefficients across sex and via moderator analysis using Model 1 of the PROCESS macro to examine the sIgA x sex interaction) suggested the effects of sIgA among men and women were not meaningfully different from one another. Previous research has shown that men tend to be higher in sIgA than women in community samples (e.g., Evans et al., 2000). Our study supported this sex difference in a large aggregate student sample. What these sex differences may mean for the utility of sIgA as a broad marker of immunocompetence that may be linked to some mate value characteristics should be considered in future work, particularly given recent research linking sIgA to some attractive phenotypic traits in women (e.g., Locke & Arnocky, 2021; breast symmetry) but not others (Cai et al., 2019; attractive facial traits).

It would be interesting for future researchers to consider whether these links vary over time, such as across menstrual phases. There is research showing how self-perceived attractiveness fluctuates across the phases of the menstrual cycle, with women in the periovulatory phase rating themselves as higher in mate value in comparison to lower fertile phases (Schleifenbaum et al., 2021). It is also important for future research to consider the potential limitations of self-reported mate value. Although measures such as the MVS correlate with self-esteem, life satisfaction, socioeconomic status, education, casual sex (among men), current and past relationship status, or casual sex, and negatively with loneliness, there remain questions about the overall ability of such measures to fully capture the complexity of sexual desirability (Csajbók et al., 2019).

Our bivariate findings also indicated that sIgA correlated negatively with frequency and severity of poor health over the previous year. Although not a specific focal point of the present study, this finding is consistent with previous literature that collectively indicates sIgA is a robust measure of immunocompetence (Aghamohammadi et al., 2009; Klentrou et al., 2002; Neville et al., 2008; Oikawa et al., 2015; Phillips et al., 2015). Whereas previous research has focused on the relationship between sIgA and specific health conditions (Klentrou et al., 2002; Neville et al., 2008; Oikawa et al., 2015; Wu et al., 2020) or on long-term prediction of mortality in older age (Phillips et al., 2015), this is the first research that we are aware of to demonstrate a link between a broad measure of diverse symptoms of poor health and sIgA. This

correlation advances the position that sIgA is a robust biological marker of general immunocompetence. This may be particularly important given other literature that has found weak or non-existent links between other in-vivo and in-vitro markers of immune function and self-reported health (Mengelkoch et al., 2022). Future researchers should consider more comprehensive indices of immunocompetence including comprehensive measures of symptoms of poor health and medical histories.

Nevertheless, consistent with Foo et al. (2017b), we did not observe links between immunocompetence and reported mating and sexual behavior (lifetime sex partners and current relationship status). Although many studies have considered such sexual histories as good proxies for ancestral mating success (e.g., Arnocky et al., 2013, 2017; Rhodes et al., 2005), it is possible that cultural confounds muddy the relevance of these variables to actual mate value. First, having multiple sex partners could be an indication of lower mate value, particularly among females who benefit their reproductive success to a lesser degree than males by accessing multiple sex partners. Individuals, particularly females, might accrue reputational and relational damage by having many sex partners (Kreager & Staff, 2009) or by signaling sexual receptivity (Arnocky et al., 2019; Vaillancourt & Sharma, 2011). Nearly 25% of our sample had never had sexual intercourse, and it is impossible to disentangle whether this is a function of age and choice in a young adult university sample, or a true function of mate value in participants.

Although lifetime heterosexual sex partners correlated positively with mate value, this could indicate an interpretation issue with questions in the measures. If one is not sexually active (even if by choice), they may rate themselves lower on sexual desirability as a function of that fact. Mate value did not correlate with current relationship status, suggesting that some individuals at this life stage may remain purposefully unattached. Moreover, there are well-established biases in reporting sexual histories, such that men may overreport and women may underreport their lifetime sex partners (Alexander & Fisher, 2003; Knox et al., 1993). Indeed, in the present study, men reported having had significantly more sex partners than women. This could reflect a true difference, since by measuring undergraduates we are not capturing the breadth of sex partners available to our participants, but at the population level we must consider that these numbers must be equal (Mitchell et al., 2019). Therefore, it would be beneficial in future research to control for the influence of social desirability (e.g., impression management; Meston et al., 1998) when examining sexual history variables.

