

Bravery of Giving Birth in the Homeland: Pregnant Women's and New Mothers' Decisions on Staying in Ukraine During the War

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1 **Bravery of Giving Birth in the Homeland: Pregnant Women's and New Mothers' Decisions**
2 **on Staying in Ukraine During the War**

3

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16 **Abstract**

17 **Background:** The full-scale Russian invasion of Ukraine has profoundly disrupted
18 maternal care systems, exposing pregnant women and new mothers to extreme contextual
19 adversity. While many relocated abroad, others remained to give birth in a war zone. The
20 psychosocial and health-related factors shaping these decisions remain poorly understood.
21 The purpose of the study is to identify the psychological, contextual, and dispositional
22 factors associated with women’s wartime decisions to remain in Ukraine or relocate
23 abroad.

24 **Methods:** Cross-sectional data were collected online between December 2022 and October
25 2023 from 734 Ukrainian women who were pregnant or postpartum during the full-scale
26 invasion. Decision tree modelling, supported by random forest analysis, was used to
27 explore predictors of relocation. Regression models and equivalence testing examined
28 group differences in personality traits. Missing data were addressed using multiple
29 imputation.

30 **Results:** Perceived disruption of daily life and geographic proximity to hostilities were the
31 strongest predictors of relocation decisions. These contextual factors consistently
32 outperformed dispositional traits, including Big Five personality dimensions. Higher
33 Extraversion was modestly associated with the decision to remain in Ukraine. Women who
34 gave birth abroad exhibited higher rates of postnatal depression than those who remained.

35 **Conclusions:** Relocation decisions among pregnant women and new mothers during war
36 are driven primarily by acute contextual adversity rather than individual personality traits.
37 These findings align with evidence from non-war migration contexts and highlight the need
38 for trauma-informed, context-sensitive approaches in perinatal care and policy during
39 armed conflict.

40 **Trial registration:** NCT05654987 (2022-12-16).

41

42 **Keywords:** perinatal mental health, women, maternity, displacement, non-displaced
43 persons, relocation decision, war, Ukraine.

44

45 **Background**

46 The full-scale Russian invasion of Ukraine, launched on 24 February 2022, has resulted in
47 widespread exposure to traumatic events, including forced or violent displacement, sexual
48 violence, restrictions on freedom, torture, and loss (Office of the United Nations High
49 Commissioner for Human Rights, 2025). These conditions have contributed to elevated rates of
50 anxiety, depression, and post-traumatic stress disorder (PTSD) across the Ukrainian population
51 (Xu et al., 2023; Wang et al., 2024). While the war has affected all segments of society, women
52 have been disproportionately impacted by its psychological and social consequences. Extensive
53 evidence from previous armed conflicts indicates that women are significantly more likely than
54 men to develop mental disorders in response to war-related adversity (Morina et al., 2018;
55 Amsalem et al., 2025).

56 For example, data from the 1998–1999 Kosovo War indicate that 19.7% of women met the
57 criteria for PTSD, compared to 12% of men, even after controlling for trauma load (Cardozo et al.,
58 2000). This gender disparity remained evident two years later, with women continuing to report
59 higher PTSD symptom severity (Ahern et al., 2004). Similar patterns have been documented
60 following the 2006 Lebanon War (Farhood et al., 2018), the 2012–2013 M23 rebellion in the
61 Democratic Republic of Congo (Ainamani et al., 2020), and the 2020–2022 Tigray War in Ethiopia
62 (Melese et al., 2024). Notably, these disparities often persisted despite women reporting fewer
63 direct traumatic exposures, with relational losses and social disruption emerging as salient
64 predictors (Baraković et al., 2013; Lafta & Merza, 2021). Recent studies in Ukraine, the Gaza
65 Strip, and Israel have confirmed similar patterns of women’s heightened vulnerability to war-
66 related mental health consequences (Kurapov et al., 2023; Aldabbour et al., 2024; Levi-Belz et al.,
67 2025).

68 Within this broader gendered impact, pregnant women and new mothers (PWNM)
69 represent an especially at-risk subgroup. In both clinical and humanitarian contexts, pregnancy
70 and the postpartum period are recognised as times of heightened biological, psychological, and
71 social vulnerability (Chrzan-Dętkoś et al., 2022). Armed conflict exacerbates these vulnerabilities
72 by disrupting access to antenatal and perinatal care, increasing risks of obstetric complications,
73 and intensifying exposure to traumatic stressors (Kearley et al., 2017). The collapse or degradation
74 of healthcare infrastructure further undermines maternal safety, heightens the risk of perinatal
75 mortality, and limits access to emergency obstetric interventions (Akol et al., 2016). A similar
76 trend has been observed since 2014, as reported by Ancheva and Morozova (2016). It persists
77 under the current full-scale war, affecting the mental and physical health of pregnant and new
78 mothers (Sukhostavets, 2022).

79 Since the onset of the full-scale invasion in 2022, the Russian Federation has systematically
80 targeted Ukraine's healthcare infrastructure, with especially severe implications for maternal care.
81 By 2025, approximately 10% of medical facilities had sustained direct damage, including
82 numerous maternity hospitals (Krupelnytska et al., 2025a). Notably, a maternity hospital in
83 Mariupol was bombed on 29 March 2022, within the first weeks of the full-scale invasion (Poole
84 et al., 2025), and more than three years later, on 11 June 2025, a maternity hospital in Kharkiv was
85 destroyed (Hnidyi, 2025). Such targeted attacks on maternal healthcare facilities have persisted
86 throughout the years of war, affecting multiple cities across the country (Safeguarding Health in
87 Conflict Coalition, 2024).

88 In response to these threats, a substantial number of PWNM were compelled to relocate
89 either within Ukraine or across international borders (Krupelnytska et al., 2025b). For instance, in
90 2022, a baby boom was recorded in Poland, largely attributed to births among Ukrainian refugees
91 (Wysocka et al., 2024). The overall scale of displacement is staggering: more Ukrainians were
92 uprooted than the entire population of Austria or Switzerland, and approximately 63% of refugees
93 are women (CARE, 2025). Nevertheless, despite the scale of trauma and disruption, some women

94 remained in Ukraine and gave birth while under siege. Emerging data indicate that remaining in
95 place was not necessarily associated with worse psychological outcomes. According to Lushchak
96 et al. (2023), women who did not flee exhibited a slightly lower prevalence of probable PTSD
97 (50.8%) compared to those who relocated (62.2%). Similarly, a review by Stevenson et al. (2023)
98 concluded that forced relocation was associated with an elevated risk of perinatal depression,
99 affecting roughly one in three displaced women. These findings challenge the intuitive assumption
100 that relocation offers psychological relief and raise important questions about the factors guiding
101 such critical decisions. Understanding what motivates PWNM to stay or leave in the face of danger
102 thus necessitates a closer examination of the underlying decision.

103 Migration has often been conceptualised as a product of rational deliberation grounded in
104 long-term cost–benefit analyses (Bertoli et al., 2020). However, empirical evidence increasingly
105 challenges this assumption, suggesting that the rational-choice framework provides, at best, an
106 oversimplified account (Brunarska, 2019; Czaika et al., 2021). Decisions in crisis contexts are
107 rarely purely rational. Instead, they are shaped by emotional distress, time constraints, individual
108 circumstances, and uncertainty or inconsistency in available information (Agrawal et al., 2007;
109 Agrawal et al., 2013). Among PWNM, this decision-making is further influenced by specific
110 psychosocial and health-related considerations (Vakhitov et al., 2025).

