

1 **Testosterone Use and Sexual Function among Transgender Men and Gender Diverse**  
2 **People Assigned Female at Birth**

3

4 **Authors:** Diana M. TORDOFF, PhD, MPH<sup>1</sup>, Mitchell R. LUNN, MD, MAS<sup>1</sup>, Bertha CHEN,  
5 MD<sup>1</sup>, Annesa FLENTJE, PhD<sup>2</sup>, Zubin DASTUR, MS, MPH<sup>1</sup>, Micah E. LUBENSKY, PhD<sup>2</sup>,  
6 Matthew CAPRIOTTI, PhD<sup>3</sup>, Juno OBEDIN-MALIVER, MD, MPH, MAS<sup>1</sup>

7 <sup>1</sup>Stanford University School of Medicine, Palo Alto, CA, USA

8 <sup>2</sup>University of California, San Francisco, San Francisco, CA, USA

9 <sup>3</sup>San Jose State University, San Jose, CA, USA

10

11 **Conflicts of Interest:** Declarations of Interest: Dr. Obedin-Maliver received consultation fees  
12 from Ibis Reproductive Health, Hims Inc., Folx Health Inc., and Sage Therapeutics on topics  
13 unrelated to this work. Dr. Lunn received consultation fees from Hims Inc., Folx Health Inc., and  
14 Otsuka Pharmaceutical Development and Commercialization, Inc. on topics unrelated to this  
15 work. All other authors have no conflicts of interest to report.

16

17 **Funding:** Funding for this work was provided by the Stanford University School of Medicine  
18 Department of Obstetrics and Gynecology. Research reported in this article was partially funded  
19 through a Patient-Centered Outcomes Research Institute (PCORI) Award [award number PPRN-  
20 1501-26848] to M.R.L. The statements in this article are solely the responsibility of the authors  
21 and do not necessarily represent the views of PCORI, its Board of Governors or Methodology  
22 Committee, nor of the National Institutes of Health. A.F. was partially supported by the National  
23 Institute on Drug Abuse [grant number K23DA039800]. J.O.M. was partially supported by the

24 National Institute of Diabetes, Digestive, and Kidney Disorders [grant number K12DK111028].  
25 The funding sponsors had no role in study design; the data collection, analysis, and interpretation  
26 of data; the writing of the report; or the decision to submit the article for publication; or the  
27 preparation of the manuscript.

28 **Meetings:** Findings were presented as an oral abstract at the National Transgender Health  
29 Summit, San Francisco, CA, May 6-7, 2023.

30

31 **Corresponding authors:** Diana M. Tordoff, PhD, MPH; Stanford University School of  
32 Medicine; [dtordoff@stanford.edu](mailto:dtordoff@stanford.edu)

33

34 **Word Count:** 377 words in abstract, 3,034 words in manuscript, 5 tables/figures, 39 references

35

36 **Tweetable Statement:** In a study of 1219 transgender men, testosterone use among transgender  
37 men is associated with positive sexual function and vulvovaginal pain during sex.

38

39 **Short Title:** Testosterone and Sexual Function

40

41 **AJOG at a Glance:**

- 42 • **Why was this study conducted?** The study aimed to improve our understanding of the  
43 impact of testosterone on the sexual health of transgender men and gender diverse people  
44 assigned female at birth.
- 45 • **Key findings.** In our cross-sectional analysis of 1,219 adult transgender participants, 65%  
46 reported any genital pain/discomfort during sexual activity in the past 30 days. Current

47 testosterone use was associated with a higher interest in sexual activity and ability to  
48 orgasm as well as vulvovaginal pain during sexual activity.

- 49 • **What does this add to what is known?** Although data from the extant literature are  
50 scarce, available evidence demonstrates that >60% of transgender men experience  
51 vulvovaginal pain during sexual activity. Given this high burden, there is an urgent need  
52 to identify effective and acceptable interventions for this population.

53 **ABSTRACT**

54 **Background:** Testosterone use among transgender people likely impacts their experience of  
55 sexual function and vulvovaginal pain via several complex pathways. Testosterone use is  
56 associated with decreased estrogen in the vagina and atrophic vaginal tissue, which may be  
57 associated with decreased vaginal lubrication and/or discomfort during sexual activity. At the  
58 same time, increased gender affirmation through testosterone use may be associated with  
59 improved sexual function. However, data on pelvic and vulvovaginal pain among transgender  
60 men and nonbinary people assigned female at birth is scarce.

61 **Objective:** To assess the association between testosterone and sexual function, with a focus on  
62 symptoms that are commonly associated with vaginal atrophy.

63 **Study Design:** We conducted a cross-sectional analysis of 1,219 participants ages 18-72 years  
64 old using 2019-2021 data from an online, prospective, longitudinal, cohort study of sexual and/or  
65 gender minority people in the US (The PRIDE Study). Our analysis included adult transgender  
66 men and gender diverse participants assigned female at birth who were categorized as never,  
67 current, and former testosterone users. Sexual function was measured across eight Patient-  
68 Reported Outcomes Measurement Information System (PROMIS) Sexual Function and  
69 Satisfaction (SexFS) domains.

70 **Results:** Overall, 516 (42.3%) had never used testosterone and 602 (49.4%) currently used  
71 testosterone. Median duration of use was 37.7 months (range 7 days to >27 years). Most  
72 participants (64.6%) reported genital pain/discomfort during sexual activity in the past 30 days,  
73 most commonly in the vagina/frontal genital opening (52.2%), followed by the clitoris (29.1%)  
74 and labia (24.5%). Current testosterone use was associated with higher interest in sexual activity  
75 ( $\beta=6.32$ , 95% CI: 4.91-7.74) and more vaginal pain/discomfort during sexual activity ( $\beta=1.80$ ,

76 95% CI: 0.61-3.00). No associations were observed between current testosterone use and  
77 satisfaction with sex life, lubrication, labial pain/discomfort, or orgasm pleasure.  
78 **Conclusions:** Testosterone use among transgender men and gender diverse people was  
79 associated with a higher interest in sexual activity and ability to orgasm as well as vaginal  
80 pain/discomfort during sexual activity. Notably, the available evidence demonstrates that >60%  
81 of transgender men experience vulvovaginal pain during sexual activity. The causes of pelvic  
82 and vulvovaginal pain are poorly understood but are likely multifactorial and include  
83 physiological (*e.g.*, testosterone-associated vaginal atrophy) and psychological factors (*e.g.*,  
84 gender affirmation). Given this high burden, there is an urgent need to identify effective and  
85 acceptable interventions for this population.

86

87 **KEYWORDS:** Dyspareunia, Sexual Function, Testosterone, Transgender, Vulvovaginal Pain

## 88 INTRODUCTION

89 At least 1.6 million transgender adults and adolescents live in the United States,<sup>1</sup> among  
90 whom an estimated 70% of transgender men have ever used testosterone as gender-affirming  
91 hormone therapy (GAHT).<sup>2</sup> Vaginectomy is rare (<3%) in this population, and the majority of  
92 transgender men and gender diverse people retain their vagina.<sup>2</sup> Testosterone GAHT likely  
93 impacts sexual function via several complex pathways: Testosterone GAHT is associated with  
94 vaginal atrophy, which may be associated with decreased lubrication and/or discomfort during  
95 sexual activity.<sup>3-5</sup> At the same time, increased gender affirmation through testosterone use may  
96 be associated with improved sexual function.

97 There is limited research on the sexual function of transgender men and gender diverse  
98 people assigned female at birth (AFAB). What does exist suggests that, although testosterone  
99 GAHT is associated with increased desire and arousal,<sup>6</sup> a high proportion of transgender men  
100 also reported dyspareunia (painful sex), a common symptom of vaginal atrophy. The prevalence  
101 of dyspareunia may be as high as 60-62% among transgender men,<sup>7,8</sup> markedly higher than the  
102 prevalence reported among cisgender women (3-48%).<sup>9</sup> Several studies also suggest that  
103 transgender men using testosterone may experience chronic genital pain and discomfort, with  
104 one study reporting that 10-16% of transgender men had been diagnosed with vulvodynia  
105 (defined as chronic burning, stinging, or irritating vulvovaginal pain for three consecutive  
106 months or longer).<sup>7,8</sup> Only one prior small study directly assessed the impact of testosterone  
107 GAHT on genital pain during sexual activity. Although 30% of transgender men reported that  
108 testosterone had caused genital dryness and 14% experienced genital tearing since initiating  
109 testosterone, they did not observe an association between testosterone use and vulvodynia or  
110 dyspareunia symptoms.<sup>10</sup>

111 The present study aimed to improve our understanding of the impact of testosterone on  
112 the sexual health of transgender people, with a focus on symptoms that are commonly associated  
113 with vaginal atrophy, including decreased lubrication, and pain during sexual activity. Using data  
114 from a large national online sample of sexual and/or gender minority adults in the US, we  
115 examined the association between current testosterone use and self-reported measures of sexual  
116 function and satisfaction experienced by transgender men and gender diverse people.

117

## 118 **MATERIALS AND METHODS**

119 This analysis used data from The Population Research in Identity and Disparities for  
120 Equality (PRIDE) Study, an online, prospective, longitudinal cohort study of sexual and/or  
121 gender minority people in the US. We conducted a cross-sectional analysis using 2019-2021 data  
122 from a questionnaire administered annually to study participants among adult transgender men  
123 and gender diverse participants AFAB. We included participants who self-reported currently  
124 having a vagina or frontal genital opening (FGO) and who completed the Patient-Reported  
125 Outcomes Measurement Information System (PROMIS) Sexual Function and Satisfaction  
126 (SexFS) items.<sup>11</sup> We excluded participants who did not self-report having a vagina/FGO or who  
127 reported having a phalloplasty or vaginectomy.