The current study was limited by the homogeneity of the sample, which consisted primarily of young adult, Caucasian, university students. Although these participants were of a target age whereby mating, mate choice, and competition for mates is prevalent, these samples were also collected due to the convenience of recruitment. Sampling reproductive-aged adults more broadly to include those who did not attend university and/or community members in the workforce, as well as participants from different regions, ethnic, and cultural backgrounds, will be an important next step for research in this area. Perhaps more heterogenous sampling would better capture a broader range in both immunocompetence, mate value, and mating success, and thus may better identify (or counter) any potential links between these variables.

Conclusion

The preference for healthy mates is well established (Apostolou, 2008; Buss et al., 1990). Because of this preference, it is assumed that healthy individuals would have higher self-reported mate value. Here, we report preliminary evidence supporting the hypothesis that healthier individuals (i.e., those who are higher in mucosal immunity, report fewer and less severe symptoms of poor health) are indeed higher in *self-reported* mate value, but not in their reports of some overt mating behavior (relationships status and lifetime sex partners). Accordingly, the idea that immunocompetence translates to observable benefits in mating success in young adults remains equivocal. Future research using more diverse participants, biological measures of immunocompetence and of mate value are required. Overall, these results provide an important extension to the mate-preference literature by demonstrating that healthier individuals report being more desirable to members of the opposite sex. In addition, these findings suggest that individuals may calibrate their perceived mate value to their level of health. Whether these two vary together over time may be an interesting direction for future research.

Authors' Contributions S.A. and B.D. conceptualized the study. B.D. compiled and aggregated data (originally collected in S.A.'s Laboratory with the assistance of H.B. and B.D.). B.D. conducted statistical analyses with figures created by J.H. and C.R.H. B.D. (primary), S.A., A.D., C.R.H., and H.B. wrote and edited the manuscript.

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Data Availability Aggregate data are available from the contact author upon request.

Declarations

Ethical Approval All data sets used in this study were collected in accordance with Canada's Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2) with approval from the Nipissing University Research Ethics Board.

Competing Interests The authors declare no competing interests.

References

Aghamohammadi, A., Cheraghi, T., Gharagozlou, M., Movahedi, M., Rezaei, N., Yeganeh, M., Parvaneh, N., Abolhassani, H., Pourpak, Z., & Moin, M. (2009). IgA deficiency: Correlation between clinical and immunological phenotypes.Journal of Clinical Immunology. 29(1),130–136. https://doi.org/10.1007/s10875-008-9229-9

Ainsworth, S. E., & Maner, J. K. (2019). Pathogen avoidance mechanisms affect women's preference for symmetrical male faces. *Evolutionary Behavioral Sciences*, *13*(3), 265–271. https://doi.org/10.1037/ebs0000139.

Albert, G., Arnocky, S., Puts, D. A., & Hodges-Simeon, C. R. (2021). Can listeners assess men's self-reported health from their voice? *Evolution and Human Behavior*, *42*(2), 91–103. https://doi.org/10.1016/j.evolhumbehav.2020.08.001.

Alexander, M. G., & Fisher, T. D. (2003). Truth and consequences: using the bogus pipeline to examine sex differences in self-reported sexuality. *Journal of Sex Research*, *40*(1), 27–35. https://doi.org/10.1080/00224490309552164.

Apostolou, M. (2008). Parent-offspring conflict over mating: the case of family background. *Evolutionary Psychology*, *6*(3), 456–468. https://doi.org/10.1177/147470490800600310.

Arnocky, S. (2018). Self-perceived mate value, facial attractiveness, and mate preferences: do desirable men want it all? *Evolutionary Psychology*, *16*(1), 1–8. https://doi.org/10.1177/1474704918763271.

Arnocky, S., Hodges-Simeon, C. R., Ouellette, D., & Albert, G. (2018). Do men with more masculine voices have better immunocompetence? *Evolution and Human Behavior*, *39*(6), 602–610. https://doi.org/10.1016/j.evolhumbehav.2018.06.003.

