

1 **Oral contraceptive use during relationship formation and current**  
2 **relationship satisfaction: Testing the congruency hypothesis in**  
3 **couples attending pregnancy and fertility clinics**

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34 **Abstract**

35 According to the congruency hypothesis, relationship satisfaction is predicted by the  
36 congruency (or non-congruency) between current use of oral contraceptives (OC) and their  
37 use during relationship formation. This is based on reports that OC may alter women’s mate  
38 preferences, so that attraction to their partner may have changed in non-congruent women.  
39 Indeed, some studies find that women in a non-congruent state were less sexually satisfied  
40 with their partner, although they were more satisfied in non-sexual aspects of the relationship.  
41 However, some other studies have produced null results, calling the hypothesis into question.  
42 In this study, we tested the congruency hypothesis in two samples of pregnant women and  
43 their partners, and in two samples of couples attending a fertility clinic. In all four samples,  
44 couples completed questionnaires on relationship and sexual satisfaction and the women also  
45 reported their previous and current contraceptive use. In one sample of pregnant women, we  
46 found that women who used OC during relationship formation were more sexually satisfied  
47 with their partner compared to women who did not use OC at that time; this pattern has  
48 previously been interpreted as supporting the congruency hypothesis in view of certain  
49 similarities in hormonal profile between OC use and pregnancy. We did not find any  
50 significant effect of OC use during relationship formation on sexual and relationship  
51 satisfaction in the other sample of pregnant women, either sample attending the fertility clinic,  
52 or in the male partners of any of our samples. Our results thus provide mixed support for the  
53 congruency hypothesis. Finally, we discuss recommendations for future studies such as use of  
54 within-subject designs and more structured assessment of sexual satisfaction.

55

56 **Keywords:** hormonal contraception, pill, relationship satisfaction, congruency hypothesis,  
57 mate choice

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## 67 **1. Introduction**

68 Ever since the 1970s, soon after the advent of oral contraceptives (OCs), numerous studies  
69 testing their effect on female sexuality have been conducted. Their results have proved  
70 inconsistent: some have found positive effects, others negative effects, and still others report  
71 no effect on female sexual functioning (Both et al., 2019). At least part of the explanation for  
72 these mixed results might be the multi-faceted nature of female sexuality, influenced as it is  
73 by a host of physiological, psychological, and relationship factors, each of which might be  
74 affected by OC use (Basson et al., 2003). Alternatively, these other factors might exert  
75 stronger effects and thus override or interact with any potential impact of OC use (Burrows et  
76 al., 2012). Together, this means there are various ways in which hormonal contraception  
77 could affect sexuality, either positively or negatively.

78 The most apparent positive effect of OC usage is linked to its primary purpose – prevention of  
79 unwanted pregnancy – because fear of unexpected pregnancy has strong negative effects on  
80 women's sexual satisfaction (Graham et al., 2004). More indirectly, OC use can positively  
81 influence sexual satisfaction through its implementation as a treatment for acne (Arowojolu et  
82 al., 2009), a condition which tends to reduce sexual self-esteem and consequently sexual  
83 satisfaction (Beisert et al., 2020).

84 On the other hand, using OCs might have negative impact on sexual satisfaction by causing  
85 sexual dysfunction. For example, OC users report lower levels of vaginal lubrication (McCoy  
86 & Matyas, 1996). This may increase pain during intercourse and arises as a consequence of  
87 OC-induced reduction of androgens that produce the glycoproteins required for lubrication  
88 (Kennedy & Armstrong, 1976). Lower androgen levels are also related to reduced sexual  
89 desire **in humans as well as in other mammals** (Bachman et al., 2002; Maseroli et al.,  
90 2020). The specific mechanism by which OC reduces androgen level is that the estrogen  
91 component in combined hormonal methods affects production of sex hormone-binding  
92 globulin (SHBG), leading to reduced levels of free testosterone (Wiegratz et al., 2003). At the  
93 same time, progestins directly suppress androgen production by ovaries and the adrenal gland,  
94 and anti-androgen progestins cause inhibition of enzyme 5–alpha reductase, that converts  
95 testosterone to functionally active dihydrotestosterone (Rabe et al., 2000). However, sexuality  
96 may not always be affected by OC use because baseline androgen levels vary widely across  
97 individual women (Pastor et al., 2013).

98 Another explanation for apparent inconsistencies in OC-associated effects on sexual  
99 functioning comes from the congruency hypothesis proposed by Roberts et al. (2013, see also  
100 Roberts et al., 2014). The authors argued that, instead of focusing solely on current OC use or  
101 non-use, one should also compare current use with that during relationship formation. They  
102 based their argument on studies showing that OC use may affect women's mate preferences  
103 (Wedekind et al., 1995; Roberts et al., 2008, but see Winternitz et al., 2017 and Havlíček et  
104 al., 2020), so that changes in OC use might influence sexual satisfaction through shifting  
105 attraction to their partner. Thus, women who started the current relationship while using OC  
106 may show higher sexual satisfaction with their partner when still using OC (congruent state)  
107 than those who discontinued use (incongruent state). Similarly, women who formed the  
108 current relationship not using OC will show higher sexual satisfaction while not using OC  
109 (congruent state) compared to those who subsequently initiate OC use (incongruent state).

110 The first evidence for this hypothesis comes from a study which compared relationship and  
111 sexual satisfaction in 2519 women (Roberts et al., 2012). The study found that women who  
112 used OC at relationship formation were less sexually satisfied with their partner, even though  
113 they were more satisfied in non-sexual aspects of the relationship and were less likely to  
114 separate. It is important to note that, in this analysis, all participants had at least one child with  
115 the partner and none were using OC at survey completion; hence, only those who used OC at  
116 relationship formation were in a non-congruent state. In a follow-up study of 365 couples,  
117 women with incongruent OC usage were again found to be less sexually satisfied with their  
118 partner, whether they had used OC at relationship formation or not (Roberts, Little, et al.,  
119 2014). No similar effects were observed in their male partners.

120 Subsequent tests of the congruency hypothesis have, however, produced mixed results.  
121 Russell et al. (2014) found overall support for the hypothesis based on two samples of 48 and  
122 70 coupled women, showing also that the effect was moderated by perceived attractiveness of  
123 male partners. In their longitudinal within-subject study of 203 women, French & Meltzer  
124 (2020) also found qualified support for the hypothesis: reported sexual satisfaction with  
125 partners reduced when women's OC usage became incongruent. However, they did not find  
126 the same effect using a between-subject analysis comparing different women. Neither did Jern  
127 et al. (2018) in their between-group study of almost 1000 women.

128 Finally, Cobey et al. (2016) tested the congruency hypothesis on a sample of 84 pregnant  
129 women. Based on the idea that hormonal dosage in OC is somewhat similar to those  
130 experienced during pregnancy (Wedekind et al., 1995; Alvergne & Lummaa 2010), the

131 authors predicted that pregnant women who used OC at relationship formation would be more  
132 sexually satisfied than pregnant women who had not. They found that, as predicted, previous  
133 OC users (at relationship formation) reported higher sexual desire towards their partner than  
134 previous non-users. Importantly, however, these differences were restricted to ratings of  
135 partners – there were no between-group differences in extra-pair desire.

