

A Content Analysis of Testosterone Websites: Sex, Muscle, and Male Age-Related Thematic Differences

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Abstract

Male testosterone supplementation is a large and growing industry. How is testosterone marketed to male consumers online? The present exploratory study entailed a content coding analysis of the home pages of 49 websites focused on testosterone supplementation for men in the United States. Four hypotheses concerning anticipated age-related differences in content coding were also tested: more frequent longevity content toward older men, and more frequent social dominance/physical formidability, muscle, and sex content toward younger men. Codes were created based on inductive observations and drawing upon the medical, life history, and human behavioral endocrinology literatures. Approximately half ($n = 24$) of websites were oriented toward younger men (estimated audience of men 40 years of age or younger) and half ($n = 25$) toward older men (estimated audience over 40 years of age). Results indicated that the most frequent content codes concerned online sales (e.g., product and purchasing information). Apart from sales information, the most frequent codes concerned, in order, muscle, sex/sexual functioning, low T, energy, fat, strength, aging, and well-being, with all four hypotheses also supported. These findings are interpreted in the light of medical, evolutionary life history, and human behavioral endocrinology approaches.

Keywords

testosterone, androgen, life history theory, aging

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Introduction

A large and growing industry focuses on male testosterone supplementation (Gabrielsen et al., 2016; Rao et al., 2017). The annual prescription sales of testosterone in the United States have increased from \$18 million in 1988 to \$70 million in 2000 to more than \$2 billion in 2013, with most of these sales oriented toward middle-aged and older men (Bhasin, 2016). A global estimate of total testosterone sales from 41 countries indicates increases from \$150 million in 2000 to \$1.8 billion in 2011, with most sales also focused on older men (Handelsman, 2013). A key question is why there has been such stunning growth in the sale of testosterone products in the United States and other parts of the world. This project draws upon the medical literature, human male evolutionary life history, and human behavioral endocrinology findings to shed light on how testosterone supplementation is marketed to men online.

The Internet has become a major source of information about health generally, including men's health (Read & Mati, 2013). In a content analysis of 70 erectile dysfunction

websites, drug company websites were more biased toward biological factors and medication than non-industry-funded websites (Read & Mati, 2013). More specific to the present focus, the Internet also serves as a major source of information for would-be consumers about the purported benefits and risks of testosterone as well as direct-to-consumer sales and other avenues for obtaining testosterone treatment. Companies and products such as Androgel, intended for testosterone supplementation of older men with relatively lower testosterone, increasingly use online content to bypass a clinician and directly reach a potential consumer (Kravitz, 2017; Schwartz & Woloshin, 2013). Prescription sales of Androgel have risen to more than \$1 billion in the

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United States. This scope of androgen products includes thousands of Web pages devoted to the use and sale of anabolic androgenic steroids (AASs) and other appearance- and performance-enhancing drugs (APEDs)—substances used to improve body appearance and athletic performance (Brennan et al., 2013). Many websites offer AASs and other drugs for sale without a prescription (Brennan et al., 2013).

Medical Views of Testosterone Supplementation

The medical literature lacks a consensus about the putative benefits and risks of testosterone supplementation in men, much less whether or how men might be treated with testosterone therapy (Bhasin et al., 2010; Morgentaler et al., 2014). The concept of testosterone replacement suggests increasing a man's testosterone to return to some previous level, while the idea of testosterone supplementation implies augmentation of a man's testosterone less tied to a specific age, meaning that testosterone replacement and supplementation may have distinct underlying motivations. The medicalization of male andropause (gradual decline in men's age-related testosterone levels) has been related to medicalizing midlife masculinity, as recognized by two reports cited by the National Institute of Medicine, with testosterone prescriptions increasingly given to men aged 45 to 60 years for decreased levels of circulating testosterone (Marshall, 2006; Vainionpää & Topa, 2006). An international survey given to endocrinologists documented wide variability in the management of low testosterone in older men (Grossmann et al., 2015). The cutoffs for discerning hypogonadism (clinically low testosterone) vary by lab and country, as does the preferred method of testosterone treatment: In North America, initial and long-term testosterone treatment is transdermal testosterone gel, whereas long-acting intramuscular testosterone undecanoate is the preferred long-term treatment in other regions (Grossmann et al., 2015).