Arnocky, S., Pearson, M., & Vaillancourt, T. (2015). Health, anticipated partner infidelity, and jealousy in men and women. *Evolutionary Psychology*, *13*(3), 1–10. https://doi.org/10.1177/1474704915593666.

Arnocky, S., Piché, T., Albert, G., Ouellette, D., & Barclay, P. (2017). Altruism predicts mating success in humans. *British Journal of Psychology*, *108*(2), 416–435. https://doi.org/10.1111/bjop.12208.

Arnocky, S., Proietti, V., Ruddick, E. L., Côté, T. R., Ortiz, T. L., Hodson, G., & Carré, J. M. (2019). Aggression toward sexualized women is mediated by decreased perceptions of humanness. *Psychological Science*, *30*(5), 748–756. https://doi.org/10.1177/0956797619836106.

Arnocky, S., Sunderani, S., & Vaillancourt, T. (2013). Mate-poaching and mating success in humans. *Journal of Evolutionary Psychology*, *11*(2), 65–83. https://doi.org/10.1556/JEP.11.2013.2.2.

Brierley, M. E., Brooks, K. R., Mond, J., Stevenson, R. J., & Stephen, I. D. (2016). The body and the beautiful: Health, attractiveness and body composition in men's and women's bodies. *Plos One*, *11*(6), https://doi.org/10.1371/journal.pone.0156722. Article e0156722.

Brooks, R., Scott, I. M., Maklakov, A. A., Kasumovic, M. M., Clark, A. P., & Penton-Voak, I. S. (2011). National income inequality predicts women's preferences for masculinized faces better than health does. *Proceedings of the Royal Society B: Biological Sciences, 278*(1707), 810–812. https://doi.org/10.1098/rspb.2010.0964

Buss, D. M., Abbott, M., Angleitner, A., Asherian, A., Biaggio, A., Blanco-Villasenor, A., Bruchon-Schweitzer, M., Ch'U, H. Y., Czapinski, J., Deraad, B., Ekehammar, B., El Lohamy, N., Fioravanti, M., Georgas, J., Gjerde, P., Guttman, R., Hazan, F., Iwawaki, S., Janakiramaiah, N., & Yang, K. S. (1990). International preferences in selecting mates: a study of 37 cultures. *Journal of Cross-Cultural Psychology*, *21*(1), 5–47. https://doi.org/10.1177/0022022190211001.

Cai, Z., Hahn, A. C., Zhang, W., Holzleitner, I. J., Lee, A. J., DeBruine, L. M., & Jones, B. C. (2019). No evidence that facial attractiveness, femininity, averageness, or coloration are cues to susceptibility to infectious illnesses in a university sample of young adult women. *Evolution and Human Behavior*, *40*(2), 156–159. https://doi.org/10.1016/j.evolhumbehav.2018.10.002.

Csajbók, Z., Havlíček, J., Demetrovics, Z., & Berkics, M. (2019). Self-perceived mate value is poorly predicted by demographic variables. *Evolutionary Psychology*. https://doi.org/10.1177/1474704919829037.

Curtis, V. A., de Barra, M., & Aunger, R. (2011). Disgust as an adaptive system for disease avoidance behaviour. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *366*, 389–401. https://doi.org/10.1098/rstb.2010.0117.

Davis, A. C., & Arnocky, S. (2022). Darwin versus Wallace: esthetic evolution and preferential mate choice. *Frontiers in Psychology*, *13*, Article 862385. https://doi.org/10.3389/fpsyg.2022.862385.

Davis, A. C., Belanger, J., Mattsson, A., & Arnocky, S. (2022). Hostility mediates the relations between self-perceived physical health status and cost-inflicting mate retention. *Evolutionary Behavioral Sciences*, *16*(1), 1–13. https://doi.org/10.1037/ebs0000188.

Debruine, L. M., Jones, B. C., Tybur, J. M., Lieberman, D., & Griskevicius, V. (2010). Women's preferences for masculinity in male faces are predicted by pathogen disgust, but not by moral or sexual disgust. *Evolution and Human Behavior*, *31*(1), 69–74. https://doi.org/10.1016/j.evolhumbehav.2009.09.003.

Edlund, J. E., & Sagarin, B. J. (2014). The mate value scale. *Personality and Individual Differences*, *64*, 72–77. https://doi.org/10.1016/j.paid.2014.02.005.

