

Gonadal Hormones: The Men, the Myths, and the Legends

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Gender is one of the most essentialized social categories, with putative differences between cisgender men and cisgender women often framed in biological terms. We propose that the consequences of inaccurate and widely held essentialist beliefs about gonadal hormones (EBAGHs) in particular—that is, that androgens signify “men” and estrogens signify “not-men”—have yet to be fully appreciated. For example, placebo effects such as increased strength, sexual desire, and irritability have been documented for the androgen testosterone. Accumulating research also suggests that lay understandings exaggerate the causal importance of testosterone in men's aggression. Consequently, testosterone is often either eschewed (i.e., men are “poisoned” by it) or enshrined (“more is good, less is bad”). Moreover, the efficacy-bolstering role of estrogens such as estradiol across the physical, cognitive, and sexual health domains for men has been downplayed or ignored by those who assert pejorative links between estrogen and weakness or effeminacy. Critically, EBAGHs may fuel “hypermasculine” behaviors such as excessive red meat consumption, problematic alcohol intake, and anabolic steroid misuse as well as treatment seeking for “low T” in the absence of proper medical diagnosis—which can all, ironically, result in disrupting men's optimal hormonal balance. Implications of our analysis for research (e.g., EBAGHs as predictors men's health behaviors, use of bogus “hormonal profiles” to induce or assuage threats to masculinity in experimental studies) and interventions (e.g., “hormone education” to offset the adverse effects of EBAGHs) are discussed.

Public Significance Statement

Inaccurate beliefs about gonadal hormones may cause testosterone to be either valued or devalued—and estrogen to be portrayed as the enemy—in men. Such beliefs may contribute to hypermasculine behaviors, poor diet, misguided health care, and other negative outcomes for men. Biologically accurate hormone education may therefore have beneficial consequences for men's self-perception, perception by others, and overall well-being.

Keywords: gonadal hormones, testosterone, estrogen, masculinity, men

We're all just bags of bones and muscle and hormones; I'll never understand what makes our minds do the things we do. It's like that statue of the monkey holding a skull. We're trying to use a thing we don't understand to understand ourselves.

—Meshell Ndegeocello (Wood, 2012)

Although “legend” and “myth” are sometimes used interchangeably in informal contexts, they reflect distinct modes of storytelling: *Legends* are often assumed to have some basis in fact but are also laden with exaggeration and distortion, whereas *myths* tend to be beyond fact, populated by symbols, and evocative by design (e.g., Saxby, 2018). In this article, our core argument is that lay understandings of gonadal hormones (GHs; specifically, androgens and estrogens) contain elements of legend and myth that have yet to be fully articulated, with implications therefore not yet fully appreciated, in the psychological literature.

In keeping with the theme of this special issue, our focus is on the group “men,” although our analysis likely has implications for women as a group and nonbinary individuals as well. Reflecting the proportion of representation in the relevant literature, most of our exposition focuses on cisgender men. We will attempt to integrate pertinent research focused on transgender men where appropriate, but we caution that its inherent limitations render our integration attempts somewhat tentative. Throughout, we will specifically refer to transgender or cisgender men when the phenomena under consideration are explicitly linked to these subgroups—otherwise, we will use “men” as the inclusive default.

Storytelling About Gonadal Hormones in Men

In humans, circulating levels of the androgen testosterone are, on average, 10 times higher in reproductive-age biological males versus reproductive-age biological females; in contrast, circulating levels of estrogens such as estradiol are 10 times *lower* in the former versus the latter group (Barry & Owens, 2019). Although one tenth of something does not equal “zero,” there is nevertheless an apparent tendency for GHs to be *essentialized*—that is, treated as putative biological markers of gender, one of the most essentialized social categories (Haslam & Whelan, 2008; Martin & Parker, 1995). Thus, the core GH essentialist assumption is that the presence of

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testosterone signifies membership in the group “men” and/or congruence with masculine identity, whereas the presence of estrogen signifies membership in the group “women” and/or incongruence with masculine identity (i.e., “not-men”).

Notwithstanding the apparent absence of broad-based corroborative empirical evidence, there is emergent scholarly consensus that many laypeople endorse “the simple formula, man + testosterone = enhanced masculinity” (Fomiatti et al., 2019, p. 324; see also Barry & Owens, 2019; Berg & Linander, 2023; Boon, 2005; Stibbe, 2004; van Anders, 2013; for representative critiques of this formula, see Fine, 2017; Gutmann et al., 2021; van Anders et al., 2015). Beyond the sex-based differences in GHs among reproductive-age females and males described above, estrogens enhance physical features (e.g., breasts) and physical processes (e.g., menstrual cycles) characteristic of biological females (Barry & Owens, 2019). At the same time, the *expected* effects of estrogen may extend beyond the physical to the psychological: For example, notwithstanding scant methodological details, one German study reported by Coenjaerts et al. (2021, p. 50) found that a mixed-gender sample linked estradiol “with attributes caring, empathetic, loving, and friendly, but also weak and anxious”—attributes that are more congruent with stereotypic femininity than stereotypic masculinity (see Hsu et al., 2021).