Besides treatment of male aging, several other key phenotypes are regularly specified as potential medical benefits of testosterone supplementation. These are sexual function (sexual desire, erectile function, and sexual behavior); body composition (increased muscle and decreased fat, particularly in the abdomen); energy, mood, and well-being (e.g., elevating energy level); and cognition (e.g., mental rotation performance, concentration; Aversa & Morgentaler, 2015; Bhasin et al., 2010; Snyder et al., 2014). Other male phenotypes are variably discussed in the medical literature as potentially improved by testosterone supplementation, including bone mineral density, insulin sensitivity, and strength. By contrast, the key potential risks of testosterone supplementation

highlighted in the medical literature are prostate cancer and cardiovascular function (Aversa & Morgentaler, 2015; Bhasin, 2016; Fernández-Balsells et al., 2010).

The medical literature reporting on these outcomes is too large to review here, though a few snapshots are offered. A meta-analysis of testosterone supplementation and male sexual function identified overall improvements of testosterone in erectile function and libido in hypogonadal (low testosterone) but not eugonadal ("normal" range of testosterone) subjects (Corona et al., 2014). Supraphysiological doses of testosterone, combined with strength training, increase fat-free mass, muscle size, and strength in normal young and older men (Bhasin et al., 2005; 1996). Three years of testosterone replacement therapy in older men was associated with improvements in chest press, muscle power, stair-climbing power, and lean body mass (Storer et al., 2016).

Evolutionary Male Life History and Behavioral Endocrinology

From an evolutionary perspective, testosterone levels appear to facilitate mating effort, leading to greater investment in same-sex competition and mate-seeking behavior (Archer, 2006; Bribiescas, 2016; Gray et al., 2017; Hau, 2007; Slatcher et al., 2011). Naturally and experimentally elevated levels of testosterone are positively correlated with social rank and dominance in a variety of species, including primates (Mehta et al., 2008). In a meta-analysis of testosterone and human competition studies, a variety of factors influenced the effects of competition on testosterone, with larger effects observed in naturalistic than lab-based studies (Geniole et al., 2016). Testosterone influences higher order human functioning, showing how testosterone predisposes an individual to be constantly safeguarding his position in a social hierarchy (Terberg & Honk, 2013). The effects of testosterone on muscle and muscle growth foster strength, dominance, and intrasexual contest competition between males (Bribiescas, 2016; Geary, 2010; Puts, 2010).

The trade-offs in humans between mating and parenting effort are key features of human male reproductive strategies (Bribiescas et al., 2012; Gray & Anderson, 2010; Gray & Crittenden, 2014). A body of research suggests that men's testosterone reflects, in part, variation in mating and parenting effort (reviews in Gettler, 2014; Gray et al., 2017). Longitudinal research in the Philippines reports that becoming a father, particularly of a very young infant, decreases men's testosterone (Gettler et al., 2011), an observation that has seemingly been ignored in the medical literature (Gray, 2011).

Evolutionary life history theory also points to age-related changes in men's life histories (Bribiescas, 2016; Daly & Wilson, 1988; Henrich & Gil-White, 2001;

Stearns, 1992). Males may strive to enhance traits aiding survival and reproductive success, or at least traits that did so in the past. Among younger males, men may strive to enhance success in male–male competition, benefiting from traits that aid their success, signaling their strength and formidability to other men (Puts, 2010; Sell, Hone, & Pound, 2012). Higher social status may, in turn, offer enhanced reproductive opportunities. As men age, they undergo reproductive senescence (declines in function with age), which may lead many older men to seek to capture the vigor of relative youth. As men age, they may invest less in status gained via dominance rather than prestige, part of a package of changes by which aging men become more risk averse since they have fewer reproductive benefits to gain and they also have more to lose (e.g., a mate or children).

The Present Study

This study entails an exploratory content-coding analysis of websites marketing testosterone to U.S. men. The first aim of this study is to determine the frequency of themes featured in these websites. Broadly, drawing upon the medical, evolutionary, and human hormone literature, it is anticipated that social dominance/status, sexual function, positive mood, and muscle (and less fat) will be among the most commonly highlighted phenotypes enhanced by testosterone. The second aim is to test four hypotheses concerning anticipated differences in how testosterone is marketed to older versus younger men. These four hypotheses are (a) the marketing of testosterone to older men will be more often associated with longevity/continuation of life; (b) the marketing of testosterone to younger men will be more often associated with physical formidability/social dominance; (c) the marketing of testosterone to younger men will be more often associated with increasing muscle; and (d) the marketing of testosterone to younger men will exhibit a higher frequency of sex-related content.