Eliasson, L., Birkhed, D., Österberg, T., & Carlén, A. (2006). Minor salivary gland secretion rates and immunoglobulin A in adults and the elderly. *European Journal of Oral Sciences*, *114*(6), 494–499. https://doi.org/10.1111/j.1600-0722.2006.00413.x.

Evans, P., Der, G., Ford, G., Hucklebridge, F., Hunt, K., & Lambert, S. (2000). Social class, sex, and age differences in mucosal immunity in a large community sample. *Brain, Behavior, and Immunity*, *14*(1), 41–48. https://doi.org/10.1006/brbi.1999.0571

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146.

Fernandez, A. M., Muñoz-Reyes, J. A., & Dufey, M. (2014). BMI, age, mate value, and intrasexual competition in chilean women. *Current Psychology*, *33*(4), 435–450. https://doi.org/10.1007/s12144-014-9221-x.

Fink, B., Grammer, K., & Matts, P. J. (2006). Visible skin color distribution plays a role in the perception of age, attractiveness, and health in female faces. *Evolution and Human Behavior*, *27*(6), 433–442. https://doi.org/10.1016/j.evolhumbehav.2006.08.007.

Fink, B., Grammer, K., & Thornhill, R. (2001). Human (Homo sapiens) facial attractiveness in relation to skin texture and color. *Journal of Comparative Psychology*, *115*(1), 92–99. https://doi.org/10.1037/0735-7036.115.1.92.

Fisher, M. (2008). Components of self-perceived mate value. *Journal of Social Evolutionary and Cultural Psychology*, *2*(4), 156–168. https://doi.org/10.1037/h0099347.

Folstad, I., & Karter, A. J. (1992). Parasites, bright males, and the immunocompetence
handicap.American Naturalist, *139*(3),603–622. https://doi.org/10.2307/2462500.

Foo, Y. Z., Nakagawa, S., Rhodes, G., & Simmons, L. W. (2017). The effects of sex hormones on immune function: a meta-analysis. *Biological Reviews*, *92*(1), 551–571. https://doi.org/10.1111/brv.12243.

Foo, Y. Z., Simmons, L. W., Perrett, D. I., Holt, P. G., Eastwood, P. R., & Rhodes, G. (2020). Immune function during early adolescence positively predicts adult facial sexual dimorphism in both men and women. *Evolution and Human Behavior*, *41*(3), 199–209. https://doi.org/10.1016/j.evolhumbehav.2020.02.002.

Foo, Y. Z., Simmons, L. W., & Rhodes, G. (2017a). Predictors of facial attractiveness and health in humans. *Scientific Reports*, *7*(1), https://doi.org/10.1038/srep39731.

Foo, Y. Z., Simmons, L. W., & Rhodes, G. (2017b). The relationship between health and mating success in humans. *Royal Society Open Science*, *4*(1), https://doi.org/10.1098/rsos.160603. Article 160603.

Frederick, D. A., & Jenkins, B. N. (2015). Height and body mass on the mating market: Associations with number of sex partners and extra-pair sex among heterosexual men and women aged 18–65. *Evolutionary Psychology*, *13*(3), 1–14. https://doi.org/10.1177/1474704915604563.

Frederick, D. A., Tylka, T. L., Rodgers, R. F., Pennesi, J. L., Convertino, L., Parent, M. C., & Murray, S. B. (2022). Pathways from sociocultural and objectification constructs to body satisfaction among women: the US Body Project I. *Body Image*, *41*, 195–208. https://doi.org/10.1016/j.bodyim.2022.01.018. https://doi-org.ezproxy.lakeheadu.ca/.

Gangestad, S. W., & Buss, D. M. (1993). Pathogen prevalence and human mate preferences. *Ethology and Sociobiology*, *14*(2), 89–96. https://doi.org/10.1016/0162-3095(93)90009-7.

Gangestad, S. W., Haselton, M. G., & Buss, D. M. (2006). Evolutionary foundations of cultural variation: evoked culture and mate preferences. *Psychological Inquiry*, *17*(2), 75–95.