136 In view of these mixed results, here we aimed to further test the congruency hypothesis in  
137 four samples of women who were currently not using OC. Two samples consisted of pregnant  
138 women, and two of non-pregnant women who were aiming to conceive. In three samples, we  
139 were further able to collect data from the women's male partners. Based on previous findings,  
140 we predicted that non-pregnant women who used OC when they met their partner would show  
141 lower sexual satisfaction than those who did not. In contrast, we predicted that pregnant  
142 women who used OC when they met their partner would show higher sexual satisfaction than  
143 those who did not. Finally, in line with previous findings, we did not expect any differences in  
144 male partners because the potential consequences of hormonal (in)congruency on sexual  
145 functioning directly affect only women.

146

## 147 **2. Methods**

148 The study was conducted in collaboration with the Department of Obstetrics and Gynecology  
149 of the General University Hospital in Prague, at both the hospital's Centre for Assisted  
150 Reproduction and Center of Fetal Medicine and Ultrasound Gynecological Diagnostics. The  
151 study was approved by the Institutional Review Board of the Faculty of Science, Charles  
152 University (Approval No. 2020/07) and by the Ethics Committee of General University  
153 Hospital in Prague (No. 384/16; 92/17; 2195/18). The data collection for this study was  
154 planned within broader project focusing on the effect of latent toxoplasmosis, MHC similarity  
155 and other factors on human fertility (Hlaváčová et al., 2021a; Hlaváčová et al., 2021b;  
156 Hlaváčová et al., 2021c).

157

### 158 *2.1. Participants*

159 There were two samples of pregnant women. Sample 1 (hereafter referred to as S1) included  
160 173 women in the first trimester of pregnancy, as well as their partners. They were recruited  
161 between November 2017 and November 2019 during medical check-up in the 11<sup>th</sup>-14<sup>th</sup>

162 gestational week in the Center of Fetal Medicine and Ultrasound Gynecological Diagnostics.  
163 Sample 2 (S2) included 323 women, who were also in the first trimester and undergoing the  
164 same medical check-up but were doing so from 20<sup>th</sup> March to 10<sup>th</sup> December 2020 during the  
165 COVID-19 pandemic when women were encouraged to visit the doctor alone wherever  
166 possible; hence S2 consisted only of women, without partners.

167         There were also two samples of non-pregnant women. Sample 3 (S3) consisted of 660  
168 women of reproductive age and 660 men – their partners – recruited between 2016-2018.  
169 These couples were suffering problems with fertility and attended the Center for Assisted  
170 Reproduction. Finally, Sample 4 (S4) included 187 women of reproductive age and their  
171 partners, recruited in the same way at the same place, between 2019-2020 but with a slightly  
172 modified questionnaire (see below).

173         In all four samples, none of the women were using hormonal contraceptives at the  
174 time of participation, as they were either pregnant or actively trying to conceive.

175

## 176         2.2. Procedure – data collection

177 Nurses recruited couples before their examination at the hospital. Participants received  
178 information about the study, signed the consent form to participate in the study, and  
179 completed questionnaires. Nurses instructed participants to complete questionnaires  
180 separately from their partners. Participants completed questionnaires with anonymous codes.  
181 Participation also included blood collection by nurses for the purposes of broader project,  
182 results of which is reported elsewhere (Hlaváčová et al., 2021a; Hlaváčová et al., 2021b;  
183 Hlaváčová et al., 2021c).

184

## 185         2.3. Questionnaires

186 In all datasets, questionnaires began with demographic questions, including date of birth,  
187 education level, size of residence, household income, number of children, length of the  
188 current relationship, smoking history, and health data. There were then two questions about  
189 relationship satisfaction. One asked about general satisfaction (“In general, how satisfied are  
190 you in your relationship with your current partner?”) and one specifically about sexual  
191 satisfaction (“How satisfied are you sexually in your relationship with your current partner?”).  
192 Participants answered both questions on a 7-point scale (1 – completely unsatisfied, 7 –

193 completely satisfied). In sample 4, we extended the relationship and sexual satisfaction part of  
194 the questionnaire by adding two additional standardised measures: the Relationship  
195 Assessment Scale (RAS) (Hendrick, 1988) and the New Sexual Satisfaction Scale (NSSS)  
196 (Štulhofer et al., 2010). The RAS consists of 7 items (2 reverse-scored) answered on a 5-point  
197 Likert scale with possible scores ranging from 7 to 35, where a higher score means greater  
198 relationship satisfaction. Example items include: "How well does your partner meet your  
199 needs?", "In general, how satisfied are you with your relationship?", and "How many  
200 problems are there in your relationship?", all answered on a 5-point satisfaction scale. The  
201 NSSS consists of two 10-item subscales, also answered on a 5-point Likert scale with possible  
202 scores ranging from 20 to 100 for both subscales and 10 to 50 for each subscale separately.  
203 Higher scores indicate greater sexual satisfaction. Subscale A is ego-focused, containing items  
204 like "The intensity of my sexual arousal" and "My body's sexual functioning". Subscale B  
205 focuses on partner and sexual activity, with items like "The balance between what I give and  
206 receive in sex", "My partner's sexual creativity". We used the NSSS because it is a  
207 multidimensional, composite measure of sexual satisfaction that covers multiple domains of  
208 sexual behavior including sexual sensations, sexual awareness and focus, sexual exchange,  
209 emotional closeness, and sexual activity (Štulhofer et al., 2010). For this reason, we chose  
210 NSSS over other commonly used measures such as the Female Sexual Function Index or  
211 Female Sexual Distress Scale (Rosen et al., 2000; Derogatis et al., 2002) because these are  
212 designed for measuring sexual dysfunction rather than sexual satisfaction.

213  
214 Female participants also answered questions concerning their use of hormonal contraception  
215 ("Have you ever used hormonal contraception?"). If they answered positively to this question,  
216 they were asked for more information ("Were you using hormonal contraception at the time  
217 when you met your current partner?", "Which type of hormonal contraception did you use?",  
218 and "Which brand of hormonal contraception did you use?").

219

#### 220 *2.4. Statistical analysis*

221 We performed all statistical analysis in R, version 3.6.2. For all tests, we determined the  
222 statistical level of significance as  $\alpha = 0.05$ . We analysed each sample separately because the  
223 congruency hypothesis leads to different predictions for pregnant and non-pregnant women,  
224 and because methodological differences such as the absence of partners during data collection  
225 in the second sample of pregnant women and the use of an additional questionnaire in the

226 second sample of non-pregnant women. Where possible, we analysed both women and men.  
 227 First, we used non-parametric Kruskal-Wallis because our data did not follow normal  
 228 distribution and we tested the relationship between OC usage during relationship formation  
 229 and sexual/relationship satisfaction. Then we used linear regression to test other factors that  
 230 explain variation in the dependent variables on interest (general relationship satisfaction,  
 231 sexual satisfaction). We had a range of demographic data available that might predict sexual  
 232 and relationship satisfaction (relationship length, number of children, age, education,  
 233 residence size, and household income), so these were added in the models together with use of  
 234 oral contraception. Sample sizes in different linear regressions vary depending on how many  
 235 participants answered the questions for all tested factors. In S3, we missed the item “number  
 236 of children” in our questionnaire at the beginning of the study (the first 185 women and their  
 237 partners); to preserve the larger sample in the main analysis we did not exclude these, but we  
 238 did run the linear regression twice – once with this item and once without. In S4, we did an  
 239 additional analysis using RAS scores, in which we again analysed sexual satisfaction using  
 240 the NSSS A and B subscales independently, as well as the total score (both Subscales A and B  
 241 summed).