To address these aims, a mixed-methods website content-coding approach is undertaken (Krippendorff, 2012). This approach involves human coding of a purposive, limited sample ($n = 49$) of highly visible U.S. websites advertising testosterone sales. This approach differs from and can be complemented by Big Data approaches in which much larger samples of randomly sampled websites are subject to automated, quantitative analysis (Couper, 2013). The sample size of the present analysis is similar to other website content-coding analyses focused on women's hormone replacement therapy (32 websites: Chilet-Rosell et al., 2010) and e-cigarettes (69 websites: Grana & Ling, 2014), for example.

Methods

Sample Identification

Between February and March 2017, a Web search was conducted using the search term “testosterone.” The U.S. versions of the search engines Google, Yahoo, Bing, and AOL were used to identify websites promoting the sale of testosterone supplements to men. A purposive sampling method was conducted. Websites were reviewed and retrieved based on specific criteria. Websites were sampled if the home page of the site promoted sales of testosterone to men, if the Web page offered direct-to-consumer marketing of testosterone supplementation, and if the website promoted sales of testosterone to a U.S. population. Websites needed to be either based in the United States or marketing testosterone within the United States. Websites were excluded if they had direct information about testosterone but were not related to promoting the sale or marketing of testosterone. An initial sample of 60 websites was retrieved and archived.

The websites retrieved promoted the sales of testosterone supplements, testosterone replacement therapy, and anabolic steroids to men. Website home pages were judged and rated by two coders in this study: a graduate student and an undergraduate student from the University of Nevada, Las Vegas. The websites were assigned to either of two age categories: younger males (40 years of age and younger) and older males (older than 40 years old). Age category assignments were based on estimated ages of men depicted in website photos, mention of a specific age range related to the marketing of testosterone (e.g., consumer reviews), marketing strategies relating testosterone to athletic competition or sports performance, and marketing strategies relating to the varying types of testosterone services offered to men (e.g., testosterone boosters or anabolic steroids). Four home pages were removed from the final analyses because they were duplicates of the same websites, and seven Web pages were removed from the final analyses because the two raters could not come to agreement on a definite age category for those websites. The final sample consisted of home pages from 49 testosterone websites.

Data Preservation

All websites were reviewed, recorded, and coded between February and April 2017. As Web page content and structure change frequently, all Web pages used were preserved using the Internet Archive Wayback Machine. Websites were retrieved by taking a screenshot of each of the website home pages. These screenshots were then archived and preserved.

Coding Instrument

The initial codebook was developed in several ways. The first author who conducted a pilot study used five websites sampled from a Google Web search using the search term “testosterone” and with the same inclusion criteria previously specified. The pilot study primarily employed an inductive approach, in which frequently featured coding themes were related to many of the purported benefits of using testosterone (e.g., muscle) and the Internet marketing strategies of websites promoting testosterone products (e.g., celebrity/medical endorsement; trustworthiness; purchasing information). This initial codebook was reviewed by the other authors, refined, and tested to generate consistent codes and strengthen the level of agreement among coders. The final coding scheme with definitions and examples can be seen in Table 1.

The final codebook also incorporated concepts drawn from the medical and evolutionary life history literature, including work referenced in the Introduction. The medicalization of testosterone therapy, for example, argues for the inclusion of codes concerning aging, erectile function, health, well-being, and side effects. Evolutionary life history-based codes consider aging, sexual function, sexually selected traits such as muscle, and social dominance/physical formidability.

Two other coders were trained by the first author (who was also a coder), and the group coded six websites to test for inter-rater reliability (IRR). The coding analysis toolkit (CAT) package in ATLAS.ti was used to test for reliability of the three coders in this study. Reliability was calculated among the six website home pages (Krippendorff's $\alpha_i = 0.705$), which represented 10% of the initial sample of 60 websites. After reliability was established, 49 websites were split between two coders, one of whom was a male graduate student and the other a male undergraduate student. Only website home pages were coded for themes.