Georgiev, A. V., Muehlenbein, M. P., Prall, S. P., Emery Thompson, M., & Maestripieri, D. (2015). Male quality, dominance rank, and mating success in free-ranging rhesus macaques. *Behavioral Ecology*, *26*(3), 763–772. https://doi.org/10.1093/beheco/arv008.

Grindstaff, J. L., Brodie, E. D., & Ketterson, E. D. (2003). Immune function across generations: Integrating mechanism and evolutionary process in maternal antibody transmission. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 270*(1531), 2309–2319. https://doi.org/10.1098/rspb.2003.2485

Hamilton, W. D., & Zuk, M. (1982). Heritable true fitness and bright birds: a role for parasites? *Science*, *218*(4570), 384–387. https://www.science.org/doi/abs/10.1126/science.7123238.

Heller, E. D., Leitner, H., Drabkin, N., & Melamed, D. (1990). Passive immunisation of chicks against Escherichia coli. *Avian Pathology*, *19*(2), 345–354. https://doi.org/10.1080/03079459008418685.

Henderson, A. J., Lasselin, J., Lekander, M., Olsson, M. J., Powis, S. J., Axelsson, J., & Perrett, D. I. (2017). Skin colour changes during experimentally-induced sickness. *Brain Behavior and Immunity*, *60*, 312–318. https://doi.org/10.1016/j.bbi.2016.11.008.

Hlay, J. K., Albert, G., Batres, C., Richardson, G., Placek, C., Arnocky, S., Lieberman, D., & Hodges-Simeon, C. R. (2021). The evolution of disgust for pathogen detection and avoidance. *Scientific Reports*, *11*(1), 1–12. https://doi.org/10.1038/s41598-021-91712-3.

Jones, A. L. (2018). The influence of shape and color cue classes on facial health perception. *Evolution and Human Behavior*, *39*(1), 19–29. https://doi.org/10.1016/j.evolhumbehav.2017.09.005.

Jones, B. C., Feinberg, D. R., Watkins, C. D., Fincher, C. L., Little, A. C., & DeBruine, L. M. (2013). Pathogen disgust predicts women's preferences for masculinity in men's voices, faces, and bodies. *Behavioral Ecology*, *24*(2), 373–379. https://doi.org/10.1093/beheco/ars173.

Jones, B. C., Fincher, C. L., Welling, L. L. M., Little, A. C., Feinberg, D. R., Watkins, C. D., Al-Dujaili, E. A. S., & DeBruine, L. M. (2013). Salivary cortisol and pathogen disgust predict men's preferences for feminine shape cues in women's faces. *Biological Psychology*, *92*(2), 233–240. https://doi.org/10.1016/j.biopsycho.2012.11.014.

Jones, B. C., Little, A. C., Penton-Voak, I. S., Tiddeman, B. P., Burt, D. M., & Perrett, D. I. (2001). Facial symmetry and judgements of apparent health: support for a "good genes" explanation of the attractiveness–symmetry relationship. *Evolution and Human Behavior*, *22*(6), 417–429. https://doi.org/10.1016/S1090-5138(01)00083-6.

Jungheim, E. S., Schon, S. B., Schulte, M. B., DeUgarte, D. A., Fowler, S. A., & Tuuli, M. G. (2013). IVF outcomes in obese donor oocyte recipients: a systematic review and meta-analysis. *Human Reproduction*, *28*(10), 2720–2727. https://doi.org/10.1093/humrep/det292.

Klentrou, P., Cieslak, T., MacNeil, M., Vintinner, A., & Plyley, M. (2002). Effect of moderate exercise on salivary immunoglobulin A and infection risk in humans. *European Journal of Applied Physiology*, *87*(2), 153–158. https://doi.org/10.1007/s00421-002-0609-1.

Knack, J. M., Jensen-Campbell, L. A., & Baum, A. (2011). Worse than sticks and stones?
Bullying is associated with altered HPA axis functioning and poorer health.Brain and Cognition, *77*(2),183–190. https://doi.org/10.1016/j.bandc.2011.06.011

Knox, D., Schacht, C., Holt, J., & Turner, J. (1993). Sexual lies among university students. *College Student Journal*, *27*, 269–272.

