

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

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## Abstract

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

**Keywords:** hormonal contraception, pill, relationship satisfaction, congruency hypothesis, 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).

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

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

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

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

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

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

## 2. Methods

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

### 2.1. Participants

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

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

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

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

## *2.2. Procedure – data collection*

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

## *2.3. Questionnaires*

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

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

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

#### *2.4. Statistical analysis*

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

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

### 3. Results

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

**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>	Primary High school University	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)

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

		Sample 1 (n = 173)	Sample 2 (n = 323)	Sample 3 (n = 660)	Sample 4 (n = 187)
<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

### 3.1. Pregnant women

#### 3.1.1. Sexual satisfaction

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

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

#### 3.1.2. Relationship satisfaction

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

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

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

### 3.2. Non-pregnant women

#### 3.2.1. Sexual satisfaction

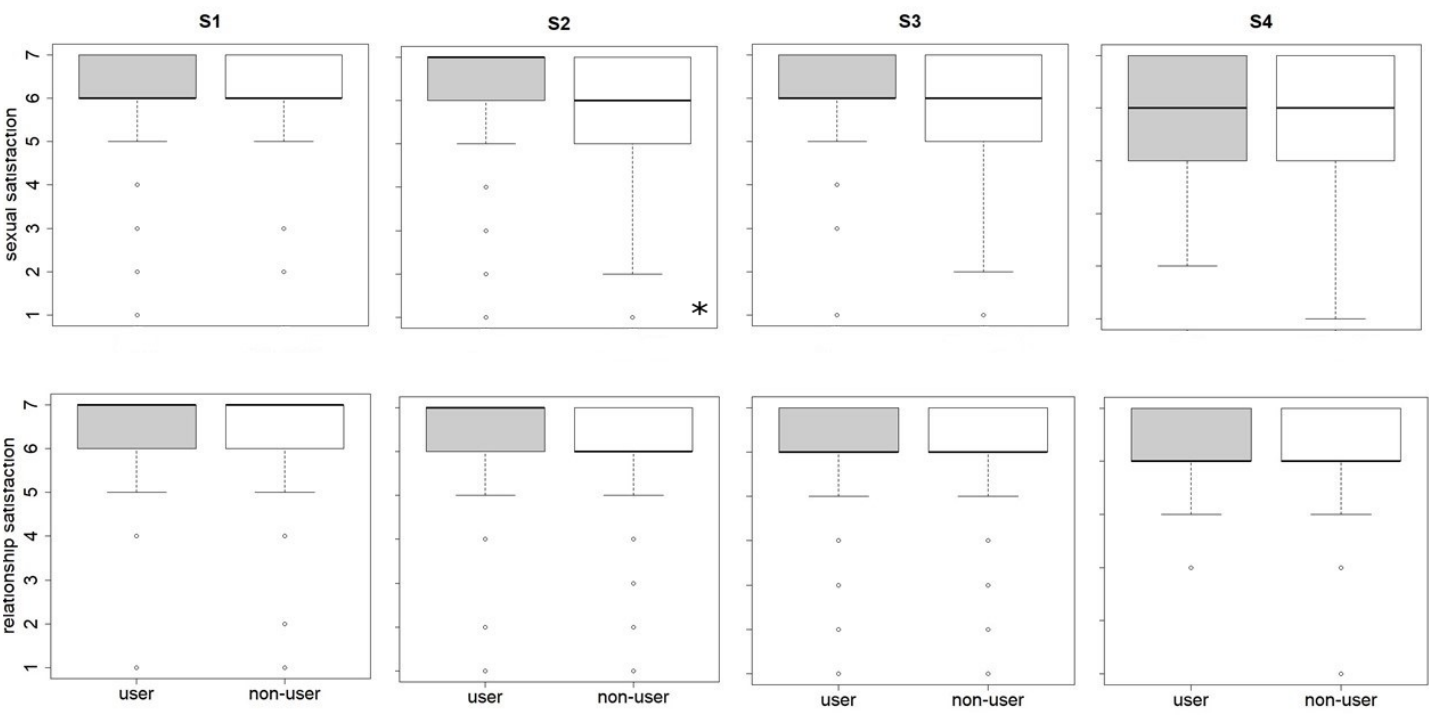
The Kruskal-Wallis test did not show any significant effect of using OC during relationship formation on women's sexual satisfaction (Fig. 1), in either S3 ( $\chi^2 = 1.78$ ,  $df = 1$ ,  $p = 0.182$ ,  $\eta^2 = 0.001$ ) or S4 ( $\chi^2 = 0.12$ ,  $df = 1$ ,  $p = 0.724$ ,  $\eta^2 = 0.005$ ). When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

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

#### 3.2.2. Relationship satisfaction

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

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



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.**

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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**Table 4. Results of linear regression models testing predictors of women’s relationship**

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**satisfaction scores across four samples. Significant models are reported in bold. In S3**

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**first line show results including variable “number of children” in a model, second line is**

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**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		

#### 4. Discussion

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

## 5. Conclusions

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

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

#### **Conflict of interest**

None.

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