The qualitative data analysis and research software ATLAS.ti was used to code the 49 websites used in this study. The primary unit of analysis in this study was the home page of the selected websites. Screenshots that were preserved in the Internet Archive Wayback Machine were taken and uploaded into ATLAS.ti. The 49 website home pages served as images when entered into the software program. A codebook was generated in ATLAS.ti using the software's code manager. The units of analyses coded for in this study were word text depicted on the website home pages, word text depicted in photos on home pages, and pictures depicted on the website home pages. The table of contents, user menus, site links, contact information, and scientific references were excluded from the coding analysis of the website home pages. Purchasing information and consumer reviews were

included in the coding analysis. Final coding analyses split the themes and codes found on Web pages with the age category for that website.

Data Analysis

Data entry was initially conducted in Microsoft Excel. Data were imported from ATLAS.ti into Microsoft Excel. Frequencies of coded themes were tallied among the younger and older male age categories and overall; χ^2 tests were conducted in SPSS to test hypotheses concerning age-related differences in coding patterns.

Results

The frequency of each code among younger men, older men, and the total sample is given in Table 2. These websites were nearly evenly split in the age groups they targeted: Twenty-four of the websites were oriented to younger men, and 25 websites to older men. These frequency data reveal that the most common codes overall were product information, purchasing information, muscle, sex/sexual functioning, low T, and energy. These recurring codes thus capture key aspects of product marketing (e.g., purchasing information) and testosterone-related marketing content (e.g., muscle and sex). Raw frequency contrasts between websites oriented toward younger and older male audiences suggest age-related differences in content patterning too, some of which were formally hypothesized and tested.

The first hypothesis tested whether longevity/continuation of life content would be more often associated with websites targeting older men. Longevity was only coded three times total in the sample, with all three tallies in websites oriented to older men. Several related themes of youth, aging, vitality, and longevity were combined to enable a more robust test of this hypothesis. Frequency data indicated this collective set of codes appeared 73 times in websites targeting older men versus 41 times among websites targeting younger men, a significant difference ($\chi^2 = 8.982$, $df = 1$, $p < .003$) in support of the first hypothesis.

The second hypothesis specified that marketing of testosterone to younger men would be more often associated with physical formidability/social dominance. All 18 tallies of social dominance/physical formidability were from websites targeting younger men, but coding suggested that masculinity also overlapped with social dominance. This combined social dominance/physical formidability and masculinity measure appeared 30 times in websites geared toward younger men versus 4 times in websites for older men, a significant difference ($\chi^2 = 19.882$, $df = 1$, $p < .000$) in support of the second hypothesis.

Table 1. Coding Scheme for Web Pages Marketing Testosterone to Men.