### 128 **Measures**

129 *Demographic Characteristics.* Participants self-reported data on race and ethnicity,  
130 current gender identity, current sexual orientation, and sex assigned at birth. Participants could  
131 select multiple response options for race, ethnicity, gender, and sexual orientation. Participants  
132 self-reported the gender(s) of people they had any sexual activity within the past year.

133           **Testosterone Use.** We categorized participants as never, current, and former testosterone  
134 users. Current testosterone use was assessed on the 2019-2021 annual questionnaires and  
135 included participants who, at the time, indicated they were currently taking testosterone (of any  
136 type in any formulation such as gel, injection or patch), testosterone cypionate, testosterone  
137 enanthate, or testosterone undecanoate for gender affirmation. To differentiate participants who  
138 had never used testosterone from participants who formerly used testosterone, we also  
139 incorporated participants' responses to a baseline survey that assessed participants' lifetime  
140 testosterone use. Duration of testosterone use was calculated based on participant's self-reported  
141 month and year of initiating testosterone and the date of survey completion. We did not collect  
142 information regarding the dose of testosterone.

143           **Sexual Function.** The PROMIS SexFS assesses self-reported sexual function and  
144 satisfaction over the past 30 days. This instrument was originally developed for cancer  
145 populations and was subsequently validated among a broad group of sexually active adults in the  
146 US who were not cancer survivors.<sup>11</sup> Although sexual minority (*e.g.*, bisexual, gay, and lesbian)  
147 individuals were involved in the development of the PROMIS SexFS, transgender people were  
148 not. The PRIDE Study implemented a modified version of the PROMIS SexFS that allowed  
149 participants to select their preferred anatomical language (*i.e.*, "vagina" or "frontal genital  
150 opening").<sup>12,13</sup> In completing the survey, each participant's selection for their preferred  
151 terminology was propagated throughout subsequent survey items.

152           Our analysis included eight PROMIS SexFS domains: interest in sexual activity,  
153 satisfaction with sex life, vaginal/FGO lubrication, ability to orgasm, orgasm pleasure, as well as  
154 vaginal/FGO, labial, or clitoral pain/discomfort during sexual activity. Interest in sexual activity  
155 was assessed for all participants while all other domains were only assessed for participants who



156 reported any sexual activity in the past 30 days (which was broadly defined and included  
157 masturbation). For each domain, we calculated each participant's raw score and T-scores. A T-  
158 score of 50 represents the mean for the US population and has a standard deviation of 10. Higher  
159 T-scores indicate more of the construct measured by the domain; for example, more interest in  
160 sexual activity, increased vaginal/FGO lubrication, and more pain/discomfort relative to lower  
161 scores.

162 *Covariates.* We considered covariates that are associated with sexual function and pelvic  
163 pain based on prior literature. These included standardized clinical assessment tools and self-  
164 reported lifetime diagnoses. We broadly considered five categories of covariates that have been  
165 previously associated with sexual function among cisgender women and transgender men:  
166 structural changes to the pelvis, inflammatory conditions in the pelvis, hormonal influences,  
167 mental health, and substance use.<sup>17-30</sup>

168 Structural changes to the pelvis included prior pregnancies, hysterectomy, and uterine  
169 fibroids. Inflammatory conditions in the pelvis included pelvic inflammatory disease,  
170 inflammatory bowel disease (including Crohn's disease and ulcerative colitis), irritable bowel  
171 syndrome, and bacterial sexually transmitted infections (STI; defined as chlamydia, gonorrhea,  
172 or syphilis diagnosis in the past year). Hormonal influences include oophorectomy, polycystic  
173 ovary syndrome, current hormonal contraceptive use (including oral contraceptives, transdermal  
174 patch, vaginal rings, medroxyprogesterone acetate injections, and etonogestrel implants), and  
175 intrauterine device use.

176 Mental health measures included lifetime diagnoses of depression and post-traumatic  
177 stress disorder (PTSD) as well as lifetime experiences of sexual abuse, rape, and sexual assault.  
178 Depressive symptoms in the past two weeks were assessed using the Patient Health

179 Questionnaire-9 (PHQ-9; score range 0-27 with higher scores indicating more depressive  
180 symptoms)<sup>14</sup> and PTSD symptoms in the last month were assessed with the brief 6-item version  
181 of the PTSD Check List (PCL-6; score range 6-30).<sup>15</sup> Substance use variables included current  
182 smoking and current alcohol consumption behaviors; the latter was assessed using the Alcohol  
183 Use Disorders Identification Test (AUDIT; score range 0-40 with higher scores indicating more  
184 disordered alcohol use).<sup>16</sup>

### 185 **Statistical Analysis**

186 We assessed cross-sectional associations between current testosterone use and sexual  
187 function. For participants who completed more than one annual questionnaire, we restricted our  
188 analysis to only include their first year of responses. We calculated descriptive statistics stratified  
189 by testosterone use and conducted Chi-squared tests. We conducted one sample t-tests to test if  
190 the SexFS domain T-scores differed from the population mean of 50 and calculated the Pearson  
191 correlation coefficient to estimate the strength and direction of the relationship between PROMIS  
192 SexFS domains.

193 We then used multivariable linear regression to estimate the association between current  
194 testosterone use (relative to never testosterone use) and the T-scores for each sexual function  
195 domain. We used causal diagrams to select covariates to include in our model (Supplemental  
196 Figure 1). We estimated three models: an unadjusted model, a minimally adjusted model, and a  
197 robustly adjusted model. We chose our primary analysis to be a minimally adjusted model that  
198 included confounding variables (*i.e.*, covariates that were associated with both the exposure  
199 [testosterone use] and outcomes [sexual function] in our sample). The minimally adjusted model  
200 included age, current depression symptoms (PHQ-9 scores), current PTSD symptoms (PCL-6  
201 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, and hormonal

202 contraception use. We conducted secondary analyses with a robustly adjusted model that  
203 included all covariates that are associated with sexual function and dyspareunia in prior  
204 literature, but were not associated with testosterone use in our sample, including history of sexual  
205 assault, prior pregnancy, inflammatory bowel disease, irritable bowel syndrome, uterine fibroids,  
206 pelvic inflammatory disease, polycystic ovary syndrome, and intrauterine devices.<sup>17-30</sup>

207         Our primary analysis considers current *versus* never testosterone users. Results  
208 comparing former to current users are provided in the Supplementary Materials. We  
209 hypothesized that asexual identity may be a potential effect modifier, as asexual participants may  
210 differ from non-asexual participants with respect to interest in sexual activity. Therefore, we  
211 conducted sensitivity analyses stratified by self-reported asexual sexual orientation. All analyses  
212 were conducted in R version 4.2.1. This study received ethical approval from University of  
213 California, San Francisco, Stanford University School of Medicine, and WCG Institutional  
214 Review Boards.

215

## 216 **RESULTS**

217         Our analysis included 1,219 participants ages 18-72 years old (median age 27.1; Table 1).  
218 Most participants (61.1%) endorsed more than one gender identity: most commonly non-binary  
219 (54.2%), transgender man (46.0%), genderqueer (33.6%), and man (21.5%). Participants were  
220 diverse in sexual orientation, although most identified as queer (65.1%). The majority (80.6%) of  
221 participants only reported White race and/or ethnicity and 12.0% of participants selected more  
222 than one racial and/or ethnicity.

223         There were 516 (42.3%) participants who had never used testosterone, 602 (49.4%) who  
224 currently used testosterone, and 76 (6.2%) former testosterone users. Twenty-five participants

225 were missing information about GAHT use. The median duration of GAHT with testosterone use  
226 was 37.7 months (range 7 days to >27 years). Current testosterone users were significantly more  
227 likely to identify as a man or transgender man, and less likely to identify as agender,  
228 genderqueer, nonbinary, or questioning (Supplemental Table 1). There were no differences in  
229 testosterone use by age, race, or ethnicity.

230 Most participants reported having sex with another person in the past year (68.9%), were  
231 in a relationship (59.4%), and reported any sexual activity (including masturbation) in the past 30  
232 days (89.5%; Table 2). Among participants who reported having sex with another person in the  
233 past year, 88.5% reported any receptive oral sex or receptive vaginal/FGO sex. Participants  
234 currently using testosterone were more likely to be sexually active in the past year (73.3% v.  
235 63.4%,  $p=0.001$ ) and in the past 30 days (93.9% v. 84.7%,  $p<0.001$ ).

236 Table 2 reports participants' pelvic health histories. Current testosterone users were more  
237 likely to have a hysterectomy (17.9% v. 5.4%,  $p<0.001$ ) and oophorectomy (14.5% v. 3.3%,  
238  $p<0.001$ ), and less likely to currently use hormonal contraceptives (5.8% v. 17.8%,  $p<0.001$ )  
239 compared to participants who never used testosterone. Current testosterone users were also more  
240 likely to have a past year bacterial STI diagnosis (3.0% v. 1.6%,  $p=0.001$ ). Testosterone use was  
241 not associated with pelvic inflammatory disease, polycystic ovary syndrome, uterine fibroids,  
242 inflammatory bowel disease, irritable bowel syndrome, pregnancy history, or intrauterine device  
243 use.

244 Participants reported very high levels of lifetime experiences of sexual abuse, sexual  
245 assault, and ever having received a depression and PTSD diagnoses (Table 2). Testosterone use  
246 was associated with lower scores (*i.e.*, better mental health) for current depressive and PTSD

247 symptoms. Testosterone use was also associated was substance use, including current smoking  
248 (7.5% v. 4.3%,  $p=0.033$ ) and higher AUDIT scores.

