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Hormonal Contraception and Anti-depressant Use in Sweden: An Intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA)

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3 **Hormonal Contraception and Anti-depressant Use in Sweden: An**
4 **Intersectional Multilevel Analysis of Individual Heterogeneity and**
5 **Discriminatory Accuracy (MAIHDA)**
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ABSTRACT

Objectives From a reproductive justice framework, we aimed to investigate how a possible association between hormonal contraceptive (HC) and anti-depressants use (as a proxy for depression) is distributed across intersectional strata in the population. We aimed to visualize how intersecting power dynamics may operate in combination with HC use to predispose for depression. Our main hypothesis was that the previously observed association between HC and anti-depressants use would vary between strata, being more pronounced in more oppressed intersectional contexts. For this purpose, we applied an intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) approach.

Design Observational prospective cohort study using record linkage of national Swedish registers.

Setting The population of Sweden.

Participants All 978 761 women aged 12-30 residing in Sweden 2010, without a recent pregnancy and alive during one-year follow-up.

Primary and secondary outcome measures Use of any anti-depressant, meaning being dispensed at least one anti-depressant (ATC N06A) during follow-up.

Results Previously mentally healthy hormonal contraceptive users had an odds ratio of 1.79 for use anti-depressants compared to non-users, whereas this number was 1.28 for women with previous mental health issues. The highest absolute risks for anti-depressant use were uniformly found in strata with previous mental health issues, with highest risk in women aged 24-30 with no immigrant background, low income, and HC use (51.4%). The largest difference in anti-depressant use between HC users and non-users was found in teenagers, and in adult women of immigrant background with low income. Of the total individual variance in the latent propensity of using antidepressant 9.01% (healthy) and 8.16% (with previous mental health issues) was found at the intersectional stratum level.

Conclusions Our study suggests teenagers and women with immigrant background and low income could be more sensitive to mood effects of HC, a heterogeneity important to consider moving forward.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Entire Swedish population of women aged 12-30 included
- Pharmacy dispensing automatically linked to individual personal identification number in Sweden through the Swedish Prescribed Drug Register and thus very reliable
- Intersectional MAHIDA is a fruitful way of epidemiologically investigating heterogeneity within a population while considering individual conditions determined by societal power dimensions such as class, gender and race
- Anti-depressant dispensing is not a perfect proxy for depression
- Registers cannot not measure actual use of any medication

INTRODUCTION

In recent years, attention in the medical community has increasingly been drawn towards depression and other adverse effects on mood related to use of hormonal contraception (HC).(1, 2) Discontinuation rates are high, with mood disturbances or depression being one of the most common complaints.(3-5) Two large epidemiological studies, one in Denmark and the other performed in Sweden, have recently shown a higher risk of anti-depressants and psychotropic drugs use in women on HC, particularly in teenagers.(6, 7) Randomized controlled trials are rare, but suggest a negative influence of HC on well-being and sexual function,(8, 9) as well as evidence of HC modulating brain activity with subsequent mood alterations in some women.(10, 11) Even though oestrogen and progesterone are known to affect mood,(12) the growing body of evidence in this field is contradictory, with recent reviews concluding that both protective and negative effects of HC on mood exist and more research is needed.(13-16) Despite this uncertainty, many scholars agree that certain subgroups of women seem more vulnerable to psychological side effects of HC than others, particularly teenagers and women with previous mental health issues.(10, 13, 17-20) A call for further investigation into these vulnerable subgroups has been made.(14)

A fruitful way of epidemiologically investigating heterogeneity within a population while considering individual conditions determined by societal power dimensions such as class, gender and race has been developed through intersectional theory in recent years.(21-26) Intersectionality theory was first articulated by Black feminist scholars as a way of understanding how an individual inhabits and is formed by more than one social relation such as gender “race” or class, and how these classification systems interconnect to create specific contexts of oppression or privilege.(27, 28) These categorizations should not be seen as individual “risky” identities, but as the social, political and economic contextual conditions that outline our lives through structural inequalities.(29) Reproductive justice is a theoretical framework that builds upon intersectionality and centres diverse groups of unprivileged women’s reproductive experiences to recognize that societal context and differing resources available shape reproductive health.(30) Applying a reproductive justice framework, it becomes clear that we need to take notice of disparate sociocultural contexts and interlocking power dimensions to understand different patterns of usage as well as possible diverse responses to HC.(31, 32)

To operationalize an intersectional mapping of heterogeneity in use of anti-depressants in relation to HC on a population level, we used a multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA).(21-23, 33, 34) We created

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3 intersectional strata based on previous literature showing that age, socioeconomic position,
4 and previous mental illness are relevant intersecting dimensions in understanding the relation
5 between HC and depression.(17, 20, 35, 36)
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8 We conceptualise the intersectional strata as social contexts rather than static
9 individual traits, thereby visualising how intersecting power dynamics can act in combination
10 with HC to predispose for depressive mood. Our main hypothesis was that the previously
11 observed association between HC and use of anti-depressants would vary between strata and
12 that this association would be more pronounced in more oppressed intersectional contexts.
13 We investigate this hypothesis on the whole population of women susceptible to HC use in
14 Sweden.
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22 **METHOD**

23 **Databases and study population**

24 After allowance from the Swedish Ethical Authority and the data safety committees from
25 Statistics Sweden and the Swedish National Board of Health and Welfare, we obtained a
26 database created by record linkage of several nationwide registers administered by Statistics
27 Sweden (the Swedish Population Register and the Longitudinal Integration Database for
28 Health Insurance and Labour Market Studies, LISA) and the Swedish National Board of
29 Health and Welfare (National Patient Register, the Swedish Prescribed Drug Register (SPDR)
30 and the Cause of Death Register). The Swedish authorities linked the registries using a unique
31 personal identification number, but the database was anonymized before delivering it to us.
32 We defined an initial cohort containing all 1 064 171 women aged 12 - 30 years residing in
33 Sweden 1st January 2010 and obtained individual level data on medication use from SPDR,
34 which contain all dispensed drug prescriptions at Swedish pharmacies since 2006.
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45 Every woman was assigned an individual baseline date, defined by the first
46 dispensed prescription of an HC drug between 1 January 2010 and 31 December 2014 after
47 12 years of age. If a woman did not fill an HC prescription during this period, she was
48 assigned a date midmost her own baseline time, i.e. July 2012 for adults, but later for the
49 youngest girls. From the individual baseline date, the women were followed for one year to
50 find out if a prescription of an antidepressant was dispensed. Data was also collected on
51 psychiatric disorders and psychotropic drug use in the past three years (see Assessment of
52 variables). After excluding women with incomplete follow-up time due to death, emigration,
53 missing information on country of birth, and pregnancies one year before and after the
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3 baseline, the final database consisted of 978 761 women. This database was divided into two
4 cohorts according to the presence or absence of previous mental health issues, see Figure 1.
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8 **Assessment of variables**

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10 Users of HC were defined as any women who, according the SPDR, filled a prescription of
11 HC (Anatomical Therapeutical Chemical (ATC) classification system codes G02B, G03AA-
12 C) between 1 January 2010 and 31 December 2014, while non-users did not have a
13 prescription filled during the same period. Most prescriptions of HC are acquired via a
14 midwife in Sweden, although physicians also can prescribe, and the prescriptions can be
15 dispensed by pharmacies annually or every three months.
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21 Anti-depressant use, the outcome of our study, was defined, according to the
22 SPDR, as being dispensed at least one prescription of antidepressants (ATC: N06A) during
23 the one-year follow-up.
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26 Previous mental health issues were defined as having any psychiatric disorder
27 (ICD: F00-F99) or psychotropic drug use (ATC: N05A, N05B, N06A) in the past three years.
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30 Pregnancies one year previous to baseline and during follow-up were identified
31 according to the 2019 version of the Nordic Diagnosis-Related Group classification
32 (NordDRG), Major Diagnostic Categories codes M14 for pregnancy, delivery and post-
33 partum care.(37)
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37 We used family level data on income as of 31 December 2010 from Statistics
38 Sweden's LISA. Individualized disposable family income was calculated by dividing the total
39 disposable income of the family by the number of family members, taking into account the
40 different consumption weights of adults and children determined by Statistics Sweden.
41 Thereafter, we created three categories (i.e., low, medium, and high) of income using tertile
42 cut-offs based on the total Swedish population aged 18 - 80 years. We considered the high-
43 income category as the reference in the comparisons.
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49 We defined immigrant status at the family level as no family member >18 years
50 of age born in Sweden, since understanding of and access to institutions such as health care
51 differ depending on social position such as it is constructed by the power dimensions of
52 race/immigration, as well as the experience of xenophobia. This variable should therefore be
53 considered as an effort to capture a social position affecting possibilities and life trajectories
54 rather than an essentialist view of otherness.
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3 We categorized age at the individual baseline into the following groups: 12 to
4 17, 18 to 23, and 24 to 30 years to capture age specific conditions of adolescents, young
5 adults, and adult women.
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10 **Intersectional Strata**

11 We generated 36 intersectional strata within each cohort stratified by previous mental health
12 issues, by combining three categories of age, three categories of income, two categories of
13 immigrant background, and finally two categories of HC use. Mental health issues can be
14 considered as a valid category of intersectional investigation in a society that consider an able
15 body and mind vital, in other words relating to the power dimension of able-bodiedness,(38,
16 39) but was also included in the analysis since it is a strong determinant of antidepressant use
17 that needs to be addressed. We could consider that over and above individual characteristics,
18 mental illness-related stigma may condition inequities in health care.(40) As with gender or
19 income, able-bodiedness concerning mental health can therefore be conceptualized as a
20 contextual dimension when defining intersectional strata.
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31 **Statistical analysis**

32 We performed an intersectional MAIHDA with individual women at the first level and the 36
33 intersectional strata at the second level stratified by previous mental health issues, see
34 Supplementary material 1-4. The risk of antidepressant use was thus analysed through two
35 successive multilevel logistic regression models distinguishing between measures of
36 association and measures of variance and discriminatory accuracy.
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43 *Model 1*

44 The first model included only an intercept and a random effect for the intersectional strata
45 with no covariates. In this model 1 we first (i) performed a simple analysis of components of
46 variance and calculated the Variance Partition Coefficient (VPC). That is, the share
47 (expressed as a percentage) of the total individual variance in the latent propensity of
48 antidepressant use that is at the intersectional strata level. In this simple model, the VPC
49 correspond with the Intraclass Correlation Coefficient (ICC) which informs on the clustering
50 of antidepressant use within intersectional strata. The VPC values extend from 0 to 100%.
51 Second, (ii) we calculate the stratum-specific absolute risks (AR) and their 95% credible
52 intervals (CI) by transformation of the information from the logistic regression to the
53 probability scale. We used this information to map the AR heterogeneity across the
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3 intersectional strata. Then, (iii) using these stratum-specific predictions, we calculated the
4 Area Under the receiver operator characteristics Curve (AUC). The AUC informs on the
5 accuracy of the intersectional strata information for discriminating those women who used
6 antidepressants from those who did not. The AUC values extend from 0.5 to 1, where 1
7 represents total accuracy and 0.5 represent absence of accuracy. Both the VPC and the AUC
8 in model 1 can be interpreted as measures of discriminatory accuracy,(41) and inform on the
9 magnitude of the general intersectional effects. The higher the VPC and AUC values are, the
10 higher the influence of the intersectional context on the individual use of antidepressants.
11 Finally, (iv) we calculated the AR difference (ARD) and 95% CI between similar pairs of
12 strata differing only on the use of HC. This ARD represents the stratum specific association
13 between HC and antidepressant use.
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23 *Model 2 or fixed main effects model*

24 This model includes the fixed, main effects of all the intersectional dimensions (i.e., age,
25 income, immigrant background and HC use) used to define the intersectional strata. In model
26 2 we quantified, (i) the association between the intersectional dimensions and the risk of
27 antidepressant use as expressed by the odds ratio (OR) and 95% CI. We also to calculate (ii)
28 the Proportional Change in the Variance (PCV). The PCV measures the overall proportion of
29 strata variance of model 1 explained by the specific intersectional dimensions. Since model 2
30 contains all the variables used to construct the intersectional strata as main effects, it should
31 explain all the strata variance (i.e., PCV= 100%). If this is not the case, the remaining
32 between strata variance would be due to the existence of multiplicative interaction of effects
33 between the intersectional dimensions defining the strata.(22, 42)
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43 The AUCs of the models 1 and 2 are expected to be the same because model 2
44 only decomposes the stratum-specific predicted probabilities obtained in model 1 into fixed
45 and random effect components and their sum equals the prediction obtained only by random
46 effects in model 1.
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50 We ran the models using MLwiN 3.00 by calling it from within Stata 14.1 using
51 the *runmlwin* command.(43) The estimations were performed using Markov chain Monte
52 Carlo (MCMC) methods. All points estimations and their 95% credible intervals were based
53 on the parameter and random effect chains obtained from the MCMC estimation. See
54 elsewhere for further information on the statistical MAIHDA analysis including Stata
55 commands,(33, 42) and discussion on the theory and methodological approach.(22, 44)
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Patient and Public Involvement statement

The research was developed with a grassroots perspective in mind, whereby women's experiences of use of hormonal contraception inspired and informed the choice of research area and research questions. The anonymised data and scope of the study, including around 1 million women, prohibited direct patient involvement.

RESULTS

Characteristics of the population

As show in Figure 1, the study population consisted of 978 761 women aged 12 – 30. Out of those 13.0% (n = 127 323) had previous mental health issues. Mean age was somewhat older for women with previous mental health issues (22.6 years; SD 4.8) than for those without such concerns (20.9 years; SD 5.3). Supplementary table 5 shows pooled statistics for usage of previous mental health issues and HC use. Table 1 displays the baseline characteristics of the population by previous mental health issues and use of hormonal contraceptives.

Table 1. Characteristics of the 978 761 women aged 12 - 30 years and residing in Sweden by 1st January 2013 by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women) if not otherwise indicated.

	Previous mental health issues			
	No 87.0 (n= 851 438)		Yes 13.0 (n= 127 323)	
	Use of HC		Use of HC	
	Yes 45.4 (n= 386 492)	No 54.6 (n= 464 946)	Yes 48.6 (n= 61 914)	No 51.4 (n= 65 409)
Anti-depressant use	3.0	1.9	42.8	39.8
<i>Age</i>				
12-17 years	16.8	42.1	13.7	19.4
18-23 years	48.4	23.3	45.8	31.2
24-30 years	34.8	34.6	40.3	49.4
<i>Income level</i>				
Low	32.5	33.1	41.7	45.6
Middle	25.3	29.5	26.4	27.5
High	42.4	37.4	31.9	27.0
<i>Immigrant background</i>				
No	93.7	82.6	89.1	93.9
Yes	6.3	17.4	10.9	6.1

Among healthy women, 45.4% (n = 386 942) were users of HC, while this share was 48.6% (n = 61 914) for women with previous mental health issues. Anti-depressants were dispensed to 3.0% of HC users compared to 1.9% of non-users among healthy women during follow-up. For women with previous mental health issues, 42.8% of HC users and 39.8% of non-users were dispensed an anti-depressant. The income levels were generally higher among women without mental health issues, but the differences between HC users and non-users within each cohort were small. Women with immigrant background were less likely use HC (6.3%) if they were previously healthy than if they had pre-existing mental issues (10.9%), while the opposite was true for women without such background.

Results from the MAIHDA

Table 2 shows the results from the MAIHDA distinguishing between measures of association and measures of variance and discriminatory accuracy.

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association and measures of variance and discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are odds ratios with (95% Confidence Intervals)

	Without metal health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
<i>Age</i>				
12-17		1.00		1.00
18-23		1.71 (1.28-2.19)		1.52 (1.33-1.73)
24-30		2.02 (1.54-2.68)		2.62 (2.28-3.07)
<i>Income</i>				
High		1.00		1.00
Middle		1.12 (0.94-1.40)		0.88 (0.76-0.99)
Low		1.06 (0.84-1.38)		0.88 (0.79-0.99)
<i>Immigrant background</i>				
No		1.00		1.00
Yes		0.64 (0.50-0.81)		0.57 (0.51-0.63)
<i>Hormonal contraceptives</i>				
No		1.00		1.00
Yes		1.79 (1.41-2.21)		1.28 (1.16-1.42)
Measures of variance				
Variance*	0.33 (0.19-0.53)	0.11 (0.06-0.18)	0.29 (0.18-0.48)	0.02 (0.01-0.04)

VPC	9.01%	3.09%	8.16%	0.55%
PCV		67.78%		93.84%
AUC	0.62 (0.62-0.62)	0.62 (0.62-0.62)	0.64 (0.64-0.640)	0.64 (0.64-0.640)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

Model 1 indicates that 9.01% (without mental health issues) and 8.16% (with previous mental health issues) of the total individual variance in the latent propensity of using antidepressant is at the intersectional strata level. These VPCs correspond with AUC values of 0.62 and 0.64 respectively. Both measures suggest the existence of a moderate intersectional effect, largely driven by the main effects of the covariates. The PCV was considerably higher in the group with previous mental health issues, meaning the intersectional dimensions or main effects explain more of the inter-strata variance. Model 2 shows that HC was associated with increased risk of antidepressant use after adjustment for all other intersectional dimensions. This result was seen within both cohorts, but more strongly so in women without previous mental health issues (OR 1.79 compared to 1.28). Finally, the VPC in model 2 was very small (3.09% and 0.55% respectively) but did not vanish. This finding means that while the intersectional strata effect was mainly due the additive effect of variables defining the strata, a small component due to interaction of effects could also be detected.

Heterogeneity concerning absolute risk of antidepressant use

Women with previous mental health issues presented much higher risk of antidepressant use than women without such issues, but the risk nonetheless varied across the other intersectional dimensions. Table 3 show the stratum-specific ARs or incidence rates for antidepressant use and 95% CI obtained in model 1.

Table 3. Absolute risk (AR) of antidepressant use, and AR difference (ARD) between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA)

Mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptive		
					Yes	No	Yes-No difference
					AR	AR	ARD

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2									
3	No	12–17	Low	No	29 274	3.8	1.3	2.5	(2.1 – 3.0)
4				Yes	7 776	1.2	0.5	0.7	(0.1 – 1.4)
5			Middle	No	78 405	3.2	1.0	2.1	(1.9 – 2.4)
6				Yes	10 291	2.0	0.6	1.4	(0.7 – 2.3)
7			High	No	130 331	2.2	0.9	1.3	(1.1 – 1.5)
8				Yes	4 745	2.9	0.8	2.0	(1.0 – 3.3)
9		18 – 23	Low	No	47 678	3.7	3.0	0.7	(0.4 – 1.1)
10				Yes	11 691	2.5	1.2	1.3	(0.8 – 1.9)
11			Middle	No	76 451	3.0	2.8	0.2	(0.0 – 0.5)
12				Yes	9 173	2.2	1.2	1.0	(0.5 – 1.7)
13			High	No	145 735	2.4	2.3	0.1	(-0.1– 0.3)
14				Yes	4 707	2.4	1.8	0.5	(-0.2– 1.3)
15		24 – 30	Low	No	141 795	3.4	3.2	0.2	(0.0 – 0.4)
16				Yes	41 436	3.1	1.4	1.8	(1.4 – 2.1)
17			Middle	No	48 389	3.9	3.0	0.8	(0.5 – 1.2)
18				Yes	11 649	2.9	2.4	0.5	(-0.1 – 1.2)
19			High	No	47 985	2.7	2.6	0.1	(-0.2 – 0.4)
20				Yes	3 927	2.1	2.3	0.2	(-1.1 – 0.8)
21	Yes	12–17	Low	No	3 693	31.2	22.7	8.6	(5.7 – 11.4)
22				Yes	458	24.8	13.6	11.2	(3.8 – 19.0)
23			Middle	No	7 427	32.8	23.4	9.4	(7.3 – 11.4)
24				Yes	603	21.8	14.3	7.5	(0.9 – 14.6)
25			High	No	8 612	34.5	28.1	6.4	(4.4 – 8.4)
26				Yes	406	30.8	19.8	11.0	(2.8 – 19.7)
27		18 – 23	Low	No	12 165	40.3	37.8	2.5	(0.8 – 4.3)
28				Yes	1 236	30.9	19.6	11.3	(6.3 – 16.2)
29			Middle	No	14 301	38.6	36.3	2.3	(0.7 – 3.9)
30				Yes	924	27.2	19.7	7.4	(2.0 – 12.9)
31			High	No	19 372	39.4	39.8	-0.4	(-1.8 – 1.1)
32				Yes	709	29.0	25.4	3.6	(-2.8 – 10.1)
33		24–30	Low	No	33 409	51.7	49.9	1.8	(0.7 – 2.9)
34				Yes	4 634	40.8	32.4	8.4	(5.5 – 11.2)
35			Middle	No	9 702	51.4	50.8	0.6	(-1.4 – 2.6)
36				Yes	1 361	38.1	37.1	1.0	(-4.6 – 6.6)
37			High	No	7 737	49.5	48.9	0.6	(-1.7 – 2.7)
38				Yes	574	44.9	37.5	7.4	(-0.6 – 15.7)
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The highest ARs were observed in non-immigrant women, aged 24-30, with previous mental health issues, using HC and with low (i.e., AR= 51.7%) as well as with middle-income (i.e., AR=51.4%). The lowest ARs were found in teenagers without previous mental health issues and no HC use, especially in the strata of immigrant girls from low (AR= 0.50%) and middle-income (AR= 0.60%) households.

Heterogeneity concerning the association between hormonal contraceptive and antidepressant use

Overall, the ARD between users and non-users of HC was highest in younger women between 12 and 17 years of age both with and without previous mental health issues, but this association was still considerable across nearly all strata. Table 3 gives detailed information on these associations. In the group of women without previous mental health issues the ARs are of low magnitude but the ARD show an increase risk of antidepressant among adolescent HC users (ARDs ranging from 0.7 to 2.5 percentage points) and adult women with immigrant background and low income (ARD 1.8 in the oldest age group). In the group of women with previous mental health issues the ARs were of much higher magnitude than in women without previous mental health issues. The ARDs were also larger, especially in teenage girls (ARD ranging from 6.4 to 11.2 percentage points) and again among women with immigrant background and low income (ARD 11.3 in ages 18 to 23), indicating a strong association between HC and antidepressant use. However, the 95% credible intervals were broad since the number of individuals was relatively small in those strata. The association between HC and antidepressant use was smaller in adult women native to Sweden no matter their income, and completely disappeared in adult women with high income regardless of immigrant background.

DISCUSSION

The main hypothesis of our study was that the previously observed association between HC and antidepressant use,(6, 7) would be modified by the intersectional context of the women, being more pronounced in more oppressed intersectional contexts. Our study replicates previous findings as we found the strongest associations between HC and antidepressant use in teenagers (6, 7). We also confirmed our hypothesis that the ARD was heterogenous across intersectional strata pairs as the ARD varied from 0.7 in low-income teenagers with immigrant background and without previous mental health issues to 11.3 in young women with previous mental health issues and immigrant background. As hypothesized, the ARD was more pronounced in more oppressed intersectional contexts like those composed by immigrant, low-income women with previous mental issues. That is, the AR and some extent ARDs varied mainly depending on previous mental health issues, but the HC-antidepressant association considerably modified across pair of strata with discrepant HC use in both cohorts.