111 Studies on crisis-driven relocation commonly draw on the framework of “*push*” and “*pull*”
112 factors, drivers that either compel individuals to leave or attract them to alternative location
113 (Schewel, 2019; Braithwaite et al., 2020). Exposure to war-related violence and threats for
114 personal security typically constitute strong *push* factors (Adhikari, 2013). However, as Biehler
115 (2023) notes, studies often focused on examining the reasons for leaving, with less attention given
116 to understanding why some choose to stay. Among the key deterrents to relocation is the complex
117 factor of “*preference for home*,” rooted in longstanding social networks, place-based identity, and
118 accumulated local economic opportunities (Braithwaite et al., 2020). For PWNM, the choice to
119 migrate may indeed offer safety and access to healthcare. Yet it often entails a separation from

120 partners and family members – a particularly acute burden during the postpartum period (Faisal-
121 Cury, 2020; Van Heumen et al., 2018). These patterns were notably confirmed in recent studies
122 examining migration decision-making and mobility trajectories during the Russian war in Ukraine
123 (Khelashvili, 2025).

124 This study seeks to expand understanding of the women who decide to give birth in war-
125 affected Ukraine. Specifically, it aims to identify the psychological, contextual, and dispositional
126 factors that are related with their decisions. In line with this objective, the following research
127 questions (RQ) were formulated:

128 RQ₁: What factors are related with pregnant women's and new mothers' decisions on
129 staying in Ukraine during the war?

130 RQ₂: Are personality traits associated with the war-driven relocation decisions among
131 pregnant women and new mothers?

132 **Methods**

133 **Design and Procedure**

134 This study forms part of a broader observational cohort investigation, with the study
135 protocol published in advance (Rodríguez-Muñoz et al., 2023). The project was preregistered as a
136 clinical trial (NCT05654987) and received ethical approval from the Research Ethics Committee
137 of the Universidad Nacional de Educación a Distancia (Ref: 21-PSI-2022), the Research Ethics
138 Committee of the Faculty of Psychology, Taras Shevchenko National University of Kyiv (Date:
139 August 2022; Decision No. 04; Protocol No. 01), and the Ethics Board for Research Projects at
140 the Faculty of Social Sciences, University of Gdańsk (Approval No. 13-2022).

141 **Data Collection**

142 Data were collected between 1 December 2022 and 1 October 2023. During this period, all
143 participants were either pregnant or in the postpartum period. The survey was administered online.
144 Recruitment was carried out through multiple channels, including Facebook groups, Instagram,
145 personal networks, and Ukrainian support centres across European countries.

146 **Sample**

147 The final sample comprised 734 women, all of whom were residing in Ukraine at the
148 outbreak of the full-scale war on 24 February 2022. Of these, 621 remained in Ukraine, while 113
149 relocated abroad as refugees. Inclusion criteria were as follows: (a) being pregnant or the biological
150 mother of an infant aged up to 12 months; (b) aged 18 years or older; (c) residing in Ukraine during
151 or after the onset of war, or having refugee status following displacement to the European Union
152 from 24 February 2022 onwards; and (d) provision of informed consent to participate.

153 **Measures**

154 *Assessment, care, and trust – in pregnant and new mothers (ACT-PNM)*

155 The questionnaire was developed specifically for the present study to assess various aspects
156 of women’s backgrounds, based on the World Health Organization’s framework for social
157 determinants of health (Solar & Irwin, 2010). The instrument captured sociodemographic, birth-
158 related, and war-related variables potentially influencing relocation decisions. Relocation status
159 was treated as a multinomial outcome, with participants categorised as either displaced or non-
160 displaced, the latter group comprising both those who stayed in their original settlements and those
161 who became internally displaced persons.

162 *Ten-Item Personality Inventory (TIPI)*

163 The TIPI is a brief self-report measure of the Big Five personality traits (Gosling et al.,
164 2003). It comprises 10 items, with two items assessing each of the five traits: Extraversion,
165 Agreeableness, Conscientiousness, Emotional stability, and Openness. Responses are rated on a
166 7-point Likert scale ranging from 1 to 7, with higher scores indicating stronger expression of the
167 respective trait. In the present study, the Ukrainian version of the TIPI developed by Klimanska
168 and Haletska (2019) was employed. As reported by the authors, internal consistency of the scales
169 ranged from poor to acceptable ($\alpha = .44-.74$), test–retest reliability and convergent validity were
170 satisfactory.

171 *The Edinburgh Postnatal Depression Scale (EPDS)*

172 The EPDS is a widely used self-report measure of the depressive symptoms in peripartum
173 women (Cox et al., 1987). It comprises 10 items, covering subscales for anhedonia, anxiety, and
174 depressive symptoms. Responses rated on a 4-point Likert scale ranging from 0 to 3, with higher
175 scores reflecting greater severity of postnatal depressive symptoms. In the present study, the
176 Ukrainian version of the EPDS was developed. This version demonstrated excellent internal
177 consistency for the overall scale ($\alpha = .87$) and good for its subscales ($\alpha = .75-.76$), as reported by
178 Chrzan-Dętkoś et al. (2025). A cut-off score of 13 was applied to identify women with clinically
179 significant postnatal depressive symptoms (Levis et al., 2020).

180 **Data Analysis**

181 ***Relocation Decisions Modelling***

182 To investigate factors associated with the decision to relocate, we constructed a random
183 forest model using a selected subset of variables identified as theoretically relevant predictors
184 (Breiman, 2001). Variables were included if they reflected experiences or characteristics present
185 before or at the onset of the full-scale invasion, as well as dispositional traits unlikely to be affected
186 by subsequent events. This variable selection strategy was necessitated by the retrospective study
187 design, in which data were collected only after participants had either relocated abroad or remained
188 in Ukraine. The inclusion of post-relocation variables would introduce substantial bias and
189 conflate predictors with outcomes. Variable importance was evaluated using two random forest
190 metrics: mean decrease in accuracy and mean decrease in the Gini index, to assess the consistency
191 of ranking across methods.

192 Given that the relocation outcome was imbalanced, with a substantially larger proportion
193 of the sample remaining in Ukraine, the random over-sampling examples (ROSE) algorithm was
194 applied to the dataset to create a balanced synthetic sample (Lunardon et al., 2014). ROSE
195 generates additional cases via bootstrapping and the introduction of minor random variation,
196 thereby enabling a more stable representation of the joint distribution and mitigating the impact of
197 class imbalance. Subsequently, a classification and regression tree (CART) model was constructed

198 based on the random forest results. The CART algorithm recursively partitioned the dataset into
199 internally homogeneous subgroups according to the selected predictors (Breiman et al., 1984). The
200 minimum terminal node size was set at 30 observations for the full sample and 10 for subgroup
201 analyses to reduce overfitting and ensure interpretability. Variable importance within the CART
202 model was quantified by the total reduction in the Gini index. Evaluation of the complexity
203 parameter indicated minimal influence on the resulting tree structure.