249         Among the 1,091 sexually active participants, most ( $n=693$ , 64.6%) reported genital pain/  
250 discomfort during sexual activity in the past 30 days, most commonly in the vagina/FGO  
251 (52.2%), followed by the clitoris (29.1%) and labia (24.5%; Table 3). There were 103 (9.6%)  
252 participants who reported pain at all three genital sites. T-scores for pain/discomfort were higher  
253 than the population mean ( $p$ -values $<0.001$ ) while T-scores for orgasm pleasure (mean T-score  
254 45.0,  $p$ -value $<0.001$ ) and satisfaction with sex life (mean T-score 45.6,  $p$ -value $<0.001$ ) were  
255 lower than the population mean. Figure 1 shows the correlation between each sexual function T-  
256 score among participants. Interest in sexual activity, satisfaction, lubrication, orgasm ability and  
257 pleasure were positively correlated. Measures of pain/discomfort were negatively correlated with  
258 all other domains.

259         Compared to participants who never used testosterone, current testosterone users were  
260 less likely to report difficulty with lubrication (58.5% v. 66.7%,  $p=0.01$ ), more like to report any  
261 vaginal pain/discomfort (56.0% v. 49.2%,  $p=0.04$ ), and more likely to achieve orgasm ( $p=0.003$ ;  
262 Table 3). In the minimally adjusted regression models (Table 4), current testosterone use was  
263 associated with higher interest in sexual activity ( $\beta=6.32$ , 95% CI: 4.91-7.74), higher ability to  
264 orgasm ( $\beta=1.50$ , 95%CI: 0.19-2.81), pain/discomfort during sexual activity in the vaginal/FGO  
265 ( $\beta=1.80$ , 95% CI: 0.61-3.00) and in the clitoris ( $\beta=1.20$ , 95%CI: 0.10-2.30). The association  
266 between testosterone use, ability to orgasm, and clitoral pain/discomfort were not statistically  
267 significant in the robustly adjusted model. No associations were observed between current  
268 testosterone use and satisfaction with sex life, lubrication, labial pain/discomfort, or orgasm  
269 pleasure.

270 Duration of testosterone use was associated with increased interested in sexual activity,  
271 but not with any other outcomes (Supplemental Table 4). In sensitivity analyses, we did not  
272 observe any evidence of effect modification by asexual sexual orientation (Supplemental Figure  
273 2), although asexual identity was independently associated with most sexual function domains.  
274

275 **COMMENT**

276 In our study, testosterone use among transgender men and gender diverse people AFAB  
277 was associated with some domains of positive sexual function (such as a higher interest in sexual  
278 activity and ability to orgasm) as well as pain/discomfort during sexual activity. Specifically, we  
279 observed a strong, consistent association between current testosterone use and higher interest in  
280 sex as well as vaginal/FGO pain during sexual activity.

281 Our findings are consistent with prior studies which found that testosterone use is  
282 associated with increased desire and interest in sex.<sup>6</sup> GAHT is associated with significant  
283 improvements in overall mental health, quality of life, and body image,<sup>31-33</sup> which in turn likely  
284 have positive impacts on other areas of wellbeing, including sexual function. For example, other  
285 studies have found that access to gender-affirming chest reconstruction surgery is associated with  
286 higher sexual function scores, while experiencing barriers to accessing gender-affirming care is  
287 associated with lower sexual function scores.<sup>25</sup> Although prior studies have not observed an  
288 association between testosterone use and orgasm,<sup>6</sup> testosterone use was associated with a higher  
289 ability to orgasm in our study.

290 Notably, we observed that a majority of transgender and gender diverse people AFAB  
291 using testosterone (67%) experienced vulvovaginal pain during sexual activity. This prevalence  
292 is consistent with prior studies, which have reported that 60-62% of transgender men experience

293 dyspareunia.<sup>7,8</sup> Although testosterone was associated with vaginal/FGO pain in all regression  
294 analyses, the prevalence of any genital pain among individuals who were testosterone naïve was  
295 also quite high (63%). The causes of genital pain during sex (including dyspareunia, vulvodynia,  
296 and vaginismus) are multifactorial.<sup>24</sup> Although physiological factors (such as vaginal atrophy,  
297 endometriosis, and pelvic floor injury) are associated with genital pain during sex,<sup>5</sup> there are  
298 complex associations with psychological and social factors, including co-occurrence with other  
299 pain disorders, mental health, substance use, and sexual trauma.<sup>22,23</sup> Our sample reported an  
300 alarmingly high level of sexual abuse (78%), sexual assault (50%), depression (81%) and PTSD  
301 diagnoses (40%)—factors that are correlated with chronic pelvic pain among presumably  
302 cisgender women.<sup>17–21</sup> This may partially account for the high prevalence of pain in our study.

303         Genital pain, including dyspareunia and chronic vulvodynia, can have a significant  
304 impact on people’s well-being and quality of life.<sup>34,35</sup> Although one prior study reports that 1 in 5  
305 transgender men reported that pain during sexual activity was causing significant problems in  
306 their life or relationship,<sup>7</sup> there has been limited investigation into how this may impact the well-  
307 being and quality of life of transgender people.

308         Intravaginal estrogen (delivered via cream, tablets, or a ring) is recommended for  
309 transgender men experiencing testosterone-associated dyspareunia, vaginitis, and cervicitis.<sup>36</sup>  
310 Locally administered estrogen therapy has been demonstrated to be a safe and effective therapy  
311 in post-menopausal cisgender women, who also experience vaginal atrophy associated with  
312 estrogen deficiency.<sup>37–39</sup> However, few existing reports likewise suggest that a minority of  
313 transgender men (<5%) have ever used intravaginal estrogen.<sup>8</sup> Therefore, there may be barriers  
314 to the uptake of this intervention among transgender populations, including acceptability,

315 provider awareness, participant/patient knowledge, insurance coverage, and other structural  
316 barriers, in addition to the limited evidence base to inform clinical use.

### 317 **Strengths and Limitations**

318 To our knowledge, this is the first study to report PROMIS SexFS outcomes for  
319 transgender men, and one of few studies to examine the association between testosterone use and  
320 vulvovaginal pain. This study has several strengths, including a large, national sample of  
321 transgender participants who were diverse with respect to their age, gender identity, and sexual  
322 orientations.

323 Our results should be interpreted considering several limitations. The PRIDE Study is a  
324 convenience sample of majority White participants that relies on self-reported health outcomes  
325 and diagnoses and therefore may be subject to sampling, recall, and social desirability biases.  
326 Although our study demonstrates the feasibility of using the PROMIS SexFS with transgender  
327 men, the PROMIS SexFS has not been validated in transgender populations. This is notable,  
328 given that the item calibration and scoring is stratified by sex assigned at birth. Although scoring  
329 for interest in sexual activity, orgasm ability, and orgasm pleasure are identical for male and  
330 female populations, the items specific to vaginal/FGO anatomy were calibrated to a sample  
331 primarily composed of (presumably) cisgender women.<sup>11</sup> Therefore, there remain opportunities  
332 to develop and validate sexual function measures for transgender and gender diverse people.

333 In addition, our survey did not collect data on several important variables. Although most  
334 participants reported any receptive oral or receptive vaginal/FGO sex, we did not assess other  
335 types of vaginal/FGO sexual activity (e.g., penetration with fingers or sex toys) and acknowledge  
336 that some transmasculine people do not use their vagina/FGO at all during sex. We also lacked  
337 detailed information of hormone doses and were unable to distinguish between low- and high-



338 dose testosterone. We did not collect data on several factors that also influence genital pain,  
339 including intravaginal estrogen use or the use of other medications used to manage symptoms of  
340 vaginal atrophy and painful sex (*e.g.*, topical lidocaine).

341         Lastly, although duration of testosterone use was associated with few outcomes in our  
342 study, this may in part be a limitation of our cross-sectional design. Future prospective  
343 longitudinal research is important for identifying changes to sexual function over time,  
344 accounting for cyclical variability in vaginal symptoms, variation in testosterone access and  
345 dosing, as well as for understanding how long-term testosterone use may impact sexual function  
346 and vulvovaginal pain.

#### 347 **Conclusions**

348         Using data from a large national sample of transgender men and gender diverse people  
349 AFAB, we observed that testosterone use was both associated with positive sexual function and  
350 dyspareunia. The relationship between receipt of testosterone GAHT and sexual function is  
351 complex, and likely includes both physiological (*e.g.*, vaginal atrophy) and psychological factors  
352 (*e.g.*, affirmation). However, given the high burden (>60%) of dyspareunia observed among  
353 transgender people AFAB, there is a need to assess its impact on the overall quality of life,  
354 identify effective and acceptable interventions, and reduce barriers to accessing treatment for  
355 transgender people experiencing dyspareunia.

356

357 **Author Contributions:** DMT and JOM conceived of the study design and methodology and had  
358 access to all data. DMT performed and verified all analyses and wrote the original manuscript  
359 draft, with support from JOM. MRL, AF, ZD, MEL, MC, and JOM contributed to data  
360 collection. All authors provided input on data interpretation and provided manuscript edits.

361

362 **Acknowledgements:** The PRIDE Study is a community-engaged research project that serves  
363 and is made possible by LGBTQ+ community involvement at multiple points in the research  
364 process, including the dissemination of findings. We acknowledge the courage and dedication of  
365 The PRIDE Study participants for sharing their stories; the careful attention of PRIDENet  
366 Participant Advisory Committee (PAC) members for reviewing and improving every study  
367 application; and the enthusiastic engagement of PRIDENet Ambassadors and Community  
368 Partners for bringing thoughtful perspectives as well as promoting enrollment and disseminating  
369 findings. For more information, please visit <https://pridestudy.org/pridenet>.