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3 Independently of previous mental health issues, the propensity for using anti-
4 depressants was consistently higher for HC users than for non-users in teenagers aged 12-17,
5 a result aligned with previous studies.(6, 7, 17, 18) As discussed in a previous paper, this
6 higher risk could be due to a *selective discontinuation bias*.(7) A heterogeneous response to
7 HC has been confirmed,(13, 20, 45, 46) where the women who experience a negative
8 influence of HC on psychological health might discontinue treatment in early ages, while
9 those without symptoms continued on HC into adulthood, creating this age disparity. Aside
10 from adolescent girls, low and middle income adult women with immigrant background had a
11 higher ARD, while adolescent girls with immigrant background had both the lowest ARs and
12 a low grade of modification by HC use.
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21 As expected, among adult women the overall propensity for using anti-depressants
22 was higher, as it is known that anti-depressant use increases by age,(47, 48) and the difference
23 between HC users and non-users was smaller. Women native to Sweden had a higher absolute
24 risk of using anti-depressants, but this was moderated by HC exposure to a lower extent than
25 for immigrant women. In adult women native to Sweden, HC use gave no risk increase of
26 antidepressant use among those with high income. The lower absolute risk does not
27 necessarily mean that immigrant women are healthier, since earlier studies have found
28 immigrants utilize healthcare to a lesser extent, even though the need is pronounced, because
29 of discrimination.(49, 50)
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37 The big difference in anti-depressant consumption depending on HC use for lower
38 income immigrant women could be interpreted as the intersectional contexts embodied by
39 these women are more susceptible to the potential detrimental effect of HC on mood. The
40 interrelating negative consequences of low income as a proxy for class or social position,
41 gender and xenophobia may accumulate over the life course and lead to a higher vulnerability
42 to exposures that predispose for antidepressant use later in life,(51-53) whereas this diverse
43 vulnerability to HC exposure might not be visible in teenagers. Social experiences can vary
44 depending on for example social position, which in turn impact psychological development,
45 mood and cognition, thus influencing health.(54, 55) In understanding how HC can impact
46 women's mental health differently, both possible individual biological predispositions and
47 social settings need to be investigated, since the emotional response to HC is influenced by
48 context.(32) In other words, the interlocking power axes that create oppression could
49 predispose women already under structural burdens for adverse mental health reactions when
50 using HC. The fact that adult women native to Sweden were almost unaffected by HC use,
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3 could strengthen this suggestion. Without the intersectional strata this disparity would not
4 have been so easily identified and visualized.
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7 Focusing on women whose lives are affected by several interlocking power
8 dimensions such as low social position and xenophobia is fundamental to achieving
9 reproductive justice.(30) Nonetheless, our intersectional strata should not be considered static
10 categories of inherently “risky identities” but must be interpreted as context specific
11 vulnerabilities of women within certain interlocking positions, constituted in relation to power
12 dynamics created by unequal schemes such as the economic system.(25, 29) It is likely that in
13 other contexts, other groups could be more vulnerable. In identifying the underlying power
14 systems creating these intersectional categories and acknowledging their constant movement
15 and changing dynamics on a societal level, it furthermore becomes possible to address these
16 inequalities through social change.
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24 In this study, we have combined a classical epidemiological approach of
25 exposure to HC and an intersectional MAHIDA to create a novel understanding of how
26 intersecting power dynamics could create particular vulnerabilities to this specific exposure.
27 Because of our study design where women are followed for one year after a dispensed
28 prescription of HC, it is more theoretically coherent to view use of HC as an exposure rather
29 than a component of the intersectional strata. However, it is possible to within our approach
30 view HC use as a socio-contextual factor that captures certain living conditions (for example
31 more likely to be sexually active or in a heterosexual relationship), which somewhat changes
32 the interpretation of the results. This epistemological tension is not necessarily a limitation,
33 but could enrich the dialogue in social epidemiology on whether it is possible to separate
34 contextual factors from “pure” exposure.(56-58)
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44 **Limitations**

45 The findings from this study must be interpreted in the context of its limitations. The SPDR
46 has highly reliable data on dispensed prescriptions but cannot measure the actual use of
47 dispensed medications. Use of anti-depressants can be considered a proxy for depression, but
48 anti-depressants are also prescribed for other reasons than depression, including generalized
49 anxiety disorder, obsessive-compulsive disorder and panic disorder.(59) Therefore it is not a
50 perfect proxy of depression but may be a more general indication of impaired mental
51 health.(60) However, out of all women with potentially unfavorable mental health effects
52 from HC, only a subset would have symptoms severe enough to get an anti-depressant
53 prescription, leading instead to many missed cases.
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3 As in any observational study, ours only allows for measurements of
4 associations and cannot determine causation. Furthermore, apparently strong average
5 associations do not necessarily convey a high discriminatory accuracy (see elsewhere for a
6 short review and discussion)(61). Nevertheless, since our analysis yielded a moderate
7 accuracy (i.e., AUC=0.6), the intersectional strata do matter for the propensity to use
8 antidepressants. A consideration in every quantitative intersectional study is the basis for
9 creating intersectional categories, since comprehensive information on background and lived
10 experiences are lacking and the categories are created based on available but crude proxies
11 such as income level. For example, in our study the group of women with immigrant
12 background was very heterogenous, so we cannot exclude that the increased AR of
13 antidepressant use is located on more specific country of birth categories. There is an ongoing
14 debate whether these crude categorizations are feasible, and extra caution should be taken
15 when investigating emerging intersectional categories rather than established ones.(62)

26 Conclusion

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28 It is important to recognise intersectional perspectives and interacting axes of oppression to
29 tailor better public health interventions, as well as recognising the experiences of oppressed
30 women to reach reproductive and social justice. (29, 63) Our intersectional MAIHDA
31 methodology operationalizes this idea by providing information on the discriminatory
32 accuracy of the contexts that define the intersectional strata. It highlights the need to consider
33 disadvantages consisting of several interlocking structural dimensions such as income/class,
34 age and immigration to better understand how HC might predispose certain women, mainly
35 teenagers and low-income women with immigrant background, for depression. These
36 vulnerabilities are based in inequalities that are not static, but structurally created and
37 therefore possible to redeem.

52 **Figure 1.** Selection of the study population.

57 Acknowledgements

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3 A previous version of this study was presented as a poster at the Gynecological
4 Endocrinology, the 19th World Congress in December 2020. We thank all colleagues at the
5 Unit for Social epidemiology, Lund university, for valuable discussions.
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10 **Ethical statement**

11 The database was approved by the Regional Ethical Review Board in Lund, Sweden, the Data
12 Safety Board at Statistics Sweden and the National Board of Health and Welfare (Dnr: 2014/
13 856, 2015/341).
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20 [2017-01321] <https://www.swecris.se/betasearch/details/project/201701321VR>
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25 **Competing interests**

26 None declared.
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30 **Data sharing statement**

31 Public access to the data is restricted by the Swedish Authorities (Public Access to
32 Information and Secrecy Act; [http://www.government.se/information-](http://www.government.se/information-material/2009/09/public-access-to-information-and-secrecy-act/)
33 [material/2009/09/public-access-to-information-and-secrecy-act/](http://www.government.se/information-material/2009/09/public-access-to-information-and-secrecy-act/)) but data can be made
34 available for researchers after a special review that includes approval of the research project
35 by both an Ethics Committee and the authorities' data safety committees. The National Board
36 of Health and Welfare is a government agency under the Ministry of Health and Social
37 Affairs. It is not their policy to provide individual level data to researchers abroad. Instead,
38 they normally advise researchers in other countries to cooperate with Swedish colleagues, to
39 whom they can provide data according to standard legal provisions and procedures. Requests
40 for access to the data can be made to the National Board of Health and Welfare and Statistics
41 Sweden (<http://www.socialstyrelsen.se/statistics>; [https://www.scb.se/en/services/guidance-](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)
42 [for-researchers-and-universities/](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)).
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54 **Contributorship statement**

55 **Sofia Zettermark:** Conceptualization, design, analysis, interpretation of data, writing original
56 draft, final improvement of version to be published.
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3 **Kani Kahlaf:** Interpretation of data, revising draft critically for intellectual content, final
4 approval of version to be published.

5
6 **Raquel Perez-Vicente:** Design, analysis, interpretation of data, revising draft critically for
7 intellectual content, final approval of version to be published.

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10 **George Leckie:** Analysis, interpretation of data, revising draft critically for intellectual
11 content, final approval of version to be published.

12
13 **Diana Mulinari:** Interpretation of data, revising draft critically for intellectual content, final
14 approval of version to be published.

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16
17 **Juan Merlo:** Conceptualization, design, analysis, interpretation of data, revising draft
18 critically for intellectual content, final approval of version to be published.

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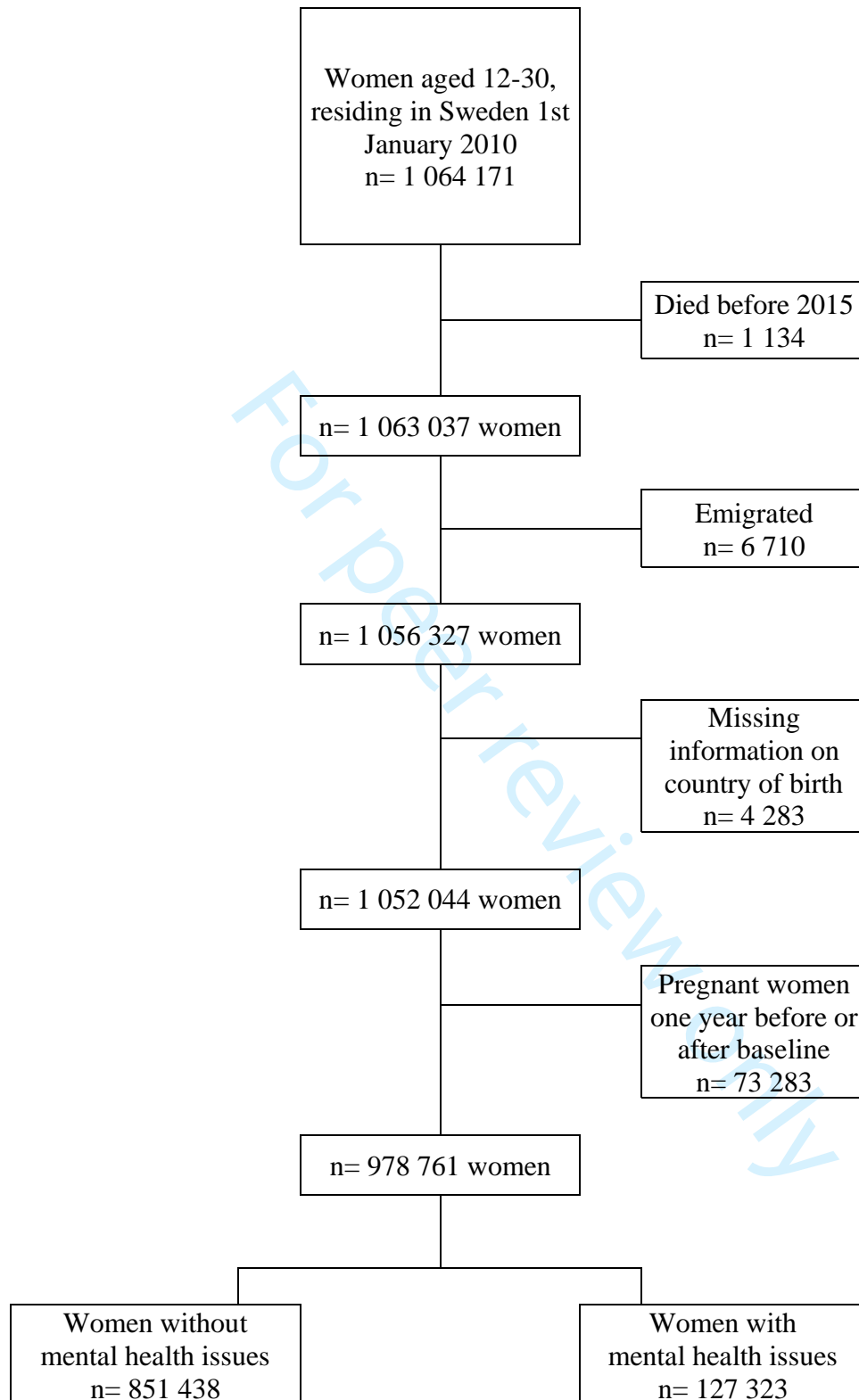


Figure 1. Selection of the study population.

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For peer review only

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4 Intersectional Multilevel Analysis of Individual Heterogeneity and
5 Discriminatory Accuracy
6 * (MAIHDA)
7 *****
8 clear *
9 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
10 set cformat %9.2f
11
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13 *****
14 * TABLE 1
15 *****
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17 * Load the data
18 use "final_mlMENTAL.dta", clear
19 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
20 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21
22 generate percentage = 100*proportion
23 drop proportion
24 format %9.2f percentage
25
26 generate age_cat = .
27 replace age_cat = 1 if age_cat1==1
28 replace age_cat = 2 if age_cat2==1
29 replace age_cat = 3 if age_cat3==1
30
31 generate inc_cat = .
32 replace inc_cat = 1 if inc1==1
33 replace inc_cat = 2 if inc2==1
34 replace inc_cat = 3 if inc3==1
35
36 * Results for the table
37 tabulate pp [fweight = denom]
38 table pp [fweight = denom], contents(mean percentage )
39 tabulate age_cat pp [fweight = denom], column nofreq
40 tabulate inc_cat pp [fweight = denom], column nofreq
41 tabulate imm pp [fweight = denom], column nofreq
42
43 *****
44 * TABLE 2: MODEL 1
45 *****
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47 * Load the data
48 use "final_mlMENTAL.dta", clear
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50 * IGLS estimation, for MCMC initial values
51 runmlwin prop cons, ///
52     level2(inter: cons) ///
53     level1(inter:) ///
54     discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
55     nopause
56
57 * MCMC
58 runmlwin prop cons, ///
59     level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///
60     level1(inter:) ///

```

```

1
2
3     discrete(distribution(binomial) link(logit) denom(denom)) ///
4     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
5     ///
6     initsprevious ///
7     nopause
8
9     * Level-2 variance
10    scalar mlsigma2u = [RP2]var(cons)
11    scalar list mlsigma2u
12
13    * Level-1 variance
14    scalar mlsigma2e = _pi^2/3
15    scalar list mlsigma2e
16
17    * VPC
18    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
19
20    * Compress and save the data
21    compress
22    save "ml.dta", replace
23
24
25    *-----*
26    * PREPARE FIXED-PART PAREMETER CHAINS
27    *-----*
28
29    use "mlb.dta", clear
30    drop deviance RP2_var_cons_ OD_bcons_1
31    rename FP1_* b_*
32    format %9.2f b_*
33    compress
34    save "mlb_prepped.dta", replace
35    isid iteration
36    codebook iteration, compact
37
38
39    *-----*
40    * PREPARE RANDOM EFFECTS CHAINS
41    *-----*
42
43    use "mlu.dta", clear
44    drop residual idnum
45    rename value u
46    format %9.2f u
47    sort inter iteration
48    order inter iteration
49    compress
50    save "mlu_prepped.dta", replace
51    isid inter iteration
52    codebook iteration, compact
53
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"
62    count

```

```

1
2
3 merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
4 count
5 compress
6 save "mldata_prepped.dta", replace
7
8
9
10 -----*
11 * ROC
12 -----*
13 use "mldata_prepped.dta", clear
14 count
15 generate p = invlogit(b_cons + u)
16 gcollapse (mean) p, by(inter num denom)
17 count
18 expand denom
19 sort inter
20 bysort inter: generate y = (_n<=numerator)
21 generate prop = denom/_N
22 generate weight = int(1/prop)
23 roctab y p [fw=weight]
24
25
26 -----*
27 * TABLE 3
28 -----*
29 use "mldata_prepped.dta", clear
30 keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
31 b_cons u
32 count
33 generate p = 100*invlogit(b_cons + u)
34 drop b_cons u
35 format %9.1f p
36 drop inter
37 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
38 imm) j(pp)
39 generate denom = denom0 + denom1
40 drop denom0 denom1
41 generate pdiff = p1 - p0
42 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
43 by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
44 format %9.1f pdiff pdifflo pdiffhi
45 order p1 p0 pdiff pdifflo pdiffhi, last
46 gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
47
48
49 *****
50 * TABLE 2: MODEL 2:
51 *****
52
53 * Load the data
54 use "final_mlMENTAL.dta", clear
55
56 * IGLS estimation, for MCMC initial values
57 runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
58 level2(inter: cons) ///
59 levell1(inter:) ///
60 discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
nopause

```

```

1
2
3
4 * MCMC
5 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
6   level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
7   level1(inter:) ///
8   discrete(distribution(binomial) link(logit) denom(denom)) ///
9   mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
10  ///
11  initsprevious ///
12  nopause
13
14 * Odds ratios
15 runmlwin, or
16
17 * Level-2 variance
18 scalar m2sigma2u = [RP2]var(cons)
19 scalar list m2sigma2u
20
21 * Level-1 variance
22 scalar m2sigma2e = _pi^2/3
23 scalar list m2sigma2e
24
25 * VPC
26 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
27
28 * Compress and save the data
29 compress
30 save "m2.dta", replace
31
32 * PCV
33 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
34
35 *-----*
36 * PREPARE FIXED-PART PAREMETER CHAINS
37 *-----*
38 use "m2b.dta", clear
39 drop deviance RP2_var_cons_ OD_bcons_1
40 rename FP1_* b_*
41 format %9.2f b_*
42 compress
43 save "m2b_prepped.dta", replace
44 isid iteration
45 codebook iteration, compact
46
47
48 *-----*
49 * PREPARE inter RANDOM EFFECTS CHAINS
50 *-----*
51 use "m2u.dta", clear
52 drop residual idnum
53 rename value u
54 format %9.2f u
55 sort inter iteration
56 order inter iteration
57 compress
58 save "m2u_prepped.dta", replace
59 isid inter iteration
60 codebook iteration, compact

```

```

1
2
3
4
5
6 *-----*
7 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
8 *-----*
9 use "final_mlMENTAL", clear
10 count
11 cross using "m2b_prepped.dta"
12 count
13 merge m:1 inter iteration using "m2u_prepped.dta"
14 count
15 save "m2data_prepped.dta", replace
16
17
18 *-----*
19 * ROC
20 *-----*
21 use "m2data_prepped.dta", clear
22 count
23 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
24 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
25 gcollapse (mean) p, by(inter num denom)
26 count
27 expand denom
28 sort inter
29 bysort inter: generate y = (_n<=numerator)
30 generate prop = denom/_N
31 generate weight = int(1/prop)
32 roctab y p [fw=weight]
33
34
35 *-----*
36 * TABLE 3
37 *-----*
38 use "m1data_prepped.dta", clear
39 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
40 b_cons u
41 count
42 generate p = 100*invlogit(b_cons + u)
43 drop b_cons u
44 format %9.1f p
45 drop inter
46 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
47 imm) j(pp)
48 generate denom = denom0 + denom1
49 drop denom0 denom1
50 generate pdiff = p1 - p0
51 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
52 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
53 format %9.1f pdiff pdifflo pdiffhi
54 order p1 p0 pdiff pdifflo pdiffhi, last
55 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
56
57
58 *****
59 exit
60

```

```

1
2
3 *****
4 * Hormonal Contraception and Antidepressant Use in Sweden: An
5 Intersectional Multilevel Analysis of Individual Heterogeneity and
6 Discriminatory Accuracy (MAIHDA)
7
8 *****
9 clear *
10 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
11 set cformat %9.2f
12
13
14 *****
15 * TABLE 1
16 *****
17
18 * Load the data
19 use "final_mlNoMENTAL.dta", clear
20 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
22
23 generate percentage = 100*proportion
24 drop proportion
25 format %9.2f percentage
26
27 generate age_cat = .
28 replace age_cat = 1 if age_cat1==1
29 replace age_cat = 2 if age_cat2==1
30 replace age_cat = 3 if age_cat3==1
31
32 generate inc_cat = .
33 replace inc_cat = 1 if inc1==1
34 replace inc_cat = 2 if inc2==1
35 replace inc_cat = 3 if inc3==1
36
37 * Results for the table
38 tabulate pp [fweight = denom]
39 table pp [fweight = denom], contents(mean percentage )
40 tabulate age_cat pp [fweight = denom], column nofreq
41 tabulate inc_cat pp [fweight = denom], column nofreq
42 tabulate imm pp [fweight = denom], column nofreq
43
44
45 *****
46 * TABLE 2: MODEL 1
47 *****
48
49 * Load the data
50 use "final_mlNoMENTAL.dta", clear
51
52 * IGLS estimation, for MCMC initial values
53 runmlwin prop cons, ///
54     level2(inter: cons) ///
55     level1(inter:) ///
56     discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
57     nopause
58
59 * MCMC
60 runmlwin prop cons, ///
61     level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///

```



```

1
2
3     level1(inter:) ///
4     discrete(distribution(binomial) link(logit) denom(denom)) ///
5     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
6     ///
7     initsprevious ///
8     nopause
9
10    * Level-2 variance
11    scalar mlsigma2u = [RP2]var(cons)
12    scalar list mlsigma2u
13
14    * Level-1 variance
15    scalar mlsigma2e = _pi^2/3
16    scalar list mlsigma2e
17
18    * VPC
19    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
20
21    * Compress and save the data
22    compress
23    save "ml.dta", replace
24
25
26    *-----*
27    * PREPARE FIXED-PART PAREMETER CHAINS
28    *-----*
29
30    use "mlb.dta", clear
31    drop deviance RP2_var_cons_ OD_bcons_1
32    rename FP1_* b_*
33    format %9.2f b_*
34    compress
35    save "mlb_prepped.dta", replace
36    isid iteration
37    codebook iteration, compact
38
39
40    *-----*
41    * PREPARE RANDOM EFFECTS CHAINS
42    *-----*
43
44    use "mlu.dta", clear
45    drop residual idnum
46    rename value u
47    format %9.2f u
48    sort inter iteration
49    order inter iteration
50    compress
51    save "mlu_prepped.dta", replace
52    isid inter iteration
53    codebook iteration, compact
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlnOMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"

```

```

1
2
3 count
4 merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
5 count
6 compress
7 save "mldata_prepped.dta", replace
8
9
10
11 *-----*
12 * ROC
13 *-----*
14 use "mldata_prepped.dta", clear
15 count
16 generate p = invlogit(b_cons + u)
17 gcollapse (mean) p, by(inter num denom)
18 count
19 expand denom
20 sort inter
21 bysort inter: generate y = (_n<=numerator)
22 generate prop = denom/_N
23 generate weight = int(1/prop)
24 roctab y p [fw=weight]
25
26
27 *-----*
28 * TABLE 3
29 *-----*
30 use "mldata_prepped.dta", clear
31 keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
32 b_cons u
33 count
34 generate p = 100*invlogit(b_cons + u)
35 drop b_cons u
36 format %9.1f p
37 drop inter
38 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
39 imm) j(pp)
40 generate denom = denom0 + denom1
41 drop denom0 denom1
42 generate pdiff = p1 - p0
43 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
44 by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
45 format %9.1f pdiff pdifflo pdiffhi
46 order p1 p0 pdiff pdifflo pdiffhi, last
47 gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
48
49
50 *****
51 * TABLE 2: MODEL 2:
52 *****
53
54 * Load the data
55 use "final_mlnOMENTAL.dta", clear
56
57 * IGLS estimation, for MCMC initial values
58 runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
59 level2(inter: cons) ///
60 level1(inter:) ///
61 discrete(distribution(binomial) link(logit) denom(denom) mql1) ///

```

```

1
2
3     nopause
4
5 * MCMC
6 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
7     level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
8     levell(inter:) ///
9     discrete(distribution(binomial) link(logit) denom(denom)) ///
10    mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
11    ///
12    initsprevious ///
13    nopause
14
15 * Odds ratios
16 runmlwin, or
17
18 * Level-2 variance
19 scalar m2sigma2u = [RP2]var(cons)
20 scalar list m2sigma2u
21
22 * Level-1 variance
23 scalar m2sigma2e = _pi^2/3
24 scalar list m2sigma2e
25
26 * VPC
27 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
28
29 * Compress and save the data
30 compress
31 save "m2.dta", replace
32
33 * PCV
34 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
35
36 *-----*
37 * PREPARE FIXED-PART PAREMETER CHAINS
38 *-----*
39 use "m2b.dta", clear
40 drop deviance RP2_var_cons_ OD_bcons_1
41 rename FP1_* b_*
42 format %9.2f b_*
43 compress
44 save "m2b_prepped.dta", replace
45 isid iteration
46 codebook iteration, compact
47
48
49 *-----*
50 * PREPARE inter RANDOM EFFECTS CHAINS
51 *-----*
52 use "m2u.dta", clear
53 drop residual idnum
54 rename value u
55 format %9.2f u
56 sort inter iteration
57 order inter iteration
58 compress
59 save "m2u_prepped.dta", replace
60 isid inter iteration

```