204 *Comparative Analysis*

205 Comparisons of categorical outcomes, such as demographic characteristics and whether
206 participants met the EPDS clinical cut-off, were conducted using chi-squared tests. Continuous
207 outcomes related to postnatal depressive symptoms were compared across groups using Welch's
208 *t*-tests, which allow for unequal variances. Group differences in personality traits were tested using
209 ordinary least squares regression models, with relocation status (displaced or non-displaced) as the
210 independent variable. Each Big Five trait served as a separate dependent variable. All between-
211 group comparisons were conducted using multiply imputed regression models. All *p*-values were
212 two-tailed and adjusted using Holm-Bonferroni correction for multiple imputed datasets. In
213 addition, equivalence testing was conducted using the two one-sided tests (TOST) procedure, with
214 equivalence bounds set at 0.25 standard deviations.

215 *Missing Data Handling*

216 Prior to analysis, six cases were excluded due to missing data on relocation status, which
217 precluded their classification into comparison groups. For the construction of the random forest
218 model, missing values were imputed using a non-iterative, single-pass procedure based on median
219 substitution. This approach was considered appropriate given that the model was employed solely
220 for assessing variable importance, not for inferential purposes. In contrast, personality trait
221 variables exhibited item-level missingness ranging from 26% to 29%, warranting a more rigorous
222 approach. Multiple imputation by chained equations (MICE) was applied using predictive mean
223 matching (Van Buuren & Groothuis-Oudshoorn, 2011). Twenty imputed datasets were generated.

224 All subsequent analyses were performed within each dataset and pooled using Rubin's rules
225 (1987). The fraction of missing information ranged from .20 to .29, with relative efficiency
226 exceeding 95% for all variables.

227 *Software*

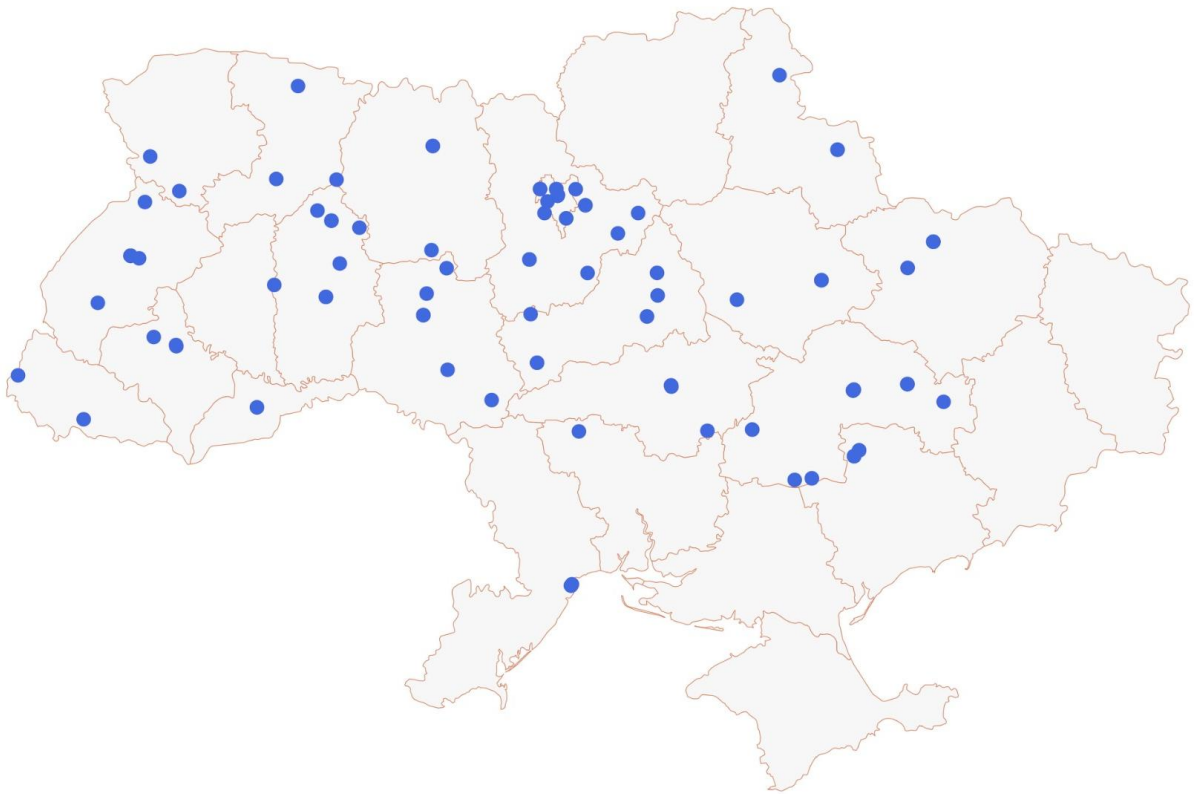
228 All statistical analyses were conducted using RStudio (version 2025.05.1 + 513) for macOS
229 Sequoia 15.5. A two-tailed significance threshold of $\alpha = .05$ was applied. The complete analysis
230 script, along with the dataset used in the present study, is available via the Open Science
231 Framework (Yatsenko & Krupelnyska, 2025).

232 **Results**

233 Participants were drawn from virtually all major regions of Ukraine; however, several
234 regions are absent from the sample (see **Figure 1**). No respondents were recorded from the
235 Russian-occupied territories, specifically, from the Luhansk and Donetsk Oblasts (*Oblast* refers to
236 an administrative region in Ukraine, similar to a province), and the Autonomous Republic of
237 Crimea. Also no respondent recruited from Kherson or Chernihiv Oblasts. Under-representation
238 of Kherson region is plausibly linked to its partial occupation at the time of data collection, whereas
239 the absence of respondents from Chernihiv may be attributable to heightened security risks and
240 ongoing aerial bombardment in the region (Naumenko, 2024).

241 **Figure 1**

242 *Geographic distribution of respondents' settlements of residence within Ukraine*



243

244 *Note. Administrative boundaries correspond to the 1991 oblast structure of sovereign Ukraine,*
 245 *prior to territorial occupation.*

246 *Alt text: Respondent residences are distributed across Ukraine, with denser clusters in central and*
 247 *eastern regions and no data from occupied territories.*

248 An overall comparison between women who stayed in Ukraine and those who relocated
 249 abroad is presented in **Table 1**. No significant differences were observed in proximity to hostilities
 250 of their original residence ($p = .078$), pre-war financial condition ($p = .5$), or highest level of
 251 education ($p = .9$). However, perceptions of wartime impact on daily life differed markedly ($p <$
 252 $.001$), with displaced women more frequently (32–40%) reporting their daily life as *very highly*
 253 *disrupted* by outbreak of war in contrast to 10–20% among non-displaced. A similar pattern
 254 emerged for postnatal depression, with significantly lower prevalence among PWNM staying in
 255 Ukraine ($p = .004$). This group also reported lower levels of depression, anxiety, and anhedonia
 256 symptoms ($p < .05$).