Codes	Definition	Examples
Youth	The condition or quality of being young	"Feel young again."
Vitality	A state of being strong and active	"Unleash your vitality."
Health	A state of being healthy or free from injury or illness	"Some of the major health problems that have been tied to low testosterone are obesity, high blood pressure, diabetes, and metabolic syndrome."
Aging	The process of growing old or elderly	"As you age, your testosterone levels decrease."
Longevity	A long life or greater duration of an individual's life	"Do you want a better and longer life?"
Mortality	The state or condition of being subject to death	"Studies show that men with low testosterone have 74% higher death rates."
Low T	The natural decline of testosterone production in men as they age	"Estimates show that as many as 15 million American men suffer from low testosterone levels."
Energy	Strength and vitality required for sustained physical or mental activity	"Discover your renewed energy and vitality."
Stamina/endurance	The ability to sustain physical or mental effort	"T-Complex will improve your stamina."
Improving cognition	Improved cognitive functioning due to testosterone products. The definition can include improved cognition in relation to increased executive functions, memory, or motivation in individuals consuming testosterone products	"Better body performance and fitness also increases mental sharpness, agility, and develops greater psychological comfort."
Well-being	A state of being happy, healthy, or comfortable	"Testosterone helps to maintain a feeling of well-being."
Social dominance/ physical formidability	An individual or public figure who competes with other males in his social group or society for dominance	"Whether you are in the gym training, or at the beach hanging, your intense pumps and extreme vascularity will also be there for everyone to notice."
Masculinity	Having qualities associated with being a man or "manly"	"Feel like a beast, perform like a champion."
Muscle	Physical power or strength	"Higher testosterone levels correlate with increased lean muscle."
Strength	State of being physically strong	"Boost strength."
Lose fat/lose body fat	A reduction of body fat or adipose tissue	"Shed your body fat and convert it into energy."
Anabolic steroids	A synthetic steroid hormone that resembles testosterone in promoting the growth of muscle	"Buy anabolic steroids online no prescription!"
Mate attraction	The state or practice of having one or more mates at a time	"Delight your partner with more virility."
Sex/sexual functioning	Any reference of sexual activity or sexual intercourse	"And, just think how much your partner will love your newfound desire for sex."
Erectile dysfunction	Inability of a man to maintain an erection sufficient enough for satisfying sexual activity.	"The physicians at Low T-99 understand that one of the primary symptoms of low testosterone is erectile dysfunction."
Relationship maintenance	Any description of the product increasing the sex life of you and your partner, any depiction of a couple together that seems like a long-term partnership	"When your libido and performance return to youthful levels your partner will notice and this can strengthen your overall relationship."
Side effects	A products warning label or potential side effects	"Natesto may cause serious side effects, including:"
Purchasing information	Information or links found on websites that give information on how to purchase the product	"Rush my order."
Product information	A set of product data or information used to market or drive sales to websites	"Where to find T-Complex?"
Trustworthy	Any reliable indicator of trust or trustworthiness of a product's benefits and uses	"Is T-Complex safe?"
Celebrity/medical endorsement/role model	An individual who others follow or look up to or a person who is looked at as "knowledgeable" or prestigious	"Dr. Armani will evaluate your health from a holistic approach and design a male hormone replacement therapy for you that fits your specific lifestyle and needs."

The third hypothesis stated that the marketing of testosterone to younger men would be more often associated with muscle. The frequency of coding of muscle content ($N = 113$) on younger male websites was greater than its frequency ($N = 33$) on older male websites. This was a statistically significant difference

($\chi^2 = 43.836$, $df = 1$, $p < .000$) in support of the third hypothesis.

The fourth hypothesis stated that the marketing of testosterone to younger men would exhibit a higher frequency of sex-related content. The frequency of appearance of sex-related content ($N = 92$) was higher on

Table 2. Frequency of Coding Themes Marketed to Men on Testosterone Websites.

Codes	Young	Old	Total
Youth	17	12	29
Vitality	6	24	30
Health	25	24	49
Aging	18	34	52
Longevity	0	3	3
Mortality	3	1	4
Low T	29	68	97
Energy	61	33	94
Stamina/endurance	37	7	44
Improving cognition	12	16	28
Well-being	21	31	52
Social dominance/physical formidability	18	0	18
Masculinity	12	4	16
Muscle	113	33	146
Strength	40	17	57
Lose fat/lose body fat	55	18	73
Anabolic steroids	29	0	29
Mate attraction	10	2	12
Sex/sexual functioning	92	39	131
Erectile dysfunction	4	11	15
Relationship maintenance	5	20	25
Side effects	0	8	8
Purchasing information	99	60	159
Product information	137	82	219
Trustworthy	78	40	118
Celebrity/medical endorsement/role model	5	16	21

websites oriented toward younger men than the frequency ($N = 39$) on websites for older men, also a statistically significant difference ($\chi^2 = 21.443$, $df = 1$, $p < .000$) in support of the fourth hypothesis.

Discussion

The present findings can be understood within an evolutionary consumerism perspective (Griskevicius & Durante, 2015; Saad, 2011). The website home page contents reflect the aim of these websites: selling a product (testosterone) to consumers. The two most commonly coded themes on these 49 websites were product information and purchasing information. Contents conveying “trustworthy” seem intended to establish the credibility of the website and the product advertised on it. A challenge for any direct-to-consumer online marketing effort is communicating to the would-be customer that the product or service can be satisfactorily delivered, making the establishment of trust important. The reference to celebrity/medical endorsement/role models can also be

viewed in this light, by communicating the seeming support of prestigious or trustworthy models as product endorsers. The emphasis on “low T,” also one of the most commonly coded themes, implies a problem in need of a solution: testosterone supplementation. Above all, websites may be marketing a perception of testosterone to induce sales.