370

371 **Data sharing:** We welcome the opportunity to facilitate high-quality, community-engaged,  
372 research collaborations that aim to improve the health and well-being of LGBTQ+ communities.  
373 Through The PRIDE Study's ancillary studies, a wide variety of investigators working on  
374 academic or community-based projects related to LGBTQ+ health can apply to work  
375 collaboratively with The PRIDE Study team and access data. For more information, please visit:

376 <https://pridestudy.org/collaborate>

377

## 378 REFERENCES

- 379 1. Herman JL, Flores AR, O’neill KK. *How Many Adults and Youth Identify as Transgender in*  
380 *the United States?* The Williams Institute, UCLA School of Law; 2022. Accessed June 23,  
381 2022. <https://williamsinstitute.law.ucla.edu/publications/trans-adults-united-states/>
- 382 2. James SE, Herman JL, Rankin S, Keisling M, Mottet L, Anafi M. *The Report of the 2015*  
383 *U.S. Transgender Survey*. National Center for Transgender Equality; 2016.
- 384 3. Krakowsky Y, Potter E, Hallarn J, et al. The Effect of Gender-Affirming Medical Care on  
385 the Vaginal and Neovaginal Microbiomes of Transgender and Gender-Diverse People.  
386 *Front Cell Infect Microbiol*. 2022;11. doi:10.3389/FCIMB.2021.769950
- 387 4. Baldassarre M, Giannone FA, Foschini MP, et al. Effects of long-term high dose  
388 testosterone administration on vaginal epithelium structure and estrogen receptor- $\alpha$  and - $\beta$   
389 expression of young women. *Int J Impot Res*. 2013;25(5):172-177. doi:10.1038/ijir.2013.9
- 390 5. Kingsberg S, Kellogg S, Krychman M. Treating dyspareunia caused by vaginal atrophy: a  
391 review of treatment options using vaginal estrogen therapy. *Int J Womens Health*.  
392 2010;1:105-111.
- 393 6. Mattawanon N, Charoenkwan K, Tangpricha V. Sexual Dysfunction in Transgender People:  
394 A Systematic Review. *Urol Clin North Am*. 2021;48(4):437-460.  
395 doi:10.1016/j.ucl.2021.06.004
- 396 7. Abern L, Maguire K, Cook J, Carugno J. Prevalence of Vulvar Pain and Dyspareunia in  
397 Trans Masculine Individuals. *LGBT Health*. Published online February 3, 2022.  
398 doi:10.1089/LGBT.2020.0357
- 399 8. Zwickl S, Burchill L, Wong AFQ, et al. Pelvic Pain in Transgender People Using  
400 Testosterone Therapy. *LGBT Health*. Published online January 4, 2023.  
401 doi:10.1089/lgbt.2022.0187
- 402 9. Weijmar Schultz W, Basson R, Binik Y, Eschenbach D, Wesselmann U, Van Lankveld J.  
403 Women’s sexual pain and its management. *J Sex Med*. 2005;2(3):301-316.  
404 doi:10.1111/j.1743-6109.2005.20347.x
- 405 10. Dadasovich R, Auerswald C, Minnis AM, Raymond HF, McFarland W, Wilson EC.  
406 Testosterone and sexual risk among transmen: a mixed methods exploratory study. *Cult*  
407 *Health Sex*. 2017;19(2):256-266. doi:10.1080/13691058.2016.1216605
- 408 11. Weinfurt KP, Lin L, Bruner DW, et al. Development and Initial Validation of the  
409 PROMIS® Sexual Function and Satisfaction Measures Version 2.0. *J Sex Med*.  
410 2015;12(9):1961-1974. doi:10.1111/jsm.12966
- 411 12. Moseson H, Lunn MR, Katz A, et al. Development of an affirming and customizable  
412 electronic survey of sexual and reproductive health experiences for transgender and gender

- 413 nonbinary people. *PLOS ONE*. 2020;15(5):e0232154.  
414 doi:10.1371/JOURNAL.PONE.0232154
- 415 13. Klein A, Golub SA. Enhancing Gender-Affirming Provider Communication to Increase  
416 Health Care Access and Utilization Among Transgender Men and Trans-Masculine Non-  
417 Binary Individuals. *LGBT Health*. 2020;7(6):292-304. doi:10.1089/lgbt.2019.0294
- 418 14. Levis B, Benedetti A, Thombs BD. Accuracy of Patient Health Questionnaire-9 (PHQ-9) for  
419 screening to detect major depression: individual participant data meta-analysis. *BMJ*.  
420 2019;365. doi:10.1136/BMJ.L1476
- 421 15. Han B, Wong EC, Mao Z, Meredith LS, Cassells A, Tobin JN. Validation of a brief PTSD  
422 screener for underserved patients in federally qualified health centers. *Gen Hosp Psychiatry*.  
423 2016;38:84-88. doi:10.1016/j.genhosppsy.2015.07.009
- 424 16. Bohn MJ, Babor TF, Kranzler HR. The Alcohol Use Disorders Identification Test (AUDIT):  
425 validation of a screening instrument for use in medical settings. *J Stud Alcohol*.  
426 1995;56(4):423-432. doi:10.15288/jsa.1995.56.423
- 427 17. Reed BD, Legocki LJ, Plegue MA, Sen A, Haefner HK, Harlow SD. Factors associated with  
428 vulvodynia incidence. *Obstet Gynecol*. 2014;123(2 Pt 1):225-231.  
429 doi:10.1097/AOG.0000000000000066
- 430 18. Chisari C, Monajemi MB, Scott W, Moss-Morris R, McCracken LM. Psychosocial factors  
431 associated with pain and sexual function in women with Vulvodynia: A systematic review.  
432 *Eur J Pain*. 2021;25(1):39-50. doi:10.1002/ejp.1668
- 433 19. Siqueira-Campos VME, Da Luz RA, de Deus JM, Martinez EZ, Conde DM. Anxiety and  
434 depression in women with and without chronic pelvic pain: prevalence and associated  
435 factors. *J Pain Res*. 2019;12:1223-1233. doi:10.2147/JPR.S195317
- 436 20. Meltzer-Brody S, Leserman J, Zolnoun D, Steege J, Green E, Teich A. Trauma and  
437 posttraumatic stress disorder in women with chronic pelvic pain. *Obstet Gynecol*.  
438 2007;109(4):902-908. doi:10.1097/01.AOG.0000258296.35538.88
- 439 21. Fishbain DA, Pulikal A, Lewis JE, Gao J. Chronic Pain Types Differ in Their Reported  
440 Prevalence of Post-Traumatic Stress Disorder (PTSD) and There Is Consistent Evidence  
441 That Chronic Pain Is Associated with PTSD: An Evidence-Based Structured Systematic  
442 Review. *Pain Med Malden Mass*. 2017;18(4):711-735. doi:10.1093/pm/pnw065
- 443 22. Bornstein J, Goldstein AT, Stockdale CK, et al. 2015 ISSVD, ISSWSH and IPPS Consensus  
444 Terminology and Classification of Persistent Vulvar Pain and Vulvodynia. *Obstet Gynecol*.  
445 2016;127(4):745-751. doi:10.1097/AOG.0000000000001359
- 446 23. Lamvu G, Carrillo J, Ouyang C, Rapkin A. Chronic Pelvic Pain in Women: A Review.  
447 *JAMA*. 2021;325(23):2381-2391. doi:10.1001/JAMA.2021.2631

- 448 24. Alimi Y, Iwanaga J, Oskouian RJ, Loukas M, Tubbs RS. The clinical anatomy of  
449 dyspareunia: A review. *Clin Anat N Y N*. 2018;31(7):1013-1017. doi:10.1002/ca.23250
- 450 25. Reisner SL, Pletta DR, Potter J, Deutsch MB. Initial Psychometric Evaluation of a Brief  
451 Sexual Functioning Screening Tool for Transmasculine Adults: Transmasculine Sexual  
452 Functioning Index. *Sex Med*. 2020;8(3):350-360. doi:10.1016/j.esxm.2020.05.006
- 453 26. McCool-Myers M, Theurich M, Zuelke A, Knuettel H, Apfelbacher C. Predictors of female  
454 sexual dysfunction: a systematic review and qualitative analysis through gender inequality  
455 paradigms. *BMC Womens Health*. 2018;18:108. doi:10.1186/s12905-018-0602-4
- 456 27. Eftekhari T, Sohrabvand F, Zabandan N, Shariat M, Haghollahi F, Ghahghaei-Nezamabadi  
457 A. Sexual dysfunction in patients with polycystic ovary syndrome and its affected domains.  
458 *Iran J Reprod Med*. 2014;12(8):539-546.
- 459 28. O'Connor A, Gracie DJ, Hamlin PJ, Ford AC. Predictors of Dyspareunia Among Female  
460 Patients With Inflammatory Bowel Disease. *Clin Gastroenterol Hepatol Off Clin Pract J  
461 Am Gastroenterol Assoc*. 2020;18(4):1000-1001. doi:10.1016/j.cgh.2019.07.065
- 462 29. Sakinci M, Ercan CM, Olgan S, Coksuer H, Karasahin KE, Kuru O. Comparative analysis  
463 of copper intrauterine device impact on female sexual dysfunction subtypes. *Taiwan J  
464 Obstet Gynecol*. 2016;55(1):30-34. doi:10.1016/j.tjog.2014.12.011
- 465 30. Rosen NO, Dawson SJ, Binik YM, et al. Trajectories of Dyspareunia From Pregnancy to 24  
466 Months Postpartum. *Obstet Gynecol*. 2022;139(3):391-399.  
467 doi:10.1097/AOG.0000000000004662
- 468 31. Nguyen HB, Chavez AM, Lipner E, et al. Gender-Affirming Hormone Use in Transgender  
469 Individuals: Impact on Behavioral Health and Cognition. *Curr Psychiatry Rep*.  
470 2018;20(12):110. doi:10.1007/s11920-018-0973-0
- 471 32. Foster Skewis L, Bretherton I, Leemaqz SY, Zajac JD, Cheung AS. Short-Term Effects of  
472 Gender-Affirming Hormone Therapy on Dysphoria and Quality of Life in Transgender  
473 Individuals: A Prospective Controlled Study. *Front Endocrinol*. 2021;12:717766.  
474 doi:10.3389/fendo.2021.717766
- 475 33. Owen-Smith AA, Gerth J, Sineath RC, et al. Association Between Gender Confirmation  
476 Treatments and Perceived Gender Congruence, Body Image Satisfaction, and Mental Health  
477 in a Cohort of Transgender Individuals. *J Sex Med*. 2018;15(4):591-600.  
478 doi:10.1016/j.jsxm.2018.01.017
- 479 34. Xie Y, Shi L, Xiong X, Wu E, Veasley C, Dade C. Economic burden and quality of life of  
480 vulvodynia in the United States. *Curr Med Res Opin*. 2012;28(4):601-608.  
481 doi:10.1185/03007995.2012.666963
- 482 35. Schneider MP, Vitonis AF, Fadayomi AB, Charlton BM, Missmer SA, DiVasta AD. Quality  
483 of Life in Adolescent and Young Adult Women With Dyspareunia and Endometriosis. *J*