257 **Table 1**

258 *Sociodemographic characteristics of the study sample*

Characteristics	Resided in Ukraine (n = 621)		Displaced Abroad (n = 113)		p-value ¹
	Pregnant women n = 205	New mothers n = 412	Pregnant women n = 29	New mothers n = 84	
Proximity to hostilities, n (%)					0.078
Distal	50 (25%)	99 (24%)	5 (17%)	7 (8.4%)	
Intermediate	94 (46%)	185 (45%)	14 (48%)	44 (53%)	
Proximal	60 (29%)	125 (31%)	10 (34%)	32 (39%)	
n/d	1 (1.2%)	3 (0.7%)		1 (0.5%)	
Pre-war financial condition, n (%)					0.5
High	32 (17%)	59 (16%)	7 (25%)	20 (26%)	
Low	14 (7.6%)	25 (6.8%)	2 (7.1%)	4 (5.3%)	
Moderate	139 (75%)	281 (77%)	19 (68%)	52 (68%)	
n/d	20 (9.8%)	47 (11%)	1 (3.4%)	8 (9.5%)	
Wartime impact on daily life, n (%)					< 0.001
High	34 (18%)	68 (19%)	8 (29%)	20 (26%)	
Low	19 (10%)	37 (10%)	1 (3.6%)	3 (3.9%)	
Moderate	73 (39%)	106 (30%)	9 (32%)	11 (14%)	
Rather high	40 (22%)	71 (20%)	1 (3.6%)	12 (16%)	
Very high	19 (10%)	72 (20%)	9 (32%)	31 (40%)	
n/d	20 (9.8%)	58 (14%)	1 (3.4%)	7 (8.3%)	
Highest level of education, n (%)					0.9
Postgraduate	111 (54%)	228 (55%)	14 (48%)	47 (56%)	
Undergraduate	94 (46%)	184 (45%)	15 (52%)	37 (44%)	
Postnatal depression ² , n (%)					0.004
No	15 (54%)	129 (72%)	31 (43%)	195 (57%)	
Yes	13 (46%)	49 (28%)	41 (57%)	149 (43%)	
EPDS score, M (SD)	13 (6)	10 (6)	13 (6)	11 (6)	< 0.001
Depressive symptoms, M (SD)	5.4 (3.3)	3.9 (3.2)	5.4 (3.5)	4.5 (3.3)	0.003
Anxiety symptoms, M (SD)	4.86 (2.07)	4.06 (2.33)	5.19 (2.01)	4.59 (2.26)	0.002
Anhedonia, M (SD)	2.39 (2.06)	1.71 (1.78)	2.60 (1.97)	2.09 (1.85)	0.006

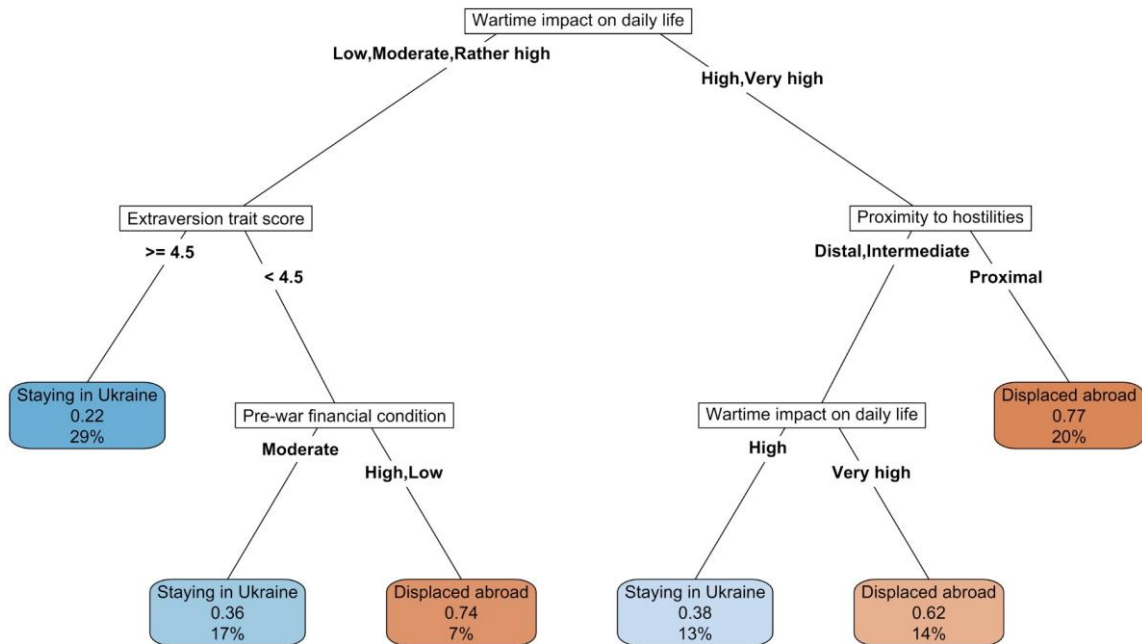
259 *Note: ¹ p-values reflect chi-squared tests for categorical variables and Welch's t-tests for*
260 *continuous variables; ² postnatal depression defined as meeting the EPDS clinical cut-off of 13.*

261 To examine factors associated with relocation decisions among PWNM in Ukraine during
262 wartime, a classification tree model was constructed using five predictors identified through
263 random forest variable selection: perceived wartime impact on everyday life, proximity of

264 residence to hostilities, perceived pre-war financial condition, and Extraversion trait score from
 265 the Five-Factor Model of personality (see Figure 2).

266 **Figure 2**

267 *Decision tree modelling relocation probability in the full sample*



268

269 *Note. Decimal values represent expected loss for non-displaced and predicted class probabilities*
 270 *for those displaced, and percentages reflect node weights.*

271 *Alt text: Lower perceived wartime disruption, higher extraversion, and moderate financial status*
 272 *are associated with remaining in Ukraine, as shown by primary splits in the decision tree.*

273 The classification model was trained on a balanced sample of 515 respondents and pruned
 274 using a complexity parameter (cp) of .002, with a minimum terminal node size of 30. The final
 275 tree consisted of five splits. The root node misclassification rate was 46.8%, with a relative error
 276 of .63 and a cross-validated error of .76 ($xstd = .045$). Despite limited performance gain compared
 277 to simpler models, this solution was retained due to its interpretability.

278 The most informative split occurred on the root node based on perceived wartime impact
 279 on daily life, with an improvement value of 21.11 and variable importance (vi) of 39. It was
 280 followed by proximity to hostilities ($vi = 22$), Extraversion ($vi = 19$), pre-war financial condition

281 ($vi = 16$), and Emotional stability ($vi = 4$). PWNM reporting *low* to *rather high* levels of daily
282 disruption caused by war (52.6%, $n = 271$) were predominantly classified as non-displaced
283 (66.8%). Within this subgroup, Extraversion was the next splitting variable. Among respondents
284 with Extraversion scores above 4.5 (28.9%, $n = 149$), 77.9% were predicted to have stayed in
285 Ukraine, for those with lower Extraversion score (23.7%, $n = 122$), the overall predicted
286 probability of remaining was 53.3%. Further splitting this latter group by pre-war financial
287 conditions revealed divergent outcomes. Participants with Extraversion scores below 4.45 and
288 reporting moderate pre-war income (17.1%, $n = 88$) were also primarily classified as non-displaced
289 (63.6%). Conversely, those with the same Extraversion scores and either low or high pre-war
290 income (6.6%, $n = 34$) were predicted to have relocated abroad in 73.5% of cases.