The recurrent content themes can be seen in the light of sexual selection (Darwin, 1871; Geary, 2010; Puts, 2010; Trivers, 1972). Many of the traits most commonly featured on these testosterone websites can be viewed as aids to male mating effort. The support of social dominance/physical formidability serves success in male–male competition. The frequent reference to stamina/energy can also be viewed as an aid to male–male status competition by promoting male cognitive and social endurance. Advertising male body composition built on enhanced muscle and reduced fat can also be seen in the light of enhanced male–male competition, as these are recognized effects of testosterone and may serve male mating effort directly in physical competition or in signals to other social competitors. All 29 coded cases of anabolic steroids were oriented toward younger men, with the driving force for these synthetic androgens to increase musculature. The regular appearance of strength serves similar ends of success in male–male competition. Interestingly, this focus on muscle appears better designed to enhance male–male competitive success than female choice, with women regularly viewing extra male muscle as less desirable than the men seeking to build it (Puts, 2010; see also Gray & Frederick, 2012).

Website content themes commonly concern sexuality and relationships. This too can be viewed in the light of male mating effort. It is hardly news to marketing that sex might be featured in advertising, with the present study another example of this phenomenon (Griskevicius & Durante, 2015; Saad, 2011). To males seeking new sexual partners or a successful sexual and romantic experience with a current partner, the focus on sex seems sensibly placed. An ultimate perspective highlights the ways in which traits might enhance reproductive success, with sex and successfully maintained romantic relationships central to this bottom line (Buss, 2016).

Shifting from sexual selection to life history theory (Clutton-Brock, 2016; Del Giudici et al., 2015; Muehlenbein, 2010; Stearns, 1992), the content coding themes also address age-related changes in male survival and reproductive concerns. Importantly, the websites appeared to target men of variable ages, with approximately half ($N = 24$) of websites oriented to men 40 years of age and younger, and approximately half ($N = 25$) to men over age 40. The age-related frequency differences in content codes also supported each of the four hypotheses. These four hypotheses anticipated the more

common content focused on longevity among older men and the more common content featuring social dominance/social dominance, muscle, and sex among younger men. Why might testosterone website contents oriented toward older men more often focus on themes concerning longevity? With advancing age, older men may become more aware of their own mortality, and the importance of health and well-being to enjoying their continued survival. With advancing age, men are subject to sexual senescence (Gray et al., in review), with less support for erectile function or sexual desire. Older men are more apt to have children and grandchildren, for which their survival may enable benefiting investment in their descendant kin (parenting and grandparenting effort; Coall & Hertwig, 2010). Consistent with this view, content codes geared toward older men more often feature concerns with aging and vitality. The marketing of "low T" was more commonly oriented toward older men than toward younger men, consistent with a view that this is more often a problem facing older men in need of an intervention.

Male mating effort varies with age (Bribiescas, 2016; Daly & Wilson, 1988; Gray & Garcia, 2013; Tuljapurkar et al., 2007). This observation informs the support for the other three hypotheses concerning greater content emphasis among older men related to social dominance, muscle, and sex. Younger men may be more sensitive to direct physical competition for which muscle has advantages, at least ancestrally if not also presently (Puts, 2016; 2010). Younger men may seek to establish their social dominance and be more sensitive to that of others given the consequences of status for same-sex competition and mate choice (e.g., von Rueden & Jaeggi, 2016). Younger men may face more potential mating opportunities and are less likely to have an existing partner, part of enhanced interest in sexual variety and finding a desirable sexual partner. As men age, they may be more concerned with maintenance of an existing romantic relationship (consistent with relationship maintenance content noted 20 times in sites oriented toward older men vs. 5 times in sites oriented toward younger men), including sexual satisfaction within it.

The findings are of medical relevance. Testosterone supplementation is a large and growing industry in the United States and other parts of the world (Bhasin, 2016; Handelsman, 2013; Snyder et al., 2016). Websites offering testosterone are one of the main ways men may be informed about potential benefits of taking testosterone or enticed to purchase testosterone, either directly from the Web or after initiating a process that entails further clinical consultation before obtaining testosterone. Side effects were rarely mentioned on the home pages of the testosterone websites coded here. Side effects were only noted eight times, all on sites oriented toward older men.