### 242 3. Results

243 Demographic and descriptive data are presented in Table 1. Relationship satisfaction  
 244 correlated positively with sexual satisfaction assessment for both women and men in all  
 245 samples. Also, female reports and partner reports about relationship and sexual satisfaction  
 246 were positively correlated in all four samples. The age and education of partners were highly  
 247 positively correlated in all samples (see Table 2). The household income and residence size  
 248 are presented only for women as participants were couples, and these variables were the same.  
 249

250 **Table 1. Demographic and descriptive data for each of the 4 samples.**

Women		Sample 1 (n = 173)	Sample 2 (n = 323)	Sample 3 (n= 660)	Sample 4 (n= 187)
<b>OC during relationship formation</b>	<i>Yes</i>	79 (45.9 %)	118 (36.5 %)	215 (32.6 %)	70 (37.4 %)
	<i>No</i>	93 (54.1 %)	205 (63.5 %)	445 (67.4 %)	117 (62.6 %)
<b>Age (in years)</b>	<i>Mean (SD)</i>	30.4 (4.2)	32 (4.2)	33.4 (4.8)	33.7 (4.8)
	<i>Range</i>	19 – 43	20 – 44	18 – 46	22 – 48
<b>Relationship satisfaction rating</b>	<i>Mean (median)</i>	6.3 (7)	6.1 (7)	6.1 (6)	6.3 (6)
<b>Sexual satisfaction rating</b>	<i>Mean (median)</i>	6.1 (6)	5.9 (6)	6 (6)	5.9 (6)



<b>Relationship length (in months)</b>	<i>Mean (SD)</i> <i>Range</i>	74.2 (51.7) 4 – 216	68.1 (45.3) 4 – 228	80.5 (55.1) 6 – 264	67.9 (44.7) 4 204
<b>Number of children</b>	0 1 2+	104 (62.3 %) 56 (33.5 %) 7 (4.2 %)	171 (53.5 %) 122 (38.1 %) 9 (8.4 %)	346 (76.1 %) 92 (20.2 %) 17 (3.7 %)	152 (82.2 %) 28 (15.1 %) 2 (2.7 %)
<b>Education</b>	<i>Primary</i> <i>High school</i> <i>University</i>	3 (1.8 %) 65 (38.2 %) 102 (60 %)	2 (0.6 %) 96 (30.3 %) 219 (69.1 %)	14 (2.2 %) 330 (50.8 %) 305 (47 %)	5 (2.6 %) 82 (43.4 %) 102 (53 %)
<b>Monthly household income (in thousands CZK)</b>	<30 31–45 46–60 61–75 >76	23 (14.1 %) 45 (27.6 %) 48 (29.5 %) 23 (14.1 %) 24 (14.7 %)	35 (10 %) 71 (22.3 %) 100 (31.4 %) 43 (13.5 %) 70 (21.9 %)	163 (28.8 %) 158 (27.9 %) 130 (22 %) 53 (9.4 %) 62 (10 %)	30 (17.7 %) 37 (21.8 %) 49 (28.8 %) 23 (13.5 %) 31 (18.2 %)
<b>Residence size (citizens in thousands)</b>	<1 1-5 5–50 50–500 >500	19 (11.3 %) 17 (10.1 %) 29 (17.3 %) 7 (4.2 %) 96 (57.1 %)	24 (7.6 %) 27 (8.5 %) 46 (14.5 %) 15 (4.7 %) 206 (64.8 %)	88 (13.6 %) 87 (13.5 %) 129 (20 %) 49 (7.6 %) 293 (45.4 %)	29 (15.7 %) 22 (11.9 %) 36 (19.5 %) 21 (11.4 %) 77 (41.6 %)
<b>Men</b>		<b>Sample 1 (n = 173)</b>	<b>Sample 2 (n = 323)</b>	<b>Sample 3 (n= 660)</b>	<b>Sample 4 (n= 187)</b>
<b>Age (in years)</b>	<i>Mean (SD)</i> <i>Range</i>	33.4 (5.4) 21 – 51	–	35.7 (5.4) 21 – 58	35.2 (5.9) 22 – 56
<b>Relationship satisfaction</b>	<i>Mean (median)</i>	6.2 (7)	–	6.1 (6)	6.3 (6)
<b>Sexual satisfaction</b>	<i>Mean (median)</i>	6 (6)	–	5.9 (6)	5.9 (6)

251

252 **Table 2: Correlations of men's and women's sexual/relationship satisfaction ratings, age,**  
253 **and education**

		<b>Sample 1 (n = 173)</b>	<b>Sample 2 (n = 323)</b>	<b>Sample 3 (n= 660)</b>	<b>Sample 4 (n= 187)</b>
<b>Women's sexual/ relationship satisfaction</b>	<i>rho</i> <i>p</i>	0.553 < 0.001	0.643 < 0.001	0.604 < 0.001	0.398 < 0.001
<b>Men's sexual/ relationship satisfaction</b>	<i>rho</i> <i>p</i>	0.646 < 0.001	–	0.726 < 0.001	0.588 < 0.001
<b>Women's/ men's sexual satisfaction</b>	<i>rho</i> <i>p</i>	0.475 < 0.001	–	0.462 < 0.001	0.358 < 0.001
<b>Women's/ men's relationship satisfaction</b>	<i>rho</i> <i>p</i>	0.447 < 0.001	–	0.329 < 0.001	0.198 0.003
<b>Women's/ men's age</b>	<i>rho</i> <i>p</i>	0.616 < 0.001	–	0.505 < 0.001	0.540 < 0.001
<b>Women's/ men's education</b>	<i>rho</i> <i>p</i>	0.381 < 0.001	–	0.440 < 0.001	0.577 < 0.001

<b>Women's ratings NSSS/ single item</b>	<i>rho</i> <i>p</i>	–	–	–	0.672 < 0.001
<b>Women's ratings RAS/ single item</b>	<i>rho</i> <i>p</i>	–	–	–	0.605 < 0.001
<b>Men's ratings NSSS/ single item</b>	<i>rho</i> <i>p</i>	–	–	–	0.762 < 0.001
<b>Men's ratings RAS/ single item</b>	<i>rho</i> <i>p</i>	–	–	–	0.630 < 0.001

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255

### 256 **3.1. Pregnant women**

#### 257 *3.1.1. Sexual satisfaction*

258 In S1, we found no significant difference in sexual satisfaction between women who used OC  
259 and women who did not use OC during relationship formation ( $\chi^2 = 0.01$ ,  $df = 1$ ,  $p = 0.920$ ,  $\eta^2$   
260  $= 0.006$ , see Fig. 1). Similarly, a linear regression that took into account other potential factors  
261 showed no significant differences in sexual satisfaction between women who used OC and  
262 women who did not use OC during relationship formation in S1 (Table 3). None of the other  
263 predictors showed a significant effect on sexual satisfaction. However, we did find a  
264 significant difference in women's sexual satisfaction in S2 (Fig. 1). Women who used OC  
265 during relationship formation were significantly more sexually satisfied with their partner  
266 than women who did not use OC at that time ( $\chi^2 = 9.42$ ,  $df = 1$ ,  $p = 0.002$ ,  $\eta^2 = 0.026$ ). This  
267 effect persisted when tested in a linear regression model alongside other factors (see Table 3).  
268 Furthermore, women whose relationship length was longer were less sexually satisfied with  
269 their partner, and women with higher household income and larger residences were more  
270 sexually satisfied with their partner.

271 There was no difference in men's sexual satisfaction in S1 depending on whether their partner  
272 was used OC or not used OC during relationship formation (Fig. S1) using either the Kruskal-  
273 Wallis test ( $\chi^2 = 0.13$ ,  $df = 1$ ,  $p = 0.719$ ,  $\eta^2 = 0.005$ ) or linear regression (Table S1).