- 484 *Adolesc Health Off Publ Soc Adolesc Med.* 2020;67(4):557-561.  
485 doi:10.1016/j.jadohealth.2020.02.024
- 486 36. Obedin-Maliver J. Pelvic pain and persistent menses in transgender men. UCSF  
487 Transgender Care & Treatment Guidelines. Published 2016. Accessed December 7, 2022.  
488 <https://transcare.ucsf.edu/guidelines/pain-transmen>
- 489 37. Krause M, Wheeler TL, Snyder TE, Richter HE. Local Effects of Vaginally Administered  
490 Estrogen Therapy: A Review. *J Pelvic Med Surg.* 2009;15(3):105.  
491 doi:10.1097/SPV.0B013E3181AB4804
- 492 38. Krause M, Wheeler TL, Richter HE, Snyder TE. Systemic Effects of Vaginally  
493 Administered Estrogen Therapy: A Review. *Female Pelvic Med Reconstr Surg.*  
494 2010;16(3):188. doi:10.1097/SPV.0B013E3181D7E86E
- 495 39. Weber MA, Kleijn MH, Langendam M, Limpens J, Heineman MJ, Roovers JP. Local  
496 Oestrogen for Pelvic Floor Disorders: A Systematic Review. *PloS One.* 2015;10(9).  
497 doi:10.1371/JOURNAL.PONE.0136265

498

499

500 **Tables and Figures**  
 501

**Table 1. Participant Characteristics**

N	1219
Age, years (median, IQR)	27.1 (22.6-33.0)
Gender Identity <sup>1</sup> (n, %)	
Agender	166 (13.6)
Genderqueer	410 (33.6)
Man	262 (21.5)
Non-binary	661 (54.2)
Transgender man	561 (46.0)
Two-spirit	14 (1.1)
Questioning	39 (3.2)
Another gender identity	166 (13.6)
Sexual Orientation <sup>1</sup> (n, %)	
Asexual	262 (21.5)
Bisexual	406 (33.3)
Gay	227 (18.6)
Lesbian	85 (7.0)
Pansexual	245 (20.1)
Queer	793 (65.1)
Same-gender loving	60 (4.9)
Straight/heterosexual	49 (4.0)
Two-spirit	5 (0.4)
Questioning	58 (4.8)
Another sexual orientation	84 (6.9)
Race and Ethnicity <sup>1</sup> (n, %)	
American Indian or Alaskan Native	39 (3.2)
Asian	59 (4.8)
Black, African American or African	49 (4.0)
Hispanic, Latinx, or Spanish	82 (6.7)
Middle Eastern or North African	15 (1.2)
Native Hawaiian or Pacific Islander	5 (0.4)
White	1120 (91.9)
Another race/ethnicity	16 (1.3)
Missing	10 (0.8)

<sup>1</sup>Participants were able to select more than one response, therefore, proportions may sum to greater than 100%. 61.1% selected more than one gender identity, 53.2% selected more than one sexual orientation, and 12.0% selected more than one race and/or ethnicity.

502

**Table 2. Sexual Behavior and Medical History of Participants, Stratified by Never or Current Testosterone Use**

	Overall	Never Testosterone Use	Current Testosterone Use	p-value
N	1219	516	602	
Sex in the past year (n, %)	750 (68.9)	291 (63.4)	400 (73.3)	<b>0.001</b>
Receptive oral sex <sup>1</sup>	598 (79.8)	218 (74.9)	333 (83.5)	<b>0.008</b>
Receptive vaginal/FGO sex <sup>1</sup>	400 (53.9)	174 (59.8)	193 (49.1)	<b>0.007</b>
Interest in sexual activity, past 30 days <sup>2</sup> (mean, sd)	46.6 (11.1)	44.2 (11.3)	49.0 (10.5)	<b>&lt;0.001</b>
Any sexual activity, past 30 days <sup>3</sup> (n, %)	1091 (89.5)	437 (84.7)	565 (93.9)	<b>&lt;0.001</b>
In a relationship (n, %)	701 (59.4)	291 (58.3)	355 (60.5)	0.509
Gender(s) of past year sex partners (n, %)				
Cisgender men	354 (29.0)	147 (28.5)	182 (30.2)	0.567
Cisgender women	286 (23.5)	107 (20.7)	160 (26.6)	<b>0.027</b>
Genderqueer, non-binary, or gender non-conforming people AFAB	183 (15.0)	75 (14.5)	92 (15.3)	0.791
Genderqueer, non-binary, or gender non-conforming people AMAB	125 (10.3)	52 (10.1)	60 (10.0)	>0.999
Transgender Men	112 (9.2)	25 (4.8)	81 (13.5)	<b>&lt;0.001</b>
Transgender Women	103 (8.4)	37 (7.2)	57 (9.5)	0.203
Pelvic Health History (n, %)				
Pelvic inflammatory disease	27 (2.2)	13 (2.5)	11 (1.8)	0.556
Polycystic ovary syndrome	120 (9.8)	51 (9.9)	55 (9.1)	0.747
Uterine Fibroids	50 (4.1)	24 (4.7)	22 (3.7)	0.493
Inflammatory bowel disease <sup>4</sup>	24 (2.0)	11 (2.1)	12 (2.0)	>0.999
Irritable bowel syndrome	218 (17.9)	86 (16.7)	112 (18.6)	0.443
Bacterial STI diagnosis <sup>5</sup>	19 (1.6)	1 (0.2)	18 (3.0)	<b>0.001</b>
Ever pregnant	130 (10.7)	60 (11.6)	56 (9.3)	0.241
Hysterectomy	142 (11.6)	28 (5.4)	108 (17.9)	<b>&lt;0.001</b>
Oophorectomy	108 (8.9)	17 (3.3)	87 (14.5)	<b>&lt;0.001</b>
Current hormonal contraceptive use <sup>6</sup>	138 (11.3)	92 (17.8)	35 (5.8)	<b>&lt;0.001</b>
Current hormonal intrauterine device use <sup>7</sup>	91 (8.4)	49 (10.0)	32 (6.5)	0.056
Current non-hormonal intrauterine device use <sup>7</sup>	29 (2.7)	11 (2.3)	16 (3.2)	0.454
Mental Health and Substance Use (n, %)				
History of sexual abuse	686 (78.0)	289 (76.3)	340 (78.3)	0.532
Ever experienced rape or sexual assault	437 (49.9)	196 (51.9)	206 (47.7)	0.266
Ever diagnosed with depression	988 (81.1)	399 (77.3)	503 (83.6)	<b>0.011</b>
PHQ-9 score for depression <sup>8</sup> (mean, sd)	10.2 (6.4)	10.7 (6.4)	9.6 (6.2)	<b>0.005</b>
Ever diagnosed with PTSD	484 (39.7)	198 (38.4)	238 (39.5)	0.737
PCL-6 score for PTSD <sup>9</sup> (mean, sd)	15.6 (5.3)	16.1 (5.2)	15.0 (5.2)	<b>0.001</b>
Current smoker	74 (6.1)	22 (4.3)	45 (7.5)	<b>0.033</b>
AUDIT score for alcohol use <sup>10</sup> (mean, sd)	3.6 (4.3)	3.2 (3.8)	3.9 (4.6)	<b>0.005</b>
Language Preferences (n, %)				



Vagina	891 (73.1)	428 (82.9)	386 (64.1)	<b>&lt;0.001</b>
Frontal genital opening	315 (25.8)	86 (16.7)	207 (34.4)	

AFAB, assigned female at birth; AMAB, assigned male at birth; AUDIT, alcohol use identification test; PHQ-9, 9-item patient health questionnaire; PTSD, post-traumatic stress disorder; sd, standard deviation

<sup>1</sup>Among participants who reported having sex in the past year

<sup>2</sup>T-scores of 50 represents the population average for the US population, and 10 points represents one standard deviation from the population average

<sup>3</sup>Including masturbation as well as sexual activity with a partner

<sup>4</sup>Including Crohn's disease, ulcerative colitis, etc

<sup>5</sup>Diagnosis with chlamydia, gonorrhea, or syphilis in the past year

<sup>6</sup>Including oral contraceptives, transdermal patch, vaginal rings, medroxyprogesterone acetate injections, and etonogestrel implants

<sup>7</sup>Excluding participants who had a hysterectomy

<sup>8</sup>The PHQ-9 measures depressive symptoms in the past two weeks, where scores of 10 or higher are suggestive of moderate to severe depression

<sup>9</sup>The PCL-6 measures PTSD symptoms in the past month, where scores of 17 or higher are associated with probable PTSD

<sup>10</sup>The AUDIT measures current alcohol consumptions behaviors, where scores of 15 or higher are suggestive of alcohol use disorder