Anecdotally, many of these websites did provide some information about side effects, just not on the home page, meaning that this important aspect of testosterone follows the initial hook of purported benefits. The credibility of websites offering testosterone may be questionable, such as those purporting to offer testosterone for sale but without requiring a prescription.

Many of the characteristics featured in this content analysis are consistent with the traits linked to testosterone in the medical literature. The medical literature thematically emphasizes the role of testosterone supplementation (and low testosterone in potential need of intervention) in male sexuality (e.g., sexual desire, behavior, erectile function), body composition (increased muscle and decreased fat, particularly in the abdomen), health and well-being, and successful aging (e.g., Snyder et al., 2014; 2016). The medical literature downplays connections between testosterone and male social dominance/physical formidability relative to this theme's appearance on testosterone websites. The potential decreases in men's testosterone associated with involved romantic relationships and parental care are also ignored in the medical literature (Gray, 2011).

The medical literature on the risks and benefits of male testosterone supplementation could be better linked, as attempted here, with literatures on evolutionary life history theory and behavioral endocrinology. Many of the studies experimentally testing the effects of testosterone in humans occur in clinical contexts, with these findings of wider scientific interest. Conversely, the conceptual and empirical findings from evolutionary life history theory and behavioral endocrinology help inform why testosterone has the effects that it has (e.g., enhancing male mating effort) and how the proximate mechanisms serve and reflect complementary ultimate (in a Tinbergian sense) life history ends.

A tension between at least some medical views of testosterone and the evolutionary literatures is whether testosterone enhances or decreases mortality (e.g., Araujo et al., 2011). The medical marketing of testosterone, particularly among older men, tends to view low testosterone as a predictor of increased mortality, with some randomized controlled trials indicating adverse effects on outcomes related to mortality. Amid an obesity epidemic, in which many men are living evolutionarily unprecedented longer lives and often subject to metabolic diseases linked to obesity, testosterone supplementation may have beneficial effects (Saad et al., 2012). Such benefits are not easily anticipated in the evolutionary life history world for which energetic constraints more often shape an appreciation of trade-offs between male survival and mating effort given the metabolic, immunomodulatory, and behavioral risks linked to testosterone (Kruger & Nesse,

2006; Muehlenbein & Bribiescas, 2005; see Trumble et al., 2015 for a related case with benign prostate hyperplasia among Tsimane forager-horticulturalists). Several human castration studies, complemented by nonhuman animal studies such as among dogs, indicate that castration may extend rather than diminish (as might be expected with “low T”) male life span (e.g., Min et al., 2012). This sort of tension needs to be better remedied in these disparate literatures.

The study is subject to limitations. Algorithms used in online searches result in different Web users potentially encountering different websites even when entering the same search term on the same search engine. The 49 websites subject to analysis here are only a small slice of the global online testosterone content. This study can thus be considered exploratory and different in approach than Big Data Web analyses that might draw upon larger and more generalizable website samples with less coding nuance. All sites were from or oriented toward a U.S. audience, meaning that potential similarities and differences in the legal, product, audience, and so forth aspects of online testosterone supplementation marketing are not addressed here. Only the home pages of websites were subject to content coding, in part due to the importance of the initial information presented to would-be consumers, but also leaving out coding of other elements of these websites. The study also excluded searches on other androgens (e.g., nandrolone) or agents that can increase endogenous testosterone (e.g., aromatase inhibitors).

Future research might build on this testosterone website content analysis by employing larger and more international website samples, coding other testosterone supplementation content (e.g., billboards), and evaluating how the online testosterone industry compares with more face-to-face communication (e.g., social networks of older men sharing stories of testosterone supplementation, or patients meeting with a clinician during a regular check-up). Future research might also directly interview and/or survey testosterone providers and users. In this latter vein, Mascarenhas et al. (2016) interviewed 9 men who have used testosterone and 13 testosterone providers in Toronto, Canada, to better understand the factors underlying increased testosterone supplementation, with these interviews highlighting the importance of Web content. A complementary question to how testosterone is marketed to consumers is why consumers use testosterone.

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