274

#### 275 *3.1.2. Relationship satisfaction*

276 We found no significant differences in relationship satisfaction between women who used and  
277 did not use OC during relationship formation (Fig.1), in either S1 ( $\chi^2 = 3.66$ ,  $df = 1$ ,  $p =$

278 0.056,  $\eta^2 = 0.016$ ) or S2 ( $\chi^2 = 3.64$ ,  $df = 1$ ,  $p = 0.056$ ,  $\eta^2 = 0.008$ ). Linear regression models  
279 also revealed no significant effects, although in S2 women with higher education and those  
280 with fewer children were more satisfied (Table 4).

281 Similarly in men (S1), there was no difference in relationship satisfaction depending on  
282 whether their partner used OC during relationship formation or not ( $\chi^2 = 0.78$ ,  $df = 1$ ,  $p =$   
283  $0.377$ ,  $\eta^2 = 0.002$ ; Fig. S1) and there was no effect of the other predictors (Table S2).

284

## 285 **3.2. Non-pregnant women**

### 286 *3.2.1. Sexual satisfaction*

287 The Kruskal-Wallis test did not show any significant effect of using OC during relationship  
288 formation on women's sexual satisfaction (Fig. 1), in either S3 ( $\chi^2 = 1.78$ ,  $df = 1$ ,  $p = 0.182$ ,  $\eta^2$   
289  $= 0.001$ ) or S4 ( $\chi^2 = 0.12$ ,  $df = 1$ ,  $p = 0.724$ ,  $\eta^2 = 0.005$ ). When tested with other factors using  
290 linear regression, we also found no significant effects (Table 3). Furthermore, we did not find  
291 a significant effect in S4 of previous OC use on women's sexual satisfaction when analysing  
292 scores on the NSSS Subscale B (partner-centred subscale), Subscale A (ego-centred subscale),  
293 or the complete score of both subscales (Table S3).

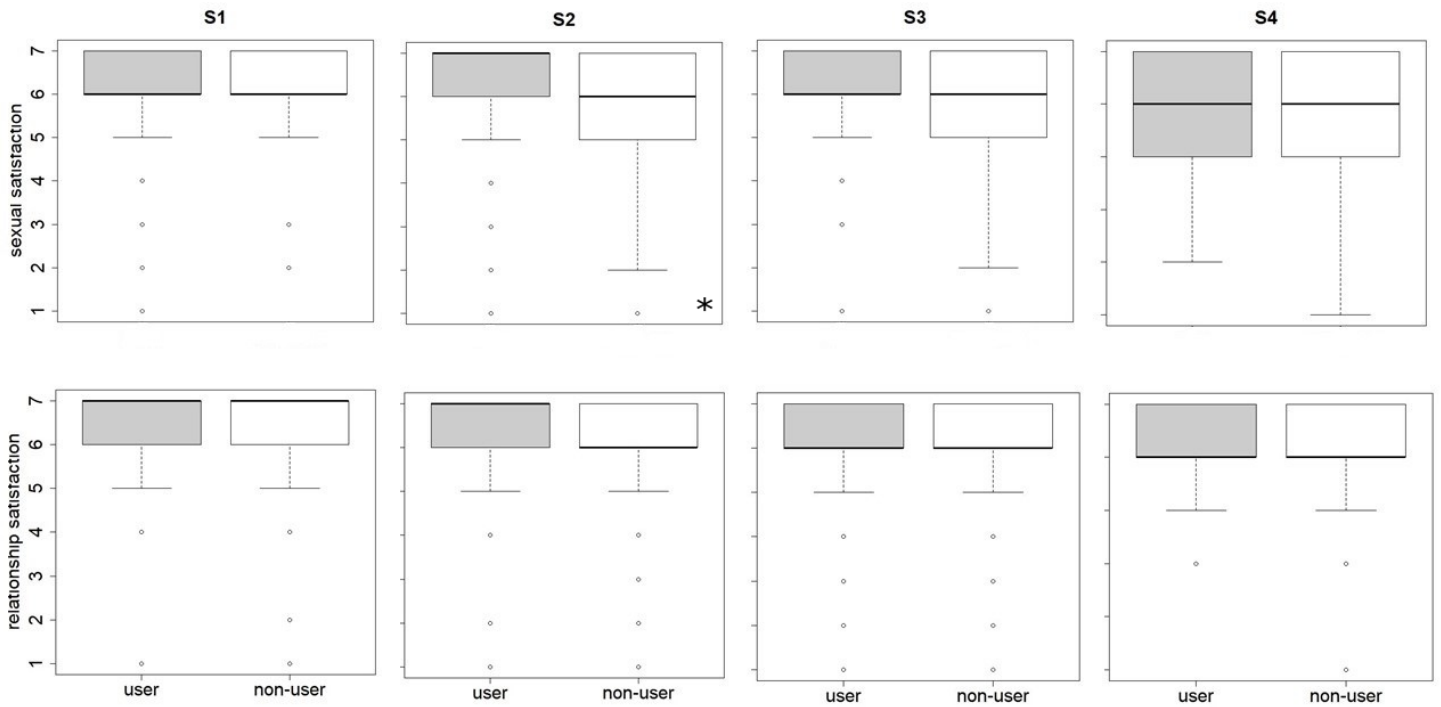
294 Neither was there a significant effect of OC use during relationship formation on men's sexual  
295 satisfaction (Fig. S1) in S3 ( $\chi^2 = 0.66$ ,  $df = 1$ ,  $p = 0.416$ ,  $\eta^2 = 0.001$ ) and S4 ( $\chi^2 = 0.006$ ,  $df = 1$ ,  
296  $p = 0.936$ ,  $\eta^2 = 0.005$ ; see Table S1 for results of linear regression).

297

### 298 *3.2.2. Relationship satisfaction*

299 For relationship satisfaction, we did not find any significant effect of previous OC usage (Fig.  
300 1) in either S3 ( $\chi^2 = 0.24$ ,  $df = 1$ ,  $p = 0.623$ ,  $\eta^2 = 0.001$ ) or S4 ( $\chi^2 = 0.89$ ,  $df = 1$ ,  $p = 0.343$ ,  $\eta^2 =$   
301  $0.001$ ). Regression models including other factors also showed no significant effects (Table  
302 4).

303 Nor were there any significant effects on men's relationship satisfaction (Fig. S1) in either  
304 Kruskal-Wallis tests (S3:  $\chi^2 = 0.50$ ,  $df = 1$ ,  $p = 0.478$ ,  $\eta^2 = 0.001$ ; S4:  $\chi^2 = 0.01$ ,  $df = 1$ ,  $p =$   
305  $0.910$ ,  $\eta^2 = 0.005$ ) or linear regressions (Table S2). Finally, in S4, we found no significant  
306 effect of previous OC use on RAS scores in either women or men (Table S3).



308

309 **Fig. 1. Effect of OC use or non-use during relationship formation on women’s current**  
 310 **sexual (upper row) and relationship satisfaction (lower row), in the four samples (S1 –**  
 311 **S4).** Horizontal bar indicate median, box indicate interquartile range, whiskers indicate upper  
 312 quartile and circles indicate outliers.