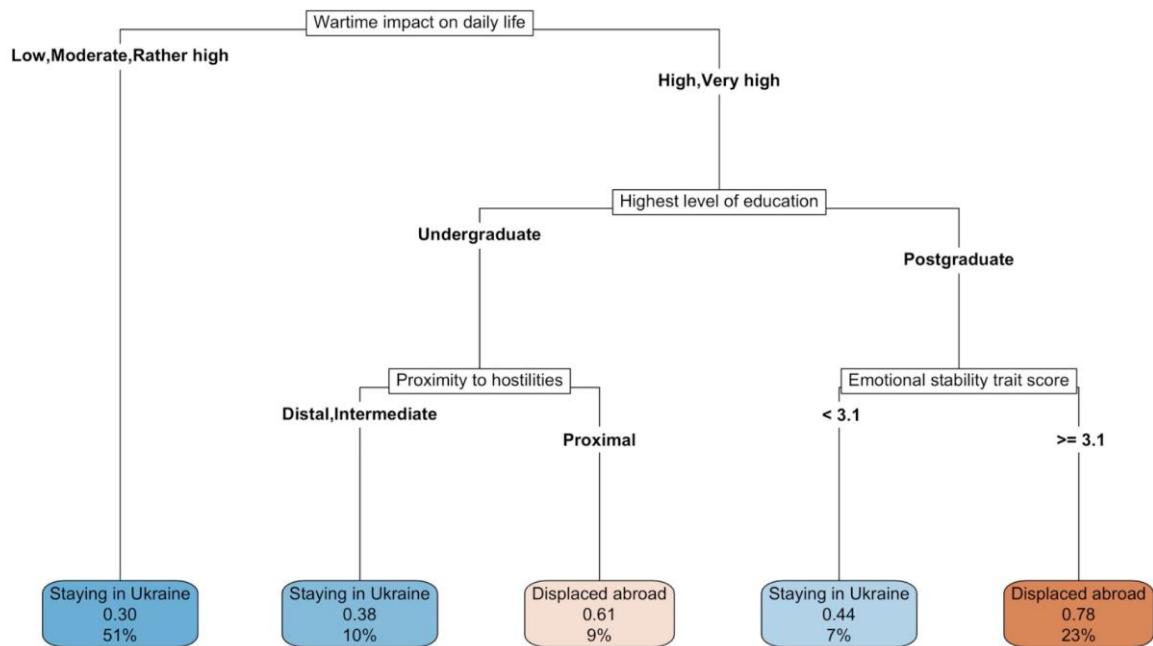
291 Among respondents who reported *high* or *very high* levels of wartime disruption (47.4%,
292 $n = 244$), 61.9% were classified as displaced abroad. A subsequent split in this subgroup showed
293 that participants not residing in immediate proximity to hostilities (27.0%, $n = 139$) were almost
294 evenly divided, with 50.4% classified as displaced abroad. Within this group, participants
295 reporting *high* disruption of daily life (13.2%, $n = 68$) were more likely to stay in Ukraine (61.8%),
296 whereas those with *very high* disruption caused by war (13.8%, $n = 71$) were predominantly
297 classified as displaced (62.0%). By contrast, participants residing in proximal regions (20.0%, $n =$
298 103) were more likely to be classified as displaced (77.1%) regardless of perceived disruption
299 intensity.

300 Given the centrality of maternal status to our study design, we first assessed whether this
301 variable would emerge as a primary splitter in the overall CART. It did not, with a mean decrease
302 in accuracy of -3.05 and a mean decrease in Gini of 5.66, ranking sixth in variable importance
303 compared to 36 for perceived wartime impact on everyday life. Acknowledging the distinct
304 psychological and contextual factors associated with pregnancy versus the postpartum period, we
305 therefore estimated separate trees for pregnant women and new mothers. The classification tree of
306 354 new mothers included as well five predictors: perceived wartime impact on everyday life,

307 highest level of education accomplished by women, proximity of region of residence to hostilities,
 308 perceived income level, and Emotional stability trait score (see Figure 3).

309 **Figure 3**

310 *Decision tree modelling relocation probability among new mothers*



311

312 *Note. Decimal values represent expected loss for non-displaced and predicted class probabilities*
 313 *for those displaced, and percentages reflect node weights.*

314 *Alt text: Lower perceived wartime disruption and emotional stability, undergraduate education,*
 315 *and residence distant from hostilities are associated with the decision to stay in Ukraine.*

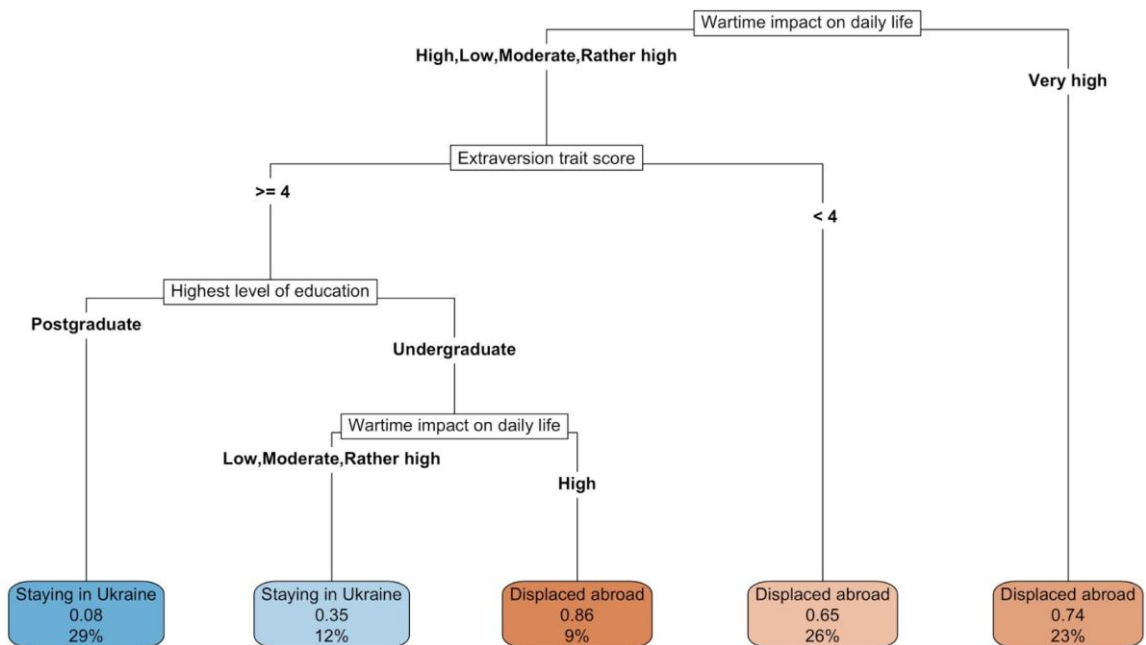
316 The model demonstrated a relative error of .67 and a cross-validated error of .88
 317 ($xstd = .056$), with a root node misclassification rate of 46.0%, indicating moderate to limited
 318 performance, consistent with the preceding tree. The initial split was again made on perceived
 319 wartime disruption to daily life with an improvement value of 18.16 ($vi = 52$). Among participants
 320 reporting low to moderately high disruption (51.1%, $n = 181$), 69.6% were predicted to stay in
 321 Ukraine. For those experiencing high or very high levels of disruption (48.9%, $n = 173$),
 322 subsequent splits occurred based on educational attainment ($vi = 14$) and Emotional stability scores
 323 ($vi = 19$), both of which contributed more strongly in this model than in the previous one.