**Table 3. Sexual Function Stratified by Never and Current Testosterone Use**

	Overall	Never Testosterone Use	Current Testosterone Use	p-value
<b>Participants who were NOT sexually active in the past 30 days, N</b>	<b>128</b>	<b>79</b>	<b>37</b>	
Reasons for No Sexual Activity (n, %)				
Not interested	93 (72.7)	67 (84.8)	17 (45.9)	<b>&lt;0.001</b>
No partners	43 (33.6)	26 (32.9)	14 (37.8)	0.756
Don't enjoy sexual activity	32 (25.0)	23 (29.1)	4 (10.8)	0.053
Partner(s) away, not interested in sex, or health condition	20 (15.6)	10 (12.7)	7 (18.9)	0.544
Difficulties with orgasm/climax	15 (11.7)	10 (12.7)	5 (13.5)	>0.999
Dryness or pain in or around my vaginal/FGO	11 (8.6)	4 (5.1)	5 (13.5)	0.225
Health condition	9 (7.0)	5 (6.3)	2 (5.4)	>0.999
Another reason	18 (14.1)	12 (15.2)	6 (16.2)	>0.999
<b>Participants who WERE sexually active in the past 30 days, N</b>	<b>1091</b>	<b>437</b>	<b>565</b>	
Lubrication				
Any difficulty achieving or maintaining lubrication (n, %)	670 (62.2)	289 (66.7)	326 (58.5)	<b>0.010</b>
T-score <sup>1</sup> (mean, sd)	50.7 (8.5)	50.2 (8.4)	51.2 (8.4)	<b>0.045</b>
Any genital pain/discomfort (n, %)	693 (64.6)	274 (63.3)	368 (66.5)	0.317
Pain/discomfort inside vagina/FGO				
Any pain or discomfort (n, %)	561 (52.2)	213 (49.2)	310 (56.0)	<b>0.040</b>
T-score <sup>2</sup> (mean, sd)	51.6 (9.1)	50.9 (8.9)	52.3 (9.2)	<b>0.013</b>
Pain/discomfort in the labia				
Any pain or discomfort (n, %)	263 (24.5)	118 (27.3)	126 (22.8)	0.124
T-score <sup>2</sup> (mean, sd)	51.2 (7.5)	51.6 (7.7)	51.0 (7.4)	0.168
Pain/discomfort in the clitoris				
Any pain or discomfort (n, %)	312 (29.1)	117 (27.1)	167 (30.2)	0.317
T-score <sup>2</sup> (mean, sd)	53.1 (8.3)	52.6 (7.7)	53.4 (8.5)	0.136
Orgasm				
Did not have an orgasm (n, %)	61 (5.6)	34 (7.8)	19 (3.4)	<b>0.003</b>
Any difficulty achieving orgasm (n, %)	559 (52.8)	216 (51.2)	289 (52.2)	0.811
T-score for achieving orgasm <sup>1</sup> (mean, sd)	49.2 (9.8)	48.4 (10.8)	50.1 (9.0)	<b>0.010</b>
T-score for orgasm pleasure <sup>1</sup> (mean, sd)	45.0 (8.4)	45.1 (8.3)	45.2 (8.3)	0.918
Satisfaction with sex life				
T-score <sup>1</sup> (mean, sd)	45.6 (7.7)	45.7 (7.9)	45.9 (7.6)	0.670

FGO, frontal genital opening

T-scores of 50 represents the population average for the US population, and 10 points represents one standard deviation from the population average

<sup>1</sup>High scores indicate more lubrication, ability to achieve orgasm, pleasure from orgasms, and satisfaction with sex life<sup>2</sup>Higher scores indicate more pain/discomfort

	Interest in sexual activity	Satisfaction with sex life	Lubrication	Pain/discomfort inside vagina/FGO	Pain/discomfort in the labia	Pain/discomfort in the clitoris	Orgasm ability	Orgasm pleasure
Interest in sexual activity	1.00							
Satisfaction with sex life	0.36	1.00						
Lubrication	0.27	0.21	1.00					
Pain/discomfort inside vagina/FGO	0.02	-0.07	-0.28	1.00				
Pain/discomfort in the labia	0.01	-0.10	-0.22	0.38	1.00			
Pain/discomfort in the clitoris	-0.04	-0.05	-0.16	0.26	0.31	1.00		
Orgasm ability	0.14	0.20	0.25	-0.16	-0.13	-0.17	1.00	
Orgasm pleasure	0.43	0.54	0.25	-0.11	-0.13	-0.17	0.42	1.00

506  
507  
508  
509  
510  
511

**Figure 1. Correlation between sexual function T-scores.**

The correlation coefficient measures the strength and directional of the linear association between two variables. It ranges from -1 to 1, with zero indicating no correlation. Blue indicates that variables are positive correlated with one another, and orange indicates variables are negatively correlated. FGO, frontal genital opening.

**Table 4. Association between Current Testosterone Use and Sexual Function**

Outcomes <sup>1</sup>	<i>Current Testosterone Use vs Never Testosterone Use</i>					
	Unadjusted		Minimally Adjusted <sup>2</sup>		Fully Adjusted <sup>3</sup>	
	$\beta$ (95% CI)	p-value	$\beta$ (95% CI)	p-value	$\beta$ (95% CI)	p-value
Interest in sexual activity	<b>6.44 (5.10, 7.78)</b>	<b>&lt;0.001</b>	<b>6.32 (4.91, 7.74)</b>	<b>&lt;0.001</b>	<b>6.02 (4.35, 7.69)</b>	<b>&lt;0.001</b>
Satisfaction with sex life	0.21 (-0.75, 1.17)	0.669	0.16 (-0.85, 1.16)	0.762	0.42 (-0.75, 1.58)	0.486
Lubrication	<b>1.08 (0.01, 2.15)</b>	<b>0.048</b>	0.61 (-0.52, 1.75)	0.289	1.15 (-0.14, 2.44)	0.081
Pain/discomfort inside vagina/FGO	<b>1.45 (0.31, 2.59)</b>	<b>0.013</b>	<b>1.80 (0.61, 3.00)</b>	<b>0.003</b>	<b>1.95 (0.53, 3.36)</b>	<b>0.007</b>
Pain/discomfort in the labia	-0.67 (-1.61, 0.28)	0.168	-0.38 (-1.38, 0.62)	0.455	-0.75 (-1.93, 0.44)	0.218
Pain/discomfort in the clitoris	0.78 (-0.25, 1.82)	0.139	<b>1.20 (0.10, 2.30)</b>	<b>0.033</b>	1.21 (-0.09, 2.51)	0.068
Orgasm ability	<b>1.62 (0.39, 2.86)</b>	<b>0.010</b>	<b>1.50 (0.19, 2.81)</b>	<b>0.025</b>	0.36 (-1.14, 1.86)	0.636
Orgasm pleasure	0.06 (-1.02, 1.13)	0.919	-0.04 (-1.15, 1.08)	0.951	0.46 (-0.81, 1.73)	0.475

CI, confidence interval; FGO, frontal genital opening

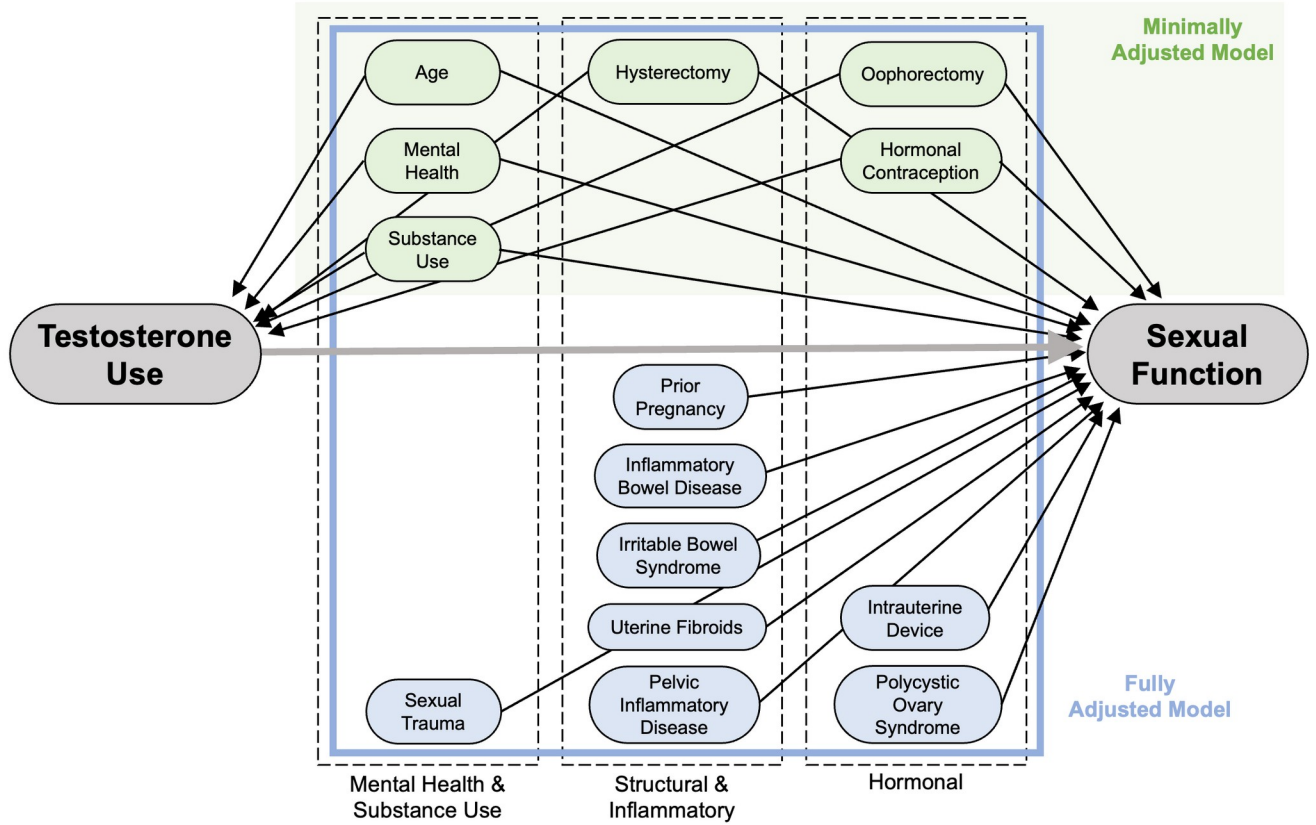
<sup>1</sup>T-scores of 50 represents the population average for the US population, and 10 points represents one standard deviation from the population average