```

1
2
3 codebook iteration, compact
4
5
6
7 *-----*
8 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
9 *-----*
10 use "final_m1NoMENTAL", clear
11 count
12 cross using "m2b_prepped.dta"
13 count
14 merge m:1 inter iteration using "m2u_prepped.dta"
15 count
16 save "m2data_prepped.dta", replace
17
18
19 *-----*
20 * ROC
21 *-----*
22 use "m2data_prepped.dta", clear
23 count
24 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
25 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
26 gcollapse (mean) p, by(inter num denom)
27 count
28 expand denom
29 sort inter
30 bysort inter: generate y = (_n<=numerator)
31 generate prop = denom/_N
32 generate weight = int(1/prop)
33 roctab y p [fw=weight]
34
35
36 *-----*
37 * TABLE 3
38 *-----*
39 use "m1data_prepped.dta", clear
40 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
41 b_cons u
42 count
43 generate p = 100*invlogit(b_cons + u)
44 drop b_cons u
45 format %9.1f p
46 drop inter
47 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
48 imm) j(pp)
49 generate denom = denom0 + denom1
50 drop denom0 denom1
51 generate pdiff = p1 - p0
52 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
53 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
54 format %9.1f pdiff pdifflo pdiffhi
55 order p1 p0 pdiff pdifflo pdiffhi, last
56 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
57
58
59 *****
60 exit

```

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For peer review only

1 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
2 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.22574355,463,2051,1
3 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.31181487,512,1642,1
4 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.12383901,40,323,1
5 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.23703703,32,135,1
6 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.23362993,1024,4383,1
7 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.32785809,998,3044,1
8 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.13422818,60,447,1
9 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.20512821,32,156,1
10 0,0,12-17 High income 0 0,1,0,0,0,0,1,.28093326,1469,5229,1
11 1,0,12-17 High income 0 1,1,0,0,0,0,1,.34466448,1166,3383,1
12 0,1,12-17 High income 1 0,1,0,0,0,0,1,.18867925,50,265,1
13 1,1,12-17 High income 1 1,1,0,0,0,0,1,.30496454,43,141,1
14 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.37809917,2013,5324,1
15 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.40359595,2761,6841,1
16 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.19350649,149,770,1
17 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.30901289,144,466,1
18 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.36302635,2164,5961,1
19 1,0,18-23 Middle income 0 1,0,1,0,0,1,0,.38645083,3223,8340,1
20 0,1,18-23 Middle income 1 0,0,1,0,0,1,0,.19285715,108,560,1
21 1,1,18-23 Middle income 1 1,0,1,0,0,1,0,.26923078,98,364,1
22 0,0,18-23 High income 0 0,0,1,0,0,0,1,.39782199,2959,7438,1
23 1,0,18-23 High income 0 1,0,1,0,0,0,1,.39391655,4701,11934,1
24 0,1,18-23 High income 1 0,0,1,0,0,0,1,.25,82,328,1
25 1,1,18-23 High income 1 1,0,1,0,0,0,1,.2887139,110,381,1
26 0,0,24-30 Low income 0 0,0,0,1,1,0,0,.49862742,9082,18214,1
27 1,0,24-30 Low income 0 1,0,0,1,1,0,0,.51707798,7857,15195,1
28 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.32457545,1013,3121,1
29 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.40912095,619,1513,1
30 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.50859779,2869,5641,1
31 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.51465154,2090,4061,1
32 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.37214136,358,962,1
33 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.38345864,153,399,1
34 0,0,24-30 High income 0 0,0,0,1,0,0,1,.48993289,1971,4023,1
35 1,0,24-30 High income 0 1,0,0,1,0,0,1,.49569198,1841,3714,1
36 0,1,24-30 High income 1 0,0,0,1,0,0,1,.37669376,139,369,1
37 1,1,24-30 High income 1 1,0,0,1,0,0,1,.4585366,94,205,1
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1
2 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
3 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.013224002,279,21098,1
4 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.038649708,316,8176,1
5 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.0040497542,28,6914,1
6 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.0092807421,8,862,1
7 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.010099272,587,58123,1
8 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.031604379,641,20282,1
9 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.0056107035,52,9268,1
10 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.019550342,20,1023,1
11 0,0,12-17 High income 0 0,1,0,0,0,0,1,.008893352,859,96589,1
12 1,0,12-17 High income 0 1,1,0,0,0,0,1,.021960761,741,33742,1
13 0,1,12-17 High income 1 0,1,0,0,0,0,1,.0076045627,30,3945,1
14 1,1,12-17 High income 1 1,1,0,0,0,0,1,.029999999,24,800,1
15 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.029676914,530,17859,1
16 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.036956303,1102,29819,1
17 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.011607248,98,8443,1
18 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.024938423,81,3248,1
19 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.027664155,771,27870,1
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29 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.013751426,446,32433,1
30 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.031545039,284,9003,1
31 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.030455342,818,26859,1
32 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.038922433,838,21530,1
33 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.023714487,202,8518,1
34 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.029383583,92,3131,1
35 0,0,24-30 High income 0 0,0,0,1,0,0,1,.025993951,593,22813,1
36 1,0,24-30 High income 0 1,0,0,1,0,0,1,.027252503,686,25172,1
37 0,1,24-30 High income 1 0,0,0,1,0,0,1,.023088569,61,2642,1
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4 **SUPPLEMENTARY**
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	Hormonal contraceptives (%)	Mental health issues (%)
<i>Age</i>		
12-17	26.0	7.5
18-23	62.6	14.2
24-30	45.3	16.3
<i>Income</i>		
Low	45.1	16.6
Middle	42.3	12.8
High	48.9	10.0
<i>Immigrant background</i>		
No	48.7	13.5
Yes	24.2	9.4

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Supplementary table 1. Summary statistics. Percentage of women within each intersectional dimension using hormonal contraceptives and with previous mental health issues.

Reporting checklist for cohort study.

Based on the STROBE cohort guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cohort reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

	Reporting Item	Page Number
Title and abstract		
Title	#1a Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction		
Background / rationale	#2 Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	#3 State specific objectives, including any prespecified hypotheses	5
Methods		
Study design	#4 Present key elements of study design early in the paper	5

1	Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
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6	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	5-6
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11	Eligibility criteria	#6b	For matched studies, give matching criteria and number of exposed and unexposed	5-6
12				
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15	Variables	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
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21	Data sources /	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
22	measurement			
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29	Bias	#9	Describe any efforts to address potential sources of bias	6-7
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31	Study size	#10	Explain how the study size was arrived at	5-6
32				
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34	Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8
35				
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39	Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	
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45	Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7-8
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49	Statistical methods	#12c	Explain how missing data were addressed	7-8
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51	Statistical methods	#12d	If applicable, explain how loss to follow-up was addressed	n/a Follow-up was complete for the final cohort
52				
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58	Statistical methods	#12e	Describe any sensitivity analyses	
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3	Results		
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5	Participants	#13a	Report numbers of individuals at each stage of study—eg 5-6 numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.
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13	Participants	#13b	Give reasons for non-participation at each stage 5-6
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15	Participants	#13c	Consider use of a flow diagram
16			
17	Figure 1		
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21	Descriptive data	#14a	Give characteristics of study participants (eg 9, table 1 demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.
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29	Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest
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33	n/a All participants		
34	included in final		
35	analysis had complete		
36	data		
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40	Descriptive data	#14c	Summarise follow-up time (eg, average and total amount)
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44	Outcome data	#15	Report numbers of outcome events or summary measures over time. Give information separately for exposed and unexposed groups if applicable.
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52	Main results	#16a	Give unadjusted estimates and, if applicable, confounder- adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included 10-11
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1	Main results	#16b	Report category boundaries when continuous variables were categorized	11-12
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4	Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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11	Other analyses	#17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-13
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14	Discussion			
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17	Key results	#18	Summarise key results with reference to study objectives	13-14
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19	Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	15-16
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24	Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	16
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30	Generalisability	#21	Discuss the generalisability (external validity) of the study results	16
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34	Other Information			
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36	Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17
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Notes:

- 12d: n/a Follow-up was complete for the final cohort
- 14b: n/a All participants included in final analysis had complete data The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist was completed on 26. January 2021 using <https://www.goodreports.org/>, a tool made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)

BMJ Open

Population Heterogeneity in Associations Between Hormonal Contraception and Antidepressant Use in Sweden: A Prospective Cohort Study Applying Intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA)

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Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Public health, Mental health, Reproductive medicine
Keywords:	MENTAL HEALTH, Sex steroids & HRT < DIABETES & ENDOCRINOLOGY, SOCIAL MEDICINE, EPIDEMIOLOGY, Depression & mood disorders < PSYCHIATRY

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3 1 **Population Heterogeneity in Associations Between Hormonal**
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5 2 **Contraception and Antidepressant Use in Sweden: A Prospective Cohort**
6
7 3 **Study Applying Intersectional Multilevel Analysis of Individual**
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9 4 **Heterogeneity and Discriminatory Accuracy (MAIHDA)**
10

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Keywords: Epidemiology, Contraception, Hormonal contraception, Mental health, Multilevel
analysis

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ABSTRACT

Objectives From a reproductive justice framework, we aimed to investigate how a possible association between hormonal contraceptive (HC) and anti-depressants use (as a proxy for depression) is distributed across intersectional strata in the population. We aimed to visualize how intersecting power dynamics may operate in combination with HC use to increase or decrease subsequent use of anti-depressants. Our main hypothesis was that the previously observed association between HC and anti-depressants use would vary between strata, being more pronounced in more oppressed intersectional contexts. For this purpose, we applied an intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) approach.

Design Observational prospective cohort study using record linkage of national Swedish registers.

Setting The population of Sweden.

Participants All 915 954 women aged 12-30 residing in Sweden 2010, without a recent pregnancy and alive during the individual one-year follow-up.

Primary outcome measure Use of any anti-depressant, meaning being dispensed at least one anti-depressant (ATC N06A) during follow-up.

Results Previously mentally healthy hormonal contraceptive users had an odds ratio of 1.79 for use of anti-depressants compared to non-users, whereas this number was 1.28 for women with previous mental health issues. The highest anti-depressant use were uniformly found in strata with previous mental health issues, with highest usage in women aged 24-30 with no immigrant background, low income, and HC use (51.4%). The largest difference in anti-depressant use between HC users and non-users was found in teenagers, and in adult women of immigrant background with low income. Of the total individual variance in the latent propensity of using antidepressant 9.01% (healthy) and 8.16% (with previous mental health issues) was found at the intersectional stratum level.

Conclusions Our study suggests teenagers and women with immigrant background and low income could be more sensitive to mood effects of HC, a heterogeneity important to consider moving forward.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

- Entire Swedish population of women aged 12-30 included
- Pharmacy dispensing automatically linked to individual personal identification number in Sweden through the Swedish Prescribed Drug Register and thus very reliable
- Intersectional MAHIDA is a fruitful way of epidemiologically investigating heterogeneity within a population while considering individual conditions determined by societal power dimensions such as class, gender and race
- Anti-depressant dispensing is not a perfect proxy for depression
- Registers cannot not measure actual use of any medication

85 INTRODUCTION

86 In recent years, attention in the medical community has increasingly been drawn towards
87 depression and other adverse effects on mood related to use of hormonal contraception
88 (HC).(1, 2) Discontinuation rates are high, with mood disturbances or depression being one of
89 the most common complaints.(3-5) Two large epidemiological studies, one in Denmark and
90 the other performed in Sweden, have recently shown a higher risk of anti-depressants and
91 psychotropic drugs use in adolescent users of HC.(6, 7) Randomized controlled trials are rare,
92 but suggest a negative influence of HC on well-being and sexual function,(8, 9) as well as
93 evidence of HC modulating brain activity with subsequent mood alterations in some
94 women.(10, 11) Even though oestrogen and progesterone are known to affect mood,(12) the
95 growing body of evidence in this field is contradictory, with recent reviews concluding that
96 both protective and negative effects of HC on mood exist and more research is needed.(13-16)
97 Despite this uncertainty, many scholars agree that certain subgroups of women seem more
98 vulnerable to psychological side effects of HC than others, particularly teenagers and women
99 with previous mental health issues.(10, 13, 17-20) A call for further investigation into these
100 vulnerable subgroups has been made.(14)

101 A fruitful way of epidemiologically investigating heterogeneity within a
102 population while considering individual conditions determined by societal power dimensions
103 such as class, gender and race has been developed through intersectional theory in recent
104 years.(21-26) Intersectionality theory was first articulated by Black feminist scholars as a way
105 of understanding how an individual inhabits and is formed by more than one social relation
106 such as gender, “race” or class, and how these classification systems interconnect to create
107 specific contexts of oppression or privilege.(27, 28) These categorizations should not be seen
108 as individual “risky” identities, but as the social, political and economic contextual conditions
109 that outline our lives through structural inequalities.(29) Reproductive justice is a theoretical
110 framework that builds upon intersectionality and centres diverse groups of unprivileged
111 women’s reproductive experiences to recognize that societal context and differing resources
112 available shape reproductive health.(30) Applying a reproductive justice framework, it
113 becomes clear that we need to take notice of disparate sociocultural contexts and interlocking
114 power dimensions to understand different patterns of usage as well as possible diverse
115 responses to HC.(31, 32)

116 To operationalize an intersectional mapping of heterogeneity in use of anti-
117 depressants in relation to HC on a population level, we used a multilevel analysis of
118 individual heterogeneity and discriminatory accuracy (MAIHDA).(21-23, 33, 34) We created

1
2
3 119 intersectional strata based on previous literature showing that age, socioeconomic position,
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5 120 and previous mental illness are relevant intersecting dimensions in understanding the relation
6
7 121 between HC and depression.(17, 20, 35, 36)

8 122 We conceptualise the intersectional strata as social contexts rather than static
9
10 123 individual traits, thereby visualising how intersecting power dynamics can act in combination
11
12 124 with HC to predispose for depressive mood. Our main hypothesis was that the previously
13
14 125 observed association between HC and use of anti-depressants would vary between strata and
15
16 126 that this association would be more pronounced in more oppressed intersectional contexts.
17
18 127 We investigate this hypothesis on the whole population of women susceptible to HC use in
19
20 128 Sweden.

21 129

22 130 **METHOD**

23 131 **Databases and study population**

24 132 After allowance from the Swedish Ethical Authority and the data safety committees from
25
26 133 Statistics Sweden and the Swedish National Board of Health and Welfare, we obtained a
27
28 134 database created by record linkage of several nationwide registers administered by Statistics
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30 135 Sweden (the Swedish Population Register and the Longitudinal Integration Database for
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32 136 Health Insurance and Labour Market Studies, LISA) and the Swedish National Board of
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34 137 Health and Welfare (National Patient Register, the Swedish Prescribed Drug Register (SPDR)
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36 138 and the Cause of Death Register). The Swedish authorities linked the registries using a unique
37
38 139 personal identification number, but the database was anonymized before delivering it to us.
39
40 140 We defined an initial cohort containing all 1,064,171 women aged 12 - 30 years residing in
41
42 141 Sweden 1st January 2010 and obtained individual level data on medication use from SPDR,
43
44 142 which contain all dispensed drug prescriptions at Swedish pharmacies since 2006.

45 143 Every woman was assigned an individual baseline date, defined by the first
46
47 144 dispensed prescription of an HC drug between 1 January 2010 and 31 December 2014 after
48
49 145 12 years of age, and was then followed for one year after her individual baseline date. A
50
51 146 woman obtaining her first prescription 1 of September 2013 was therefore followed to the 1
52
53 147 of September 2014. For non-users of HC the baseline date could not be based on a HC-
54
55 148 prescription and was therefore assigned, to 1st of July 2012 for all adults, but later for some of
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57 149 the younger girls turning 12 during our period of investigation. This means all non-users had
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59 150 been true non-users for at least 1.5 years before their follow-up started (1 January 2010 to 1
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151 July 2012) but also continued to be non-users all the way to 31 December 2014. From the
152
152 152 individual baseline date, the women were followed for one year to find out if a prescription of

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3 153 an antidepressant was dispensed. Data was also collected on psychiatric disorders and
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5 154 psychotropic drug use in the past three years (see Assessment of variables). After excluding
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7 155 women with incomplete follow-up time due to death, emigration, missing information on
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9 156 country of birth, and pregnancies one year before and after the baseline as well as, the final
10
11 157 database consisted of 915 952 women. This database was divided into two cohorts according
12
13 158 to the presence or absence of previous mental health issues, see Figure 1.
14

159

160 **Assessment of variables**

161 Users of HC were defined as any women who, according the SPDR, filled a prescription of
162
163 HC (Anatomical Therapeutical Chemical (ATC) classification system codes G02B, G03AA-
164
165 C) between 1 January 2010 and 31 December 2014, while non-users did not have a
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167 prescription filled during the same period. Emergency contraception (G03AD) that are mainly
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169 bought over the counter in Sweden was excluded. The majority of HC prescriptions are
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171 acquired via midwives in Sweden (86.0% in our original cohort), whom can only prescribe
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173 HC for contraceptive purposes. Physicians, most often gynecologists, can also can prescribe
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175 HC for other purposes such as in response to bleeding disturbances or endometriosis. Since
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177 these indications could confound our results, we excluded women with physician-issued
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179 prescriptions, see Figure 1. HC prescriptions can be dispensed by pharmacies annually or
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181 every three months.

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172 Anti-depressant use, the outcome of our study, was defined, according to the
173 SPDR, as being dispensed at least one prescription of antidepressants (ATC: N06A) during
174 the individual one-year follow-up.

175 Previous mental health issues were defined as having any psychiatric disorder
176 diagnosed at a hospital (ICD: F00-F99) or a dispensed prescription of a psychotropic drug
177 (ATC: N05A, N05B, N06A) in the past three years.

178 Pregnancies one year previous to baseline and during follow-up were identified
179 according to the 2019 version of the Nordic Diagnosis-Related Group classification
180 (NordDRG), Major Diagnostic Categories codes M14 for pregnancy, delivery and post-
181 partum care.(37)

182 We used family level data on income as of 31 December 2010 from Statistics
183 Sweden's LISA. Individualized disposable family income was calculated by dividing the total
184 disposable income of the family by the number of family members, taking into account the
185 different consumption weights of adults and children determined by Statistics Sweden.
186 Thereafter, we created three categories (i.e., low, medium, and high) of income using tertile

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3 187 cut-offs based on the total Swedish population aged 18 - 80 years. We considered the high-
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5 188 income category as the reference in the comparisons.

6 189 We defined immigrant status at the family level as no family member >18 years
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8 190 of age born in Sweden, since understanding of and access to institutions such as health care
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10 191 differ depending on social position such as it is constructed by the power dimensions of
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12 192 race/immigration, as well as the experience of xenophobia. This variable should therefore be
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14 193 considered as an effort to capture a social position affecting possibilities and life trajectories
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16 194 rather than an essentialist view of otherness. We categorized age at the individual baseline into
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18 195 the following groups: 12 to 17, 18 to 23, and 24 to 30 years to capture age specific conditions
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20 196 of adolescents, young adults, and adult women.

21 197

22 198 **Intersectional Strata**

23
24 199 Within each cohort stratified by previous mental health issues, we generated 36 intersectional
25
26 200 strata by combining three categories of age, three categories of income, two categories of
27
28 201 immigrant background, and two categories of HC use. Mental health issues can be considered
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30 202 as a valid category of intersectional investigation in a society that considers an able body and
31
32 203 mind vital, in other words relating to the power dimension of able-bodiedness,(38, 39).
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34 204 Mental health issues were also included in the analysis since they are a strong determinant of
35
36 205 antidepressant use that needs to be addressed. We could consider that over and above
37
38 206 individual characteristics, mental illness-related stigma may condition inequities in health
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40 207 care.(40) As with gender or income, able-bodiedness concerning mental health can therefore
41
42 208 be conceptualized as a contextual dimension when defining intersectional strata.

43 209

44 210 **Statistical analysis**

45 211 We performed an intersectional MAIHDA with individual women at the first level of analysis
46
47 212 and the 36 intersectional strata at the second level, stratified by previous mental health issues
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49 213 (See Supplementary material 1-4). The use of antidepressants in the population was thus
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51 214 analysed through two successive multilevel logistic regression models distinguishing between
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53 215 measures of association and measures of variance and discriminatory accuracy.

54 216

55 217 *Model 1*

56 218 The first model included only an intercept and a random effect for the intersectional strata
57
58 219 with no covariates. In this model 1 we first (i) performed a simple analysis of components of
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60 220 variance and calculated the Variance Partition Coefficient (VPC). That is, the share

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3 221 (expressed as a percentage) of the total individual variance in the latent propensity of
4 222 antidepressant use that is at the intersectional strata level. In this simple model, the VPC
5 223 correspond with the Intraclass Correlation Coefficient (ICC) which informs on the clustering
6 224 of antidepressant use within intersectional strata. The VPC values extend from 0 to 100%.
7 225 Second, (ii) we calculate the stratum-specific absolute usage of anti-depressants and their
8 226 95% credible intervals (CI) by transformation of the information from the logistic regression
9 227 to the probability scale. We used this information to map the user heterogeneity across the
10 228 intersectional strata. Then, (iii) using these stratum-specific predictions, we calculated the
11 229 Area Under the receiver operator characteristics Curve (AUC). The AUC informs on the
12 230 accuracy of the intersectional strata information for discriminating those women who used
13 231 antidepressants from those who did not. The AUC values extend from 0.5 to 1, where 0.5
14 232 represent absence of accuracy and 1 represents total accuracy. Both the VPC and the AUC in
15 233 model 1 can be interpreted as measures of discriminatory accuracy,(41) and inform on the
16 234 magnitude of the general intersectional effects. The higher the VPC and AUC values, the
17 235 higher the influence of the intersectional context on individual use of antidepressants. Finally,
18 236 (iv) we calculated the difference in anti-depressant use and 95% CI between similar pairs of
19 237 strata differing only on the use of HC. This represents the stratum specific association
20 238 between HC and antidepressant use.
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36 240 *Model 2 or fixed main effects model*

37 241 This model includes the fixed, main effects of all the intersectional dimensions (i.e., age,
38 242 income, immigrant background, and HC use) used to define the intersectional strata. In model
39 243 2 we quantified, (i) the association between the intersectional dimensions and use of
40 244 antidepressants as expressed by odds ratio (OR) and 95% CI. We also calculate (ii) the
41 245 Proportional Change in the Variance (PCV). The PCV measures the overall proportion of
42 246 strata variance of model 1 explained by the specific intersectional dimensions. Since model 2
43 247 contains all the variables used to construct the intersectional strata as main effects, it should
44 248 explain all the strata variance (i.e., PCV= 100%). If this is not the case, the remaining
45 249 between strata variance would be due to the existence of multiplicative interaction of effects
46 250 between the intersectional dimensions defining the strata.(22, 42)
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55 251 The AUCs of the models 1 and 2 are expected to be the same because model 2
56 252 only decomposes the stratum-specific predicted probabilities obtained in model 1 into fixed
57 253 and random effect components and their sum equals the prediction obtained only by random
58 254 effects in model 1.

255 We ran the models using MLwiN 3.00 by calling it from within Stata 14.1 using
 256 the *runmlwin* command.(43) The estimations were performed using Markov chain Monte
 257 Carlo (MCMC) methods. All points estimations and their 95% credible intervals were based
 258 on the parameter and random effect chains obtained from the MCMC estimation. See
 259 elsewhere for further information on the statistical MAIHDA analysis including Stata
 260 commands,(33, 42) and discussion on the theory and methodological approach.(22, 44)

261

262 Patient and Public Involvement statement

263 The research was developed with a grassroots perspective in mind, whereby women's
 264 experiences of use of hormonal contraception inspired and informed the choice of research
 265 area and research questions. The anonymised data and scope of the study, including around 1
 266 million women, prohibited direct patient involvement.

267

268 RESULTS

269 Characteristics of the population

270 The selection of the study population is shown in Figure 1. Out of the 915 952 women 12.4%
 271 (n = 113 711) had previous mental health issues. Mean age was somewhat older for women
 272 with previous mental health issues (22.5 years; SD 4.8) than for those without such concerns
 273 (20.8 years; SD 5.3). Supplementary material 5 shows pooled statistics for usage of previous
 274 mental health issues and HC use, while Supplementary material 6 displays a frequency table
 275 over all included HC. Table 1 displays the baseline characteristics of the population by
 276 previous mental health issues and use of hormonal contraceptives.

Table 1. Characteristics of the 915 954 women aged 12 - 30 years by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women in parenthesis).

	Previous mental health issues			
	Yes 12.4 (113 711)		No 87.6 (802 243)	
	Use of HC		Use of HC	
	Yes 42.5 (48 302)	No 57.5 (65 409)	Yes 42.0 (337 297)	No 58.0 (464 946)
Antidepressant during follow-up	41.2 (19 886)	39.8 (26 013)	2.7 (9 215)	1.9 (8 699)
Age				
12-17 years	14.2 (6 838)	19.4 (12 698)	16.7 (56 343)	42.1 (195 937)
18-23 years	48.3 (23 347)	31.2 (20 381)	50.1 (168 968)	23.3 (108 939)

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3	24-30 years	37.5 (18 117)	49.4 (32 330)	33.2 (11 986)	34.6 (160 616)
4	Income level				
5	Low inc.	40.4 (19 513)	45.6 (29 803)	31.8 (107 119)	33.1 (154 098)
6	Medium inc.	27.1 (13 078)	27.5 (17 954)	25.4 (85 620)	29.5 (137 098)
7	High inc.	32.5 (15 711)	27.0 (17 652)	42.9 (144 558)	37.4 (173 750)
8	Immigrant				
9	background				
10	None	94.6 (45 674)	89.1 (58 264)	94.2 (317 716)	82.6 (383 878)
11	Yes	5.4 (2 628)	10.9 (7 145)	5.8 (19 581)	17.4 (81 068)
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The share of HC users was very similar in healthy women and those with previous mental health issues, 42.0% and 42.5%, respectively. Anti-depressants were dispensed to 2.7% of HC users compared to 1.9% of non-users among healthy women during follow-up. For women with previous mental health issues, 41.2% of HC users and 39.8% of non-users dispensed an anti-depressant prescription. The income levels were generally higher among women without mental health issues, and HC users were somewhat more affluent in both cohorts.

Results from the MAIHDA

Table 2 shows the results from the MAIHDA distinguishing between measures of association and measures of variance and discriminatory accuracy.

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association (Odds Ratios) and measures of variance and

discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are point estimations (with 95% credible intervals) or percentages where indicated.

	Without mental health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
Measures of association				
Age				
<i>12-17 years</i>		Reference		Reference
<i>18-23 years</i>		1.78 (1.36-2.42)		1.57 (1.38-1.76)
<i>24-30 years</i>		2.09 (1.65-2.70)		2.66 (2.36-3.00)
Income				
<i>High inc.</i>		Reference		Reference
<i>Medium inc.</i>		1.05 (0.78-1.37)		0.87 (0.77-0.98)
<i>Low inc.</i>		1.10 (0.81-1.41)		0.87 (0.77-0.98)
Immigrant background				
<i>None</i>		Reference		Reference
<i>Yes</i>		0.63 (0.49-0.79)		0.55 (0.49-0.61)
Hormonal contraception				
<i>No</i>		Reference		Reference
<i>Yes</i>		1.62 (1.34-2.06)		1.19 (1.08-1.31)
Measures of variance and discriminatory accuracy*				
Variance	0.30 (0.18-0.50)	0.10 (0.06-0.18)	0.29 (0.18-0.49)	0.02 (0.01-0.03)
VPC	8.45%	3.02%	8.18%	0.49%
PCV		66.29%		94.48%
AUC	0.62 (0.62-0.62)	0.62 (0.62-0.62)	0.64 (0.64-0.64)	0.64 (0.64-0.64)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

288
 289 Model 1 indicates that 8.45% (without mental health issues) and 8.18% (with previous mental
 290 health issues) of the total individual variance in the latent propensity of using antidepressant is
 291 at the intersectional strata level. These VPCs correspond with AUC values of 0.62 and 0.64
 292 respectively. Both measures suggest the existence of a moderate intersectional effect. The
 293 PCV was high in both groups, but especially so in the group with previous mental health
 294 issues, meaning the intersectional dimensions or main effects explain more of the inter-strata
 295 variance for these women. Model 2 shows that HC was associated with increased usage of
 296 antidepressants after adjustment for all other intersectional dimensions. This result was seen
 297 within both cohorts, but more strongly so in women without previous mental health issues

298 (OR 1.62 compared to 1.19). Finally, the VPC in model 2 was very small (3.02% and 0.49%
 299 respectively) but did not vanish. This finding means that while the intersectional strata effect
 300 was mainly due the additive effect of variables defining the strata, a small component due to
 301 interaction of effects could also be detected.

302

303 **Heterogeneity concerning antidepressant use in our cohort**

304 Women with previous mental health issues had a much higher usage of antidepressants than
 305 women without such issues, but the association with HC use nonetheless varied across the
 306 other intersectional dimensions. Table 3 show the stratum-specific incidence rates for
 307 antidepressant use and 95% CI obtained in model 1.

308

Table 3. Distribution of antidepressant use between different intersectional strata, and difference in usage between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA). Numbers are percentages.

Previous mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptives (%)		
					Yes	No	Yes-No difference
No	12 – 17	Low	No	28182	3.7	1.3	2.4 (1.9 , 2.8)
			Yes	7643	1.2	0.5	0.7 (0.1 , 1.5)
		Middle	No	75836	3.0	1.0	2.0 (1.8 , 2.3)
			Yes	10110	1.8	0.6	1.2 (0.5 , 2.1)
		High	No	125903	2.0	0.9	1.1 (0.9 , 1.2)
			Yes	4606	2.5	0.8	1.6 (0.6 , 2.8)
	18 – 23	Low	No	44723	3.5	3.0	0.5 (0.2 , 0.9)
			Yes	11174	2.3	1.2	1.1 (0.5 , 1.7)
		Middle	No	72018	2.8	2.8	0.1 (-0.2 , 0.3)
			Yes	8776	2.3	1.2	1.1 (0.5 , 1.8)
		High	No	136284	2.3	2.3	0 (-0.2 , 0.1)
			Yes	4386	2.0	1.8	0.2 (-0.6 , 0.9)
24 – 30	Low	No	130127	3.1	3.2	-0.1 (-0.3 , 0.1)	
		Yes	39368	2.7	1.4	1.3 (0.9 , 1.7)	
	Middle	No	45013	3.6	3.0	0.5 (0.2 , 0.9)	
		Yes	10965	2.7	2.4	0.4 (-0.3 , 1.1)	
	High	No	43508	2.4	2.6	-0.2 (-0.5 , 0.1)	
		Yes	3621	1.9	2.3	-0.3 (-1.3 , 0.7)	
Yes	12 – 17	Low	No	3402	30.5	22.7	7.8 (4.7 , 10.8)
			Yes	434	20.8	13.7	7.1 (-0.3 , 15.1)
		Middle	No	6854	31.2	23.4	7.8 (5.6 , 10.1)

		Yes	569	19.9	14.2	5.7 (-1.2 , 13.1)
	High	No	7906	34.2	28.1	6.1 (3.9 , 8.3)
		Yes	371	30.4	19.8	10.6 (1.4 , 19.9)
18 – 23	Low	No	10937	39.2	37.8	1.4 (-0.4 , 3.2)
		Yes	1127	28.5	19.7	8.8 (3.4 , 14.4)
	Middle	No	12915	37.8	36.3	1.5 (-0.2 , 3.1)
		Yes	844	27.4	19.7	7.7 (1.9 , 13.7)
	High	No	17276	38.3	39.8	-1.5 (-3 , 0)
		Yes	629	28.1	25.4	2.8 (-4 , 9.4)
24 – 30	Low	No	29333	50.1	49.9	0.2 (-1 , 1.4)
		Yes	4083	37.3	32.4	4.9 (1.5 , 8.4)
	Middle	No	8629	49.7	50.8	-1.1 (-3.4 , 1.1)
		Yes	1221	33.5	37.1	-3.6 (-10 , 2.6)
	High	No	6686	48.5	48.9	-0.4 (-2.9 , 2)
		Yes	495	43.7	37.5	6.3 (-3.2 , 15.8)

309

310

311 The highest use of anti-depressants were observed in non-immigrant women, aged 24-30,
 312 with previous mental health issues, using HC and with low income (50.1%). The lowest usage
 313 were found in teenagers without previous mental health issues and no HC use, especially in
 314 the strata of immigrant girls from low (0.50%) and middle-income (0.60%) households.

315

316 **Heterogeneity concerning the association between hormonal contraceptive and** 317 **antidepressant use**

318 Overall, the propensity to use antidepressants was consistently higher in HC users compared
 319 to non-users in younger women between 12 and 17 years of age, both without previous mental
 320 health issues (0.7 – 2.4 percentage points), and with a mental health history (5.7 – 7.8
 321 percentage points) with the magnitude being higher in the latter group. However, the 95%
 322 credible intervals were broad since the number of individuals was relatively small in these
 323 latter strata. Table 3 gives detailed information on these associations. In adolescents the
 324 tendency was that an immigrant background lowered the use of anti-depressants, while the
 325 opposite was true for adult women, where a positive association between HC use and later
 326 antidepressant use was mainly found in women with low income and immigrant background,
 327 again with higher magnitudes in women with previous mental health issues. The association
 328 between HC and antidepressant use was smaller in adult women native to Sweden no matter
 329 their income, and completely disappeared in adult women with high income regardless of
 330 immigrant background.

331

DISCUSSION

The main hypothesis of our study was that the previously observed association between HC and antidepressant use, mainly seen in adolescent girls(6-9, 17, 45), would be modified by the intersectional context of the women, being more pronounced in more oppressed intersectional contexts. We confirmed that subsequent use of anti-depressants after an HC prescription compared to non-users of HC within the same intersectional context was heterogeneous across intersectional strata pairs. As hypothesized, the difference in propensity to use anti-depressants was more pronounced in more oppressed intersectional contexts like those composed by immigrant, low-income women with previous mental issues. That is, the use of antidepressants and to some extent the difference in use between HC users and non-users varied mainly depending on previous mental health issues, but the HC-antidepressant association was considerably modified across pair of strata with other characteristics equal but where HC use and non-use differed, in both cohorts. Aside from adolescent girls, low and middle income adult women with immigrant background had a more pronounced difference in propensity for using anti-depressants, while adult women without immigrant background had both the lowest anti-depressant use and a low grade of modification by HC use.

Independently of previous mental health issues, the propensity for using anti-depressants was consistently higher for HC users than for non-users in teenagers aged 12-17, a result aligned with previous studies that has found a heterogeneous response with regard to both age and other factors.(6, 7, 17, 18, 20, 45-47) As discussed in a previous paper, this higher risk for adolescents could be due to a *selective discontinuation bias*,⁽⁷⁾ a development of the *healthy worker survivor effect*, describing how bias is introduced through a continuous selection where those staying in the workforce are healthier than those who leave.⁽⁴⁸⁾ Women who experience a negative influence of HC on psychological health might discontinue treatment in early ages, while those without symptoms continued on HC into adulthood, creating this age-dependent *selective discontinuation bias*. This could explain why the observed association between HC and adverse mental health outcomes are stronger in adolescents. Most Swedish women do however continue their HC treatment with the same method.⁽⁴⁹⁾ A previous study found that new users of HC has a higher risk of obtaining antidepressants within the first six months of HC use than continuous users.⁽⁶⁾ To address this possible bias we ran a sensitivity analysis differentiating between women who filed a first prescription of an HC for the first time during the study period (26.2% of HC users) and those

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3 364 that had a repeat prescription. The results showed that in our cohort the association between
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5 365 HC use and subsequent anti-depressant use was very similar in new and continuous users
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7 366 (Odds Ratio 1.52 and 1.45, respectively, with overlapping 95% confidence intervals).

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9 367 As expected, among adult women the overall propensity for using anti-depressants
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11 368 was higher, as it is known that anti-depressant use increases by age,(50,51) and the difference
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13 369 between HC users and non-users was smaller. Women native to Sweden had a higher
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15 370 propensity for using anti-depressants, but this was moderated by HC exposure to a lower
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17 371 extent than for immigrant women. In adult women native to Sweden, HC use gave no increase
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19 372 of antidepressant use among those with high income. The lower utilization of anti-depressants
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21 373 does not necessarily mean that immigrant women are healthier, since earlier studies have
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23 374 found immigrants utilize healthcare to a lesser extent, even though the need is pronounced,
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25 375 with reasons including discrimination.(52,53) A recent study found that adjustment for
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27 376 health care access eliminated the association between HC initiation and subsequent anti-
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29 377 depressant use in a US population.(54) Although the health care system is different in Sweden
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31 378 and visits to midwives for contraceptive purposes free, we conducted a sensitivity analysis
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33 379 including only women who had accessed health care within the last three years to address this.
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35 380 Using only care-accessors as the reference group did not change our results in any substantive
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37 381 way, see Supplementary material 7 .

382 **Intersectional considerations**

383 The big difference in anti-depressant consumption depending on HC use for lower income
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385 immigrant women could be interpreted as the intersectional contexts embodied by these
386
387 women are more susceptible to the potential detrimental effect of HC on mood. The
388
389 interrelating negative consequences of low income as a proxy for class or social position,
390
391 gender and xenophobia may accumulate over the life course and lead to a higher vulnerability
392
393 to exposures that predispose for antidepressant use later in life,(55-57) whereas this diverse
394
395 vulnerability to HC exposure might not be visible in teenagers. Social experiences can vary
396
397 depending on for example social position, which in turn impact psychological development,
398
399 mood and cognition, thus influencing health.(58, 59) In understanding how HC can impact
400
401 women's mental health differently, both possible individual biological predispositions and
402
403 social settings need to be investigated, since the emotional response to HC is influenced by
404
405 context.(32) In other words, the interlocking power axes that create oppression could
406
407 predispose women already under structural burdens for adverse mental health reactions when
408
409 using HC. The fact that adult women native to Sweden were almost unaffected by HC use,

1
2
3 397 could strengthen this suggestion. Without the intersectional strata this disparity would not
4
5 398 have been so easily identified and visualized.

6
7 399 Focusing on women whose lives are affected by several interlocking power
8
9 400 dimensions such as low social position and xenophobia is fundamental to achieving
10
11 401 reproductive justice.(30) Nonetheless, our intersectional strata should not be considered static
12
13 402 categories of inherently “risky identities” but must be interpreted as context specific
14
15 403 vulnerabilities of women within certain interlocking positions, constituted in relation to power
16
17 404 dynamics created by unequal schemes such as the economic system.(25, 29) It is likely that in
18
19 405 other contexts, other groups could be more vulnerable. It is also important to remember that
20
21 406 the purpose of HC most commonly is protection against unwanted pregnancy, a situation that
22
23 407 if it arises in itself can have negative mental health effects. In identifying the underlying
24
25 408 power systems creating these intersectional categories and acknowledging their constant
26
27 409 movement and changing dynamics on a societal level, it furthermore becomes possible to
28
29 410 address these inequalities through social change.

30
31 411 In this study, we have combined a classical epidemiological approach of
32
33 412 exposure to HC and an intersectional MAHIDA to create a novel understanding of how
34
35 413 intersecting power dynamics could create particular vulnerabilities to this specific exposure.
36
37 414 Because of our study design, where women are followed for one year after a dispensed
38
39 415 prescription of HC, it is more theoretically coherent to view use of HC as an exposure rather
40
41 416 than a component of the intersectional strata. However, it is possible to within our approach
42
43 417 view HC use as a socio-contextual factor that captures certain living conditions (for example
44
45 418 more likely to be sexually active or in a heterosexual relationship), which somewhat changes
46
47 419 the interpretation of the results. This epistemological tension is not necessarily a limitation,
48
49 420 but could enrich the dialogue in social epidemiology on whether it is possible to separate
50
51 421 contextual factors from “pure” exposure.(60-62)

52 422 **Limitations**

53
54 423 The findings from this study must be interpreted in the context of its limitations. The SPDR
55
56 424 has highly reliable data on dispensed prescriptions but cannot measure the actual use of
57
58 425 dispensed medications. Along the same line of reasoning, whether the women was exposed to
59
60 426 HC treatment during her entire follow-up is not possible to determine with our method,
61
62 427 although previous Swedish data suggest continuation rates for any HC after 6 months are
63
64 428 almost 90%.(47) Use of anti-depressants can be considered a proxy for depression, but anti-
65
66 429 depressants are also prescribed for other reasons than depression, including generalized

1
2
3 430 anxiety disorder, obsessive-compulsive disorder and panic disorder.(63) Therefore it is not a
4
5 431 perfect proxy of depression but may be a more general indication of impaired mental
6
7 432 health.(64) However, out of all women with potentially unfavorable mental health effects
8
9 433 from HC, only a subset would have symptoms severe enough to get an anti-depressant
10
11 434 prescription, leading instead to many missed cases. Since the outcome is rather common, the
12
13 435 risk of underestimation is further enhanced and the true risk of adverse mental health effects
14
15 436 could be higher.

16 437 As in any observational study, ours only allows for measurements of
17
18 438 associations and cannot determine causation. Furthermore, apparently strong average
19
20 439 associations do not necessarily convey a high discriminatory accuracy (see elsewhere for a
21
22 440 short review and discussion).(65) Nevertheless, since our analysis yielded a moderate
23
24 441 accuracy (i.e., AUC=0.6), the intersectional strata do matter for the propensity to use
25
26 442 antidepressants. A consideration in every quantitative intersectional study is the basis for
27
28 443 creating intersectional categories, since comprehensive information on background and lived
29
30 444 experiences are lacking and the categories are created based on available but crude proxies
31
32 445 such as income level. For example, in our study the group of women with immigrant
33
34 446 background was very heterogenous, so we cannot exclude that the increased antidepressant
35
36 447 use is located on more specific country of birth categories. There is an ongoing debate
37
38 448 whether these crude categorizations are feasible, and extra caution should be taken when
39
40 449 investigating emerging intersectional categories rather than established ones.(66)

450 **Conclusion**

41 451 It is important to recognise intersectional perspectives and interacting axes of oppression to
42
43 452 tailor better public health interventions, as well as acknowledging the experiences of
44
45 453 oppressed women to reach reproductive and social justice. (29, 66) Our intersectional
46
47 454 MAIHDA methodology operationalizes this idea by providing information on the
48
49 455 discriminatory accuracy of the contexts that define the intersectional strata. It highlights the
50
51 456 need to consider disadvantages consisting of several interlocking structural dimensions such
52
53 457 as income/class, age and immigration to better understand how HC might predispose certain
54
55 458 women, mainly teenagers and low-income women with immigrant background, for
56
57 459 depression. These vulnerabilities are based in inequalities that are not static, but structurally
58
59 460 created and therefore possible to redeem.

60 461

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7 464 **Figure 1.** Selection of the study population.8
9 46510
11 46612 467 **Acknowledgements**

13
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15 469 Endocrinology, the 19th World Congress in December 2020. We thank all colleagues at the
16 470 Unit for Social epidemiology, Lund university, for valuable discussions.

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21 472 **Ethical statement**

22 473 The database was approved by the Regional Ethical Review Board in Lund, Sweden, the Data
23 474 Safety Board at Statistics Sweden and the National Board of Health and Welfare (Dnr: 2014/
24 475 856, 2015/341).

25
26 47627
28
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30
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34 48035
36 481 **Competing interests**

37
38 482 None declared.

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40 48341
42 484 **Data sharing statement**

43 485 Public access to the data is restricted by the Swedish Authorities (Public Access to
44 486 Information and Secrecy Act; [http://www.government.se/information-](http://www.government.se/information-material/2009/09/public-access-to-information-and-secrecy-act/)
45 487 [material/2009/09/public-access-to-information-and-secrecy-act/](http://www.government.se/information-material/2009/09/public-access-to-information-and-secrecy-act/)) but data can be made
46 488 available for researchers after a special review that includes approval of the research project
47 489 by both an Ethics Committee and the authorities' data safety committees. The National Board
48 490 of Health and Welfare is a government agency under the Ministry of Health and Social
49 491 Affairs. It is not their policy to provide individual level data to researchers abroad. Instead,
50 492 they normally advise researchers in other countries to cooperate with Swedish colleagues, to
51 493 whom they can provide data according to standard legal provisions and procedures. Requests
52 494 for access to the data can be made to the National Board of Health and Welfare and Statistics

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3 495 Sweden (<http://www.socialstyrelsen.se/statistics>; [https://www.scb.se/en/services/guidance-](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)
4 496 [for-researchers-and-universities/](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)).

5 497

6
7
8 498 **Contributorship statement**

9
10 499 **Sofia Zettermark:** Conceptualization, design, analysis, interpretation of data, writing original
11 500 draft, final approval of version to be published.

12 501 **Kani Kahlaf:** Interpretation of data, revising draft critically for intellectual content, final
13 502 approval of version to be published.

14 503 **Raquel Perez-Vicente:** Design, analysis, interpretation of data, revising draft critically for
15 504 intellectual content, final approval of version to be published.

16 505 **George Leckie:** Analysis, interpretation of data, revising draft critically for intellectual
17 506 content, final approval of version to be published.

18 507 **Diana Mulinari:** Interpretation of data, revising draft critically for intellectual content, final
19 508 approval of version to be published.

20 509 **Juan Merlo:** Conceptualization, design, analysis, interpretation of data, revising draft
21 510 critically for intellectual content, final approval of version to be published.

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24 513

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For peer review only

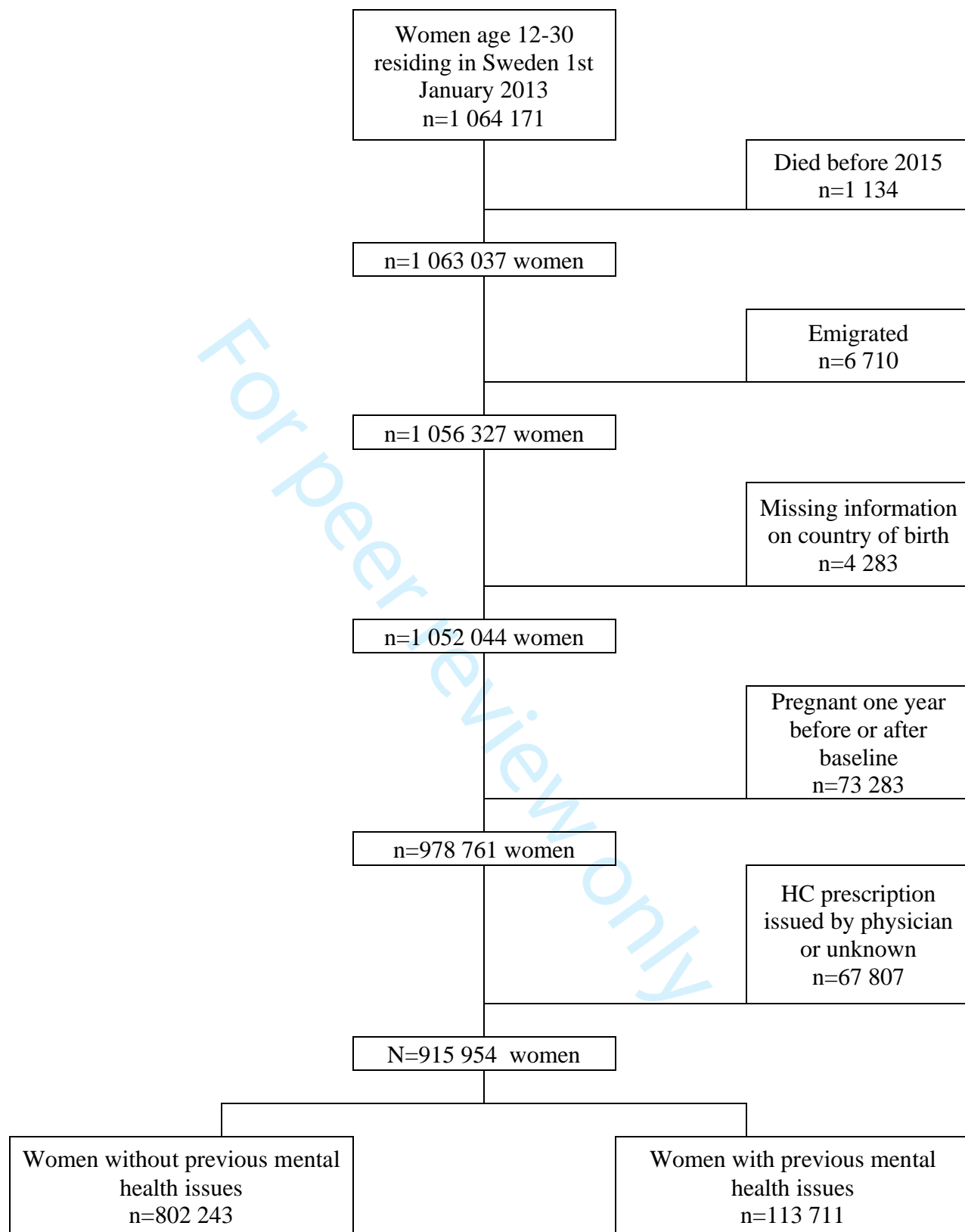


Figure 1. Selection of the study population.

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1
2
3 * Hormonal Contraception and Antidepressant Use in Sweden: An
4 Intersectional Multilevel Analysis of Individual Heterogeneity and
5 Discriminatory Accuracy
6 * (MAIHDA)
7 *****
8 clear *
9 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
10 set cformat %9.2f
11
12
13 *****
14 * TABLE 1
15 *****
16
17 * Load the data
18 use "final_mlMENTAL.dta", clear
19 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
20 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21
22 generate percentage = 100*proportion
23 drop proportion
24 format %9.2f percentage
25
26 generate age_cat = .
27 replace age_cat = 1 if age_cat1==1
28 replace age_cat = 2 if age_cat2==1
29 replace age_cat = 3 if age_cat3==1
30
31 generate inc_cat = .
32 replace inc_cat = 1 if inc1==1
33 replace inc_cat = 2 if inc2==1
34 replace inc_cat = 3 if inc3==1
35
36 * Results for the table
37 tabulate pp [fweight = denom]
38 table pp [fweight = denom], contents(mean percentage )
39 tabulate age_cat pp [fweight = denom], column nofreq
40 tabulate inc_cat pp [fweight = denom], column nofreq
41 tabulate imm pp [fweight = denom], column nofreq
42
43 *****
44 * TABLE 2: MODEL 1
45 *****
46
47 * Load the data
48 use "final_mlMENTAL.dta", clear
49
50 * IGLS estimation, for MCMC initial values
51 runmlwin prop cons, ///
52     level2(inter: cons) ///
53     level1(inter:) ///
54     discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
55     nopause
56
57 * MCMC
58 runmlwin prop cons, ///
59     level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///
60     level1(inter:) ///