Kreager, D. A., & Staff, J. (2009). The sexual double standard and adolescent peer acceptance. *Social Psychology Quarterly*, *72*(2), 143–164. https://doi.org/10.1177/019027250907200205.

Lieberman, D., Billingsley, J., & Patrick, C. (2018). Consumption, contact and copulation: How pathogens have shaped human psychological adaptations. *Proceedings of the Royal Society B: Biological Sciences, 373*, Article 20170203. https://doi.org/10.1098/rstb.2017.0203

Little, A. C., DeBruine, L. M., & Jones, B. C. (2011). Exposure to visual cues of pathogen contagion changes preferences for masculinity and symmetry in opposite-sex faces. *Proceedings of the Royal Society B: Biological Sciences, 278*(1714), 2032–2039. https://doi.org/10.1098/rspb.2010.1925

Locke, A., & Arnocky, S. (2021). Breast symmetry, but not size or volume, predicts salivary immunoglobulin-A (sIgA) in women. *Evolution and Human Behavior*, *42*(6), 517–523. https://doi.org/10.1016/j.evolhumbehav.2021.05.001.

Macpherson, A. J., McCoy, K. D., Johansen, F. E., & Brandtzaeg, P. (2008). The immune geography of IgA induction and function. *Mucosal Immunology*, *1*(1), 11–22. https://doi.org/10.1038/mi.2007.6.

Marcinkowska, U. M., Rantala, M. J., Lee, A. J., Kozlov, M. V., Aavik, T., Cai, H., Contreras-Garduño, J., David, O. A., Kaminski, G., Li, N. P., Onyishi, I. E., Prasai, K., Pazhoohi, F., Prokop, P., Cardozo, S. L. R., Sydney, N., Taniguchi, H., Krams, I., & Dixson, B. J. W. (2019). Women's preferences for men's facial masculinity are strongest under favorable ecological conditions. *Scientific Reports*, *9*(1), https://doi.org/10.1038/s41598-019-39350-8. Article 3387.

Mengelkoch, S., Gassen, J., Prokosch, M. L., Boehm, G. W., & Hill, S. E. (2022). More than just a pretty face? The relationship between immune function and perceived facial attractiveness *Proceedings of the Royal Society B: Biological Sciences, 289*(1969), Article 20212476. https://doi.org/10.1098/rspb.2021.2476

Meston, C. M., Heiman, J. R., Trapnell, P. D., & Paulhus, D. L. (1998). Socially desirable responding and sexuality self-reports. *The Journal of Sex Research*, *35*(2), 148–157. https://doi.org/10.1080/00224499809551928.

Mitchell, K. R., Mercer, C. H., Prah, P., Clifton, S., Tanton, C., Wellings, K., & Copas, A. (2019). Why do men report more opposite-sex sexual partners than women? Analysis of the gender discrepancy in a british national probability survey. *The Journal of Sex Research*, *56*(1), 1–8. https://doi.org/10.1080/00224499.2018.1481193.

Murray, D. R., Jones, D. N., & Schaller, M. (2013). Perceived threat of infectious disease and its implications for sexual attitudes. *Personality and Individual Differences*, *54*(1), 103–108. https://doi.org/10.1016/j.paid.2012.08.021.

Nathan, C. (2002). Catalytic antibody bridges innate and adaptive immunity. *Science*, *298*(5601), 2143–2144. https://doi.org/10.1126/science.1080005.

Neff, B. D., & Pitcher, T. E. (2005). Genetic quality and sexual selection: an integrated framework for good genes and compatible genes. *Molecular Ecology*, *14*(1), 19–38. https://doi.org/10.1111/j.1365-294X.2004.02395.x.

Neville, V., Gleeson, M., & Folland, J. P. (2008). Salivary IgA as a risk factor for upper respiratory infections in elite professional athletes. *Medicine and Science in Sports and Exercise*, *40*(7), 1228–1236. https://doi.org/10.1249/MSS.0b013e31816be9c3.