Consistent with a *legend* conceptualization of GH storytelling, there may be empirical grains of truth in the testosterone/masculinity and estrogen/femininity pairings. For example, Roney et al. (2006) found that cisgender heterosexual men with faces rated as more masculine and more desirable for short-term romantic connection by American women were in fact higher in circulating testosterone (but also see Peters et al., 2008). Similarly, premenopausal cisgender women’s physical attractiveness as perceived by men appears to vary across the menstrual cycle, likely due to corresponding fluctuations in estradiol (e.g., Catena et al., 2019; for a review, see Haselton & Gildersleeve, 2011). Of critical importance, however, the drift toward *essentialist beliefs about gonadal hormones* (henceforth, EBAGHs) is an oversimplification of relevant biopsychological research, for as Barry and Owens (2019, p. 5) noted, “all healthy men and women have a balance of testosterone and estrogen”—not 50–50, but not 100–0, either. As such, EBAGHs can also function as *myths*, wherein GHs are treated more like symbols than chemicals. That is, stereotypic conceptions of testosterone and estrogen elicit evaluative reactions to both that may, in turn, exacerbate problematic attitudes and behaviors across multiple domains.

Testosterone in Men: To Enshrine or to Eschew?

A vintage example of the *eschewal* of testosterone appeared in American actor Alan Alda’s 1975 mini essay titled “What Every Woman Should Know about Men”: If one considers “how abnormal [men’s] behavior [purportedly characterized by systematizing, competition, and aggression] is, then you are led to the hypothesis that almost all men are suffering from *testosterone poisoning*” (Ashton-Jones & Olson, 1991, p. 56). Despite Alda’s overtly satirical tone—exemplified by his concluding statement that such “poisoning” does not exist—esteemed gender-roles researcher Sandra Bem (1993, p. 37) ventured that Alda’s “argument may contain a kernel of truth” and subsequently invoked “prenatal testosterone poisoning” to interpret men’s physical aggression. Turanovic et al. (2017) offered meta-analytic evidence suggesting

that the usefulness of prenatal testosterone exposure as a predictor of subsequent aggression in men is quite limited, however.

Moreover, Geniole et al.’s (2020) meta-analysis revealed that the correlation between baseline testosterone and aggression in humans is weak overall ($r = .054$), albeit statistically significant for men ($r = .071$) but not for women ($r = .002$); the pattern was similar for acute changes in testosterone. When Geniole et al. (2020) examined experimental studies that offered the strongest test of a cause–effect relationship, they did *not* find a significant link between exogenously administered testosterone and aggression, however (see also Carré & Robinson, 2020). Thus, extant data simply do not support wholesale, evaluative assertions concerning testosterone’s impact on aggression in cisgender men. Likewise, based on their review of seven longitudinal studies totaling over 600 European transgender men receiving long-term testosterone supplementation, Kristensen et al. (2021, p. 8) concluded that it was “impossible to draw any definite conclusions on the effect of exogenous testosterone on aggression dimensions in transgender men” due, in part, to the fact that treatment-induced masculinization of physical features practically prohibits long-term placebo groups (see Doyle et al., 2023, for a broader discussion of the challenges associated with differentiating biologically from psychosocially induced psychological changes among transgender individuals receiving hormone treatment). Nevertheless, there is anecdotal evidence that transgender men are sensitized and averse to the *prospect* of increased aggression resulting from testosterone supplementation (see Bosom & Medico, 2021).

Emerging research points to nuance that is not reflected in simplistic, EBAGH-congruent understandings of the testosterone/aggression relationship. For example, Knight et al. (2022, p. 693; U.S.-based, 28% people of color) concluded that “[t]estosterone flexibly directs men’s competitive behavior contingent on basal cortisol levels and cues that signal an opponent’s status”—so aggression may be (only) one of many possible outcomes. Gray et al.’s (2017) international review echoed the importance of context: For example, whereas testosterone can perhaps be linked to hostility or aggression toward outgroups, it seems to be associated with agreeableness/benevolence when dealing with ingroups. Individual differences also matter: Although Welker et al. (2017) reported a positive correlation between acute testosterone change and aggression in Canadian men (14% people of color) endorsing independent self-construals, they discovered an inverse relationship between basal testosterone and aggression among men who endorsed interdependent self-construals (see also Bos et al., 2012).