```

```

1
2
3     discrete(distribution(binomial) link(logit) denom(denom)) ///
4     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
5     ///
6     initsprevious ///
7     nopause
8
9     * Level-2 variance
10    scalar mlsigma2u = [RP2]var(cons)
11    scalar list mlsigma2u
12
13    * Level-1 variance
14    scalar mlsigma2e = _pi^2/3
15    scalar list mlsigma2e
16
17    * VPC
18    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
19
20    * Compress and save the data
21    compress
22    save "ml.dta", replace
23
24
25    *-----*
26    * PREPARE FIXED-PART PAREMETER CHAINS
27    *-----*
28
29    use "mlb.dta", clear
30    drop deviance RP2_var_cons_ OD_bcons_1
31    rename FP1_* b_*
32    format %9.2f b_*
33    compress
34    save "mlb_prepped.dta", replace
35    isid iteration
36    codebook iteration, compact
37
38
39    *-----*
40    * PREPARE RANDOM EFFECTS CHAINS
41    *-----*
42
43    use "mlu.dta", clear
44    drop residual idnum
45    rename value u
46    format %9.2f u
47    sort inter iteration
48    order inter iteration
49    compress
50    save "mlu_prepped.dta", replace
51    isid inter iteration
52    codebook iteration, compact
53
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"
62    count

```



```

1
2
3 merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
4 count
5 compress
6 save "mldata_prepped.dta", replace
7
8
9
10 -----*
11 * ROC
12 -----*
13 use "mldata_prepped.dta", clear
14 count
15 generate p = invlogit(b_cons + u)
16 gcollapse (mean) p, by(inter num denom)
17 count
18 expand denom
19 sort inter
20 bysort inter: generate y = (_n<=numerator)
21 generate prop = denom/_N
22 generate weight = int(1/prop)
23 roctab y p [fw=weight]
24
25
26 -----*
27 * TABLE 3
28 -----*
29 use "mldata_prepped.dta", clear
30 keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
31 b_cons u
32 count
33 generate p = 100*invlogit(b_cons + u)
34 drop b_cons u
35 format %9.1f p
36 drop inter
37 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
38 imm) j(pp)
39 generate denom = denom0 + denom1
40 drop denom0 denom1
41 generate pdiff = p1 - p0
42 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
43 by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
44 format %9.1f pdiff pdifflo pdiffhi
45 order p1 p0 pdiff pdifflo pdiffhi, last
46 gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
47
48
49 *****
50 * TABLE 2: MODEL 2:
51 *****
52
53 * Load the data
54 use "final_mlMENTAL.dta", clear
55
56 * IGLS estimation, for MCMC initial values
57 runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
58 level2(inter: cons) ///
59 levell(inter:) ///
60 discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
nopause