324 Among participants with postgraduate education (30.5%, $n = 108$), the majority (70.4%)
 325 were classified as displaced abroad. Within this group, those with lower Emotional stability (7.1%,
 326 $n = 25$) were moderately likely to be classified as non-displaced (56.0%), whereas those with
 327 higher Emotional stability (23.4%, $n = 83$) were predominantly classified as displaced (78.3%). In
 328 contrast, participants with undergraduate education (18.4%, $n = 65$) were almost evenly split, with
 329 50.8% predicted to stay and 49.2% predicted to relocate. Among this group, proximity to hostilities
 330 emerged as the key differentiator ($vi = 10$). 61.3% of those residing in proximal areas (8.8%, $n =$
 331 31) were classified as displaced, while 61.8% of those living in distal or intermediate regions
 332 (9.6%, $n = 34$) were predicted to have stayed to give birth in Ukraine.

333 The subsequent model focused on the subsample of pregnant women ($n = 163$),
 334 representing the smallest group analysed (see Figure 4).

335 **Figure 4**

336 *Decision tree modelling relocation probability among pregnant women*



337
 338 *Note. Decimal values represent expected loss for non-displaced and predicted class probabilities*
 339 *for those displaced, and percentages reflect node weights.*

340 *Alt text: Lower perceived wartime disruption and higher extraversion are associated with the*
341 *decision to stay in Ukraine.*

342 The model yielded a relative error of .48 and a cross-validated error of .68 ($xstd = .076$).
343 Binomial regression analysis identified only 12 misclassified cases, likely attributable to missing
344 data. The area under the curve ($AUC = .75$) further supported the model's acceptable
345 discriminatory performance despite the limited sample size. The first and most informative split
346 occurred on perceived wartime disruption to daily life, with an improvement value of 6.30 ($v_i =$
347 35). Among participants reporting *very high* levels of disruption (23.1%, $n = 38$), 73.7% were
348 classified as displaced abroad. The remaining PWNM (76.9%, $n = 125$), those with *low* to *high*,
349 but not *very high*, disruption, had a predicted probability of remaining in Ukraine of 59.2%.
350 Although the initial split did distinguish between *high* and *very high* levels of disruption,
351 subsequent patterns were consistent with previous models. Notably, even within the presumed
352 non-displaced subgroup (those with undergraduate education and high Extraversion), those
353 reporting *high* disruption (9.2%, $n = 15$) had a predicted displacement rate of 85.7%, underscoring
354 previous results on the salience of perceived wartime impact on daily life.

355 Subsequent splits among participants not reporting *very high* disruption were based on
356 Extraversion scores and education level, each with a variable importance of 28. Among PWNM
357 with lower Extraversion scores (26.4%, $n = 43$), 65.1% were classified as displaced abroad,
358 whereas among those with higher scores (50.3%, $n = 82$), only 28.0% were predicted to be
359 displaced, replicating the pattern observed in the overall and new mothers' models. Within the
360 high Extraversion subgroup, further splits were observed based on educational attainment.
361 Participants with postgraduate education (29.4%, $n = 48$) were classified as remaining in Ukraine
362 in 91.7% of cases, forming the most stable profile across all models. This outcome contrasts with
363 the new mothers' model, where postgraduate education was linked with higher displacement rates,
364 suggesting that among pregnant women, Extraversion trait may play a more decisive role than
365 educational level per se. By contrast, participants with similar levels of Extraversion but

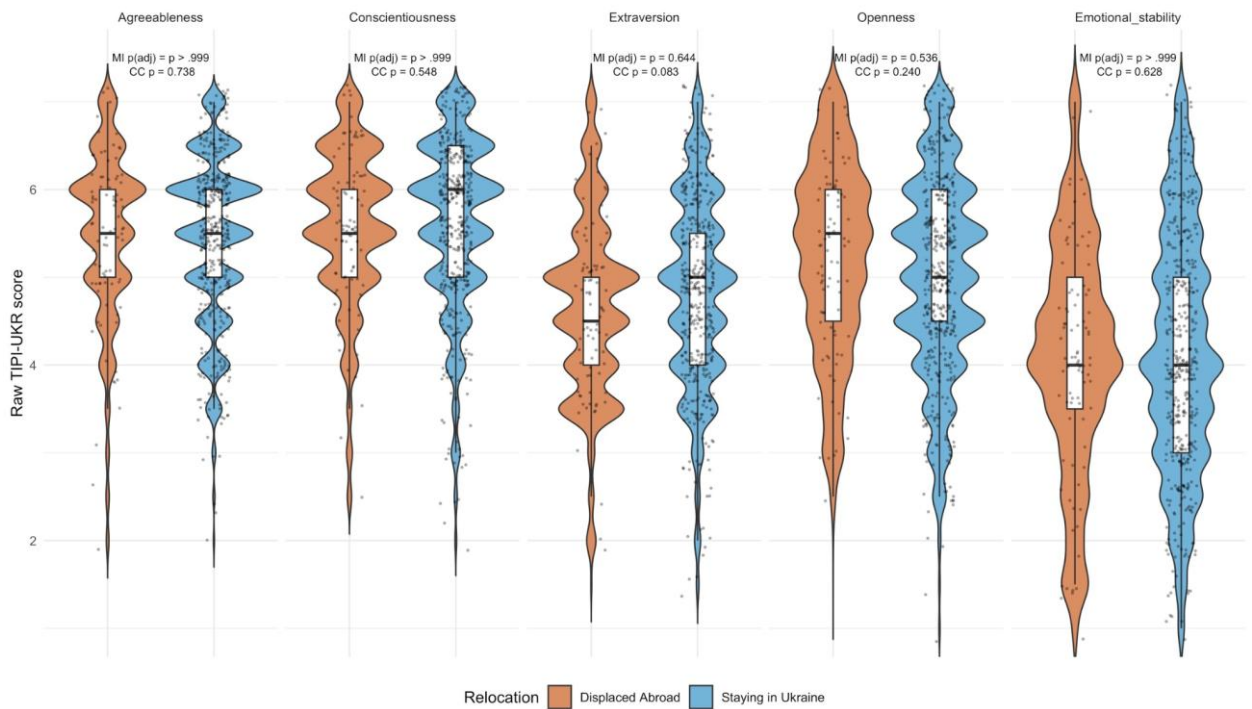
366 undergraduate education (20.9%, $n = 34$) were more evenly distributed: the overall predicted
367 probability of displacement was 55.9%. Among them, those reporting *high* disruption (9.2%, $n =$
368 15) had a predicted displacement rate of 85.7%, whereas those with lower disruption (12.3%, $n =$
369 20) were predicted to be displaced in only 34.9% of cases.