Lay assumptions about testosterone’s impact can be triangulated further by examining placebo effects that have appeared across a scattered set of studies. For example, Cussons et al. (2002) provided evidence that the beneficent physical (e.g., strength) and cognitive (e.g., clarity) results of self-injection of markedly subtherapeutic testicular extracts reported by the reputed originator of androgen therapy—Charles E. Brown-Séquard—were almost certainly placebo effects. Reminiscent of this was a small study by Maganaris et al. (2000), wherein an “anabolic steroid” placebo increased maximum performance among elite United Kingdom powerlifters compared to baseline, followed by the loss of observed gains among those men who were informed that they had, in fact, received a placebo. Strikingly, Björkqvist et al.’s (1994) small double-blind study showed that cisgender Finnish men who received placebo testosterone orally reported being angrier and more frustrated, irritable, and

impulsive compared to both the no-treatment *and* oral testosterone conditions.

In a double-blind study of cisgender Swiss women reported by Eisenegger et al. (2010), although oral testosterone (vs. placebo) was associated with “fairer” offers in an ultimatum game, *belief* that one had received testosterone predicted the opposite—that is, *less* fair offers. Exemplifying the contextual nature of testosterone-facilitated responding, Wagels et al. (2018) showed that cisgender German men who received oral testosterone displayed more retaliatory aggression when provoked compared to placebo, but *less* aggression compared to placebo when not provoked. In addition to this effect, however, men who *believed* that they had received testosterone were “angrier after the task and dispensed increased punishment levels to their apparent opponent” (p. 6). Thus, without dismissing bona fide testosterone effects that have been documented by careful lab studies, multiple placebo results suggest that cisgender men and women also appear to be cognitively predisposed to manifest enhanced aggression-congruent responses, consistent with the *expected* effect of testosterone (see also Davis et al., 2008; Seftel et al., 2004, for testosterone-related placebo effects on reported sexual desire among hypogonadal cisgender American men and premenopausal cisgender Australian women, respectively).

Based on the evidence reviewed above, the assumption that testosterone is a prime driver of men’s aggression seems misguided. Such caricatured depictions arguably direct attention away from testosterone’s apparently benign effects—for example, an increased sense of agency and optimism in a sample of cisgender South African women (van der Westhuizen et al., 2017) and less cheating among cisgender German men in a private die-roll-for-payment lab task (Wibral et al., 2012). Moreover, the assumed volatility of the “men and testosterone” combo has fueled at least one moral panic: The media-proffered “causal” link between synthetic testosterone variants—that is, androgenic anabolic steroids (AAS)—and violent attacks in Australia about a decade ago resulted in severe criminalization of AAS use, such that “when used by young men, steroids achieved symbolic status as a substance symptomatic of pathological masculinity” (James & Wynn, 2022, p. 1; see also Fomiatti et al., 2019; Handelsman, 2021).

Whereas some who overestimate the impact of testosterone on cisgender men eschew the hormone, others *enshrine* it—so more is good, and less is bad. Indeed, Zajenkowski et al. (2023) recently found that higher scores on measures of agentic (i.e., self-aggrandizing) narcissism were linked to higher self-ratings of testosterone relative to peers in a large sample of young Polish men. Toward the other end of the age continuum, James and Wynn (2022, p. 5) suggested that older cisgender men are medically prescribed testosterone “to transform into the men that they used to be, to reclaim a sense of masculinity and vitality.” In fact, testosterone replacement therapy (TRT) has been touted by some (e.g., Dandona & Rosenberg, 2010) as the go-to treatment for hypogonadism in cisgender men. Handelsman (2022) expressed grave concern that the precise clinical meaning of “hypogonadism”—wherein low testosterone is a symptom stemming from reproductive pathologies—has been subverted, however, such that “low T” is now implicated as a nontrivial *cause* (vs. correlate) of a rather diffuse set of psychological and physical symptoms. Handelsman further asserted that this subversion has fueled a “quasiepidemic increase in testosterone prescribing” in recent decades (p. 1) despite significant unanswered questions concerning TRT’s efficacy and long-term side effects.

Congruent with this critique, Jasuja et al. (2017) found that only 6.3% of cisgender men in a large U.S. Veteran’s Administration TRT sample met the diagnostic criteria for hypogonadism (which was noted by those authors as the only context in which TRT treatment has been approved by U.S. Food and Drug Administration). Of note, one fifth of the sample had been prescribed TRT without even having had their baseline testosterone levels checked. Moreover, even when prescription is clinically appropriate, the biological effects of TRT appear more modest than many recipients might hope: For example, a meta-analysis of TRT efficacy (vs. placebo) among cisgender men with hypogonadism revealed only small improvements on sexual indices (i.e., self-reported desire, functioning, and satisfaction) and no significant effects on mood, memory, or energy (Ponce et al., 2018). Although increased sexual desire and increased sexual activity was attributed to testosterone treatment by a large majority (89% and 72%, respectively) of transgender men in a multiethnic U.S. sample (Dadasovich et al., 2017), methodological limitations render the parsing of bona fide biological versus psychosocial effects of hormone treatment practically impossible (see Doyle et al., 2023).