```

```

1
2
3
4 * MCMC
5 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
6   level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
7   level1(inter:) ///
8   discrete(distribution(binomial) link(logit) denom(denom)) ///
9   mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
10  ///
11  initsprevious ///
12  nopause
13
14 * Odds ratios
15 runmlwin, or
16
17 * Level-2 variance
18 scalar m2sigma2u = [RP2]var(cons)
19 scalar list m2sigma2u
20
21 * Level-1 variance
22 scalar m2sigma2e = _pi^2/3
23 scalar list m2sigma2e
24
25 * VPC
26 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
27
28 * Compress and save the data
29 compress
30 save "m2.dta", replace
31
32 * PCV
33 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
34
35 *-----*
36 * PREPARE FIXED-PART PAREMETER CHAINS
37 *-----*
38 use "m2b.dta", clear
39 drop deviance RP2_var_cons_ OD_bcons_1
40 rename FP1_* b_*
41 format %9.2f b_*
42 compress
43 save "m2b_prepped.dta", replace
44 isid iteration
45 codebook iteration, compact
46
47
48 *-----*
49 * PREPARE inter RANDOM EFFECTS CHAINS
50 *-----*
51 use "m2u.dta", clear
52 drop residual idnum
53 rename value u
54 format %9.2f u
55 sort inter iteration
56 order inter iteration
57 compress
58 save "m2u_prepped.dta", replace
59 isid inter iteration
60 codebook iteration, compact

```

```

1
2
3
4
5
6 *-----*
7 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
8 *-----*
9 use "final_mlMENTAL", clear
10 count
11 cross using "m2b_prepped.dta"
12 count
13 merge m:1 inter iteration using "m2u_prepped.dta"
14 count
15 save "m2data_prepped.dta", replace
16
17
18 *-----*
19 * ROC
20 *-----*
21 use "m2data_prepped.dta", clear
22 count
23 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
24 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
25 gcollapse (mean) p, by(inter num denom)
26 count
27 expand denom
28 sort inter
29 bysort inter: generate y = (_n<=numerator)
30 generate prop = denom/_N
31 generate weight = int(1/prop)
32 roctab y p [fw=weight]
33
34
35 *-----*
36 * TABLE 3
37 *-----*
38 use "m1data_prepped.dta", clear
39 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
40 b_cons u
41 count
42 generate p = 100*invlogit(b_cons + u)
43 drop b_cons u
44 format %9.1f p
45 drop inter
46 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
47 imm) j(pp)
48 generate denom = denom0 + denom1
49 drop denom0 denom1
50 generate pdiff = p1 - p0
51 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
52 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
53 format %9.1f pdiff pdifflo pdiffhi
54 order p1 p0 pdiff pdifflo pdiffhi, last
55 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
56
57
58 *****
59 exit
60

```

```

1
2
3 *****
4 * Hormonal Contraception and Antidepressant Use in Sweden: An
5 Intersectional Multilevel Analysis of Individual Heterogeneity and
6 Discriminatory Accuracy (MAIHDA)
7 *****
8 clear *
9 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
10 set cformat %9.2f
11
12
13
14 *****
15 * TABLE 1
16 *****
17
18 * Load the data
19 use "final_mlNoMENTAL.dta", clear
20 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
22
23 generate percentage = 100*proportion
24 drop proportion
25 format %9.2f percentage
26
27 generate age_cat = .
28 replace age_cat = 1 if age_cat1==1
29 replace age_cat = 2 if age_cat2==1
30 replace age_cat = 3 if age_cat3==1
31
32 generate inc_cat = .
33 replace inc_cat = 1 if inc1==1
34 replace inc_cat = 2 if inc2==1
35 replace inc_cat = 3 if inc3==1
36
37 * Results for the table
38 tabulate pp [fweight = denom]
39 table pp [fweight = denom], contents(mean percentage )
40 tabulate age_cat pp [fweight = denom], column nofreq
41 tabulate inc_cat pp [fweight = denom], column nofreq
42 tabulate imm pp [fweight = denom], column nofreq
43
44
45 *****
46 * TABLE 2: MODEL 1
47 *****
48
49 * Load the data
50 use "final_mlNoMENTAL.dta", clear
51
52 * IGLS estimation, for MCMC initial values
53 runmlwin prop cons, ///
54   level2(inter: cons) ///
55   level1(inter:) ///
56   discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
57   nopause
58
59 * MCMC
60 runmlwin prop cons, ///
61   level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///

```

```

1
2
3     levell(inter:) ///
4     discrete(distribution(binomial) link(logit) denom(denom)) ///
5     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
6     ///
7     initsprevious ///
8     nopause
9
10    * Level-2 variance
11    scalar mlsigma2u = [RP2]var(cons)
12    scalar list mlsigma2u
13
14    * Level-1 variance
15    scalar mlsigma2e = _pi^2/3
16    scalar list mlsigma2e
17
18    * VPC
19    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
20
21    * Compress and save the data
22    compress
23    save "ml.dta", replace
24
25
26    *-----*
27    * PREPARE FIXED-PART PAREMETER CHAINS
28    *-----*
29
30    use "mlb.dta", clear
31    drop deviance RP2_var_cons_ OD_bcons_1
32    rename FP1_* b_*
33    format %9.2f b_*
34    compress
35    save "mlb_prepped.dta", replace
36    isid iteration
37    codebook iteration, compact
38
39
40    *-----*
41    * PREPARE RANDOM EFFECTS CHAINS
42    *-----*
43
44    use "mlu.dta", clear
45    drop residual idnum
46    rename value u
47    format %9.2f u
48    sort inter iteration
49    order inter iteration
50    compress
51    save "mlu_prepped.dta", replace
52    isid inter iteration
53    codebook iteration, compact
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlnOMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"

```

```

1
2
3     count
4     merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
5     count
6     compress
7     save "mldata_prepped.dta", replace
8
9
10
11     *-----*
12     * ROC
13     *-----*
14     use "mldata_prepped.dta", clear
15     count
16     generate p = invlogit(b_cons + u)
17     gcollapse (mean) p, by(inter num denom)
18     count
19     expand denom
20     sort inter
21     bysort inter: generate y = (_n<=numerator)
22     generate prop = denom/_N
23     generate weight = int(1/prop)
24     roctab y p [fw=weight]
25
26
27     *-----*
28     * TABLE 3
29     *-----*
30     use "mldata_prepped.dta", clear
31     keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
32     b_cons u
33     count
34     generate p = 100*invlogit(b_cons + u)
35     drop b_cons u
36     format %9.1f p
37     drop inter
38     reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
39     imm) j(pp)
40     generate denom = denom0 + denom1
41     drop denom0 denom1
42     generate pdiff = p1 - p0
43     gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
44     by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
45     format %9.1f pdiff pdifflo pdiffhi
46     order p1 p0 pdiff pdifflo pdiffhi, last
47     gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
48
49
50     *****
51     * TABLE 2: MODEL 2:
52     *****
53
54     * Load the data
55     use "final_mlNoMENTAL.dta", clear
56
57     * IGLS estimation, for MCMC initial values
58     runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
59     level2(inter: cons) ///
60     levell(inter:) ///
61     discrete(distribution(binomial) link(logit) denom(denom) mql1) ///

```

```

1
2
3     nopause
4
5 * MCMC
6 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
7     level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
8     levell(inter:) ///
9     discrete(distribution(binomial) link(logit) denom(denom)) ///
10    mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
11    ///
12    initsprevious ///
13    nopause
14
15 * Odds ratios
16 runmlwin, or
17
18 * Level-2 variance
19 scalar m2sigma2u = [RP2]var(cons)
20 scalar list m2sigma2u
21
22 * Level-1 variance
23 scalar m2sigma2e = _pi^2/3
24 scalar list m2sigma2e
25
26 * VPC
27 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
28
29 * Compress and save the data
30 compress
31 save "m2.dta", replace
32
33 * PCV
34 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
35
36 *-----*
37 * PREPARE FIXED-PART PAREMETER CHAINS
38 *-----*
39 use "m2b.dta", clear
40 drop deviance RP2_var_cons_ OD_bcons_1
41 rename FP1_* b_*
42 format %9.2f b_*
43 compress
44 save "m2b_prepped.dta", replace
45 isid iteration
46 codebook iteration, compact
47
48
49 *-----*
50 * PREPARE inter RANDOM EFFECTS CHAINS
51 *-----*
52 use "m2u.dta", clear
53 drop residual idnum
54 rename value u
55 format %9.2f u
56 sort inter iteration
57 order inter iteration
58 compress
59 save "m2u_prepped.dta", replace
60 isid inter iteration

```

```

1
2
3 codebook iteration, compact
4
5
6
7 *-----*
8 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
9 *-----*
10 use "final_mlNoMENTAL", clear
11 count
12 cross using "m2b_prepped.dta"
13 count
14 merge m:1 inter iteration using "m2u_prepped.dta"
15 count
16 save "m2data_prepped.dta", replace
17
18
19 *-----*
20 * ROC
21 *-----*
22 use "m2data_prepped.dta", clear
23 count
24 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
25 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
26 gcollapse (mean) p, by(inter num denom)
27 count
28 expand denom
29 sort inter
30 bysort inter: generate y = (_n<=numerator)
31 generate prop = denom/_N
32 generate weight = int(1/prop)
33 roctab y p [fw=weight]
34
35
36 *-----*
37 * TABLE 3
38 *-----*
39 use "m1data_prepped.dta", clear
40 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
41 b_cons u
42 count
43 generate p = 100*invlogit(b_cons + u)
44 drop b_cons u
45 format %9.1f p
46 drop inter
47 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
48 imm) j(pp)
49 generate denom = denom0 + denom1
50 drop denom0 denom1
51 generate pdiff = p1 - p0
52 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
53 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
54 format %9.1f pdiff pdifflo pdiffhi
55 order p1 p0 pdiff pdifflo pdiffhi, last
56 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
57
58
59 *****
60 exit

```


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For peer review only

1
2 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
3 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.013224002,279,21098,1
4 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.037408244,265,7084,1
5 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.0040497542,28,6914,1
6 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.0096021947,7,729,1
7
8 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.010099272,587,58123,1
9 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.030316716,537,17713,1
10 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.0056107035,52,9268,1
11 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.017814728,15,842,1
12
13 0,0,12-17 High income 0 0,1,0,0,0,0,1,.008893352,859,96589,1
14 1,0,12-17 High income 0 1,1,0,0,0,0,1,.01951286,572,29314,1
15 0,1,12-17 High income 1 0,1,0,0,0,0,1,.0076045627,30,3945,1
16 1,1,12-17 High income 1 1,1,0,0,0,0,1,.025718609,17,661,1
17
18 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.029676914,530,17859,1
19 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.034916617,938,26864,1
20 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.011607248,98,8443,1
21 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.022702307,62,2731,1
22
23 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.027664155,771,27870,1
24 1,0,18-23 Middle income 0 1,0,1,0,0,1,0,.0282459,1247,44148,1
25 0,1,18-23 Middle income 1 0,0,1,0,0,1,0,.011609907,75,6460,1
26 1,1,18-23 Middle income 1 1,0,1,0,0,1,0,.023316063,54,2316,1
27
28 0,0,18-23 High income 0 0,0,1,0,0,0,1,.023347162,1058,45316,1
29 1,0,18-23 High income 0 1,0,1,0,0,0,1,.022887168,2082,90968,1
30 0,1,18-23 High income 1 0,0,1,0,0,0,1,.017995911,44,2445,1
31 1,1,18-23 High income 1 1,0,1,0,0,0,1,.019577537,38,1941,1
32
33 0,0,24-30 Low income 0 0,0,0,1,1,0,0,.032189574,2168,67351,1
34 1,0,24-30 Low income 0 1,0,0,1,1,0,0,.031126546,1954,62776,1
35 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.013751426,446,32433,1
36 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.026964672,187,6935,1
37
38 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.030455342,818,26859,1
39 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.03591495,652,18154,1
40 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.023714487,202,8518,1
41 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.027789129,68,2447,1
42
43 0,0,24-30 High income 0 0,0,0,1,0,0,1,.025993951,593,22813,1
44 1,0,24-30 High income 0 1,0,0,1,0,0,1,.024208747,501,20695,1
45 0,1,24-30 High income 1 0,0,0,1,0,0,1,.023088569,61,2642,1
46 1,1,24-30 High income 1 1,0,0,1,0,0,1,.019407559,19,979,1
47
48
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1
2 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
3 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.22574355,463,2051,1
4 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.3049593,412,1351,1
5 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.12383901,40,323,1
6 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.1891892,21,111,1
7
8 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.23362993,1024,4383,1
9 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.31201944,771,2471,1
10 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.13422818,60,447,1
11 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.18032786,22,122,1
12 0,0,12-17 High income 0 0,1,0,0,0,0,1,.28093326,1469,5229,1
13 1,0,12-17 High income 0 1,1,0,0,0,0,1,.34217408,916,2677,1
14 0,1,12-17 High income 1 0,1,0,0,0,0,1,.18867925,50,265,1
15 1,1,12-17 High income 1 1,1,0,0,0,0,1,.3018868,32,106,1
16 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.37809917,2013,5324,1
17 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.39212543,2201,5613,1
18 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.19350649,149,770,1
19 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.28291318,101,357,1
20 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.36302635,2164,5961,1
21 1,0,18-23 Middle income 0 1,0,1,0,0,1,0,.37776819,2627,6954,1
22 0,1,18-23 Middle income 1 0,0,1,0,0,1,0,.19285715,108,560,1
23 1,1,18-23 Middle income 1 1,0,1,0,0,1,0,.27112675,77,284,1
24 0,0,18-23 High income 0 0,0,1,0,0,0,1,.39782199,2959,7438,1
25 1,0,18-23 High income 0 1,0,1,0,0,0,1,.38269973,3765,9838,1
26 0,1,18-23 High income 1 0,0,1,0,0,0,1,.25,82,328,1
27 1,1,18-23 High income 1 1,0,1,0,0,0,1,.27906978,84,301,1
28 0,0,24-30 Low income 0 0,0,0,1,1,0,0,.49862742,9082,18214,1
29 1,0,24-30 Low income 0 1,0,0,1,1,0,0,.50085437,5569,11119,1
30 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.32457545,1013,3121,1
31 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.37422037,360,962,1
32 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.50859779,2869,5641,1
33 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.49799198,1488,2988,1
34 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.37214136,358,962,1
35 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.33590734,87,259,1
36 0,0,24-30 High income 0 0,0,0,1,0,0,1,.48993289,1971,4023,1
37 1,0,24-30 High income 0 1,0,0,1,0,0,1,.48666918,1296,2663,1
38 0,1,24-30 High income 1 0,0,0,1,0,0,1,.37669376,139,369,1
39 1,1,24-30 High income 1 1,0,0,1,0,0,1,.45238096,57,126,1
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Supplementary material 5

Supplementary table, summary statistics. Numbers are percentages (numbers within brackets).

		Hormonal contraception	Mental health issues
<i>Age</i>	12-17	23.2 (63 181)	7.2 (19 536)
	18-23	59.9 (192 315)	13.6 (43 729)
	24-30	40.3 (130 103)	15.6 (50 447)
<i>Income</i>	Low	40.8 (126 632)	15.9 (49 316)
	Middle	38.9 (98 698)	12.2 (31 032)
	High	45.6 (160 269)	9.5 (33 363)
<i>Immigrant background</i>	No	45.1 (363 390)	12.9 (103 938)
	Yes	20.1 (22 209)	8.9 (9 773)

Supplementary table. Percentage of women within each intersectional dimension using hormonal contraceptives and with previous mental health issues.

Supplementary material 6

ATC	Freq.	Percent
G02BA03	12 535	3.25
G02BB	96	0.02
G0BB01	26 022	6.75
G02BB01	48	0.01
G03AA03	4 786	1.24
G03AA07	126 061	32.69
G03AA09	3 227	0.84
G03AA11	15 463	4.01
G03AA12	4 596	13.69
G03AA13	12 329	1.19
G03AA14	5 958	3.20
G03AB	5 958	1.55
G03AB03	8 014	2.08
G03AB04	5 341	1.39
G03AC01	4 249	1.10
G03AC02	2 483	0.64
G03AC06	2 710	0.70
G03AC08	21 284	5.52
G03AC09	77 595	20.12

Supplementary table, frequency table of hormonal contraceptives. Frequency of all included hormonal contraceptives in the final cohort of 915 954 women.

Supplementary material 7

Sensitivity analysis only including women with a recent health care contact (defined as any dispensed prescription or appointment at a hospital in the last 3 years) = 60.46% of the original population

Table 1. Characteristics of the 553 789 women aged 12 - 30 years and residing in Sweden by 1st January 2013 by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women) if not otherwise indicated.

	Previous mental health issues			
	Yes		No	
	19.01 (n = 105 283)		80.99 (n = 448 506)	
	Use of Hormonal contraceptives		Use of Hormonal contraceptives	
	Yes	No	Yes	No
	42.42 (n = 44657)	57.58 (n = 60 626)	44.41 (n = 199 170)	55.59 (n = 249 336)
Antidepressant drugs	41.17 (19 886)	39.77 (26 013)	2.73 (9 215)	1.87 (8 699)
Age				
12-17 years	15.11 (6 747)	20.75 (12 581)	15.63 (31 133)	37.24 (92 846)
18-23 years	48.78 (21 784)	31.29 (18 968)	48.30 (96 200)	22.75 (56 735)
24-30 years	36.11 (16 126)	47.96 (29 077)	36.07 (71 837)	40.01 (99 755)
Income level				
Low	39.70 (17 731)	45.01 (27 286)	33.06 (65 847)	35.08 (87 456)
Middle	27.55 (12 302)	27.85 (16 887)	26.00 (51 776)	29.91 (74 575)
High	32.75 (14 624)	27.14 (16 453)	40.94 (81 547)	35.01 (87 305)
Immigrant background				
No	94.50 (42 200)	88.94 (53 919)	93.76 (186 745)	83.61 (208 465)
Yes	5.50 (2 457)	11.06 (6 707)	6.24 (12 425)	16.39 (40 871)

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association and measures of variance and discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are point estimations with (95% Confidence Intervals)

	Without metal health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
Measures of association, Odds				
Ratios				
Age				
12-17		Reference		Reference
18-23		1.73 (1.33-2.22)		1.52 (1.33-1.71)
24-30		1.90 (1.48-2.40)		2.58 (2.29-2.91)
Income				
High		Reference		Reference
Middle		1.16 (0.91-1.48)		0.89 (0.79-1.01)
Low		1.17 (0.92-1.55)		0.89 (0.78-1.01)
Immigrant background				
No		Reference		Reference
Yes		0.65 (0.53-0.81)		0.55 (0.49-0.61)
Hormonal contraceptives				
No		Reference		Reference
Yes		1.40 (1.12-1.71)		1.18 (1.06-1.34)
Measures of variance				
Variance*	0.224 (0.130-0.372)	0.077 (0.038-0.141)	0.287 (0.174-0.468)	0.017 (0.008-0.033)
VPC	6.38%	2.29%	8.02%	0.51%
PCV		65.67%		94.09%
AUC	0.61 (0.61-0.61)	0.61 (0.61-0.61)	0.64 (0.64-0.64)	0.64 (0.64-0.64)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

Table 3. Absolute risk (AR) of antidepressant use, and AR difference (ARD) between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA)

Previous mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptive				
					Yes AR	No AR	Yes-No difference ARD		
No	12 – 17	Low	No	14060	4.4	1.8	2.7 (2 - 3.4)		
			Yes	3123	1.5	0.8	0.8 (-0.1 - 2)		
		Middle	No	37376	3.6	1.3	2.2 (1.8 - 2.6)		
			Yes	4543	2.4	1.0	1.4 (0.3 - 2.8)		
	High	No	62712	2.4	1.1	1.3 (1 - 1.5)			
		Yes	2165	2.8	1.2	1.7 (0.4 - 3.3)			
		Low	No	25939	4.2	3.4	0.8 (0.3 - 1.2)		
			Yes	5720	2.5	2.0	0.5 (-0.3 - 1.4)		
	Middle	No	40241	3.3	3.6	-0.3 (-0.6 - 0.1)			
		Yes	4547	2.7	1.8	0.9 (0 - 1.9)			
		High	No	74281	2.7	2.9	-0.2 (-0.4 - 0.1)		
			Yes	2207	2.0	2.7	-0.6 (-1.9 - 0.5)		
	24 – 30	Low	No	83448	3.6	3.7	0 (-0.3 - 0.2)		
			Yes	21013	2.9	2.1	0.8 (0.3 - 1.4)		
		Middle	No	31818	4.0	3.5	0.5 (0.1 - 0.9)		
			Yes	7826	3.0	2.7	0.3 (-0.5 - 1.2)		
		High	No	25335	2.9	3.0	-0.1 (-0.5 - 0.3)		
			Yes	2152	2.5	2.7	-0.2 (-1.5 - 1.2)		
		Yes	12 – 17	Low	No	3371	30.1	22.3	7.8 (4.7 - 10.9)
					Yes	429	20.4	13.4	7 (-0.4 - 14.8)
Middle	No			6787	31.0	23.1	7.9 (5.7 - 10.1)		
	Yes			565	19.5	14.3	5.2 (-1.5 - 12.7)		
High	No		7807	33.8	27.7	6.1 (3.9 - 8.2)			
	Yes		369	29.7	19.4	10.3 (1.2 - 19.6)			
	Low		No	10205	38.8	36.9	1.9 (0.1 - 3.8)		
			Yes	1068	28.1	19.0	9.1 (3.5 - 14.6)		
Middle	No		12082	36.6	35.0	1.6 (-0.1 - 3.3)			
	Yes		805	27.2	19.1	8.1 (2 - 14.3)			
	High		No	15994	37.2	38.5	-1.3 (-2.8 - 0.3)		
			Yes	598	26.3	25.4	0.8 (-6.1 - 7.7)		
24 – 30	Low		No	26185	49.2	48.9	0.3 (-0.9 - 1.6)		
			Yes	3759	36.0	32.6	3.4 (-0.3 - 7)		
	Middle		No	7820	49.2	50.4	-1.3 (-3.6 - 1)		
			Yes	1130	31.4	37.2	-5.8 (-12.4 - 0.9)		

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3		High	No	5868	47.8	47.8	0 (-2.6 - 2.6)
4			Yes	441	41.3	35.2	6.1 (-3.6 - 16)
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Population Heterogeneity in Associations Between Hormonal Contraception and Antidepressant Use in Sweden: A Prospective Cohort Study Applying Intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA)

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3 1 **Population Heterogeneity in Associations Between Hormonal**
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5 2 **Contraception and Antidepressant Use in Sweden: A Prospective Cohort**
6
7 3 **Study Applying Intersectional Multilevel Analysis of Individual**
8
9 4 **Heterogeneity and Discriminatory Accuracy (MAIHDA)**
10

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ABSTRACT

Objectives From a reproductive justice framework, we aimed to investigate how a possible association between hormonal contraceptive (HC) and anti-depressants use (as a proxy for depression) is distributed across intersectional strata in the population. We aimed to visualize how intersecting power dynamics may operate in combination with HC use to increase or decrease subsequent use of anti-depressants. Our main hypothesis was that the previously observed association between HC and anti-depressants use would vary between strata, being more pronounced in more oppressed intersectional contexts. For this purpose, we applied an intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) approach.

Design Observational prospective cohort study using record linkage of national Swedish registers.

Setting The population of Sweden.

Participants All 915 954 women aged 12-30 residing in Sweden 2010, without a recent pregnancy and alive during the individual one-year follow-up.

Primary outcome measure Use of any anti-depressant, meaning being dispensed at least one anti-depressant (ATC N06A) during follow-up.

Results Previously mentally healthy hormonal contraceptive users had an odds ratio of 1.79 for use of anti-depressants compared to non-users, whereas this number was 1.28 for women with previous mental health issues. The highest anti-depressant use were uniformly found in strata with previous mental health issues, with highest usage in women aged 24-30 with no immigrant background, low income, and HC use (51.4%). The largest difference in anti-depressant use between HC users and non-users was found in teenagers, and in adult women of immigrant background with low income. Of the total individual variance in the latent propensity of using antidepressant 9.01% (healthy) and 8.16% (with previous mental health issues) was found at the intersectional stratum level.