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322 **Table 3. Results of linear regression models testing predictors of women’s sexual**  
 323 **satisfaction scores across four samples. Significant models are reported in bold. In S3**  
 324 **first line show results including variable “number of children” in a model, second line is**  
 325 **model without this variable.**

Women – sexual satisfaction	S1			S2			S3			S4		
	Est.	SE	p	Est.	SE	p	Est.	SE	p	Est.	SE	p
<i>Intercept</i>	6.34	0.94	<0.001	4.97	0.79	<0.001	5.77 6.04	0.56 0.45	<0.001 <0.001	5.39	0.68	<0.001
<i>OC use</i>	-0.08	0.22	0.716	0.41	0.17	<b>0.018</b>	0.11 0.13	0.14 0.12	0.438 0.277	0.12	0.18	0.503
<i>Age</i>	-0.01	0.03	0.804	0.03	0.02	0.102	<-0.01 -0.01	0.01 0.01	0.791 0.258	0.02	0.03	0.397
<i>Education</i>	-0.18	0.25	0.468	0.09	0.18	0.634	0.13 0.10	0.14 0.11	0.348 0.377	<0.01	0.16	0.991
<i>Income</i>	0.13	0.08	0.119	0.13	0.06	0.048	0.04 0.07	0.05 0.04	0.487 0.117	<0.01	0.07	0.940
<i>Number of children</i>	-0.15	0.29	0.615	-0.09	0.13	0.510	0.01 -	0.13 -	0.939 -	0.13	0.19	0.476
<i>Relationship length</i>	<0.01	<0.01	0.793	<-0.01	<0.01	<b>0.024</b>	<-0.01 <-0.01	<0.01 <0.01	0.580 0.547	<-0.01	<0.01	0.993
<i>Residence size</i>	0.03	0.08	0.678	-0.14	0.06	<b>0.030</b>	<-0.01 <-0.01	0.04 0.04	0.785 0.856	<-0.01	0.06	0.992
	F (7, 140) = 0.55, p = 0.795			<b>F (7, 295) = 2.92, p = 0.006</b>			F (7, 354) = 0.45, p = 0.873 F (6, 510) = 1.5, p = 0.177			F (7, 141) = 0.26, p = 0.967		

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327

328 **Table 4. Results of linear regression models testing predictors of women’s relationship**  
329 **satisfaction scores across four samples. Significant models are reported in bold. In S3**  
330 **first line show results including variable “number of children” in a model, second line is**  
331 **model without this variable.**

Women – relationship satisfaction	S1			S2			S3			S4		
	Est.	SE	p	Est.	SE	p	Est.	SE	p	Est.	SE	p
<i>Intercept</i>	5.82	0.86	<0.001	4.87	0.83	<0.001	5.28 4.97	0.54 0.46	<0.001 <0.001	5.86	0.47	<0.001
<i>OC use</i>	0.20	0.19	0.316	0.29	0.18	0.115	-0.08 0.07	0.14 0.12	0.577 0.562	0.12	0.12	0.335
<i>Age</i>	0.01	0.02	0.660	0.01	0.02	0.605	<0.01 <0.01	0.01 0.01	0.796 0.420	0.004 0.420	0.01	0.751
<i>Education</i>	-0.14	0.23	0.522	0.40	0.19	<b>0.038</b>	0.32 0.33	0.13 0.11	<b>0.018</b> <b>0.003</b>	0.13	0.11	0.227
<i>Income</i>	0.13	0.07	0.089	0.07	0.07	0.303	0.01 0.06	0.05 0.05	0.845 0.222	0.01	0.05	0.825
<i>Number of children</i>	-0.27	0.23	0.231	-0.28	0.14	<b>0.045</b>	0.09 -	0.13 -	0.445 .	-0.26	0.14	0.063
<i>Relationship length</i>	<0.01	<0.01	0.522	<-0.01	<0.01	0.966	<0.01 <0.01	0.001 0.001	0.545 0.557	<-0.01	<0.01	0.870
<i>Residence size</i>	0.01	0.07	0.933	-0.097	0.07	0.14	-0.02 -0.04	0.04 0.04	0.589 0.314	-0.02	0.04	0.654
	F (7, 143) = 0.99, p = 0.437			<b>F (7, 295) = 2.15, p = 0.039</b>			F (7, 353) = 1.19, p = 0.310 <b>F (6, 510) = 2.87, p = 0.009</b>			F (7, 142) = 1.004, p = 0.431		

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334

#### 335 **4. Discussion**

336 In this study, we tested whether OC use during relationship formation predicts aspects of  
337 relationship satisfaction, especially sexual satisfaction, in two samples of pregnant women  
338 and two samples of non-pregnant women. We found no significant differences in women's  
339 sexual and relationship satisfaction in the first sample of pregnant women (S1) and neither  
340 sample of non-pregnant women (S3, S4). However, in one sample of pregnant women (S2),  
341 those who used OC during relationship formation were more sexually satisfied with their  
342 partner. Only this last result is consistent with the congruency hypothesis. We also tested if  
343 there were differences in men's sexual and relationship satisfaction, depending on whether  
344 their partner used OC when they met, but found no differences in any of the three samples.

345 We tested the congruency hypothesis in both pregnant women and non-pregnant women  
346 because even though no group of women used hormonal contraception, the hypothesis  
347 generates opposing predictions in each of them. To enable this comparison, we recruited both  
348 samples from different departments of the same hospital. There are several advantages of  
349 choosing these particular samples. First, we were able to collect relatively large samples of  
350 couples that are otherwise challenging to reach. Second, couples from both groups were in the  
351 same relationship phase because both groups were planning a family. Finally, the women's  
352 pregnancies were medically confirmed and the scheduled assessment meant that they were all  
353 at almost the same stage of pregnancy. Similarly, we can be sure that the women from the  
354 fertility clinic were not pregnant.

355 In sample 2, we found that pregnant women who used OC when they met their partner were  
356 more sexually satisfied than those who had not. At first sight, this is contrary to what we  
357 would expect according to the congruency hypothesis, since it predicts that women who met  
358 their partner using OC, but who do not currently use it, will report relatively reduced sexual  
359 satisfaction. Pregnant women obviously do not use OC. However, it has been suggested that  
360 their hormonal profile resembles that of women using OC (Wedekind et al., 1995; Alvergne  
361 and Lummaa 2009) and there is some evidence to suggest that pregnant women and OC users  
362 have similar preferences. For example, Jones et al. (2005) found that both these groups  
363 showed stronger preferences for healthy-looking faces than normally cycling women. Our

364 result can therefore be taken as supporting the hormonal congruency hypothesis and are  
365 consistent with those from a similar previous study (Cobey et al., 2016), though that study  
366 was based on a relatively small sample (n= 84, compared to our 323 women).

367 It is worth noting, however, that we failed to find a similar result in the other sample of  
368 pregnant women (S1, n = 173). Sexuality is very complex, and many physical, psychological,  
369 and social changes occur during pregnancy, any of which may outweigh the consequences of  
370 hormonal congruency. For example, as pregnancy advances, women are increasingly afraid of  
371 fetal harm related to sexual activity (Babazadeh et al., 2013). Many pregnant women also  
372 report feeling less attractive during pregnancy (Von Sydow, 1999; Pauls et al., 2008), which  
373 can negatively influence their sexual experience or willingness to have intercourse with their  
374 partner. Other aspects such as frequency of sexual activity, initiation of sexual intercourse or  
375 acceptance of initiation from their partner, sexual desire, and experience of orgasm all tend to  
376 decline with progressing pregnancy (Von Sydow, 1999). A further barrier to sustained sexual  
377 activities during pregnancy is early pregnancy nausea, sometimes connected with fatigue,  
378 stress or even symptoms of depression and anxiety (Fiurašková et al., 2021; Dekkers et al.,  
379 2019; Köken et al., 2008). The issues or dysfunctions mentioned above can lead to sexual  
380 distress (defined as negative emotions towards one's own sexual life, such as guilt, frustration,  
381 stress, anger, or embarrassment (Vannier & Rosen, 2017)). Such feelings can affect women's  
382 sexual satisfaction and could be more potent than any OC congruency effect. However,  
383 because all pregnant women in our samples were in the first trimester, they should still be  
384 relatively unaffected by these changes than women in mid-late pregnancy. Furthermore, an  
385 effect of congruency was detected in the sample of Cobey et al. (2016), who surveyed women  
386 in the second trimester.