According to Wolfson (2019), testosterone has been elevated and imbued with symbolic significance by some alt-right proponents, such that “low T” has become shorthand for “being a liberally minded man who supports feminism.” It is also “the ultimate insult, alongside other masculinity-challenging burns” on sympathetic message boards (cf. Stibbe’s, 2004, observation of the dual emphasis on testosterone boosting and conservative politics in *Men’s Health* magazine).

One of the other “burns” cited by Wolfson (2019) is “soy boy,” rooted in claims that dietary phytoestrogens suppress cisgender men’s testosterone (see also Gambert & Linné, 2018; Hubertz, 2020; Salmen & Dhont, 2021, 2023). Such claims appear specious: Reed et al.’s (2021) international meta-analysis found no link between soy/isoflavone consumption and testosterone (or estrogen) levels in men.

As an extension of the unfounded testosterone-suppression assertion, the “soy boy” epithet (code for “plant-based diet”) has been appropriated for racist (predominantly anti-Asian) purposes as well (see Gambert & Linné, 2018; Stănescu, 2018). Once again, data contradict the purported connection: For example, Wu et al. (1995) reported higher average levels of testosterone in older Asian men (especially those born in Asia) compared to an age-comparable North American White sample. Suggestive of the critical importance of local dietary practices (see also the section on health implications below), the difference between Asia-dwelling Asian men and White North American men was replicated by Orwoll et al. (2010).

Estrogen: For Women Only?

Protestosterone rhetoric often brands estrogen as the enemy of men. For example, Calasanti and King (2007, p. 362) noted use of phrases such as “estrogen assault” in their analysis of men’s antiaging products websites—phrases congruent with a subtext wherein “anything that approximates femininity, such as increased estrogen, is both emasculating and a sign of incipient decay” (p. 367).

Owing to the paucity of experimental research that makes use of exogenous estrogen to explore the hormone’s impact on men (see Tan et al., 2015), we were only able to locate one report (Coenjaerts et al., 2021) that offered data relevant to stereotypic expectations of

estrogen's effects: German participants in an auxiliary study linked estradiol "with attributes caring, empathetic, loving, and friendly, but also weak and anxious" (p. 50). Moreover, in the main (double-blind) study's placebo condition, cisgender men and women *who believed that they received estradiol* were more likely to accept offers framed as "unfair" in an ultimatum game relative to those who thought they got the placebo. Although Coenjaerts et al. (2021) speculated that this effect may have reflected an empathy-congruent attempt to "show concern for the proposer" (p. 52), we suspect that the effect is more likely a manifestation of enacted passivity (i.e., "weak"), for similar belief effects were found when there was no fairness framing or when offers were attributed to a computer rather than to an ostensible other participant. Indeed, the belief effect was stronger for men versus women in the latter condition.

Congruent with the depiction of estrogen as the "emasculating enemy," and complementing the apparently lax thresholds for prescribing TRT noted by Jasuja et al. (2017), Tan et al. (2015) reported that antiestrogens were prescribed to 30% of cisgender men receiving TRT in their U.S. sample regardless of their actual estradiol levels and despite the fact that less than 1% manifested gynecomastia (a reliable indicator of GH imbalance) based on clinical records. Practitioners who were interviewed explained their decisions to prescribe antiestrogens stemmed, in part, from "patient pressure, practitioner confusion, and fear of the harmful effects of high E2 [i.e., estradiol] in long term" (p. 232).

Critically, we suggest that EBAGHs and the antagonistic conceptualization of testosterone and estrogen embedded therein distort—if not outright discard—a wide range of pertinent research. For example, in one of the most comprehensive reviews concerning the impact of estrogens in biological males, Cooke et al. (2017) summarized evidence from nonhuman animal studies suggesting that masculinization of the male brain is facilitated, in part, by the *conversion of testosterone to estradiol* via aromatization, and they speculated that this process generalizes to humans. Cooke et al. (2017) noted, moreover, that the testes produce about one fifth of circulating estrogens in biological males, with the remaining four-fifths produced via aromatization of testosterone in bone, skin, fat, and brain tissue, and that sufficient estradiol must complement testosterone to maintain men's sexual functioning.