Conclusions Our study suggests teenagers and women with immigrant background and low income could be more sensitive to mood effects of HC, a heterogeneity important to consider moving forward.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

- Entire Swedish population of women aged 12-30 included
- Pharmacy dispensing automatically linked to individual personal identification number in Sweden through the Swedish Prescribed Drug Register and thus very reliable
- Intersectional MAHIDA is a fruitful way of epidemiologically investigating heterogeneity within a population while considering individual conditions determined by societal power dimensions such as class, gender and race
- Anti-depressant dispensing is not a perfect proxy for depression
- Registers cannot not measure actual use of any medication

85 INTRODUCTION

86 In recent years, attention in the medical community has increasingly been drawn towards
87 depression and other adverse effects on mood related to use of hormonal contraception
88 (HC).(1, 2) Discontinuation rates are high, with mood disturbances or depression being one of
89 the most common complaints.(3-5) Two large epidemiological studies, one in Denmark and
90 the other performed in Sweden, have recently shown a higher risk of anti-depressants and
91 psychotropic drugs use in adolescent users of HC.(6, 7) Randomized controlled trials are rare,
92 but suggest a negative influence of HC on well-being and sexual function,(8, 9) as well as
93 evidence of HC modulating brain activity with subsequent mood alterations in some
94 women.(10, 11) Even though oestrogen and progesterone are known to affect mood,(12) the
95 growing body of evidence in this field is contradictory, with recent reviews concluding that
96 both protective and negative effects of HC on mood exist and more research is needed.(13-16)
97 Despite this uncertainty, many scholars agree that certain subgroups of women seem more
98 vulnerable to psychological side effects of HC than others, particularly teenagers and women
99 with previous mental health issues.(10, 13, 17-20) A call for further investigation into these
100 vulnerable subgroups has been made.(14)

101 A fruitful way of epidemiologically investigating heterogeneity within a
102 population while considering individual conditions determined by societal power dimensions
103 such as class, gender and race has been developed through intersectional theory in recent
104 years.(21-26) Intersectionality theory was first articulated by Black feminist scholars as a way
105 of understanding how an individual inhabits and is formed by more than one social relation
106 such as gender, “race” or class, and how these classification systems interconnect to create
107 specific contexts of oppression or privilege.(27, 28) These categorizations should not be seen
108 as individual “risky” identities, but as the social, political and economic contextual conditions
109 that outline our lives through structural inequalities.(29) Reproductive justice is a theoretical
110 framework that builds upon intersectionality and centres diverse groups of unprivileged
111 women’s reproductive experiences to recognize that societal context and differing resources
112 available shape reproductive health.(30) Applying a reproductive justice framework, it
113 becomes clear that we need to take notice of disparate sociocultural contexts and interlocking
114 power dimensions to understand different patterns of usage as well as possible diverse
115 responses to HC.(31, 32)

116 To operationalize an intersectional mapping of heterogeneity in use of anti-
117 depressants in relation to HC on a population level, we used a multilevel analysis of
118 individual heterogeneity and discriminatory accuracy (MAIHDA).(21-23, 33, 34) We created

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2
3 119 intersectional strata based on previous literature showing that age, socioeconomic position,
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5 120 and previous mental illness are relevant intersecting dimensions in understanding the relation
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7 121 between HC and depression.(17, 20, 35, 36)

8 122 We conceptualise the intersectional strata as social contexts rather than static
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10 123 individual traits, thereby visualising how intersecting power dynamics can act in combination
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12 124 with HC to predispose for depressive mood. Our main hypothesis was that the previously
13
14 125 observed association between HC and use of anti-depressants would vary between strata and
15
16 126 that this association would be more pronounced in more oppressed intersectional contexts.
17
18 127 We investigate this hypothesis on the whole population of women susceptible to HC use in
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20 128 Sweden.

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22 130 **METHOD**

23 131 **Databases and study population**

24 132 After allowance from the Swedish Ethical Authority and the data safety committees from
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26 133 Statistics Sweden and the Swedish National Board of Health and Welfare, we obtained a
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28 134 database created by record linkage of several nationwide registers administered by Statistics
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30 135 Sweden (the Swedish Population Register and the Longitudinal Integration Database for
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32 136 Health Insurance and Labour Market Studies, LISA) and the Swedish National Board of
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34 137 Health and Welfare (National Patient Register, the Swedish Prescribed Drug Register (SPDR)
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36 138 and the Cause of Death Register). The Swedish authorities linked the registries using a unique
37
38 139 personal identification number, but the database was anonymized before delivering it to us.
39
40 140 We defined an initial cohort containing all 1,064,171 women aged 12 - 30 years residing in
41
42 141 Sweden 1st January 2010 and obtained individual level data on medication use from SPDR,
43
44 142 which contain all dispensed drug prescriptions at Swedish pharmacies since 2006.

45 143 Every woman was assigned an individual baseline date, defined by the first
46
47 144 dispensed prescription of an HC drug between 1 January 2010 and 31 December 2014 after
48
49 145 12 years of age, and was then followed for one year after her individual baseline date. A
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51 146 woman obtaining her first prescription 1 of September 2013 was therefore followed to the 1
52
53 147 of September 2014. For non-users of HC the baseline date could not be based on a HC-
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55 148 prescription and was therefore assigned, to 1st of July 2012 for all adults, but later for some of
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57 149 the younger girls turning 12 during our period of investigation. This means all non-users had
58
59 150 been true non-users for at least 1.5 years before their follow-up started (1 January 2010 to 1
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151 July 2012) but also continued to be non-users all the way to 31 December 2014. From the
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152 individual baseline date, the women were followed for one year to find out if a prescription of

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3 153 an antidepressant was dispensed. Data was also collected on psychiatric disorders and
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5 154 psychotropic drug use in the past three years (see Assessment of variables). After excluding
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7 155 women with incomplete follow-up time due to death, emigration, missing information on
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9 156 country of birth, and pregnancies one year before and after the baseline as well as, the final
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11 157 database consisted of 915 952 women. This database was divided into two cohorts according
12
13 158 to the presence or absence of previous mental health issues, see Figure 1.
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160 **Assessment of variables**

161 Users of HC were defined as any women who, according the SPDR, filled a prescription of
162
163 HC (Anatomical Therapeutical Chemical (ATC) classification system codes G02B, G03AA-
164
165 C) between 1 January 2010 and 31 December 2014, while non-users did not have a
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167 prescription filled during the same period. Emergency contraception (G03AD) that are mainly
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169 bought over the counter in Sweden was excluded. The majority of HC prescriptions are
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171 acquired via midwives in Sweden (86.0% in our original cohort), whom can only prescribe
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173 HC for contraceptive purposes. Physicians, most often gynecologists, can also can prescribe
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175 HC for other purposes such as in response to bleeding disturbances or endometriosis. Since
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177 these indications could confound our results, we excluded women with physician-issued
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179 prescriptions, see Figure 1. HC prescriptions can be dispensed by pharmacies annually or
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181 every three months.

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172 Anti-depressant use, the outcome of our study, was defined, according to the
173 SPDR, as being dispensed at least one prescription of antidepressants (ATC: N06A) during
174 the individual one-year follow-up.

175 Previous mental health issues were defined as having any psychiatric disorder
176 diagnosed at a hospital (ICD: F00-F99) or a dispensed prescription of a psychotropic drug
177 (ATC: N05A, N05B, N06A) in the past three years.

178 Pregnancies one year previous to baseline and during follow-up were identified
179 according to the 2019 version of the Nordic Diagnosis-Related Group classification
180 (NordDRG), Major Diagnostic Categories codes M14 for pregnancy, delivery and post-
181 partum care.(37)

182 We used family level data on income as of 31 December 2010 from Statistics
183 Sweden's LISA. Individualized disposable family income was calculated by dividing the total
184 disposable income of the family by the number of family members, taking into account the
185 different consumption weights of adults and children determined by Statistics Sweden.
186 Thereafter, we created three categories (i.e., low, medium, and high) of income using tertile

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3 187 cut-offs based on the total Swedish population aged 18 - 80 years. We considered the high-
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5 188 income category as the reference in the comparisons.

6 189 We defined immigrant status at the family level as no family member >18 years
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8 190 of age born in Sweden, since understanding of and access to institutions such as health care
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10 191 differ depending on social position such as it is constructed by the power dimensions of
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12 192 race/immigration, as well as the experience of xenophobia. This variable should therefore be
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14 193 considered as an effort to capture a social position affecting possibilities and life trajectories
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16 194 rather than an essentialist view of otherness. We categorized age at the individual baseline into
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18 195 the following groups: 12 to 17, 18 to 23, and 24 to 30 years to capture age specific conditions
19
20 196 of adolescents, young adults, and adult women.

21 197

22 198 **Intersectional Strata**

23
24 199 Within each cohort stratified by previous mental health issues, we generated 36 intersectional
25
26 200 strata by combining three categories of age, three categories of income, two categories of
27
28 201 immigrant background, and two categories of HC use. Mental health issues can be considered
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30 202 as a valid category of intersectional investigation in a society that considers an able body and
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32 203 mind vital, in other words relating to the power dimension of able-bodiedness,(38, 39).
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34 204 Mental health issues were also included in the analysis since they are a strong determinant of
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36 205 antidepressant use that needs to be addressed. We could consider that over and above
37
38 206 individual characteristics, mental illness-related stigma may condition inequities in health
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40 207 care.(40) As with gender or income, able-bodiedness concerning mental health can therefore
41
42 208 be conceptualized as a contextual dimension when defining intersectional strata.

43 209

44 210 **Statistical analysis**

45 211 We performed an intersectional MAIHDA with individual women at the first level of analysis
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47 212 and the 36 intersectional strata at the second level, stratified by previous mental health issues
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49 213 (See Supplementary material 1-4). The use of antidepressants in the population was thus
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51 214 analysed through two successive multilevel logistic regression models distinguishing between
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53 215 measures of association and measures of variance and discriminatory accuracy.

54 216

55 217 *Model 1*

56 218 The first model included only an intercept and a random effect for the intersectional strata
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58 219 with no covariates. In this model 1 we first (i) performed a simple analysis of components of
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60 220 variance and calculated the Variance Partition Coefficient (VPC). That is, the share

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3 221 (expressed as a percentage) of the total individual variance in the latent propensity of
4 222 antidepressant use that is at the intersectional strata level. In this simple model, the VPC
5 223 correspond with the Intraclass Correlation Coefficient (ICC) which informs on the clustering
6 224 of antidepressant use within intersectional strata. The VPC values extend from 0 to 100%.
7 225 Second, (ii) we calculate the stratum-specific absolute usage of anti-depressants and their
8 226 95% credible intervals (CI) by transformation of the information from the logistic regression
9 227 to the probability scale. We used this information to map the user heterogeneity across the
10 228 intersectional strata. Then, (iii) using these stratum-specific predictions, we calculated the
11 229 Area Under the receiver operator characteristics Curve (AUC). The AUC informs on the
12 230 accuracy of the intersectional strata information for discriminating those women who used
13 231 antidepressants from those who did not. The AUC values extend from 0.5 to 1, where 0.5
14 232 represent absence of accuracy and 1 represents total accuracy. Both the VPC and the AUC in
15 233 model 1 can be interpreted as measures of discriminatory accuracy,(41) and inform on the
16 234 magnitude of the general intersectional effects. The higher the VPC and AUC values, the
17 235 higher the influence of the intersectional context on individual use of antidepressants. Finally,
18 236 (iv) we calculated the difference in anti-depressant use and 95% CI between similar pairs of
19 237 strata differing only on the use of HC. This represents the stratum specific association
20 238 between HC and antidepressant use.
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240 *Model 2 or fixed main effects model*

36 241 This model includes the fixed, main effects of all the intersectional dimensions (i.e., age,
37 242 income, immigrant background, and HC use) used to define the intersectional strata. In model
38 243 2 we quantified, (i) the association between the intersectional dimensions and use of
39 244 antidepressants as expressed by odds ratio (OR) and 95% CI. We also calculate (ii) the
40 245 Proportional Change in the Variance (PCV). The PCV measures the overall proportion of
41 246 strata variance of model 1 explained by the specific intersectional dimensions. Since model 2
42 247 contains all the variables used to construct the intersectional strata as main effects, it should
43 248 explain all the strata variance (i.e., PCV= 100%). If this is not the case, the remaining
44 249 between strata variance would be due to the existence of multiplicative interaction of effects
45 250 between the intersectional dimensions defining the strata.(22, 42)
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55 251 The AUCs of the models 1 and 2 are expected to be the same because model 2
56 252 only decomposes the stratum-specific predicted probabilities obtained in model 1 into fixed
57 253 and random effect components and their sum equals the prediction obtained only by random
58 254 effects in model 1.
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255 We ran the models using MLwiN 3.00 by calling it from within Stata 14.1 using
 256 the *runmlwin* command.(43) The estimations were performed using Markov chain Monte
 257 Carlo (MCMC) methods. All points estimations and their 95% credible intervals were based
 258 on the parameter and random effect chains obtained from the MCMC estimation. See
 259 elsewhere for further information on the statistical MAIHDA analysis including Stata
 260 commands,(33, 42) and discussion on the theory and methodological approach.(22, 44)

261

262 Patient and Public Involvement statement

263 The research was developed with a grassroots perspective in mind, whereby women's
 264 experiences of use of hormonal contraception inspired and informed the choice of research
 265 area and research questions. The anonymised data and scope of the study, including around 1
 266 million women, prohibited direct patient involvement.

267

268 RESULTS

269 Characteristics of the population

270 The selection of the study population is shown in Figure 1. Out of the 915 952 women 12.4%
 271 (n = 113 711) had previous mental health issues. Mean age was somewhat older for women
 272 with previous mental health issues (22.5 years; SD 4.8) than for those without such concerns
 273 (20.8 years; SD 5.3). Supplementary material 5 shows pooled statistics for usage of previous
 274 mental health issues and HC use, while Supplementary material 6 displays a frequency table
 275 over all included HC. Table 1 displays the baseline characteristics of the population by
 276 previous mental health issues and use of hormonal contraceptives.

Table 1. Characteristics of the 915 954 women aged 12 - 30 years by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women in parenthesis).

	Previous mental health issues			
	Yes 12.4 (113 711)		No 87.6 (802 243)	
	Use of HC		Use of HC	
	Yes 42.5 (48 302)	No 57.5 (65 409)	Yes 42.0 (337 297)	No 58.0 (464 946)
Antidepressant during follow-up	41.2 (19 886)	39.8 (26 013)	2.7 (9 215)	1.9 (8 699)
Age				
12-17 years	14.2 (6 838)	19.4 (12 698)	16.7 (56 343)	42.1 (195 937)
18-23 years	48.3 (23 347)	31.2 (20 381)	50.1 (168 968)	23.3 (108 939)

24-30 years	37.5 (18 117)	49.4 (32 330)	33.2 (11 986)	34.6 (160 616)
Income level				
<i>Low inc.</i>	40.4 (19 513)	45.6 (29 803)	31.8 (107 119)	33.1 (154 098)
<i>Medium inc.</i>	27.1 (13 078)	27.5 (17 954)	25.4 (85 620)	29.5 (137 098)
<i>High inc.</i>	32.5 (15 711)	27.0 (17 652)	42.9 (144 558)	37.4 (173 750)
Immigrant background				
<i>None</i>	94.6 (45 674)	89.1 (58 264)	94.2 (317 716)	82.6 (383 878)
<i>Yes</i>	5.4 (2 628)	10.9 (7 145)	5.8 (19 581)	17.4 (81 068)

277

278 The share of HC users was very similar in healthy women and those with previous mental
 279 health issues, 42.0% and 42.5%, respectively. Anti-depressants were dispensed to 2.7% of HC
 280 users compared to 1.9% of non-users among healthy women during follow-up. For women
 281 with previous mental health issues, 41.2% of HC users and 39.8% of non-users dispensed an
 282 anti-depressant prescription. The income levels were generally higher among women without
 283 mental health issues, and HC users were somewhat more affluent in both cohorts.

284

285 **Results from the MAIHDA**

286 Table 2 shows the results from the MAIHDA distinguishing between measures of association
 287 and measures of variance and discriminatory accuracy.

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association (Odds Ratios) and measures of variance and

discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are point estimations (with 95% credible intervals) or percentages where indicated.

	Without metal health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
Measures of association				
Age				
<i>12-17 years</i>		Reference		Reference
<i>18-23 years</i>		1.78 (1.36-2.42)		1.57 (1.38-1.76)
<i>24-30 years</i>		2.09 (1.65-2.70)		2.66 (2.36-3.00)
Income				
<i>High inc.</i>		Reference		Reference
<i>Medium inc.</i>		1.05 (0.78-1.37)		0.87 (0.77-0.98)
<i>Low inc.</i>		1.10 (0.81-1.41)		0.87 (0.77-0.98)
Immigrant background				
<i>None</i>		Reference		Reference
<i>Yes</i>		0.63 (0.49-0.79)		0.55 (0.49-0.61)
Hormonal contraception				
<i>No</i>		Reference		Reference
<i>Yes</i>		1.62 (1.34-2.06)		1.19 (1.08-1.31)
Measures of variance and discriminatory accuracy*				
Variance	0.30 (0.18-0.50)	0.10 (0.06-0.18)	0.29 (0.18-0.49)	0.02 (0.01-0.03)
VPC	8.45%	3.02%	8.18%	0.49%
PCV		66.29%		94.48%
AUC	0.62 (0.62-0.62)	0.62 (0.62-0.62)	0.64 (0.64-0.64)	0.64 (0.64-0.64)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

288
 289 Model 1 indicates that 8.45% (without mental health issues) and 8.18% (with previous mental
 290 health issues) of the total individual variance in the latent propensity of using antidepressant is
 291 at the intersectional strata level. These VPCs correspond with AUC values of 0.62 and 0.64
 292 respectively. Both measures suggest the existence of a moderate intersectional effect. The
 293 PCV was high in both groups, but especially so in the group with previous mental health
 294 issues, meaning the intersectional dimensions or main effects explain more of the inter-strata
 295 variance for these women. Model 2 shows that HC was associated with increased usage of
 296 antidepressants after adjustment for all other intersectional dimensions. This result was seen
 297 within both cohorts, but more strongly so in women without previous mental health issues

298 (OR 1.62 compared to 1.19). Finally, the VPC in model 2 was very small (3.02% and 0.49%
 299 respectively) but did not vanish. This finding means that while the intersectional strata effect
 300 was mainly due the additive effect of variables defining the strata, a small component due to
 301 interaction of effects could also be detected.

302

303 **Heterogeneity concerning antidepressant use in our cohort**

304 Women with previous mental health issues had a much higher usage of antidepressants than
 305 women without such issues, but the association with HC use nonetheless varied across the
 306 other intersectional dimensions. Table 3 show the stratum-specific incidence rates for
 307 antidepressant use and 95% CI obtained in model 1.

308

Table 3. Distribution of antidepressant use between different intersectional strata, and difference in usage between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA). Numbers are percentages.

Previous mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptives (%)		
					Yes	No	Yes-No difference
No	12 – 17	Low	No	28182	3.7	1.3	2.4 (1.9 , 2.8)
			Yes	7643	1.2	0.5	0.7 (0.1 , 1.5)
		Middle	No	75836	3.0	1.0	2.0 (1.8 , 2.3)
			Yes	10110	1.8	0.6	1.2 (0.5 , 2.1)
		High	No	125903	2.0	0.9	1.1 (0.9 , 1.2)
			Yes	4606	2.5	0.8	1.6 (0.6 , 2.8)
	18 – 23	Low	No	44723	3.5	3.0	0.5 (0.2 , 0.9)
			Yes	11174	2.3	1.2	1.1 (0.5 , 1.7)
		Middle	No	72018	2.8	2.8	0.1 (-0.2 , 0.3)
			Yes	8776	2.3	1.2	1.1 (0.5 , 1.8)
		High	No	136284	2.3	2.3	0 (-0.2 , 0.1)
			Yes	4386	2.0	1.8	0.2 (-0.6 , 0.9)
24 – 30	Low	No	130127	3.1	3.2	-0.1 (-0.3 , 0.1)	
		Yes	39368	2.7	1.4	1.3 (0.9 , 1.7)	
	Middle	No	45013	3.6	3.0	0.5 (0.2 , 0.9)	
		Yes	10965	2.7	2.4	0.4 (-0.3 , 1.1)	
	High	No	43508	2.4	2.6	-0.2 (-0.5 , 0.1)	
		Yes	3621	1.9	2.3	-0.3 (-1.3 , 0.7)	
Yes	12 – 17	Low	No	3402	30.5	22.7	7.8 (4.7 , 10.8)
			Yes	434	20.8	13.7	7.1 (-0.3 , 15.1)
		Middle	No	6854	31.2	23.4	7.8 (5.6 , 10.1)

		Yes	569	19.9	14.2	5.7 (-1.2 , 13.1)
	High	No	7906	34.2	28.1	6.1 (3.9 , 8.3)
		Yes	371	30.4	19.8	10.6 (1.4 , 19.9)
18 – 23	Low	No	10937	39.2	37.8	1.4 (-0.4 , 3.2)
		Yes	1127	28.5	19.7	8.8 (3.4 , 14.4)
	Middle	No	12915	37.8	36.3	1.5 (-0.2 , 3.1)
		Yes	844	27.4	19.7	7.7 (1.9 , 13.7)
	High	No	17276	38.3	39.8	-1.5 (-3 , 0)
		Yes	629	28.1	25.4	2.8 (-4 , 9.4)
24 – 30	Low	No	29333	50.1	49.9	0.2 (-1 , 1.4)
		Yes	4083	37.3	32.4	4.9 (1.5 , 8.4)
	Middle	No	8629	49.7	50.8	-1.1 (-3.4 , 1.1)
		Yes	1221	33.5	37.1	-3.6 (-10 , 2.6)
	High	No	6686	48.5	48.9	-0.4 (-2.9 , 2)
		Yes	495	43.7	37.5	6.3 (-3.2 , 15.8)

309

310

311 The highest use of anti-depressants were observed in non-immigrant women, aged 24-30,
 312 with previous mental health issues, using HC and with low income (50.1%). The lowest usage
 313 were found in teenagers without previous mental health issues and no HC use, especially in
 314 the strata of immigrant girls from low (0.50%) and middle-income (0.60%) households.

315

316 **Heterogeneity concerning the association between hormonal contraceptive and** 317 **antidepressant use**

318 Overall, the propensity to use antidepressants was consistently higher in HC users compared
 319 to non-users in younger women between 12 and 17 years of age, both without previous mental
 320 health issues (0.7 – 2.4 percentage points), and with a mental health history (5.7 – 7.8
 321 percentage points) with the magnitude being higher in the latter group. However, the 95%
 322 credible intervals were broad since the number of individuals was relatively small in these
 323 latter strata. Table 3 gives detailed information on these associations. In adolescents the
 324 tendency was that an immigrant background lowered the use of anti-depressants, while the
 325 opposite was true for adult women, where a positive association between HC use and later
 326 antidepressant use was mainly found in women with low income and immigrant background,
 327 again with higher magnitudes in women with previous mental health issues. The association
 328 between HC and antidepressant use was smaller in adult women native to Sweden no matter
 329 their income, and completely disappeared in adult women with high income regardless of
 330 immigrant background.

331

DISCUSSION

The main hypothesis of our study was that the previously observed association between HC and antidepressant use, mainly seen in adolescent girls(6-9, 17, 45), would be modified by the intersectional context of the women, being more pronounced in more oppressed intersectional contexts. We confirmed that subsequent use of anti-depressants after an HC prescription compared to non-users of HC within the same intersectional context was heterogeneous across intersectional strata pairs. As hypothesized, the difference in propensity to use anti-depressants was more pronounced in more oppressed intersectional contexts like those composed by immigrant, low-income women with previous mental issues. That is, the use of antidepressants and to some extent the difference in use between HC users and non-users varied mainly depending on previous mental health issues, but the HC-antidepressant association was considerably modified across pair of strata with other characteristics equal but where HC use and non-use differed, in both cohorts. Aside from adolescent girls, low and middle income adult women with immigrant background had a more pronounced difference in propensity for using anti-depressants, while adult women without immigrant background had both the lowest anti-depressant use and a low grade of modification by HC use.

Independently of previous mental health issues, the propensity for using anti-depressants was consistently higher for HC users than for non-users in teenagers aged 12-17, a result aligned with previous studies that has found a heterogeneous response with regard to both age and other factors.(6, 7, 17, 18, 20, 45-47) As discussed in a previous paper, this higher risk for adolescents could be due to a *selective discontinuation bias*,⁽⁷⁾ a development of the *healthy worker survivor effect*, describing how bias is introduced through a continuous selection where those staying in the workforce are healthier than those who leave.⁽⁴⁸⁾ Women who experience a negative influence of HC on psychological health might discontinue treatment in early ages, while those without symptoms continued on HC into adulthood, creating this age-dependent *selective discontinuation bias*. This could explain why the observed association between HC and adverse mental health outcomes are stronger in adolescents. Most Swedish women do however continue their HC treatment with the same method.⁽⁴⁹⁾ A previous study found that new users of HC has a higher risk of obtaining antidepressants within the first six months of HC use than continuous users.⁽⁶⁾ To address this possible bias we ran two different sensitivity analyses differentiating between women who filed a first prescription of an HC for the first time during the study period (26.2% of HC

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3 364 users) and those that had a repeat prescription. In our cohort the association between HC use
4
5 365 and subsequent anti-depressant use was very similar in new and continuous users, but slightly
6
7 366 higher among new users, as expected (OR 1.52 and 1.45, respectively, with overlapping 95%
8
9 367 confidence intervals). We then excluded all women with HC use any time during 5 years
10
11 368 before baseline, thus including using only new users of HC during baseline and never-users as
12
13 369 reference group (n = 532 543) and reran the analysis. The association between HC use and
14
15 370 subsequent antidepressant use became somewhat stronger in women without mental health
16
17 371 issues (OR 1.86) and the VPC also increased. The pattern of antidepressant use in the
18
19 372 intersectional strata stayed the same, but the confidence intervals increased since the number
20
21 373 of women included was smaller, see Supplementary material 7.

22
23 374 As expected, among adult women the overall propensity for using anti-depressants
24
25 375 was higher, as it is known that anti-depressant use increases by age,(50,51) and the difference
26
27 376 between HC users and non-users was smaller. Women native to Sweden had a higher
28
29 377 propensity for using anti-depressants, but this was moderated by HC exposure to a lower
30
31 378 extent than for immigrant women. In adult women native to Sweden, HC use gave no increase
32
33 379 of antidepressant use among those with high income. The lower utilization of anti-depressants
34
35 380 does not necessarily mean that immigrant women are healthier, since earlier studies have
36
37 381 found immigrants utilize healthcare to a lesser extent, even though the need is pronounced,
38
39 382 with reasons including discrimination.(52,53) A recent study found that adjustment for
40
41 383 health care access eliminated the association between HC initiation and subsequent anti-
42
43 384 depressant use in a US population.(54) Although the health care system is different in Sweden
44
45 385 and visits to midwives for contraceptive purposes free, we conducted a sensitivity analysis
46
47 386 including only women who had accessed health care within the last three years to address this.
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49 387 Using only care-accessors as the reference group did not change our results in any substantive
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51 388 way, see Supplementary material 8 .