387 As the two groups, S1 and S2, were otherwise comparable, an alternative explanation of  
388 inconsistent results is that women in S1 were with their partners at the time they completed  
389 the questionnaires, while those in S2 were not. Although couples in S1 were asked to  
390 complete the questionnaires separately from their partners, it is possible that they still felt  
391 constrained in how they answered questions regarding sexual satisfaction in case their partner  
392 later saw their responses. On the other hand, the women in S2 could be sure that their partners  
393 would not do so because they were not there. In the study by Cobey et al. (2016), in which  
394 they found comparable effects as we did in S2, women were also alone. A second possibility  
395 is the conditions under which S2 women completed the study. Many weeks of COVID-19  
396 lockdown, including enforced time spent together in close spatial proximity and perhaps

397 altered frequency or quality of sexual activities, may have intensified women's experiences  
398 and thus exposed an otherwise difficult to observe between-group difference. However, in S4,  
399 part of the sample (100 couples) was also recruited unplanned during COVID-19 pandemic,  
400 but their partners had to attend the fertility clinic. Discussing the above, we examined the  
401 relationship and sexual satisfaction ratings pre-COVID and during the pandemic in S4. We  
402 found that women did not rate relationship and sexual satisfaction differently in these two  
403 periods (relationship satisfaction: Wilcoxon test,  $W = 6073$ ,  $p = 0.789$ , sexual satisfaction:  $W$   
404  $= 6024.5$ ,  $p = 0.872$ ). This suggests that the differences observed in S2 are likely not caused  
405 by COVID *per se*, but rather that the partner's absence influenced sexual and relationship  
406 satisfaction ratings.

407 In contrast to the results in pregnant women, we did not find significant differences in sexual  
408 satisfaction depending on previous OC use in either sample of non-pregnant women. This was  
409 despite our relatively large sample sizes ( $S3 = 660$ ,  $S4 = 187$ ), which compare very  
410 favourably to most previous studies that did find the hypothesised effect ( $n = 365$ , Roberts et  
411 al., 2014; 48 and 70, Russell et al., 2014). Indeed, S3 achieved quite a large sample size,  
412 although not so large as Jern et al. (2018;  $n = 948$ ), which also failed to find the tested effect.

413 This mixed evidence remains challenging to interpret, but it is worth noting that two recent  
414 studies to find support for the congruency hypothesis used a longitudinal, within-subject  
415 design (Russell et al., 2014; French and Meltzer, 2020). Both found that women whose OC  
416 use was incongruent were less sexually satisfied with their partner, and where tested, they did  
417 not find the same result between subjects (French and Meltzer, 2020). This suggests that  
418 individual differences between women (including but not limited to their hormonal levels and  
419 how these react to OC use) might be more substantial than the purported OC congruency  
420 effect. This methodological difference in approaches could be crucial. Investigating how OC  
421 discontinuation affects sexual and relationship satisfaction in individual women should in  
422 future include the within-subject design wherever possible.

423 The effect of previous OC usage on general relationship satisfaction (i.e. different from sexual  
424 aspects) was not statistically significant in any of the four samples. This is in line with  
425 previous studies (e.g. Roberts et al., 2012, 2014) and is not unexpected if the congruency  
426 effect works as a result of women's altered romantic partner preference, which would be  
427 expected to have a much more direct and profound impact on sexual attraction to the partner  
428 than other aspects of the relationship.



429 Similarly, we also tested the effect of women's OC former use on their male partners' sexual  
430 and relationship satisfaction, as this is still a somewhat neglected area. Women's  
431 attractiveness (as perceived by men) varies across the menstrual cycle and depending on her  
432 OC use (Cobey et al., 2013; Kuukasjärvi et al., 2004; Havlíček et al., 2006), but such effects  
433 should be related only to the woman's current hormonal state. In contrast, an association with  
434 congruency is less likely to affect men unless it is an indirect result of their partner's  
435 behaviour towards them. Indeed, one previous study (Roberts et al., 2014) did not find any  
436 evidence for an effect of OC congruency on either men's general relationship or sexual  
437 satisfaction. Similarly, we did not find any such differences.

438

#### 439 **4.1. Study Limitations**

440 Some differences in our study design may have affected the chance to find effects found by  
441 previous studies. We have already mentioned above that our samples are between-groups by  
442 design, whereas a more sensitive approach would use a longitudinal design. In addition to  
443 this, perhaps the most severe limitation is that participants may have had concerns about their  
444 partner seeing their answers and therefore may not have answered entirely honestly. Whereas  
445 previous studies recruited and tested women or couples mainly online, we recruited couples in  
446 person through nurses in the hospital. While completing the questionnaires, participants were  
447 sitting close to each other in a waiting room and had limited control over what their partners  
448 saw, except the S2 sample, where pregnant women participated without a partner.

449 Furthermore, couples in samples 3 and 4 completed the forms at the fertility clinic. People  
450 visit this clinic after unsuccessful attempts to conceive naturally. Because it is a stressful time  
451 for many couples (Maroufizadeh et al., 2019), it could result in a biased sample of people, as  
452 less satisfied couples were more likely to break up than decide to visit the fertility clinic. This  
453 is perhaps reflected in somewhat lower variability in the assessment of both sexual and  
454 relationship satisfaction, which was typically very high (most were scores of 6 or 7 out of 7).  
455 This could have produced a ceiling effect – meaning that we were unable to find the predicted  
456 effect, even if it exists. Indeed, pre-selection of relatively satisfied couples is likely to be a  
457 problem of recruiting couples to studies, in general, since there is a higher probability that  
458 both partners will agree to participate if they are satisfied, rather than dissatisfied, in their  
459 relationship. However, it is perhaps also worth mentioning here that because this study was  
460 also part of a larger project focusing on effects of latent toxoplasmosis on fertility (Hlaváčová  
461 et al., 2021a; Hlaváčová et al., 2021b; Hlaváčová et al., 2021c), some couples might have

462 been motivated to participate in order to receive results of toxoplasmosis tests, as acute  
463 Toxoplasma infection during pregnancy may have serious consequences for a foetus, and for  
464 which they would otherwise have to pay.

465 In samples 1-3, participants' overall and sexual satisfaction were assessed by means of a  
466 single item. We used a single-item measure because the current study was part of a larger  
467 project (see above), which meant that inclusion of each item had to be carefully considered in  
468 order to limit the burden on participants. It is possible that this approach is less sensitive than  
469 using a multi-item questionnaire. However, Jern et al. (2014) provide evidence that such brief  
470 measures can compare favourably with multi-item scales. They found significant positive  
471 correlations between relationship and sexual satisfaction as assessed by a single composite of  
472 two items drawn from the study by Roberts et al. (2014) with their multi-item equivalents  
473 (Perceived Relationship Quality Components – PRQC and the FSFI sexual satisfaction  
474 subscale). These results were further confirmed in S4 where we used RAS to assess  
475 relationship satisfaction and NSSS to assess sexual satisfaction, as well as their single-item  
476 equivalents. In both cases there was a high correlation between the overall score and the  
477 single-item equivalent (Table 2). Nevertheless, we would recommend using multi-item  
478 questionnaires wherever possible, because analysis of individual subscales allow for more  
479 differentiated assessment of relationship and sexual satisfaction as compared to the single-  
480 item measure.