Oikawa, J., Ukawa, S., Ohira, H., Kawamura, T., Wakai, K., Ando, M., Hata, A., & Tamakoshi, A. (2015). Diabetes mellitus is associated with low secretion rates of immunoglobulin A in saliva. *Journal of Epidemiology*, *25*(7), 470–474. https://doi.org/10.2188/jea.JE20140088.

Olfert, M. D., Barr, M. L., Charlier, C. M., Famodu, O. A., Zhou, W., Mathews, A. E., Byrd-Bredbenner, C., & Colby, S. E. (2018). Self-reported vs. measured height, weight, and BMI in young adults. *Journal of Environmental Research and Public Health*, *15*(10), 2216.
https://doi.org/10.3390/ijerph15102216

Paasch, U., Grunewald, S., Kratzsch, J., & Glander, H. J. (2010). Obesity and age affect male fertility potential. *Fertility and Sterility*, *94*(7), 2898–2901. https://doi.org/10.1016/j.fertnstert.2010.06.047.

Palmer, N. O., Bakos, H. W., Owens, J. A., Setchell, B. P., & Lane, M. (2012). Diet and exercise in an obese mouse fed a high-fat diet improve metabolic health and reverse perturbed sperm function. *American Journal of Physiology-Endocrinology and Metabolism*, *302*(7), E768–E780. https://doi.org/10.1152/ajpendo.00401.2011.

Paul, C., Fitzjohn, J., Herbison, P., & Dickson, N. (2000). The determinants of sexual intercourse before age 16. *Journal of Adolescent Health*, *27*(2), 136–147. https://doi.org/10.1016/S1054-139X(99)00095-6.

Penn, D. J., & Számadó, S. (2020). The Handicap Principle: how an erroneous hypothesis became a scientific principle. *Biological Reviews*, *95*(1), 267–290. https://doi.org/10.1111/brv.12563.

Phalane, K. G., Tribe, C., Steel, H. C., Cholo, M. C., & Coetzee, V. (2017). Facial appearance reveals immunity in african men. *Scientific Reports*, *7*(1), https://doi.org/10.1038/s41598-017-08015-9.

Phillips, A. C., Carroll, D., Drayson, M. T., & Der, G. (2015). Salivary immunoglobulin A secretion rate is negatively associated with cancer mortality: the west of Scotland twenty-07 study. *Plos One*, *10*(12), https://doi.org/10.1371/journal.pone.0145083. Article e0145083.

Pound, N., Lawson, D. W., Toma, A. M., Richmond, S., Zhurov, A. I., & Penton-Voak, I. S. (2014). Facial fluctuating asymmetry is not associated with childhood ill-health in a large British cohort study. *Proceedings of the Royal Society B: Biological Sciences, 281*(1792), Article 20141639. https://doi.org/10.1098/rspb.2014.1639

Prum, R. O. (2012). Aesthetic evolution by mate choice: Darwin's really dangerous ideas. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*, 2253–2265. doi:https://doi.org/10.1098/rstb.2011.0285.

Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behavior: does attractiveness enhance mating success? *Evolution and Human Behavior*, *26*(2), 186–201. https://doi.org/10.1016/j.evolhumbehav.2004.08.014.

Roberts, S. C., Little, A. C., DeBruine, L. M., & Petrie, M. (2017). Discrimination of attractiveness and health in men's faces: the impact of color cues and variation in relation to sex and age of rater. *Adaptive Human Behavior and Physiology*, *3*(4), 401–411. https://doi.org/10.1007/s40750-017-0081-0.

Rosenthal, M. K. (1999). Out-of-home child care research: a cultural perspective. *International Journal of Behavioral Development*, *23*(2), 477–518. https://doi.org/10.1080/016502599383928.

Schaller, M. (2011). The behavioural immune system and the psychology of human sociality. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *366*, 3418–3426. https://doi.org/10.1098/rstb.2011.0029.

Schaller, M., & Park, J. H. (2011). The behavioral immune system (and why it matters). *Current Directions in Psychological Science*, *20*(2), 99–103. https://doi.org/10.1177/0963721411402596.

Schleifenbaum, L., Driebe, J., Gerlach, T., Penke, L., & Arslan, R. (2021). Women feel more attractive before ovulation: evidence from a large-scale online diary study. *Evolutionary Human Sciences*, *3*, E47. https://doi.org/10.1017/ehs.2021.44.