<sup>2</sup>Adjusted for age, current depression symptoms (PHQ-9 scores), current post-traumatic stress symptoms (PCL-6 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, and hormonal contraception use

<sup>3</sup>Adjusted for age, current depression symptoms (PHQ-9 scores), current post-traumatic stress symptoms (PCL-6 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, intrauterine devices use, hormonal contraception use history of sexual assault, inflammatory bowel disease, irritable bowel syndrome, uterine fibroids, pelvic inflammatory disease, polycystic ovary syndrome, prior pregnancy, and intrauterine devices use

515  
516 **Supplemental Materials**

517  
518  
519  
520  
521  
522  
523  
524  
525



526  
527  
528 **Supplemental Figure 1. Directed acyclic graph (DAG) illustrating covariates included in regression models**  
529  
530

**Supplemental Table 1. Participant Characteristics Stratified by Never, Current, and Former Testosterone Use**

	Never Testosterone Use	Current Testosterone Use	p-value (Never v. Current)	Former Testosterone Use	p-value (Current v. Former)
N	516	602		76	
Age, years (mean, range)	28.3 (8.7)	29.9 (9.6)	<b>0.003</b>	30.7 (9.9)	0.505
Gender Identity <sup>1</sup> (n, %)					
Agender	99 (19.2)	50 (8.3)	<b>&lt;0.001</b>	15 (19.7)	<b>0.003</b>
Genderqueer	234 (45.3)	135 (22.4)	<b>&lt;0.001</b>	30 (39.5)	<b>0.002</b>
Man	21 (4.1)	231 (38.4)	<b>&lt;0.001</b>	8 (10.5)	<b>&lt;0.001</b>
Non-binary	379 (73.4)	209 (34.7)	<b>&lt;0.001</b>	54 (71.1)	<b>&lt;0.001</b>
Transgender man	67 (13.0)	458 (76.1)	<b>&lt;0.001</b>	31 (40.8)	<b>&lt;0.001</b>
Two-spirit	8 (1.6)	5 (0.8)	0.401	1 (1.3)	1.000
Questioning	27 (5.2)	10 (1.7)	<b>0.002</b>	1 (1.3)	1.000
Another gender identity	86 (16.7)	59 (9.8)	<b>0.001</b>	16 (21.1)	<b>0.006</b>
Sexual Orientation <sup>1</sup> (n, %)					
Asexual	145 (28.1)	95 (15.8)	<b>&lt;0.001</b>	17 (22.4)	0.196
Bisexual	173 (33.5)	203 (33.7)	0.996	21 (27.6)	0.350
Gay	56 (10.9)	154 (25.6)	<b>&lt;0.001</b>	16 (21.1)	0.473
Lesbian	59 (11.4)	14 (2.3)	<b>&lt;0.001</b>	7 (9.2)	<b>0.004</b>
Pansexual	115 (22.3)	108 (17.9)	<b>0.082</b>	14 (18.4)	1.000
Queer	336 (65.1)	384 (63.8)	0.689	58 (76.3)	<b>0.042</b>
Same-gender loving	17 (3.3)	39 (6.5)	<b>0.022</b>	3 (3.9)	0.542
Straight/heterosexual	6 (1.2)	42 (7.0)	<b>&lt;0.001</b>	1 (1.3)	0.097
Two-spirit	2 (0.4)	2 (0.3)	1.000	1 (1.3)	0.764
Questioning	18 (3.5)	34 (5.6)	0.117	4 (5.3)	1.000
Another sexual orientation	39 (7.6)	34 (5.6)	0.243	9 (11.8)	0.066
Race and Ethnicity <sup>1</sup> (n, %)					
American Indian or Alaskan Native	23 (4.5)	15 (2.5)	0.100	1 (1.3)	0.814
Asian	25 (4.8)	28 (4.7)	0.991	6 (7.9)	0.346
Black, African American or African	19 (3.7)	29 (4.8)	0.432	1 (1.3)	0.270
Hispanic, Latinx, or Spanish	36 (7.0)	39 (6.5)	0.832	6 (7.9)	0.824
Middle Eastern or North African	6 (1.2)	7 (1.2)	1.000	2 (2.6)	0.601
Native Hawaiian or Pacific Islander	1 (0.2)	3 (0.5)	0.728	0 (0.0)	1.000
White	480 (93.0)	551 (91.5)	0.413	72 (94.7)	0.458
Another race/ethnicity	8 (1.6)	7 (1.2)	0.764	1 (1.3)	1.000
Missing	0 (0.0)	2 (0.3)	0.548	0 (0.0)	1.000

<sup>1</sup>Participants were able to select more than one response, therefore, proportions may sum to greater than 1

**Supplemental Table 2. Sexual Behavior and Medical History of Participants, Stratified by Current and Former Testosterone Use**

	Current Testosterone Use	Former Testosterone Use	p-value
N	602	76	
Sex in the past year (n, %)	400 (73.3)	50 (75.8)	0.774
Interest in sexual activity, past 30 days <sup>1</sup> (mean, sd)	48.96 (10.54)	41.99 (9.93)	<b>&lt;0.001</b>
Any sexual activity, past 30 days <sup>2</sup> (n, %)	565 (93.9)	64 (84.2)	<b>0.005</b>
In a relationship (n, %)	355 (60.5)	45 (61.6)	0.948
Gender(s) of past year sex partners (n, %)			
Cisgender men	182 (30.2)	18 (23.7)	0.296
Cisgender women	160 (26.6)	16 (21.1)	0.370
Genderqueer, non-binary, or gender non-conforming people AFAB	92 (15.3)	14 (18.4)	0.588
Genderqueer, non-binary, or gender non-conforming people AMAB	60 (10.0)	13 (17.1)	0.090
Transgender Men	81 (13.5)	6 (7.9)	0.237
Transgender Women	57 (9.5)	8 (10.5)	0.930
Pelvic Health History (n, %)			
Pelvic inflammatory disease	11 (1.8)	3 (3.9)	0.426
Polycystic ovary syndrome	55 (9.1)	9 (11.8)	0.581
Uterine Fibroids	22 (3.7)	4 (5.3)	0.711
Inflammatory bowel disease <sup>3</sup>	12 (2.0)	1 (1.3)	1.000
Irritable bowel syndrome	112 (18.6)	15 (19.7)	0.934
Bacterial STI diagnosis <sup>4</sup>	18 (3.0)	0 (0.0)	0.250
Ever pregnant	56 (100.0)	12 (100.0)	0.116
Hysterectomy	108 (100.0)	6 (100.0)	<b>0.041</b>
Oophorectomy	87 (14.5)	4 (5.3)	<b>0.042</b>
Current hormonal contraceptive use <sup>5</sup>	35 (5.8)	8 (10.5)	0.181
Current hormonal intrauterine device use <sup>6</sup>	32 (6.5)	8 (11.4)	0.207
Current non-hormonal intrauterine device use <sup>6</sup>	16 (3.2)	2 (2.9)	1.000
Mental Health and Substance Use (n, %)			
History of sexual abuse	340 (78.3)	46 (88.5)	0.127
Ever experienced rape or sexual assault	206 (47.7)	29 (55.8)	0.340
Ever diagnosed with depression	503 (83.6)	70 (92.1)	0.076
PHQ-9 score for depression <sup>7</sup> (mean, sd)	9.6 (6.2)	11.08 (7.12)	0.053
Ever diagnosed with PTSD	238 (39.5)	42 (55.3)	<b>0.012</b>
PCL-6 score for PTSD <sup>8</sup> (mean, sd)	15.1 (5.2)	16.8 (5.8)	<b>0.007</b>
Current smoker	45 (7.5)	6 (7.9)	1.000
AUDIT score for alcohol use <sup>9</sup> (mean, sd)	3.9 (4.6)	4.0 (4.7)	0.886
Language Preferences (n, %)			
Vagina	386 (64.1)	54 (71.1)	0.309
Front genital opening	207 (34.4)	20 (26.3)	

AFAB, assigned female at birth; AMAB, assigned male at birth; AUDIT, alcohol use identification test; PHQ-9, 9-item patient health questionnaire; PTSD, post-traumatic stress disorder

<sup>1</sup>T-scores of 50 represents the population average for the US population, and 10 points represents one standard deviation from the population average

<sup>2</sup>Including masturbation as well as sexual activity with a partner

<sup>3</sup>Including Crohn's disease, ulcerative colitis, etc

<sup>4</sup>Diagnosis with chlamydia, gonorrhea, or syphilis in the past year

<sup>5</sup>Including oral contraceptives, transdermal patch, vaginal rings, medroxyprogesterone acetate injections, and etonogestrel implants

<sup>6</sup>Excluding participants who had a hysterectomy

---

<sup>7</sup>The PHQ-9 measures depressive symptoms in the past two weeks, where scores of 10 or higher are suggestive of moderate to severe depression

<sup>8</sup>The PCL-6 measures PTSD symptoms in the past month, where scores of 17 or higher are associated with probable PTSD.