481 Finally, there is some evidence of the influence of estrogen dosage on aspects of relationship  
482 functioning, such as relationship jealousy (Cobey et al., 2011). Therefore, we intended to test  
483 the effect of hormonal doses contained in various contraception formulations. Where possible  
484 therefore, we obtained information on the OC brand that women used, so we could make an  
485 estimation of hormonal dose. Unfortunately, we were not able to collect a sufficiently large  
486 sample size to do this analysis, because many women could not remember their brand.

487

## 488 5. Conclusions

489

490 The various effects of OC on women's sexuality and relationships show inconsistent patterns  
491 and need further carefully designed large-scale studies. This point was recently emphasized in  
492 the position paper by the European Society of Sexual Medicine: "there is not enough evidence  
493 to draw a clear algorithm for the management of HC-induced sexual dysfunction, and further

494 studies are warranted before conclusions can be drawn” (Both et al., 2019). Our paper further  
495 illustrates these points. We found some support for the congruency hypothesis in one of our  
496 samples of pregnant women, but not in another sample of pregnant women and not in either of  
497 two samples of non-pregnant women. Although we tested the hypothesis on four relatively  
498 large samples, the study had some specific limitations, such as using a between-subject design  
499 and pre-selection of mostly satisfied couples. While the recruitment of participants in person  
500 (i.e. not online) has specific advantages, it is of critical importance that partners can complete  
501 the questionnaire separately and feel safe to answer honestly. It is therefore of interest that the  
502 only sample where results matched the prediction of the congruency hypothesis (S2) was also  
503 the only sample where all women completed questionnaires in the absence of their partner.  
504 Further within-subject studies that avoid these problems are needed, especially while focusing  
505 on OC dosage in different OC formulations and ideally in collaboration with a gynaecologist  
506 who prescribes a particular formulation, as many women do not recall the brand of their OC.  
507 This remains a very challenging but important task for researchers.

508

509

#### 510 **Conflict of interest**

511 None.

512

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#### 521 **References**

522 Arowojolu, A. O., Gallo, M. F., Lopez, L. M., Grimes, D. A., & Garner, S. E. (2009).  
523 Combined oral contraceptive pills for treatment of acne. In A. O. Arowojolu (Ed.),  
524 *Cochrane Database of Systematic Reviews*, pp. 1–48.

- 525 <https://doi.org/10.1002/14651858.CD004425.pub4>
- 526 Babazadeh, R., Mirzaii Najmabadi, K., & Masomi, Z. (2013). Erratum: Changes in sexual  
527 desire and activity during pregnancy among women in Shahroud, Iran. *International*  
528 *Journal of Gynecology and Obstetrics*, *121*(3), 294.  
529 <https://doi.org/10.1016/j.ijgo.2013.03.001>
- 530 Basson, R., Leiblum, S., Brotto, L., Derogatis, L., Fourcroy, J., Fugl-Meyer, K., ... Weijmar  
531 Schultz, W. (2003). Definitions of women's sexual dysfunction reconsidered:  
532 Advocating expansion and revision. *Journal of Psychosomatic Obstetrics and*  
533 *Gynecology*, *24*(4), 221–229. <https://doi.org/10.3109/01674820309074686>
- 534 Beisert, M., Pilarczyk, K., Zakrzewska, M., & Pawlaczyk, M. (2020). Sexual satisfaction and  
535 self-esteem in women with acne. *Journal of Cosmetic Dermatology*, *19*(7), 1768–1773.  
536 <https://doi.org/10.1111/jocd.13207>
- 537 Both, S., Lew-Starowicz, M., Luria, M., Sartorius, G., Maseroli, E., Tripodi, F., ... Vignozzi,  
538 L. (2019). Hormonal contraception and female sexuality: Position statements from the  
539 European Society of Sexual Medicine (ESSM). *Journal of Sexual Medicine*, *16*(11),  
540 1681–1695. <https://doi.org/10.1016/j.jsxm.2019.08.005>
- 541 Burrows, L. J., Basha, M., & Goldstein, A. T. (2012). The effects of hormonal contraceptives  
542 on female sexuality: A Review. *Journal of Sexual Medicine*, *9*(9), 2213–2223.  
543 <https://doi.org/10.1111/j.1743-6109.2012.02848.x>
- 544 Cobey, K. D., Buunk, A. P., Pollet, T. V., Klipping, C., & Roberts, S. C. (2013). Men  
545 perceive their female partners, and themselves, as more attractive around ovulation.  
546 *Biological Psychology*, *94*(3), 513–516. <https://doi.org/10.1016/j.biopsycho.2013.09.011>
- 547 Cobey, K. D., Pollet, T. V., Roberts, S. C., & Buunk, A. P. (2011). Hormonal birth control  
548 use and relationship jealousy: Evidence for estrogen dosage effects. *Personality and*  
549 *Individual Differences*, *50*(2), 315–317. <https://doi.org/10.1016/j.paid.2010.09.012>
- 550 Dekkers, G. W. F., Broeren, M. A. C., Truijens, S. E. M., Kop, W. J., & Pop, V. J. M. (2019).  
551 Hormonal and psychological factors in nausea and vomiting during pregnancy.  
552 *Psychological Medicine*, *50*(2), 229–236. <https://doi.org/10.1017/S0033291718004105>
- 553 Derogatis, L. R., Rosen, R., Leiblum, S., Burnett, A., & Heiman, J. (2002). The Female  
554 Sexual Distress Scale (FSDS): Initial validation of a standardized scale for assessment of

555 sexually related personal distress in women. *Journal of Sex and Marital Therapy*, 28(4),  
556 317–330. <https://doi.org/10.1080/00926230290001448>

557 Fiurašková, K., Havlíček, J., & Roberts, S. C. (2021). Dietary and psychosocial correlates of  
558 nausea and vomiting in pregnancy. *Food Quality and Preference*, 93(September 2020).  
559 <https://doi.org/10.1016/j.foodqual.2021.104266>

560 Graham, C. A., Sanders, S. A., Milhausen, R. R., & McBride, K. R. (2004). Turning on and  
561 turning off: A focus group study of the factors that affect women’s sexual arousal.  
562 *Archives of Sexual Behavior*, 33(6), 527–538.  
563 <https://doi.org/10.1023/B:ASEB.0000044737.62561.f0>

564 Havlíček, J., Dvořáková, R., Bartoš, L., & Flegr, J. (2006). Non-advertized does not mean  
565 concealed: Body odour changes across the human menstrual cycle. *Ethology*, 112(1), 81–  
566 90. <https://doi.org/10.1111/j.1439-0310.2006.01125.x>

567 Havlíček, J., Winternitz, J., & Roberts, S. C. (2020). Major histocompatibility complex-  
568 associated odour preferences and human mate choice: Near and far horizons.  
569 *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1800).  
570 <https://doi.org/10.1098/rstb.2019.0260>

571 Hendrick, S. S. (1988). A generic measure of relationship satisfaction. *Journal of Marriage*  
572 *and Family*, 50, 93–98.