Schmitt, D. P., & International Sexuality Description Project. (2003). Universal sex differences in the desire for sexual variety: tests from 52 nations, 6 continents, and 13 islands. *Journal of Personality and Social Psychology*, *85*(1), 85–104. https://doi.org/10.1037/0022-3514.85.1.85.

Shackelford, T. K., Schmitt, D. P., & Buss, D. M. (2005). Universal dimensions of human mate preferences. *Personality and Individual Differences*, *39*(2), 447–458. https://doi.org/10.1016/j.paid.2005.01.023.

Shukla, K. K., Chambial, S., Dwivedi, S., Misra, S., & Sharma, P. (2014). Recent scenario of obesity and male fertility. *Andrology*, *2*(6), 809–818. https://doi.org/10.1111/andr.270.

Silvestris, E., de Pergola, G., Rosania, R., & Loverro, G. (2018). Obesity as disruptor of the female fertility. *Reproductive Biology and Endocrinology*, *16*(1), 22. https://doi.org/10.1186/s12958-018-0336-z.

Stoehr, A. M., & Kokko, H. (2006). Sexual dimorphism in immunocompetence: what does life-history theory predict? *Behavioral Ecology*, *17*(5), 751–756. https://doi.org/10.1093/beheco/ark018.

Strugnell, R. A., & Wijburg, O. L. C. (2010). The role of secretory antibodies in infection immunity. *Nature Reviews Microbiology*, *8*(9), 656–667. https://doi.org/10.1038/nrmicro2384.

Thornhill, R., & Gangestad, S. W. (2006). Facial sexual dimorphism, developmental stability, and susceptibility to disease in men and women. *Evolution and Human Behavior*, *27*(2), 131–144. https://doi.org/10.1016/j.evolhumbehav.2005.06.001.

Tybur, J. M., Fan, L., Jones, B. C., Holzleitner, I. J., Lee, A. J., & DeBruine, L. M. (2022). Re-evaluating the relationship between pathogen avoidance and preferences for facial symmetry and sexual dimorphism: a registered report. *Evolution and Human Behavior*. https://doi.org/10.1016/j.evolhumbehav.2022.01.003.

Tybur, J. M., & Gangestad, S. W. (2011). Mate preferences and infectious disease: theoretical considerations and evidence in humans. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *366*, 3375–3388. https://doi.org/10.1098/rstb.2011.0136.

Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology*, *97*(1), 103–122. https://doi.org/10.1037/a0015474.

Tybur, J. M., Lieberman, D., Kurzban, R., & Descioli, P. (2013). Disgust: evolved function and structure. *Psychological Review*, *120*(1), 65–84. https://doi.org/10.1037/a0030778.

Vaillancourt, T., & Sharma, A. (2011). Intolerance of sexy peers: intrasexual competition among women. *Aggressive Behavior*, *37*(6), 569–577. https://doi.org/10.1002/ab.20413.

Warner, C. M., Meeker, D. L., & Rothschild, M. F. (1987). Genetic control of immune responsiveness: a review of its use as a tool for selection for disease resistance. *Journal of Animal Science*, *64*(2), 394–406. https://doi.org/10.2527/jas1987.642394x.

Watkins, C. D., DeBruine, L. M., Little, A. C., & Jones, B. C. (2012). Social support influences preferences for feminine facial cues in potential social partners. *Experimental Psychology*, *59*(6), 340–347. https://doi.org/10.1027/1618-3169/a000162.

Woof, J. M., & Mestecky, J. (2015). Mucosal immunoglobulins. In J. Mestecky, M. W. Russell, H. Cheroutre, W. Strober, B. L. Kelsall, & B. N. Lambrecht (Eds.), *Mucosal immunology* (4th ed., pp. 287–324). Amsterdam, NL: Elsevier.

Young, S. G., Sacco, D. F., & Hugenberg, K. (2011). Vulnerability to disease is associated with a domain-specific preference for symmetrical faces relative to symmetrical non-face stimuli. *European Journal of Social Psychology*, *41*(5), 558–563. https://doi.org/10.1002/ejsp.800.