47 389 **Intersectional considerations**

48
49 390 The big difference in anti-depressant consumption depending on HC use for lower income
50
51 391 immigrant women could be interpreted as the intersectional contexts embodied by these
52
53 392 women are more susceptible to the potential detrimental effect of HC on mood. The
54
55 393 interrelating negative consequences of low income as a proxy for class or social position,
56
57 394 gender and xenophobia may accumulate over the life course and lead to a higher vulnerability
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59 395 to exposures that predispose for antidepressant use later in life,(55-57) whereas this diverse
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396 vulnerability to HC exposure might not be visible in teenagers. Social experiences can vary

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3 397 depending on for example social position, which in turn impact psychological development,
4 398 mood and cognition, thus influencing health.(58, 59) In understanding how HC can impact
5 399 women's mental health differently, both possible individual biological predispositions and
6 400 social settings need to be investigated, since the emotional response to HC is influenced by
7 401 context.(32) In other words, the interlocking power axes that create oppression could
8 402 predispose women already under structural burdens for adverse mental health reactions when
9 403 using HC. The fact that adult women native to Sweden were almost unaffected by HC use,
10 404 could strengthen this suggestion. Without the intersectional strata this disparity would not
11 405 have been so easily identified and visualized.

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19 406 Focusing on women whose lives are affected by several interlocking power
20 407 dimensions such as low social position and xenophobia is fundamental to achieving
21 408 reproductive justice.(30) Nonetheless, our intersectional strata should not be considered static
22 409 categories of inherently "risky identities" but must be interpreted as context specific
23 410 vulnerabilities of women within certain interlocking positions, constituted in relation to power
24 411 dynamics created by unequal schemes such as the economic system.(25, 29) It is likely that in
25 412 other contexts, other groups could be more vulnerable. It is also important to remember that
26 413 the purpose of HC most commonly is protection against unwanted pregnancy, a situation that
27 414 if it arises in itself can have negative mental health effects. In identifying the underlying
28 415 power systems creating these intersectional categories and acknowledging their constant
29 416 movement and changing dynamics on a societal level, it furthermore becomes possible to
30 417 address these inequalities through social change.

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40 418 In this study, we have combined a classical epidemiological approach of
41 419 exposure to HC and an intersectional MAHIDA to create a novel understanding of how
42 420 intersecting power dynamics could create particular vulnerabilities to this specific exposure.
43 421 Because of our study design, where women are followed for one year after a dispensed
44 422 prescription of HC, it is more theoretically coherent to view use of HC as an exposure rather
45 423 than a component of the intersectional strata. However, it is possible to within our approach
46 424 view HC use as a socio-contextual factor that captures certain living conditions (for example
47 425 more likely to be sexually active or in a heterosexual relationship), which somewhat changes
48 426 the interpretation of the results. This epistemological tension is not necessarily a limitation,
49 427 but could enrich the dialogue in social epidemiology on whether it is possible to separate
50 428 contextual factors from "pure" exposure.(60-62)

51 429 **Limitations**

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3 430 The findings from this study must be interpreted in the context of its limitations. The SPDR
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5 431 has highly reliable data on dispensed prescriptions but cannot measure the actual use of
6
7 432 dispensed medications. Whether the women was exposed to HC treatment during her entire
8
9 433 follow-up is thus not possible to determine with our method, although previous Swedish data
10
11 434 suggest continuation rates for any HC after 6 months are almost 90%.(47) Our methodology
12
13 435 does furthermore not allow for differentiation between new users and continuous users of HC.
14
15 436 Previous studies has shown an increased risk for depression in new users,(6) which could
16
17 437 mean we underestimate the associations when also including continuous users. Nevertheless,
18
19 438 a sensitivity analysis (see Supplementary material 7) showed that the pattern of antidepressant
20
21 439 use and heterogeneity between groups that the MAIHDA shows remain the same when
22
23 440 including only new users. Combining MAIHDA with a survival analysis would possibly
24
25 441 address this issue better and could be considered in the future. Use of anti-depressants can be
26
27 442 considered a proxy for depression, but anti-depressants are also prescribed for other reasons
28
29 443 than depression, including generalized anxiety disorder, obsessive-compulsive disorder and
30
31 444 panic disorder.(63) Therefore it is not a perfect proxy of depression but may be a more
32
33 445 general indication of impaired mental health.(64) However, out of all women with potentially
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35 446 unfavorable mental health effects from HC, only a subset would have symptoms severe
36
37 447 enough to get an anti-depressant prescription, leading instead to many missed cases. Since the
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39 448 outcome is rather common, the risk of underestimation is further enhanced and the true risk of
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41 449 adverse mental health effects could be higher.

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43 450 As in any observational study, ours only allows for measurements of
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45 451 associations and cannot determine causation. Furthermore, apparently strong average
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47 452 associations do not necessarily convey a high discriminatory accuracy (see elsewhere for a
48
49 453 short review and discussion).(65) Nevertheless, since our analysis yielded a moderate
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51 454 accuracy (i.e., AUC=0.6), the intersectional strata do matter for the propensity to use
52
53 455 antidepressants. A consideration in every quantitative intersectional study is the basis for
54
55 456 creating intersectional categories, since comprehensive information on background and lived
56
57 457 experiences are lacking and the categories are created based on available but crude proxies
58
59 458 such as income level. For example, in our study the group of women with immigrant
60
459 background was very heterogenous, so we cannot exclude that the increased antidepressant
460
461 use is located on more specific country of birth categories. There is an ongoing debate
462
whether these crude categorizations are feasible, and extra caution should be taken when
investigating emerging intersectional categories rather than established ones.(66)

463 **Conclusion**

464 It is important to recognise intersectional perspectives and interacting axes of oppression to
465 tailor better public health interventions, as well as acknowledging the experiences of
466 oppressed women to reach reproductive and social justice. (29, 66) Our intersectional
467 MAIHDA methodology operationalizes this idea by providing information on the
468 discriminatory accuracy of the contexts that define the intersectional strata. It highlights the
469 need to consider disadvantages consisting of several interlocking structural dimensions such
470 as income/class, age and immigration to better understand how HC might predispose certain
471 women, mainly teenagers and low-income women with immigrant background, for
472 depression. These vulnerabilities are based in inequalities that are not static, but structurally
473 created and therefore possible to redeem.

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476

477 **Figure 1.** Selection of the study population.

478

479

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483 Unit for Social epidemiology, Lund university, for valuable discussions.

484

485 **Ethical statement**

486 The database was approved by the Regional Ethical Review Board in Lund, Sweden, the Data
487 Safety Board at Statistics Sweden and the National Board of Health and Welfare (Dnr: 2014/
488 856, 2015/341).

489

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493

494 **Competing interests**

495 None declared.

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3 4964
5 497 **Data sharing statement**

6 498 Public access to the data is restricted by the Swedish Authorities (Public Access to
7
8 499 Information and Secrecy Act; <http://www.government.se/information->
9
10 500 [material/2009/09/public-access-to-information-and-secrecy-act/](http://www.government.se/information-material/2009/09/public-access-to-information-and-secrecy-act/)) but data can be made
11
12 501 available for researchers after a special review that includes approval of the research project
13
14 502 by both an Ethics Committee and the authorities' data safety committees. The National Board
15
16 503 of Health and Welfare is a government agency under the Ministry of Health and Social
17
18 504 Affairs. It is not their policy to provide individual level data to researchers abroad. Instead,
19
20 505 they normally advise researchers in other countries to cooperate with Swedish colleagues, to
21
22 506 whom they can provide data according to standard legal provisions and procedures. Requests
23
24 507 for access to the data can be made to the National Board of Health and Welfare and Statistics
25
26 508 Sweden (<http://www.socialstyrelsen.se/statistics>; [https://www.scb.se/en/services/guidance-](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)
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28 509 [for-researchers-and-universities/](https://www.scb.se/en/services/guidance-for-researchers-and-universities/)).

29 511 **Contributorship statement**

30 512 **Sofia Zettermark:** Conceptualization, design, analysis, interpretation of data, writing original
31
32 513 draft, final approval of version to be published.

33
34 514 **Kani Kahlaf:** Interpretation of data, revising draft critically for intellectual content, final
35
36 515 approval of version to be published.

37
38 516 **Raquel Perez-Vicente:** Design, analysis, interpretation of data, revising draft critically for
39
40 517 intellectual content, final approval of version to be published.

41
42 518 **George Leckie:** Analysis, interpretation of data, revising draft critically for intellectual
43
44 519 content, final approval of version to be published.

45
46 520 **Diana Mulinari:** Interpretation of data, revising draft critically for intellectual content, final
47
48 521 approval of version to be published.

49
50 522 **Juan Merlo:** Conceptualization, design, analysis, interpretation of data, revising draft
51
52 523 critically for intellectual content, final approval of version to be published.

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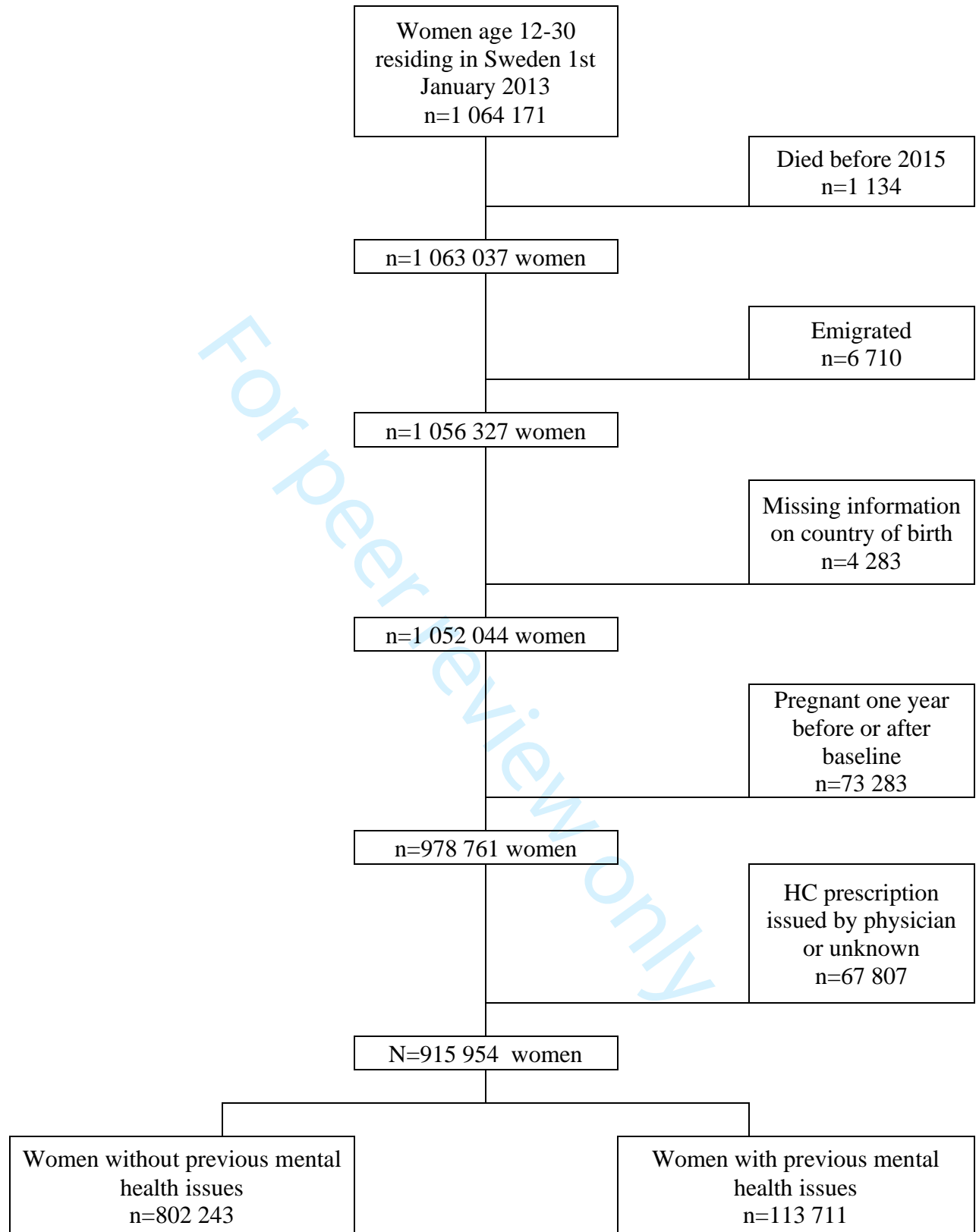


Figure 1. Selection of the study population.

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2
3 * Hormonal Contraception and Antidepressant Use in Sweden: An
4 Intersectional Multilevel Analysis of Individual Heterogeneity and
5 Discriminatory Accuracy
6 * (MAIHDA)
7 *****
8 clear *
9 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
10 set cformat %9.2f
11
12
13 *****
14 * TABLE 1
15 *****
16
17 * Load the data
18 use "final_mlMENTAL.dta", clear
19 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
20 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21
22 generate percentage = 100*proportion
23 drop proportion
24 format %9.2f percentage
25
26 generate age_cat = .
27 replace age_cat = 1 if age_cat1==1
28 replace age_cat = 2 if age_cat2==1
29 replace age_cat = 3 if age_cat3==1
30
31 generate inc_cat = .
32 replace inc_cat = 1 if inc1==1
33 replace inc_cat = 2 if inc2==1
34 replace inc_cat = 3 if inc3==1
35
36 * Results for the table
37 tabulate pp [fweight = denom]
38 table pp [fweight = denom], contents(mean percentage )
39 tabulate age_cat pp [fweight = denom], column nofreq
40 tabulate inc_cat pp [fweight = denom], column nofreq
41 tabulate imm pp [fweight = denom], column nofreq
42
43 *****
44 * TABLE 2: MODEL 1
45 *****
46
47 * Load the data
48 use "final_mlMENTAL.dta", clear
49
50 * IGLS estimation, for MCMC initial values
51 runmlwin prop cons, ///
52   level2(inter: cons) ///
53   level1(inter:) ///
54   discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
55   nopause
56
57 * MCMC
58 runmlwin prop cons, ///
59   level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///
60   level1(inter:) ///

```

```

1
2
3     discrete(distribution(binomial) link(logit) denom(denom)) ///
4     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
5     ///
6     initsprevious ///
7     nopause
8
9     * Level-2 variance
10    scalar mlsigma2u = [RP2]var(cons)
11    scalar list mlsigma2u
12
13    * Level-1 variance
14    scalar mlsigma2e = _pi^2/3
15    scalar list mlsigma2e
16
17    * VPC
18    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
19
20    * Compress and save the data
21    compress
22    save "ml.dta", replace
23
24
25    *-----*
26    * PREPARE FIXED-PART PAREMETER CHAINS
27    *-----*
28
29    use "mlb.dta", clear
30    drop deviance RP2_var_cons_ OD_bcons_1
31    rename FP1_* b_*
32    format %9.2f b_*
33    compress
34    save "mlb_prepped.dta", replace
35    isid iteration
36    codebook iteration, compact
37
38
39    *-----*
40    * PREPARE RANDOM EFFECTS CHAINS
41    *-----*
42
43    use "mlu.dta", clear
44    drop residual idnum
45    rename value u
46    format %9.2f u
47    sort inter iteration
48    order inter iteration
49    compress
50    save "mlu_prepped.dta", replace
51    isid inter iteration
52    codebook iteration, compact
53
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"
62    count

```

```

1
2
3 merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
4 count
5 compress
6 save "mldata_prepped.dta", replace
7
8
9
10 *-----*
11 * ROC
12 *-----*
13 use "mldata_prepped.dta", clear
14 count
15 generate p = invlogit(b_cons + u)
16 gcollapse (mean) p, by(inter num denom)
17 count
18 expand denom
19 sort inter
20 bysort inter: generate y = (_n<=numerator)
21 generate prop = denom/_N
22 generate weight = int(1/prop)
23 roctab y p [fw=weight]
24
25
26 *-----*
27 * TABLE 3
28 *-----*
29 use "mldata_prepped.dta", clear
30 keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
31 b_cons u
32 count
33 generate p = 100*invlogit(b_cons + u)
34 drop b_cons u
35 format %9.1f p
36 drop inter
37 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
38 imm) j(pp)
39 generate denom = denom0 + denom1
40 drop denom0 denom1
41 generate pdiff = p1 - p0
42 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
43 by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
44 format %9.1f pdiff pdifflo pdiffhi
45 order p1 p0 pdiff pdifflo pdiffhi, last
46 gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
47
48
49 *****
50 * TABLE 2: MODEL 2:
51 *****
52
53 * Load the data
54 use "final_mlMENTAL.dta", clear
55
56 * IGLS estimation, for MCMC initial values
57 runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
58 level2(inter: cons) ///
59 level1(inter:) ///
60 discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
nopause

```

```

1
2
3
4 * MCMC
5 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
6   level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
7   level1(inter:) ///
8   discrete(distribution(binomial) link(logit) denom(denom)) ///
9   mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
10  ///
11  initsprevious ///
12  nopause
13
14 * Odds ratios
15 runmlwin, or
16
17 * Level-2 variance
18 scalar m2sigma2u = [RP2]var(cons)
19 scalar list m2sigma2u
20
21 * Level-1 variance
22 scalar m2sigma2e = _pi^2/3
23 scalar list m2sigma2e
24
25 * VPC
26 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
27
28 * Compress and save the data
29 compress
30 save "m2.dta", replace
31
32 * PCV
33 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
34
35 *-----*
36 * PREPARE FIXED-PART PAREMETER CHAINS
37 *-----*
38 use "m2b.dta", clear
39 drop deviance RP2_var_cons_ OD_bcons_1
40 rename FP1_* b_*
41 format %9.2f b_*
42 compress
43 save "m2b_prepped.dta", replace
44 isid iteration
45 codebook iteration, compact
46
47
48 *-----*
49 * PREPARE inter RANDOM EFFECTS CHAINS
50 *-----*
51 use "m2u.dta", clear
52 drop residual idnum
53 rename value u
54 format %9.2f u
55 sort inter iteration
56 order inter iteration
57 compress
58 save "m2u_prepped.dta", replace
59 isid inter iteration
60 codebook iteration, compact

```

```

1
2
3
4
5
6 *-----*
7 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
8 *-----*
9 use "final_mlMENTAL", clear
10 count
11 cross using "m2b_prepped.dta"
12 count
13 merge m:1 inter iteration using "m2u_prepped.dta"
14 count
15 save "m2data_prepped.dta", replace
16
17
18 *-----*
19 * ROC
20 *-----*
21 use "m2data_prepped.dta", clear
22 count
23 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
24 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
25 gcollapse (mean) p, by(inter num denom)
26 count
27 expand denom
28 sort inter
29 bysort inter: generate y = (_n<=numerator)
30 generate prop = denom/_N
31 generate weight = int(1/prop)
32 roctab y p [fw=weight]
33
34
35 *-----*
36 * TABLE 3
37 *-----*
38 use "m1data_prepped.dta", clear
39 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
40 b_cons u
41 count
42 generate p = 100*invlogit(b_cons + u)
43 drop b_cons u
44 format %9.1f p
45 drop inter
46 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
47 imm) j(pp)
48 generate denom = denom0 + denom1
49 drop denom0 denom1
50 generate pdiff = p1 - p0
51 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
52 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
53 format %9.1f pdiff pdifflo pdiffhi
54 order p1 p0 pdiff pdifflo pdiffhi, last
55 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
56
57
58 *****
59 exit
60

```



```

1
2
3 *****
4 * Hormonal Contraception and Antidepressant Use in Sweden: An
5 Intersectional Multilevel Analysis of Individual Heterogeneity and
6 Discriminatory Accuracy (MAIHDA)
7 *****
8 clear *
9 global MLwiN_path "C:\Program Files\MLwiN v3.05\mlwin.exe"
10 set cformat %9.2f
11
12
13
14 *****
15 * TABLE 1
16 *****
17
18 * Load the data
19 use "final_mlNoMENTAL.dta", clear
20 keep age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
21 order age_cat1 age_cat2 age_cat3 inc1 inc2 inc3 imm pp proportion denom
22
23 generate percentage = 100*proportion
24 drop proportion
25 format %9.2f percentage
26
27 generate age_cat = .
28 replace age_cat = 1 if age_cat1==1
29 replace age_cat = 2 if age_cat2==1
30 replace age_cat = 3 if age_cat3==1
31
32 generate inc_cat = .
33 replace inc_cat = 1 if inc1==1
34 replace inc_cat = 2 if inc2==1
35 replace inc_cat = 3 if inc3==1
36
37 * Results for the table
38 tabulate pp [fweight = denom]
39 table pp [fweight = denom], contents(mean percentage )
40 tabulate age_cat pp [fweight = denom], column nofreq
41 tabulate inc_cat pp [fweight = denom], column nofreq
42 tabulate imm pp [fweight = denom], column nofreq
43
44
45 *****
46 * TABLE 2: MODEL 1
47 *****
48
49 * Load the data
50 use "final_mlNoMENTAL.dta", clear
51
52 * IGLS estimation, for MCMC initial values
53 runmlwin prop cons, ///
54   level2(inter: cons) ///
55   level1(inter:) ///
56   discrete(distribution(binomial) link(logit) denom(denom) mql1) ///
57   nopause
58
59 * MCMC
60 runmlwin prop cons, ///
61   level2(inter: cons, residuals(u, savechains("mlu.dta",replace))) ///

```

```

1
2
3     levell(inter:) ///
4     discrete(distribution(binomial) link(logit) denom(denom)) ///
5     mcmc(burnin(10000) chain(50000) thin(10) savechains("mlb.dta", replace))
6 ///
7     initsprevious ///
8     nopause
9
10    * Level-2 variance
11    scalar mlsigma2u = [RP2]var(cons)
12    scalar list mlsigma2u
13
14    * Level-1 variance
15    scalar mlsigma2e = _pi^2/3
16    scalar list mlsigma2e
17
18    * VPC
19    display "VPC_u = " %9.4f mlsigma2u/(mlsigma2u + mlsigma2e)
20
21    * Compress and save the data
22    compress
23    save "ml.dta", replace
24
25
26    *-----*
27    * PREPARE FIXED-PART PAREMETER CHAINS
28    *-----*
29
30    use "mlb.dta", clear
31    drop deviance RP2_var_cons_ OD_bcons_1
32    rename FP1_* b_*
33    format %9.2f b_*
34    compress
35    save "mlb_prepped.dta", replace
36    isid iteration
37    codebook iteration, compact
38
39
40    *-----*
41    * PREPARE RANDOM EFFECTS CHAINS
42    *-----*
43
44    use "mlu.dta", clear
45    drop residual idnum
46    rename value u
47    format %9.2f u
48    sort inter iteration
49    order inter iteration
50    compress
51    save "mlu_prepped.dta", replace
52    isid inter iteration
53    codebook iteration, compact
54
55    *-----*
56    * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
57    *-----*
58
59    use "final_mlnOMENTAL", clear
60    count
61    cross using "mlb_prepped.dta"

```

```

1
2
3     count
4     merge m:1 inter iteration using "mlu_prepped.dta", nogenerate assert(match)
5     count
6     compress
7     save "mldata_prepped.dta", replace
8
9
10
11     *-----*
12     * ROC
13     *-----*
14     use "mldata_prepped.dta", clear
15     count
16     generate p = invlogit(b_cons + u)
17     gcollapse (mean) p, by(inter num denom)
18     count
19     expand denom
20     sort inter
21     bysort inter: generate y = (_n<=numerator)
22     generate prop = denom/_N
23     generate weight = int(1/prop)
24     roctab y p [fw=weight]
25
26
27     *-----*
28     * TABLE 3
29     *-----*
30     use "mldata_prepped.dta", clear
31     keep iteration inter age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm pp denom
32     b_cons u
33     count
34     generate p = 100*invlogit(b_cons + u)
35     drop b_cons u
36     format %9.1f p
37     drop inter
38     reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl1 incl2 incl3
39     imm) j(pp)
40     generate denom = denom0 + denom1
41     drop denom0 denom1
42     generate pdiff = p1 - p0
43     gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
44     by(age_cat1 age_cat2 age_cat3 incl1 incl2 incl3 imm denom)
45     format %9.1f pdiff pdifflo pdiffhi
46     order p1 p0 pdiff pdifflo pdiffhi, last
47     gsort -age_cat1 -age_cat2 -age_cat3 -incl1 -incl2 -incl3 imm
48
49
50     *****
51     * TABLE 2: MODEL 2:
52     *****
53
54     * Load the data
55     use "final_mlNoMENTAL.dta", clear
56
57     * IGLS estimation, for MCMC initial values
58     runmlwin prop cons age_cat2 age_cat3 incl1 incl2 imm pp, ///
59     level2(inter: cons) ///
60     levell(inter:) ///
61     discrete(distribution(binomial) link(logit) denom(denom) mql1) ///

```