573 Hlaváčová, J., Flegr, J., Fiurašková, K., & Kaňková, Š. (2021c). Relationship between latent  
574 toxoplasmosis and depression in clients of a center for assisted reproduction. *Pathogens*,  
575 10(8), 1052. <https://doi.org/10.3390/pathogens10081052>

576 Hlaváčová, J., Flegr, J., Řežábek, K., Calda, P., & Kaňková, Š. (2021a). Association between  
577 latent toxoplasmosis and fertility parameters of men. *Andrology*, 9(3), 854–862.  
578 <https://doi.org/10.1111/andr.12969>

579 Hlaváčová, J., Flegr, J., Řežábek, K., Calda, P., & Kaňková, Š. (2021b). Male-to-female  
580 presumed transmission of toxoplasmosis between sexual partners. *American Journal of*  
581 *Epidemiology*, 190(3), 386–392. <https://doi.org/10.1093/aje/kwaa198>

582 Kennedy T.G., & Armstrong D.T. (1976). Induction of vaginal mucification in rats. *Steroids*,  
583 27(3), 423–430. [https://doi.org/10.1016/0039-128X\(76\)90061-1](https://doi.org/10.1016/0039-128X(76)90061-1)

584 Köken, G., Yilmazer, M., Cosar, E., Sahin, F. K., Cevrioglu, S., & Gecici, Ö. (2008). Nausea

- 585 and vomiting in early pregnancy: Relationship with anxiety and depression. *Journal of*  
586 *Psychosomatic Obstetrics and Gynecology*, 29(2), 91–95.  
587 <https://doi.org/10.1080/01674820701733697>
- 588 Kuukasjärvi, S., Eriksson, C. J. P., Koskela, E., Mappes, T., Nissinen, K., & Rantala, M. J.  
589 (2004). Attractiveness of women's body odors over the menstrual cycle: The role of oral  
590 contraceptives and receiver sex. *Behavioral Ecology*, 15(4), 579–584.  
591 <https://doi.org/10.1093/beheco/arh050>
- 592 Maroufizadeh, S., Hosseini, M., Foroushani, A. R., Omani-Samani, R., & Amini, P. (2019).  
593 The relationship between perceived stress and marital satisfaction in couples with  
594 infertility: Actor-partner interdependence model. *International Journal of Fertility and*  
595 *Sterility*, 13(1), 66–71. <https://doi.org/10.22074/ijfs.2019.5437>
- 596 Maseroli, E., Santangelo, A., Lara-Fontes, B., Quintana, G. R., Mac Cionnaith, C. E.,  
597 Casarrubea, M., ... Pfaus, J. G. (2020). The non-aromatizable androgen  
598 dihydrotestosterone (DHT) facilitates sexual behavior in ovariectomized female rats  
599 primed with estradiol. *Psychoneuroendocrinology*, 115(July 2019), 104606.  
600 <https://doi.org/10.1016/j.psyneuen.2020.104606>
- 601 Pauls, R. N., Occhino, J. A., & Dryfhout, V. L. (2008). Effects of pregnancy on female sexual  
602 function and body image: A prospective study. *Journal of Sexual Medicine*, 5(8), 1915–  
603 1922. <https://doi.org/10.1111/j.1743-6109.2008.00884.x>
- 604 Rabe, T., Kowald, A., Ortmann, J., & Rehberger-Schneider, S. (2000). Inhibition of skin 5 $\alpha$ -  
605 reductase by oral contraceptive progestins in vitro. *Gynecological Endocrinology*, 14(4),  
606 223–230. <https://doi.org/10.3109/09513590009167685>
- 607 Roberts, S. C., Cobey, K. D., Klapilová, K., & Havlíček, J. (2013). An evolutionary approach  
608 offers a fresh perspective on the relationship between oral contraception and sexual  
609 desire. *Archives of Sexual Behavior*, 42(8), 1369–1375. [https://doi.org/10.1007/s10508-](https://doi.org/10.1007/s10508-013-0126-9)  
610 013-0126-9
- 611 Roberts, S. C., Cobey, K. D., Republic, C., & Republic, C. (2014). Oral contraception and  
612 romantic relationships – From the lab to the real world. *Human Ethology Bulletin*, 29, 4–  
613 13.
- 614 Roberts, S. C., Gosling, L. M., Carter, V., & Petrie, M. (2008). MHC-correlated odour  
615 preferences in humans and the use of oral contraceptives. *Proceedings of the Royal*

- 616 *Society B: Biological Sciences*, 275(1652), 2715–2722.  
617 <https://doi.org/10.1098/rspb.2008.0825>
- 618 Roberts, S. C., Little, A. C., Burriss, R. P., Cobey, K. D., Klapilov??, K., Havlíček, J., ...  
619 Petrie, M. (2014). Partner choice, relationship satisfaction, and oral contraception: The  
620 Congruency Hypothesis. *Psychological Science*, 25(7), 1497–1503.  
621 <https://doi.org/10.1177/0956797614532295>
- 622 Rosen, R., Brown, C., Heiman, J., Leiblum, S., Meston, C., Shabsigh, R., ... D'Agostino, R.  
623 (2000). The Female Sexual Function Index (FSFI): A multidimensional self-report  
624 instrument for the assessment of female sexual function. *Journal of Sex and Marital*  
625 *Therapy*, 26(2), 191–205. <https://doi.org/10.1080/009262300278597>
- 626 Štulhofer, A., Buško, V., & Brouillard, P. (2010). Development and bicultural validation of  
627 the new sexual satisfaction scale. *Journal of Sex Research*, 47(4), 257–268.  
628 <https://doi.org/10.1080/00224490903100561>
- 629 Vannier, S. A., & Rosen, N. O. (2017). Sexual distress and sexual problems during  
630 pregnancy: Associations with sexual and relationship satisfaction. *Journal of Sexual*  
631 *Medicine*, 14(3), 387–395. <https://doi.org/10.1016/j.jsxm.2016.12.239>
- 632 Von Sydow, K. (1999). Sexuality during pregnancy and after childbirth: A metacontent  
633 analysis of 59 studies. *Journal of Psychosomatic Research*, 47(1), 27–49.  
634 [https://doi.org/10.1016/S0022-3999\(98\)00106-8](https://doi.org/10.1016/S0022-3999(98)00106-8)
- 635 Watkins, C. D., DeBruine, L. M., Smith, F. G., Jones, B. C., Vukovic, J., & Fraccaro, P.  
636 (2011). Like father, like self: Emotional closeness to father predicts women's preferences  
637 for self-resemblance in opposite-sex faces. *Evolution and Human Behavior*, 32(1), 70–  
638 75. <https://doi.org/10.1016/j.evolhumbehav.2010.09.001>
- 639 Wedekind, C., & Furi, S. (1997). Body odour preferences in men and women: do they aim for  
640 specific MHC combinations or simply heterozygosity? *Proceedings. Biological Sciences*  
641 */ The Royal Society*, 264(1387), 1471–1479. <https://doi.org/10.1098/rspb.1997.0204>
- 642 Wiegatz, I., Kutschera, E., Lee, J. H., Moore, C., Mellinger, U., Winkler, U. H., & Kuhl, H.  
643 (2003). Effect of four different oral contraceptives on various sex hormones and serum-  
644 binding globulins. *Contraception*, 67(1), 25–32. [https://doi.org/10.1016/S0010-](https://doi.org/10.1016/S0010-7824(02)00436-5)  
645 [7824\(02\)00436-5](https://doi.org/10.1016/S0010-7824(02)00436-5)

646 Winternitz, J., Abbate, J. L., Huchard, E., Havlíček, J., & Garamszegi, L. Z. (2017). Patterns  
647 of MHC-dependent mate selection in humans and nonhuman primates: a meta-analysis.  
648 *Molecular Ecology*, 26(2), 668–688. <https://doi.org/10.1111/mec.13920>

649