Research also points to the beneficent effects of estrogen beyond the enhancement of sexual functioning. For example, estrogen appears to protect against neurodegenerative diseases such as Alzheimer's and Parkinson's in aging brains, whereas testosterone's role appears more circumscribed and conditional (see Maioli et al., 2021). Schultheiss et al. (2021) showed that salivary estradiol (but not testosterone) predicted written verbal fluency—which they speculated was a proxy for working memory capacity—as strongly in men as in women, and that this relationship was geographically robust (but evident only among individuals with high estradiol/low testosterone prenatal exposure based on 2D:4D digit ratio; see also Marrocco & McEwen, 2016). Cooke et al. (2017) pointed to suggestive evidence that estrogen plays an important role—in some instances, more so than testosterone—in the promotion and maintenance of growth hormone concentration, bone density, and immune function while also being cardioprotective. Thus, the beneficent cognitive and physiological effects of normative levels of estrogen arguably facilitate agency in men, congruent with a core facet of masculine identity (e.g., Boon, 2005; Hsu et al., 2021)—thereby undermining an

EBAGH-congruent framing of testosterone and estrogen as antagonists.

EBAGHs and Their Ironic Implications for Men's Health

If our analysis is correct, then the health implications of some men's lifestyle choices are complicated by EBAGHs' symbolic conflation of testosterone with men/masculinity (and estrogen with women/femininity). At worst, these lifestyle choices may have ironically counterproductive implications for men's GH-related well-being. For example, notwithstanding recent decreases in gender-based disparity, alcohol use—especially if excessive—has long been designated a marker of "manliness" among cisgender men across many cultures (e.g., Hunt & Antin, 2019; Iwamoto et al., 2011; Parks & Parisi, 2019). Despite this association, alcohol "has been experimentally shown to have a deleterious effect at all levels of the male reproductive system" among heavy users according to Salas-Huetos et al.'s (2017) 18-country review—including testicular atrophy, reduced semen volume, suboptimal sperm morphology, and impaired testosterone production (see also Smith et al., 2023). Thus, "hypermasculine" levels of drinking risk draining men's symbolic GH capital.

Similarly, Stibbe (2004) concluded that, along with "beer drinker," *Men's Health* magazine readers were presented with the message that the "the ideal man" is also "a meat eater" (p. 39). In fact, Mesler et al. (2022) recently offered experimental evidence consistent with the conceptualization of red meat as symbol of masculinity: Higher scores on a "masculinity stress" scale (e.g., "Sometimes I worry about my masculinity") predicted behavioral intentions of more red meat consumption among Western men—but not when they were informed that women consumed a lot or when their masculine identity was bolstered beforehand (via false feedback concerning their above-average scores on an ostensible masculinity measure). As was the case for alcohol, however, research suggests that greater consumption may be linked to counterproductive GH outcomes. For example, M. C. Afeiche et al. (2014) showed that processed red meat consumption predicted lower ejaculate volume and sperm count even after many covariates were applied in an active U.S. (mostly White) sample. Salas-Huetos et al. (2017; see also Libera et al., 2021) similarly noted a link between red/processed meat intake and lower male fecundability. Moreover, although Lopez et al. (2022) found no consistent relationship between testosterone levels and the so-called "Western diet" (which includes higher levels of red meat consumption) among men in their sample of middle-aged U.S. health professionals, it was linked to higher estradiol. Thus, "manly" cuts of meat may undercut men's GH-related well-being.

Also consider the misuse of AAS, typically in pursuit of enhanced muscularity for performance and/or appearance purposes (see Cranswick et al., 2020, for an analysis of symbolic connections between muscularity and masculinity in men; for a broader overview of AAS misuse, see Iyer & Handelsman, 2023). AAS misuse has been characterized as an "uncommon but important cause of male infertility" by Whitaker et al. (2021, p. 109). Supraclinical exogenous doses of testosterone and its synthetic variants suppress endogenous testosterone production, sometimes accompanied by shrinkage of the testicles. Excess testosterone can convert to estradiol via aromatization, leading to gynecomastia—one of the "telltale stigmata" of AAS misuse, according to Handelsman (2021, p. 481). Consequently, AAS users will sometimes also take estrogen blockers, which may

increase the likelihood of sexual dysfunction (Young, 2023; see also Ip et al., 2019). Thus, in sum, the available research suggests that—at least at “hypermasculine” (i.e., excessive) levels—alcohol intake, red meat consumption, and AAS use can contribute ironically to GH dysregulation associated with deleterious effects on core contributors to masculine identity, that is, sexual functioning and physical appearance (e.g., Eisler & Skidmore, 1987).