```

1
2
3     nopause
4
5 * MCMC
6 runmlwin prop cons age_cat2 age_cat3 incl inc2 imm pp, ///
7     level2(inter: cons, residuals(u,savechains("m2u.dta",replace))) ///
8     level1(inter:) ///
9     discrete(distribution(binomial) link(logit) denom(denom)) ///
10    mcmc(burnin(10000) chain(50000) thin(10) savechains("m2b.dta", replace))
11    ///
12    initsprevious ///
13    nopause
14
15 * Odds ratios
16 runmlwin, or
17
18 * Level-2 variance
19 scalar m2sigma2u = [RP2]var(cons)
20 scalar list m2sigma2u
21
22 * Level-1 variance
23 scalar m2sigma2e = _pi^2/3
24 scalar list m2sigma2e
25
26 * VPC
27 display "VPC_u = " %9.4f m2sigma2u/(m2sigma2u + m2sigma2e)
28
29 * Compress and save the data
30 compress
31 save "m2.dta", replace
32
33 * PCV
34 display "PCV = " %9.4f (m2sigma2u - m1sigma2u)/m1sigma2u
35
36 *-----*
37 * PREPARE FIXED-PART PAREMETER CHAINS
38 *-----*
39 use "m2b.dta", clear
40 drop deviance RP2_var_cons_ OD_bcons_1
41 rename FP1_* b_*
42 format %9.2f b_*
43 compress
44 save "m2b_prepped.dta", replace
45 isid iteration
46 codebook iteration, compact
47
48
49 *-----*
50 * PREPARE inter RANDOM EFFECTS CHAINS
51 *-----*
52 use "m2u.dta", clear
53 drop residual idnum
54 rename value u
55 format %9.2f u
56 sort inter iteration
57 order inter iteration
58 compress
59 save "m2u_prepped.dta", replace
60 isid inter iteration

```

```

1
2
3 codebook iteration, compact
4
5
6
7 *-----*
8 * MERGE DATA, FIXED-PART PARAMETER AND RANDOM EFFECT CHAINS TOGETHER
9 *-----*
10 use "final_mlNoMENTAL", clear
11 count
12 cross using "m2b_prepped.dta"
13 count
14 merge m:1 inter iteration using "m2u_prepped.dta"
15 count
16 save "m2data_prepped.dta", replace
17
18
19 *-----*
20 * ROC
21 *-----*
22 use "m2data_prepped.dta", clear
23 count
24 generate p = invlogit(b_cons + b_age_cat2*age_cat2 + b_age_cat3*age_cat3 +
25 b_incl*incl + b_inc2*inc2 + b_imm*imm + b_pp*pp)
26 gcollapse (mean) p, by(inter num denom)
27 count
28 expand denom
29 sort inter
30 bysort inter: generate y = (_n<=numerator)
31 generate prop = denom/_N
32 generate weight = int(1/prop)
33 roctab y p [fw=weight]
34
35
36 *-----*
37 * TABLE 3
38 *-----*
39 use "m1data_prepped.dta", clear
40 keep iteration inter age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm pp denom
41 b_cons u
42 count
43 generate p = 100*invlogit(b_cons + u)
44 drop b_cons u
45 format %9.1f p
46 drop inter
47 reshape wide denom p, i(iteration age_cat1 age_cat2 age_cat3 incl inc2 inc3
48 imm) j(pp)
49 generate denom = denom0 + denom1
50 drop denom0 denom1
51 generate pdiff = p1 - p0
52 gcollapse (mean) p0 p1 pdiff (p2.5) pdifflo=pdiff (p97.5) pdiffhi=pdiff,
53 by(age_cat1 age_cat2 age_cat3 incl inc2 inc3 imm denom)
54 format %9.1f pdiff pdifflo pdiffhi
55 order p1 p0 pdiff pdifflo pdiffhi, last
56 gsort -age_cat1 -age_cat2 -age_cat3 -incl -inc2 -inc3 imm
57
58
59 *****
60 exit

```

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For peer review only

1
2 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
3 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.013224002,279,21098,1
4 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.037408244,265,7084,1
5 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.0040497542,28,6914,1
6 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.0096021947,7,729,1
7
8 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.010099272,587,58123,1
9 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.030316716,537,17713,1
10 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.0056107035,52,9268,1
11 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.017814728,15,842,1
12
13 0,0,12-17 High income 0 0,1,0,0,0,0,1,.008893352,859,96589,1
14 1,0,12-17 High income 0 1,1,0,0,0,0,1,.01951286,572,29314,1
15 0,1,12-17 High income 1 0,1,0,0,0,0,1,.0076045627,30,3945,1
16 1,1,12-17 High income 1 1,1,0,0,0,0,1,.025718609,17,661,1
17
18 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.029676914,530,17859,1
19 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.034916617,938,26864,1
20 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.011607248,98,8443,1
21 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.022702307,62,2731,1
22
23 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.027664155,771,27870,1
24 1,0,18-23 Middle income 0 1,0,1,0,0,1,0,.0282459,1247,44148,1
25 0,1,18-23 Middle income 1 0,0,1,0,0,1,0,.011609907,75,6460,1
26 1,1,18-23 Middle income 1 1,0,1,0,0,1,0,.023316063,54,2316,1
27
28 0,0,18-23 High income 0 0,0,1,0,0,0,1,.023347162,1058,45316,1
29 1,0,18-23 High income 0 1,0,1,0,0,0,1,.022887168,2082,90968,1
30 0,1,18-23 High income 1 0,0,1,0,0,0,1,.017995911,44,2445,1
31 1,1,18-23 High income 1 1,0,1,0,0,0,1,.019577537,38,1941,1
32
33 0,0,24-30 Low income 0 0,0,0,1,1,0,0,.032189574,2168,67351,1
34 1,0,24-30 Low income 0 1,0,0,1,1,0,0,.031126546,1954,62776,1
35 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.013751426,446,32433,1
36 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.026964672,187,6935,1
37
38 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.030455342,818,26859,1
39 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.03591495,652,18154,1
40 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.023714487,202,8518,1
41 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.027789129,68,2447,1
42
43 0,0,24-30 High income 0 0,0,0,1,0,0,1,.025993951,593,22813,1
44 1,0,24-30 High income 0 1,0,0,1,0,0,1,.024208747,501,20695,1
45 0,1,24-30 High income 1 0,0,0,1,0,0,1,.023088569,61,2642,1
46 1,1,24-30 High income 1 1,0,0,1,0,0,1,.019407559,19,979,1
47
48
49
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51
52
53
54
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1
2 pp,imm,inter,age_cat1,age_cat2,age_cat3,inc1,inc2,inc3,proportion,numerator,denom,cons
3 0,0,12-17 Low income 0 0,1,0,0,1,0,0,.22574355,463,2051,1
4 1,0,12-17 Low income 0 1,1,0,0,1,0,0,.3049593,412,1351,1
5 0,1,12-17 Low income 1 0,1,0,0,1,0,0,.12383901,40,323,1
6 1,1,12-17 Low income 1 1,1,0,0,1,0,0,.1891892,21,111,1
7
8 0,0,12-17 Middle income 0 0,1,0,0,0,1,0,.23362993,1024,4383,1
9 1,0,12-17 Middle income 0 1,1,0,0,0,1,0,.31201944,771,2471,1
10 0,1,12-17 Middle income 1 0,1,0,0,0,1,0,.13422818,60,447,1
11 1,1,12-17 Middle income 1 1,1,0,0,0,1,0,.18032786,22,122,1
12
13 0,0,12-17 High income 0 0,1,0,0,0,0,1,.28093326,1469,5229,1
14 1,0,12-17 High income 0 1,1,0,0,0,0,1,.34217408,916,2677,1
15 0,1,12-17 High income 1 0,1,0,0,0,0,1,.18867925,50,265,1
16 1,1,12-17 High income 1 1,1,0,0,0,0,1,.3018868,32,106,1
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18 0,0,18-23 Low income 0 0,0,1,0,1,0,0,.37809917,2013,5324,1
19 1,0,18-23 Low income 0 1,0,1,0,1,0,0,.39212543,2201,5613,1
20 0,1,18-23 Low income 1 0,0,1,0,1,0,0,.19350649,149,770,1
21 1,1,18-23 Low income 1 1,0,1,0,1,0,0,.28291318,101,357,1
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23 0,0,18-23 Middle income 0 0,0,1,0,0,1,0,.36302635,2164,5961,1
24 1,0,18-23 Middle income 0 1,0,1,0,0,1,0,.37776819,2627,6954,1
25 0,1,18-23 Middle income 1 0,0,1,0,0,1,0,.19285715,108,560,1
26 1,1,18-23 Middle income 1 1,0,1,0,0,1,0,.27112675,77,284,1
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28 0,0,18-23 High income 0 0,0,1,0,0,0,1,.39782199,2959,7438,1
29 1,0,18-23 High income 0 1,0,1,0,0,0,1,.38269973,3765,9838,1
30 0,1,18-23 High income 1 0,0,1,0,0,0,1,.25,82,328,1
31 1,1,18-23 High income 1 1,0,1,0,0,0,1,.27906978,84,301,1
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33 0,0,24-30 Low income 0 0,0,0,1,1,0,0,.49862742,9082,18214,1
34 1,0,24-30 Low income 0 1,0,0,1,1,0,0,.50085437,5569,11119,1
35 0,1,24-30 Low income 1 0,0,0,1,1,0,0,.32457545,1013,3121,1
36 1,1,24-30 Low income 1 1,0,0,1,1,0,0,.37422037,360,962,1
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38 0,0,24-30 Middle income 0 0,0,0,1,0,1,0,.50859779,2869,5641,1
39 1,0,24-30 Middle income 0 1,0,0,1,0,1,0,.49799198,1488,2988,1
40 0,1,24-30 Middle income 1 0,0,0,1,0,1,0,.37214136,358,962,1
41 1,1,24-30 Middle income 1 1,0,0,1,0,1,0,.33590734,87,259,1
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43 0,0,24-30 High income 0 0,0,0,1,0,0,1,.48993289,1971,4023,1
44 1,0,24-30 High income 0 1,0,0,1,0,0,1,.48666918,1296,2663,1
45 0,1,24-30 High income 1 0,0,0,1,0,0,1,.37669376,139,369,1
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Supplementary material 5

Supplementary table, summary statistics. Numbers are percentages (numbers within brackets).

		Hormonal contraception	Mental health issues
<i>Age</i>	12-17	23.2 (63 181)	7.2 (19 536)
	18-23	59.9 (192 315)	13.6 (43 729)
	24-30	40.3 (130 103)	15.6 (50 447)
<i>Income</i>	Low	40.8 (126 632)	15.9 (49 316)
	Middle	38.9 (98 698)	12.2 (31 032)
	High	45.6 (160 269)	9.5 (33 363)
<i>Immigrant background</i>	No	45.1 (363 390)	12.9 (103 938)
	Yes	20.1 (22 209)	8.9 (9 773)

Supplementary table. Percentage of women within each intersectional dimension using hormonal contraceptives and with previous mental health issues.

Supplementary material 6

ATC	Freq.	Percent
G02BA03	12 535	3.25
G02BB	96	0.02
G0BB01	26 022	6.75
G02BB01	48	0.01
G03AA03	4 786	1.24
G03AA07	126 061	32.69
G03AA09	3 227	0.84
G03AA11	15 463	4.01
G03AA12	4 596	13.69
G03AA13	12 329	1.19
G03AA14	5 958	3.20
G03AB	5 958	1.55
G03AB03	8 014	2.08
G03AB04	5 341	1.39
G03AC01	4 249	1.10
G03AC02	2 483	0.64
G03AC06	2 710	0.70
G03AC08	21 284	5.52
G03AC09	77 595	20.12

Supplementary table, frequency table of hormonal contraceptives. Frequency of all included hormonal contraceptives in the final cohort of 915 954 women.

Supplementary material 7

Sensitivity analysis only including only new users and never-users of HC. Women with any dispensed prescription of HC during five years prior to baseline were excluded and only women with a HC prescription fill exclusively during follow-up are included as users. Non-users of HC are defined as not filing any prescription of HC during five years prior to baseline or during follow-up.

Table 1. Characteristics of the 532 543 women aged 12 - 30 years by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women in parenthesis).

	Previous mental health issues			
	Yes 11.12 (59 238)		No 88.88 (473 305)	
	Use of HC		Use of HC	
	Yes 38.87 (23 034)	No 61.13 (36 214)	Yes 1.83 (8 678)	No 98.17 (464 627)
Antidepressant during follow-up	60.11 (35 610)	39.89 (23 629)		
Age				
12-17 years	32.53 (4 065)	25.56 (11 946)	43.24 (38 426)	50.37 (193 658)
18-23 years	37.18 (4 646)	27.22 (12 722)	35.44 (31 489)	20.09 (77 244)
24-30 years	30.28 (3 784)	47.23 (22 075)	21.32 (18 948)	29.53 (113 540)
Income level				
Low inc.	35.93 (4 489)	43.77 (20 458)	24.00 (21 331)	30.34 (116 635)
Medium inc.	30.21 (3 775)	28.13 (13 147)	29.43 (26 151)	30.46 (117 109)
High inc.	33.86 (4 231)	28.11 (13 138)	46.57 (41 381)	39.20 (150 698)
Immigrant background				
None	92.84 (11 600)	88.12 (41 188)	91.78 (81 560)	81.40 (312 926)
Yes	7.16 (895)	11.88 (5 555)	8.22 (7 303)	18.60 (71 516)

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association (Odds Ratios) and measures of variance and discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are point estimations (with 95% credible intervals) or percentages where indicated.

	Without metal health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
Measures of association				
Age				
12-17 years		Reference		Reference
18-23 years		1.76 (1.35-2.21)		1.64 (1.42-1.89)
24-30 years		2.34 (1.79-2.90)		2.69 (2.32-3.09)
Income				
High inc.		Reference		Reference
Medium inc.		1.06 (0.81-1.34)		0.84 (0.72-0.98)
Low inc.		1.08 (0.86-1.35)		0.87 (0.75-1.00)
Immigrant background				
None		Reference		Reference
Yes		0.63 (0.51-0.76)		0.52 (0.46-0.59)
Hormonal contraception				
No		Reference		Reference
Yes		1.86 (1.51-2.28)		1.18 (1.05-1.34)
Measures of variance and discriminatory accuracy*				
Variance	0.36 (0.22-0.60)	0.08 (0.04-0.15)	0.31 (0.19-0.51)	0.02 (0.01-0.14)
VPC	9.88%	2.34%	8.67%	0.63%
PCV		76.32%		92.73%
AUC	0.63 (0.63-0.63)	0.62 (0.62-0.62)	0.65 (0.64-0.65)	0.64 (0.64-0.64)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

Table 3. Distribution of antidepressant use between different intersectional strata, and difference in usage between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA). Numbers are percentages.

Previous mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptives (%)		
					Yes	No	Yes-No difference
No	12 – 17	Low	No	25342	3.7	1.2	2.4 (1.9-3)
			Yes	7416	1.2	0.4	0.7 (0.1-1.6)
		Middle	No	69096	2.9	1	1.9 (1.6-2.2)
			Yes	9839	2	0.6	1.4 (0.5-2.5)
		High	No	115995	1.9	0.9	1 (0.8-1.2)
			Yes	4396	2.5	0.8	1.7 (0.6-3.2)
	18 – 23	Low	No	15523	3.9	2.7	1.2 (0.5-1.8)
			Yes	8238	2.2	1.1	1 (0.2-2)
		Middle	No	27757	2.9	2.2	0.7 (0.3-1.1)
			Yes	6642	2.2	1.1	1.1 (0.2-2.1)
		High	No	47988	2.3	2	0.3 (0-0.6)
			Yes	2585	2.5	1.8	0.7 (-0.5-2.1)
	24 – 30	Low	No	51819	4.2	3.3	0.9 (0.4-1.3)
			Yes	29628	2.7	1.3	1.4 (0.8-2.1)
		Middle	No	22251	4.7	2.8	1.9 (1.2-2.6)
			Yes	7675	2.8	2.1	0.6 (-0.4-1.8)
		High	No	18715	3.1	2.6	0.6 (0-1.2)
			Yes	2400	2.9	2.3	0.6 (-1-2.7)
Yes	12 – 17	Low	No	2671	30.5	21.8	8.6 (4.9-12.4)
			Yes	372	19.7	12.6	7.1 (-1.3-16.6)
		Middle	No	5554	31.6	22.9	8.7 (6-11.5)
			Yes	507	17.3	14.4	2.9 (-4.8-11.9)
		High	No	6585	35.2	27.9	7.3 (4.6-10)
			Yes	322	29.5	19.6	9.9 (-0.5-21.1)
	18 – 23	Low	No	4197	38.9	39	-0.1 (-3.5-3.4)
			Yes	666	29.2	20.1	9.1 (0.7-17.9)
		Middle	No	5049	38.2	36.4	1.8 (-1.2-4.8)
			Yes	549	31.1	18.6	12.5 (3.2-22.2)

	High	No	6601	39.5	40.6	-1.1 (-3.6-1.6)
		Yes	306	32.7	23.6	9.1 (-1.5-20.1)
24 – 30	Low	No	14408	48.5	50.5	-2 (-4.4-0.3)
		Yes	2633	32.7	32.1	0.6 (-4.9-6.3)
	Middle	No	4486	49.5	50.8	-1.3 (-5.3-2.7)
		Yes	777	34.4	36.5	-2.1 (-11.7-8)
	High	No	3237	46.3	49.3	-3 (-7.6-1.7)
		Yes	318	41.4	36.6	4.8 (-9-19.7)

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Supplementary material 8

Sensitivity analysis only including women with a recent health care contact (defined as any dispensed prescription or appointment at a hospital in the last 3 years) = 60.46% of the original population

Table 1. Characteristics of the 553 789 women aged 12 - 30 years and residing in Sweden by 1st January 2013 by previous mental health issues and use of hormonal contraceptives. Values are percentages (number of women) if not otherwise indicated.

	Previous mental health issues			
	Yes		No	
	19.01 (n = 105 283)		80.99 (n = 448 506)	
	Use of Hormonal contraceptives		Use of Hormonal contraceptives	
	Yes	No	Yes	No
	42.42 (n = 44657)	57.58 (n = 60 626)	44.41 (n = 199 170)	55.59 (n = 249 336)
Antidepressant drugs	41.17 (19 886)	39.77 (26 013)	2.73 (9 215)	1.87 (8 699)
Age				
12-17 years	15.11 (6 747)	20.75 (12 581)	15.63 (31 133)	37.24 (92 846)
18-23 years	48.78 (21 784)	31.29 (18 968)	48.30 (96 200)	22.75 (56 735)
24-30 years	36.11 (16 126)	47.96 (29 077)	36.07 (71 837)	40.01 (99 755)
Income level				
Low	39.70 (17 731)	45.01 (27 286)	33.06 (65 847)	35.08 (87 456)
Middle	27.55 (12 302)	27.85 (16 887)	26.00 (51 776)	29.91 (74 575)
High	32.75 (14 624)	27.14 (16 453)	40.94 (81 547)	35.01 (87 305)
Immigrant background				
No	94.50 (42 200)	88.94 (53 919)	93.76 (186 745)	83.61 (208 465)
Yes	5.50 (2 457)	11.06 (6 707)	6.24 (12 425)	16.39 (40 871)

Table 2. Results from the Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) distinguishing between measures of association and measures of variance and discriminatory accuracy. The analyses are stratified by the existence of previous mental issues. Values are point estimations with (95% Confidence Intervals)

	Without metal health issues		With mental health issues	
	Model 1	Model 2	Model 1	Model 2
Measures of association, Odds				
Ratios				
Age				
12-17		Reference		Reference
18-23		1.73 (1.33-2.22)		1.52 (1.33-1.71)
24-30		1.90 (1.48-2.40)		2.58 (2.29-2.91)
Income				
High		Reference		Reference
Middle		1.16 (0.91-1.48)		0.89 (0.79-1.01)
Low		1.17 (0.92-1.55)		0.89 (0.78-1.01)
Immigrant background				
No		Reference		Reference
Yes		0.65 (0.53-0.81)		0.55 (0.49-0.61)
Hormonal contraceptives				
No		Reference		Reference
Yes		1.40 (1.12-1.71)		1.18 (1.06-1.34)
Measures of variance				
Variance*	0.224 (0.130-0.372)	0.077 (0.038-0.141)	0.287 (0.174-0.468)	0.017 (0.008-0.033)
VPC	6.38%	2.29%	8.02%	0.51%
PCV		65.67%		94.09%
AUC	0.61 (0.61-0.61)	0.61 (0.61-0.61)	0.64 (0.64-0.64)	0.64 (0.64-0.64)

*Between-strata variance, variance partition coefficient (VPC), proportional change of the variance (PCV), Area under the curve (AUC)

Table 3. Absolute risk (AR) of antidepressant use, and AR difference (ARD) between user and non-users of hormonal contraceptives but otherwise sharing the same intersectional stratum. The values are calculated from the multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA)

Previous mental health issues	Age (years)	Income level	Immigrant background	Number of women	Use of hormonal contraceptive				
					Yes AR	No AR	Yes-No difference ARD		
No	12 – 17	Low	No	14060	4.4	1.8	2.7 (2 - 3.4)		
			Yes	3123	1.5	0.8	0.8 (-0.1 - 2)		
		Middle	No	37376	3.6	1.3	2.2 (1.8 - 2.6)		
			Yes	4543	2.4	1.0	1.4 (0.3 - 2.8)		
	High	No	62712	2.4	1.1	1.3 (1 - 1.5)			
		Yes	2165	2.8	1.2	1.7 (0.4 - 3.3)			
		Low	No	25939	4.2	3.4	0.8 (0.3 - 1.2)		
			Yes	5720	2.5	2.0	0.5 (-0.3 - 1.4)		
	Middle	No	40241	3.3	3.6	-0.3 (-0.6 - 0.1)			
		Yes	4547	2.7	1.8	0.9 (0 - 1.9)			
		High	No	74281	2.7	2.9	-0.2 (-0.4 - 0.1)		
			Yes	2207	2.0	2.7	-0.6 (-1.9 - 0.5)		
	24 – 30	Low	No	83448	3.6	3.7	0 (-0.3 - 0.2)		
			Yes	21013	2.9	2.1	0.8 (0.3 - 1.4)		
		Middle	No	31818	4.0	3.5	0.5 (0.1 - 0.9)		
			Yes	7826	3.0	2.7	0.3 (-0.5 - 1.2)		
		High	No	25335	2.9	3.0	-0.1 (-0.5 - 0.3)		
			Yes	2152	2.5	2.7	-0.2 (-1.5 - 1.2)		
		Yes	12 – 17	Low	No	3371	30.1	22.3	7.8 (4.7 - 10.9)
					Yes	429	20.4	13.4	7 (-0.4 - 14.8)
Middle	No			6787	31.0	23.1	7.9 (5.7 - 10.1)		
	Yes			565	19.5	14.3	5.2 (-1.5 - 12.7)		
High	No		7807	33.8	27.7	6.1 (3.9 - 8.2)			
	Yes		369	29.7	19.4	10.3 (1.2 - 19.6)			
	Low		No	10205	38.8	36.9	1.9 (0.1 - 3.8)		
			Yes	1068	28.1	19.0	9.1 (3.5 - 14.6)		
Middle	No		12082	36.6	35.0	1.6 (-0.1 - 3.3)			
	Yes		805	27.2	19.1	8.1 (2 - 14.3)			
	High		No	15994	37.2	38.5	-1.3 (-2.8 - 0.3)		
			Yes	598	26.3	25.4	0.8 (-6.1 - 7.7)		
24 – 30	Low		No	26185	49.2	48.9	0.3 (-0.9 - 1.6)		
			Yes	3759	36.0	32.6	3.4 (-0.3 - 7)		
	Middle		No	7820	49.2	50.4	-1.3 (-3.6 - 1)		
			Yes	1130	31.4	37.2	-5.8 (-12.4 - 0.9)		

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3		High	No	5868	47.8	47.8	0 (-2.6 - 2.6)
4			Yes	441	41.3	35.2	6.1 (-3.6 - 16)
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Reporting checklist for cohort study.

Based on the STROBE cohort guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cohort reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandembroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	#3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	#4	Present key elements of study design early in the paper	5

1	Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
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6	Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	5-6
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11	Eligibility criteria	#6b	For matched studies, give matching criteria and number of exposed and unexposed	5-6
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15	Variables	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
16				
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21	Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6-7
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30	Bias	#9	Describe any efforts to address potential sources of bias	6-7
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34	Study size	#10	Explain how the study size was arrived at	5-6
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37	Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	7-8
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42	Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	
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48	Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7-8
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52	Statistical methods	#12c	Explain how missing data were addressed	7-8
53				
54	Statistical methods	#12d	If applicable, explain how loss to follow-up was addressed	n/a Follow-up was complete
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Statistical methods	#12e	Describe any sensitivity analyses	
14-15			
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5-6
Participants	#13b	Give reasons for non-participation at each stage	5-6
Participants	#13c	Consider use of a flow diagram	
Figure 1			
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	9, table 1
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
n/a All participants included in final analysis had complete data			
Descriptive data	#14c	Summarise follow-up time (eg, average and total amount)	
5-6			
Outcome data	#15	Report numbers of outcome events or summary measures over time. Give information separately for exposed and unexposed groups if applicable.	
9-10			

1	Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11
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9	Main results	#16b	Report category boundaries when continuous variables were categorized	11-12
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13	Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
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17	10-12			
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19	Other analyses	#17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-13
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24	Discussion			
25				
26				
27	Key results	#18	Summarise key results with reference to study objectives	13-14
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31	Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	15-16
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36	Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	16
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43	Generalisability	#21	Discuss the generalisability (external validity) of the study results	16
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47	Other Information			
48				
49	Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17
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Notes:

- 12d: n/a Follow-up was complete for the final cohort

- 1 • 14b: n/a All participants included in final analysis had complete data The STROBE checklist is
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3 was completed on 26. January 2021 using <https://www.goodreports.org/>, a tool made by the
4 [EQUATOR Network](#) in collaboration with [Penelope.ai](#)
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