<sup>9</sup>The AUDIT measures current alcohol consumption behaviors, where scores of 15 or higher are suggestive of alcohol use disorder

535  
536  
537  
538



**Supplemental Table 3. Sexual Function Stratified by Current and Former Testosterone Use**

	<b>Current Testosterone Use</b>	<b>Former Testosterone Use</b>	<b>p-value</b>
<b>Participants who were NOT sexually active in the past 30 days, N</b>	<b>37</b>	<b>12</b>	
Reasons for No Sexual Activity (n, %)			
Not interested	17 (45.9)	9 (75.0)	0.156
Dryness or pain in or around my vaginal/FGO	5 (13.5)	2 (16.7)	1.000
Difficulties with orgasm/climax	5 (13.5)	0 (0.0)	0.427
Don't enjoy sexual activity	4 (10.8)	5 (41.7)	<b>0.049</b>
Health condition	2 (5.4)	2 (16.7)	0.528
No partners	14 (37.8)	3 (25.0)	0.643
Partner(s) away, not interested, or health condition	7 (18.9)	3 (25.0)	0.966
Another reason	6 (16.2)	0 (0.0)	0.326
<b>Participants who WERE sexually active in the past 30 days, N</b>	<b>565</b>	<b>64</b>	
Lubrication			
Any difficulty achieving or maintaining lubrication (n, %)	326 (58.5)	41 (66.1)	0.308
T-score <sup>1</sup> (mean, sd)	51.2 (8.4)	48.6 (10.2)	<b>0.020</b>
Pain/discomfort inside vagina/FGO			
Any pain or discomfort (n, %)	310 (56.0)	27 (43.5)	0.084
T-score <sup>2</sup> (mean, sd)	52.3 (9.2)	50.7 (9.6)	0.182
Pain/discomfort in the labia			
Any pain or discomfort (n, %)	126 (22.8)	15 (24.2)	0.928
T-score <sup>2</sup> (mean, sd)	51.0 (7.4)	51.4 (7.9)	0.664
Pain/discomfort in the clitoris			
Any pain or discomfort (n, %)	167 (30.2)	21 (34.4)	0.594
T-score <sup>2</sup> (mean, sd)	53.4 (8.5)	54.3 (9.3)	0.419
Orgasm			
Did not have an orgasm (n, %)	19 (3.4)	6 (9.4)	<b>0.047</b>
Any difficulty achieving orgasm (n, %)	289 (52.2)	41 (67.2)	<b>0.036</b>
T-score for achieving orgasm <sup>1</sup> (mean, sd)	50.1 (9.0)	46.1 (10.7)	<b>0.001</b>
T-score for orgasm pleasure <sup>1</sup> (mean, sd)	45.2 (8.3)	42.3 (9.0)	<b>0.013</b>
Satisfaction with sex life			
T-score <sup>1</sup> (mean, sd)	45.9 (7.6)	42.9 (7.0)	<b>0.003</b>

FGO, frontal genital opening

T-scores of 50 represents the population average for the US population, and 10 point represents one standard deviation from the population average

<sup>1</sup>High scores indicate more lubrication, ability to achieve orgasm, pleasure from orgasms, and satisfaction with sex life<sup>2</sup>Higher scores indicate more pain/discomfort540  
541  
542  
543  
544  
545  
546  
547

548  
549

**Supplemental Table 4. Association between Duration of Testosterone Use (Years) and Sexual Function**

Outcomes <sup>1</sup>	Unadjusted		Minimally Adjusted <sup>2</sup>		Fully Adjusted <sup>3</sup>	
	beta (95% CI)	p-value	beta (95% CI)	p-value	beta (95% CI)	p-value
Interest in sexual activity	<b>0·38 (0·20, 0·56)</b>	<b>&lt;0·001</b>	<b>0·39 (0·18, 0·59)</b>	<b>&lt;0·001</b>	<b>0·35 (0·11, 0·60)</b>	<b>0·005</b>
Satisfaction with sex life	-0·01 (-0·13, 0·12)	0·917	0·00 (-0·14, 0·14)	0·969	0·01 (-0·16, 0·17)	0·949
Lubrication	0·10 (-0·04, 0·23)	0·165	0·11 (-0·04, 0·27)	0·161	0·17 (-0·01, 0·35)	0·062
Pain/discomfort inside vagina/FGO	0·01 (-0·14, 0·15)	0·945	0·06 (-0·11, 0·23)	0·500	0·05 (-0·14, 0·25)	0·599
Pain/discomfort in the labia	-0·10 (-0·22, 0·02)	0·099	-0·07 (-0·21, 0·07)	0·325	-0·08 (-0·24, 0·09)	0·367
Pain/discomfort in the clitoris	-0·17 (-0·3, -0·04)	0·012	-0·05 (-0·2, 0·11)	0·557	-0·06 (-0·24, 0·12)	0·521
Orgasm ability	0·20 (0·04, 0·35)	0·012	0·16 (-0·02, 0·34)	0·078	0·03 (-0·17, 0·24)	0·753
Orgasm pleasure	0·06 (-0·07, 0·2)	0·335	0·03 (-0·12, 0·18)	0·655	0·08 (-0·09, 0·25)	0·358

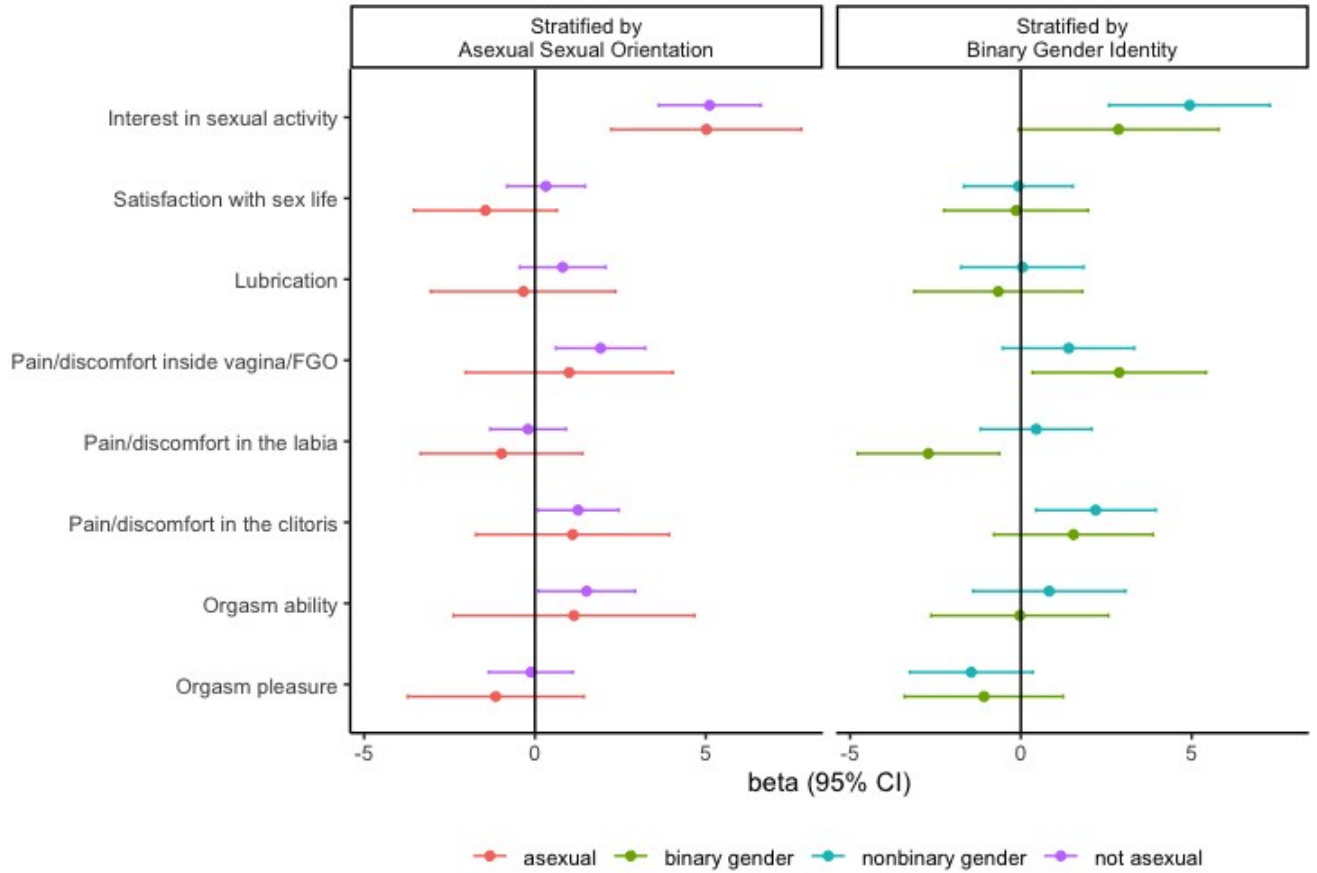
CI, confidence interval; FGO, frontal genital opening

<sup>1</sup>T-scores of 50 represents the population average for the US population, and 10 points represents one standard deviation from the population average

<sup>2</sup>Adjusted for age, current depression symptoms (PHQ-9 scores), current post-traumatic stress symptoms (PCL-6 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, and hormonal contraception use

<sup>3</sup>Adjusted for age, current depression symptoms (PHQ-9 scores), current post-traumatic stress symptoms (PCL-6 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, intrauterine devices use, hormonal contraception use, history of sexual assault, inflammatory bowel disease, irritable bowel syndrome, uterine fibroids, pelvic inflammatory disease, polycystic ovary syndrome, prior pregnancy, and intrauterine devices use

550  
551



553  
 554  
 555  
 556  
 557  
 558  
 559  
 560  
 561  
 562

**Supplemental Figure 2. Minimally Adjusted Regression Results Stratified by Binary versus Nonbinary Gender Identity.** Adjusted for age, current depression symptoms (PHQ-9 scores), current post-traumatic stress symptoms (PCL-6 scores), alcohol use (AUDIT score), current smoker, hysterectomy, oophorectomy, and hormonal contraception use.