One other dietary source—dairy—merits comment as well: Heffernan (2022) described a mid-20th century movement among American bodybuilding promoters that (raw, unpasteurized) dairy had “mystical power” (p. 830) to transform men’s bodies into the presumed masculine ideal—suggesting that dairy is sometimes accorded symbolic status. Indeed, Stănescu (2018) has documented the confluence of dairy advocacy, “masculinity,” and racism that preceded the bodybuilder movement and persists in contemporary alt-right contexts, such that “milk specifically has been chosen as [the] ‘new’ symbol for racial purity [that is contrasted with greater consumption of plant-based milk in non-White majority populations]” (p. 104).

Although there is some evidence that high-protein dairy can complement resistance training to increase muscle mass (e.g., Pourabbas et al., 2021), excessive consumption by men may not be without risk. For example, Gao et al.’s (2005) meta-analysis yielded a small but significant association between dairy intake and prostate cancer across Western samples (see also Song et al., 2013), and Ganmaa et al. (2002) reported a strong correlation between estimated dairy intake and incidence of testicular and prostate cancers across 42 countries—and both cancer types can have adverse effects on men’s self-perceived masculinity (e.g., Andreasson et al., 2023; Dax et al., 2022). Moreover, M. Afeiche et al. (2013) discovered an inverse relationship between total dairy intake and semen quality (especially sperm morphology) in a sample of young, active U.S. men (see also Salas-Huetos et al., 2017). Research that isolates the impact of dairy consumption on GHs specifically seems inconclusive, however: For example, although the high-protein dairy group in Pourabbas et al. (2021) showed a significant pre–post increase in testosterone relative to placebo among those young Iranian men undergoing strength training, the specific causal mechanism was unclear. Likewise, neither testosterone nor estradiol appeared to be direct mediators of the dairy/semen quality relationship reported by M. Afeiche et al. (2013). Thus, although dairy consumption has been touted by some as a marker of men’s commitment to masculinity, the actual GH-related effects on men’s health appear mixed at best.

Toward an EBAGH-Informed Research Agenda

Methodological Implications

Our understanding of EBAGHs has methodological, conceptual, and intervention-related implications for the psychology of men. With respect to the methodology, one obvious agenda item is the development of a scale to tap individual differences in EBAGH endorsement that should include, at minimum, items assessing the extent to which respondents: (a) equate testosterone with “men” and estrogen with “not-men;” (b) assume that testosterone and estrogen are antagonistic re.: men’s functioning; (c) regard testosterone as “all good” and estrogen as “all bad” for men; and (d) make wholesale attributions to testosterone and/or estrogen for variation in men’s behaviors, values, moods, etc. We recommend that such

items be interspersed with others that assess research-based factual knowledge concerning GHs—for example, that testes produce estrogen, and that testosterone is converted to estradiol via aromatization in men.

Researchers should consider supplementing explicit assessment of EBAGHs with implicit measures, for example, the extent to which respondents spontaneously associate testosterone and estrogen with “good” or “bad” and “men” or “not-men,” as such “gut” responses may not necessarily correspond with an individual’s demonstrable factual knowledge of GHs. Moreover, GH self-assessment in conjunction with explicit or implicit EBAGH measures could prove useful—that is, asking naïve respondents to estimate their own levels of testosterone and estrogen (as well as “masculinity” and “femininity”) compared to peers matched for gender, age, and ethnicity (cf. Zajenkowski et al., 2023). We would expect self-estimates of GH levels to be more consequential among men who endorse EBAGHs compared to those who do not. For example, whereas EBAGH-endorsing men with low self-perceived testosterone would presumably see themselves as falling short on a core metric of masculinity, other endorsees who reckon (accurately or not) that their testosterone levels are acceptable may feel more secure. Consequently, it seems plausible that deconstructing EBAGHs would be welcomed by the former, perhaps reducing the felt need to engage in compensatory behaviors, whereas challenging EBAGHs would be met with resistance by the latter.

Along with measurement, EBAGH-informed manipulations could prove useful. Previous techniques for inducing “masculinity threat” include having men engage in “feminine” tasks such as braiding hair, giving false performance feedback on ostensible measures of masculinity and/or femininity, and presenting bogus statistics pointing to a projected gender gap in unemployment favoring women (see Bosson et al., 2009; Carian & Sobotka, 2018; Willer et al., 2013). In contrast to these approaches, an EBAGH-informed threat induction would be *intrinsic*, centered on an individual’s presumed biochemistry. For example, saliva swab tests could be administered to naïve participants to yield bogus, norm-referenced “results” for testosterone and estrogen to be matched to a color key (akin to ketone testing kits). We suspect that low testosterone/high estrogen feedback might serve as a particularly potent masculinity threat among high EBAGH-scoring men. Likewise, we might expect high testosterone/low estrogen feedback to defuse or buffer masculinity threat—once again, especially among high EBAGH-scoring men (cf. Himmelstein et al., 2019).