370 Personality traits did not emerge as primary splitting variables in any of the three
371 classification models. However, they consistently served as surrogate splits, reflecting partial
372 explanatory overlap with the main contextual factors. In the classification tree based on the full
373 PWNM sample ($n = 515$), Extraversion served as the first-ranked surrogate at the root node,
374 replicating the split on perceived wartime disruption with 56.3% agreement, while Emotional
375 stability achieved 55% as the second-ranked surrogate. Across the full tree, agreement for
376 Extraversion ranged from 57% to 78%, and for Emotional stability from 57% to 64%, reflecting
377 moderate consistency with the main model structure. In the model based on new mothers ($n = 354$),
378 Emotional stability was again the top-ranked surrogate at the root node, with 55.1% agreement,
379 and maintained agreement rates of 63% to 64% at subsequent nodes. In the model for pregnant
380 women ($n = 163$), Openness, though not retained in the final tree, was the most informative first-
381 ranked surrogate, replicating the root split with 78% agreement and maintaining 61% to 82%
382 agreement at other nodes.

383 While the analysis of surrogate splits indicated that certain personality traits tracked the
384 structure of relocation decisions to a moderate extent, their role appeared to be indirect and
385 context-dependent. To further assess the relevance of personality in shaping relocation outcomes,
386 we conducted a direct comparison of Big Five trait scores between women who stayed in Ukraine
387 and those who were displaced abroad (see **Figure 5**).

388 **Figure 5**

389 *Visualisation of Big Five personality traits scores among relocation groups*



390

391 *Note. Violin and box plots represent weighted imputed data, dots represent observed values.*

392 *Alt text: Smoothed distributions of trait scores across relocation groups, with no visible*
 393 *divergence.*

394 Descriptive statistics indicated comparable central tendencies across groups, with mean
 395 scores ranging from 4.1 to 5.6 across all traits. No statistically significant differences were
 396 observed for any of the five traits following multiple comparison adjustment. Point estimates were
 397 uniformly small in magnitude ($|\beta| \leq 0.21$), and all 95% confidence intervals
 398 encompassed zero, indicating an absence of statistically and
 399 practically meaningful effects. The largest unadjusted difference was
 400 observed for Openness score ($\beta = -0.21$, 95% CI [-0.47, 0.05]), with displaced PWNM
 401 reporting marginally higher scores; however, the adjusted p -value of .54 provided no support for
 402 rejecting the null hypothesis. Equivalence testing using the TOST confirmed that differences in
 403 traits fell within the predefined ± 0.25 standard deviation bounds, indicating practical equivalence.
 404 Complete-case analyses yielded comparable results, supporting the robustness of findings obtained
 405 from the imputed dataset.

406 **Discussion**

407 The decisions faced by Ukrainian women during the war are marked by profound
408 difficulty. Staying in the homeland entails living under constant threat, frequent air-raid alarms,
409 and disrupted healthcare infrastructure – albeit within a familiar environment and established
410 social support networks (Krupelnytska & Morozova-Larina, 2025). Conversely, relocation,
411 especially during pregnancy or early motherhood, entails separation from family, navigation of
412 linguistic and cultural barriers, and persistent concern for those left behind (Chrzan-Dętkoś &
413 Murawska, 2023). Although distinct in nature, both choices reflect an act of considerable bravery.
414 This study aimed to identify the factors associated with wartime relocation decisions among
415 pregnant women and new mothers in Ukraine.

416 The findings indicate that perceived wartime disruption to daily life and proximity to active
417 hostilities were primary factors, associated with relocation decisions. Across the full sample and
418 subsamples, the classification trees consistently identified perceived disruption of daily life as the
419 principal discriminator. Women reporting high or very high levels of disruption were markedly
420 more likely to relocate, whereas those experiencing lower levels of disruption tended to remain.
421 The shared motivation to protect oneself and one’s (unborn) child rendered participants especially
422 sensitive to contextual adversity as a salient “*push*” driver (Vakhitov et al., 2025). These findings
423 are consistent with previous studies conducted in other sociocultural contexts (Artzi-Medvedik et
424 al., 2025; Takševa & Sgoutas, 2015).

425 Geographic proximity to active hostilities further shaped these decisions. Among those
426 who perceived severe disruption of daily life in proximal for hostilities regions produced the
427 highest displacement probabilities (77% overall, 35%–78% among subgroups), in distal or
428 intermediate regions was less decisive (62% overall, 30%–63% among subgroups), even taking in
429 account perceived disruption everyday life. These patterns support prior evidence that proximity
430 to active hostilities amplifies perceived risk and increases displacement likelihood (Moore &
431 Shellman, 2004). Across diverse conflicts, measures of distance to violent events consistently

432 emerge among the strongest predictors of displacement, though effect sizes vary with conflict type
433 and duration (Erdal et al., 2023).

434 While wartime impact and proximity to hostilities area emerged as dominant factors for
435 PWNM, other characteristics also demonstrated predictive relevance. Notably, pre-war financial
436 conditions exhibited a U-shaped association with relocation decisions, suggesting that both
437 resource scarcity, as a “*push*” factor, and resource sufficiency, as a “*pull*” factor, can facilitate
438 displacement. In contrast, women with moderate financial resources likely face fewer economic
439 constraints yet also experience weaker incentives to leave. This pattern diverges from findings in
440 non-war contexts, where disaster-related displacement in Nigeria (Letta et al., 2024) and Ethiopia
441 (Gray & Mueller, 2012) followed different economic dynamics. Still, our findings on women’s
442 migration decisions highlights the ambivalence within middle-income groups: such women often
443 remain due to family obligations and sufficient local opportunities, while experiencing less
444 financial “*pushes*” to flee.

445 It should be noted that no significant group differences in personality traits were observed
446 between displaced and non-displaced PWNM in our sample. However, these traits emerged as
447 relevant discriminators and surrogate split variables in the decision tree models, suggesting a
448 potential, albeit secondary, role in shaping relocation decision-making. Specifically, higher levels
449 of Extraversion were associated with a greater likelihood of remaining in Ukraine. This finding
450 aligns with the study by Olowojolu and Ettang (2021), conducted in north-eastern Nigeria during
451 the Boko Haram conflict, where individuals with higher risk aversion were more likely to flee,
452 while those exhibiting greater risk tolerance tended to stay. This association may reflect the
453 established link between Extraversion and risk-taking tendencies (Moncel et al., 2025). This
454 pattern stands in contrast to economically motivated voluntary migration, where individuals with
455 higher risk tolerance are typically more inclined to migrate, as described in the study by Otonneli
456 and Toresu (2013).

457 Subgroup analysis revealed additional patterns in relocation decisions. Among new
458 mothers who experienced more severe disruption of daily life due to the war, educational
459 attainment and emotional stability appeared to play a more prominent role. Those with higher
460 levels of education and greater emotional stability were more likely to relocate abroad. One
461 possible explanation lies in the demands of caring for an infant, which may require greater personal
462 resources to manage stress effectively (Puyané et al., 2022). This finding suggests that both
463 educational background and individual dispositions may facilitate relocation under threat,
464 potentially by enabling strategic planning or better access to relevant resources (Olowojolu &
465 Ettang, 2021).

466 A slightly different trend was observed in the classification tree for pregnant women.
467 Among those with higher levels of extraversion, higher education was associated with remaining
468 in Ukraine. Similarly, Salelew et al. (2024), in a study of war-survivor women in Northern
469 Ethiopia, reported an interaction between psychological distress and educational level, further
470 supporting the importance of both personal and contextual factors in shaping displacement-related
471 decisions. However, Openness to experience appeared to shape decision-making in a manner
472 similar to perceived wartime disruption – more open individuals tended to relocate. Flynn and
473 Smith (2007) also found that higher Openness is associated with a preference for active decision-
474 making, a finding consistent with broader literature on this trait (Abu Raya et al., 2023).