Respondents’ reactions to the presentation of accurate (research-based) information about normative GH levels and functions across the gender spectrum should also be explored. Among high EBAGH scorers, the presentation of such information is tantamount to belief disconfirmation. What emotions are evoked among EBAGH endorsees? How intransigent are EBAGHs? What cognitive strategies might endorsees use to maintain them? What are the secondary effects of EBAGH disconfirmation—for example, would endorsees’ attitudes toward ingroups and outgroups polarize (further)? Mapping out such responses is essential if effective educational interventions (see Intervention Implications section) are to be devised.

Conceptual Implications

Our EBAGH analysis has implications for a variety of phenomena that merit empirical examination. For example, the utility of EBAGHs as predictors of counterproductive health behaviors in

men—especially, compared to other candidate predictors focused on deviation or conformity to “masculine” role expectations (e.g., Burkley et al., 2016; Eisler & Skidmore, 1987; O’Neil et al., 1986)—should be explored. We suggest that EBAGHs may also prove to be substantive predictors of negative attitudes toward a variety of “outgroups.”

Target age may be one relevant differentiating characteristic: Berg and Linander (2023) documented low testosterone concerns among both young (peripubertal) and aging cisgender Swedish men—exacerbated by actual age-related decline in some men (see Anawalt & Matsumoto, 2022). Moreover, estradiol levels are similar in cisgender girls and cisgender boys but diverge in puberty as women outpace men before beginning to converge again postmenopause (Schultheiss et al., 2021). In fact, Sumien et al. (2021) noted that, due to aromatization of androgens, aging men’s estrogen levels tend to be higher than those of aging women. Thus, from the perspective of EBAGH endorsees, postpubertal-but-“not too old” cisgender men may be regarded as “real men” because they come the closest to having “proper” GH profiles (The same sort of GH heuristic may also be applied when designating “real women.”). Consequently, we would expect age-based departures from this ideal to be evaluated less positively by EBAGH endorsees.

Sexual orientation may also be seen as EBAGH-relevant by endorsees: LeVay (1996) offered a historical overview of the extent to which the assumption of deficient circulating levels of testosterone and/or excess estrogen in gay men has been embraced by some as justification for extreme surgical and biochemical “curative” attempts. Moreover, there is recent anecdotal evidence from China that the assumption of higher estrogen among (at least a subset) of gay men persists (Zhou, 2023). Although Tasos (2022) conceded that there is suggestive evidence that distinct patterns of embryonic GH exposure may be linked to sexual orientation in later life, Balthazart’s (2011) review revealed *no link* between circulating GH levels and sexual orientation in adulthood. Illustrative of this, Juster et al. (2016) found that although sexual orientation moderated associations between GHs and stress markers among Canadian men, mean levels of testosterone and estradiol did not differ significantly as a function of self-declared gay/bisexual versus heterosexual orientation. With this as a backdrop, it seems reasonable to investigate the extent to which the persistence of EBAGHs fuels negative attitudes toward statistically less frequent sexual orientations.

Likewise, EBAGHs may contribute to negative attitudes toward transgender individuals: Although biological essentialism usually implies immutability (Martin & Parker, 1995), circulating GH levels *can* create significant physical changes—which may make salient the precariousness of an EBAGH-informed conceptualization of gender. For example, Handelsman (2021) regarded persistent gynecomastia as a signature complication of AAS misuse among cisgender men, with the resulting visual incongruity sometimes prompting them to seek breast reduction surgery. Likewise, we might expect that the notable visual transformations stemming, in part, from voluntary GH treatment among transgender individuals would be experienced as threatening by EBAGH endorsees. Congruent with this possibility, a sample of White cisgender heterosexual U.K. men who rated (presumed cisgender) women as highly attractive reported less positive attitudes toward gay men after being accurately informed (vs. not) that the women were transgender—and this effect was mediated by increased support for traditional gender norms (West & Borrás-Guevara, 2022). We suspect that such effects

would be especially pronounced among those who strongly endorse EBAGHs.

Finally, our conceptual analysis suggests that EBAGH endorsement may put cisgender men in a sort of “damned if they do and damned if they don’t” position. On the one hand, oversimplified understandings of testosterone may lead to overestimating men’s propensity for aggression, interpreting men’s ambiguous behavior as aggression-congruent, and/or blaming testosterone for other “objectionable” behaviors enacted by men. On the other hand, cisgender men’s failure to exemplify “masculine” ideals may also be framed in GH terms—that is, the result of too little testosterone and/or too much estrogen.