475 While relocation may remove individuals from immediate physical danger, it should not
476 be regarded as a comprehensive solution. Across diverse conflict contexts and host countries, post-
477 migration stressors have been shown to maintain or even intensify war-related mental health
478 difficulties. Factors such as poverty, discrimination, social isolation, and uncertain legal status
479 contribute to prolonged psychological distress, sustaining conditions such as PTSD, depression,
480 and anxiety (Wu et al., 2021; Hossain et al., 2021). These patterns have also been observed among
481 Ukrainian refugees, as documented by Bilewicz et al. (2024).

482 Our findings reflect a similar trend, with particular concern for maternal and infant well-
483 being. Women who gave birth abroad exhibited a higher prevalence of postnatal depression
484 compared to those who remained in Ukraine. This observation is consistent with previous studies
485 conducted among Syrian (Stevenson et al., 2019) and Palestinian (Yoneda et al., 2021) refugee
486 populations. Additionally, our results correspond with findings from Lushchak et al. (2023), who
487 reported that remaining in one's place of residence was associated with comparatively lower levels
488 of psychopathological symptoms. However, it is important to note that most existing studies were
489 not conducted specifically on pregnant or postpartum women, which may partly explain observed
490 differences between groups.

491 At the same time, it is critical to avoid pathologising pregnancy or motherhood as causes
492 of psychological distress. Mental health challenges among Ukrainians were evident well before
493 the full-scale invasion of 2022. Following the annexation of Crimea and the occupation of parts of
494 the Donbas region in 2014, Ukraine experienced large waves of internal displacement and external
495 migration. These events had notable psychological consequences. According to the World Bank
496 Group (2017), by 2015 the prevalence of depression in Ukraine had reached 6.3%, anxiety 3.2%,
497 and PTSD 8%. Mental disorders became the second most significant cause of disability
498 nationwide, as measured by disability-adjusted life years.

499 Understanding the decisions of pregnant women and new mothers to remain in Ukraine or
500 relocate abroad is therefore essential – not only for researchers, but also for policy-makers,
501 humanitarian organisations, and wider society. As Biehler (2023) argues, the choice to stay or
502 move is rarely driven solely by individual characteristics. Rather, it reflects a complex interaction
503 of external constraints and personal circumstances. Some individuals may lack the financial means
504 to leave, possess lower levels of education, or face restrictions on their freedom of movement. This
505 was notably the case in cities such as Mariupol in 2022, where civilians were unable to evacuate
506 due to the threat of violence by Russian soldiers who occupied the city (Office of the United
507 Nations High Commissioner for Human Rights, 2022). Similarly, legal restrictions preventing

508 Ukrainian men from leaving the country may have influenced the decisions of women who would
509 otherwise have relocated with their partners.

510 It remains difficult to describe the situation in Ukraine with precision. A substantial portion
511 of the country is under occupation, making data from those territories largely inaccessible. Official
512 statistics fail to reflect the full scale of maternal displacement, as countless women have crossed
513 borders without documentation, been abducted by occupying forces, disappeared from healthcare
514 systems, or given birth without any medical assistance (Amnesty International, 2022; Awuah et
515 al., 2022). Only indirect estimates are available regarding the number of pregnant women and new
516 mothers who have been forced from their homes. Although comprehensive data on wartime births
517 are lacking, existing evidence points to a significant decline in pregnancy rates and widespread
518 disruption of maternal healthcare services (Vezhnovets et al., 2024). The situation in war-affected
519 regions serves as a reminder that, for many Ukrainian women, even the most basic conditions for
520 life – birth, care, and safety – can no longer be guaranteed.

521 **Limitations**

- 522 1. Precise demographic information was not collected due to ethical considerations regarding
523 participant safety, particularly for those with relatives in occupied territories.
- 524 2. The retrospective design introduces potential recall bias. As a post hoc analysis, causal
525 inference is limited due to absence of pre-relocation data collected.
- 526 3. The classification trees explained moderate variance, suggesting that additional
527 unmeasured factors likely contribute to PWNM's relocation decisions.

528 **Conclusions**

529 Perinatal women's relocation decisions during wartime are related primarily with *perceived* war-
530 related adversity and war-related stress, rather than by individual or demographic factors typically
531 emphasised in perinatal research. These findings challenge existing assumptions in the literature
532 and underscore the need for context-sensitive policies that account for the psychological and
533 practical realities of war. It is essential for healthcare professionals and other specialists working

534 with refugee women to recognize that these women may be significantly affected by war-related
535 adversity and stress, even when such experiences are not explicitly verbalized. A trauma-informed
536 approach to care is strongly recommended not only for professionals in perinatal mental health but
537 also for maternity care providers. Humanitarian agencies and host countries should prioritise
538 stability, safety, and continuity of care, recognising that traditional models of perinatal support
539 may be insufficient in conflict settings. War fundamentally alters the framework within which
540 these decisions are made.

541 **List of abbreviations**

542 PWNM – pregnant women and new mothers

543 PTSD – post-traumatic stress disorder

544 TIPI – Ten-Item Personality Inventory

545 EPDS – Edinburgh Postnatal Depression Scale (EPDS)

546 ROSE – random over-sampling examples

547 MICE – multiple imputation by chained equations

548 CART – classification and regression tree

549 TOST – two one-sided tests

550 **Declarations**

551 **Ethics approval and consent to participate**

552 The project was preregistered as a clinical trial (NCT05654987) and received ethical
553 approval from the Research Ethics Committee of the Universidad Nacional de Educación a
554 Distancia (Ref: 21-PSI-2022), the Research Ethics Committee of the Faculty of Psychology, Taras
555 Shevchenko National University of Kyiv (Date: August 2022; Decision No. 04; Protocol No. 01),
556 and the Ethics Board for Research Projects at the Faculty of Social Sciences, University of Gdańsk
557 (Approval No. 13-2022).

558 **Consent for publication**

559 Not applicable

560 **Availability of data and materials**

561 The datasets supporting the conclusions of this article are available in the Open Science
562 Framework repository, <https://doi.org/10.17605/OSF.IO/K2N9M>.

563 **Competing interests**

564 The authors declare that they have no competing interests

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567 **Authors' contributions**

568 **LK** conceptualised the study, led the investigation, provided supervision, and contributed
569 to writing the original draft and to reviewing and editing the manuscript. **NY** curated the data,
570 developed the methodology, performed the formal analysis and visualisation, and contributed to
571 writing the original draft. **MC-D** participated in the investigation, and contributed to writing the
572 original draft and to reviewing and editing the manuscript. **NM** contributed to validation and to
573 writing the original draft, as well as to reviewing and editing the manuscript. **AV** participated in
574 the investigation and in reviewing and editing the manuscript. **OM-L** contributed to
575 conceptualisation, investigation, and to reviewing and editing the manuscript. **HSG-L** was
576 responsible for data curation and resources. **MFR-M** managed the project, provided resources and
577 supervision, and contributed to reviewing and editing the manuscript. All authors read and
578 approved the final manuscript.

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582

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