At this point, an important but heretofore unstated qualifier of our conceptual analysis needs to be explicitly acknowledged: EBAGHs, even if inaccurate, make use of the vocabulary and framework of the Western biomedical model. Consequently, although mapping the cross-cultural pervasiveness of EBAGHs remains an empirical task (hopefully aided by the methodological toolset sketched out above), it is necessarily true that EBAGHs per se can only exist in contexts wherein “hormones” are understood to be chemical agents that can affect humans’ physical structure, physiology, and psychology. EBAGH analogs that make use of concepts such as *life force*, *vital essence*, or *virility* rather than testosterone appear in other contexts, however. For example, Orathinkal (2009) noted that some cultures in Papua New Guinea conceptualize men’s “life force” as a depletable resource linked to semen that must be supplemented by eating meat or—in the case of boys—by the ritualized ingestion of adult men’s ejaculate. Elsewhere, despite the counterproductive GH-related implications of (especially) long-term alcohol use documented above, herbal bitters with high alcohol content are explicitly marketed to, and consumed by, men as “virility” boosters in Ghana and Nigeria (Dumbili, 2016; Fiaveh, 2020). Likewise, dos Reis et al. (2018, p. 284) concluded that the high rate of alcohol consumption among *torcedores* (i.e., young Brazilian men who are members hardcore football fan clubs) could be understood “as a way to affirm masculine status and ... to demonstrate how virile they are as ‘real men’.” Thus, although testosterone is not invoked in any of these examples, multiple substances—often with unproven and/or overtly harmful effects on GH-related functioning—are prescribed as means of bolstering the physical and psychosocial essence of “manhood.”

Intervention Implications

Educational interventions focused on provision of empirically supported information concerning the presence and function of GHs across the gender spectrum could be useful in reducing the problematic potential implications of EBAGHs that we have described. With respect to men’s health, for example, the main driver of expressed regret among Kovac et al.’s (2015) U.S.-based AAS users was failure to comprehend the potential impact on their own fecundability. It seems worthwhile to consider also whether affected men would be more open to lifestyle shifts if the ironically counterproductive GH-related risks of “hypermasculine” eating and drinking patterns were made salient (cf. Smith et al., 2023). Similarly, would informing cisgender men of placebo effects and the apparently modest efficacy of treatment for “low T” (see Mazur, 2017) help to reduce the over-prescription of testosterone? If our conceptual analysis is correct, hormone education may also help

diminish threat-based negative attitudes toward statistically less frequent variations in sexual orientation and gender identity as well as EBAGH-driven stereotypes of cisgender men.

Lastly, reminiscent of AAS users (see Kimergård, 2015), some members of the transgender community self-treat with nonprescribed hormones (Havnes & Muller, 2021; Rotondi et al., 2013) and/or offer peer-to-peer guidance born out of dissatisfaction with the content and framing of relevant information available through medical sources (Bosom & Medico, 2021). EBAGH-congruent conceptualizations of testosterone in such contexts could have adverse consequences: For example, Castañeda (2020) observed that some Filipino transgender men who videorecorded their experiences appeared euphoric before their first testosterone dose, but given an “expectation of being gendered as male after T, the tolerance for misgendering is lowered,” which could trigger “relapse to dysphoria since their masculinity is even further questioned despite testosterone” (p. 14). Also suggestive of a discrepancy between expectations and outcomes, Wierckx et al. (2014) noted that dissatisfaction with hormone treatment was linked to a higher incidence of hypoactive sexual desire disorder in a Belgian sample of transgender men (and transgender women). In fact, physiological responses to GH supplementation appear quite variable: For example, van Velzen et al. (2020) reported that 20% of their sizable sample of European/Israeli transgender men showed no change in lean body mass after 2 years on testosterone. Thus, education that targets EBAGHs may help transgender men receiving testosterone supplementation—especially new users—to manage their treatment expectations, which could bolster the generally positive outcomes associated with such treatment (see D’hoore & T’Sjoen, 2022).

Conclusion

Humans are not *just* “bags of bones and muscle and hormones”: They are also storytellers seeking to make sense out of their own and others’ experiences. Stories about gender that involve gonadal hormones often contain elements of both legend (distortions and exaggerations that extend far beyond any grains of truth) and myth (with gonadal hormones functioning as evocative symbols). In this article, we have argued that such EBAGHs—wherein testosterone in men is either enshrined or eschewed and estrogen is portrayed as an antagonist—have potentially far-reaching consequences for men’s physical health, self-perception, perception of others, and perception by others. With that in mind, we have offered methodological suggestions (e.g., EBAGH-related measures and manipulations) to test the links that we have postulated. Pending empirical support for our EBAGH model, we suggest that educational interventions focused on biologically accurate depictions of the tandem functions of testosterone and estrogen in healthy bodies may go a long way toward “detoxifying” stories about men and their fellow humans.

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