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Disparities in Breast Cancer Screening Uptake for Women With Mental Illness in the United Kingdom

Ross, E., Maguire, A., Mairs, A., Hall, C., Donnelly, M. J. C., & O'Reilly, D. P. J. (2021). Disparities in Breast Cancer Screening Uptake for Women With Mental Illness in the United Kingdom. *American Journal of Preventive Medicine*, 60(3), e123-e130. <https://doi.org/10.1016/j.amepre.2020.09.010>

Published in:
American Journal of Preventive Medicine

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
[Link to publication record in Queen's University Belfast Research Portal](#)

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1 **Introduction**

2 Breast cancer is the leading cause of cancer mortality in women worldwide, accounting for
3 approximately 522,000 deaths each year.¹ In an effort to reduce breast cancer mortality,
4 population-wide screening programmes have been implemented in over 27 countries globally. In
5 the United Kingdom (UK), women aged 50-70 years are invited to attend screening every three
6 years on the National Health Service (NHS). Despite some controversy surrounding the potential
7 harms of breast screening, an independent review commissioned by the Department of Health
8 and Cancer Research UK determined that breast screening contributes to a 20% reduction in
9 breast cancer mortality.² However, inadequate screening uptake represents a central barrier to
10 optimising the mortality benefit of such programmes.

11
12 Cancer is one of the leading causes of death in individuals with mental illness, and although
13 incidence rates appear comparable to the general population, there is evidence that cancer case-
14 fatality rates are significantly higher.^{3,4} Given the compelling body of evidence indicating
15 disparities in health service utilisation for individuals with mental illness, it is highly plausible
16 that reduced participation in cancer screening may represent a significant and potentially
17 modifiable factor contributing to the cancer mortality gap. Among other factors, this may be
18 attributable to the continued stigmatisation of mental illness, circumstantial factors such as
19 hospitalisation, and the varying impact of psychiatric symptoms on an individual's ability to
20 attend screening.

21
22 In a recent systematic review, Mitchell et al observed a 29% reduction in the odds of receiving
23 mammography in those with mental illness.⁵ In stratified analyses, the authors also identified

24 variations in the magnitude of association according to the type of mental disorder examined: in
25 individuals with serious mental illness (SMI), the odds of mammography were halved, whilst a
26 17% reduction was observed in those with mood disorders.⁵ However, the generalisability of
27 this finding is limited as only two of the twenty-four studies included in the meta-analysis were
28 carried out in a setting outside of North America. Given the vast disparities in healthcare
29 organisation and screening policy, it is unlikely that this finding is generalisable to the UK
30 where population-wide breast screening is provided free at the point of access. Woodhead et al
31 attempted to corroborate these findings in the UK, and although these findings pointed to
32 significant reductions in breast screening uptake for individuals with SMI, the generalisability of
33 these findings to the wider population of individuals with mental illness is limited by the
34 classification of the target sample as those with SMI who had accessed both primary and
35 secondary healthcare services for their illness.⁶ It is therefore unclear whether these disparities
36 apply to the wider body of individuals with mental illness.

37

38 This study examines the impact of mental illness on attendance at breast screening in the UK, as
39 assessed by receipt of psychotropic medication. Analyses were also conducted to determine
40 whether this association varies by type or duration of medication prescribed.

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46 **Methods**

47 Study Design and Setting:

48 This study used the 2011 Census to define a cohort of 57,328 women eligible for breast
49 screening in Northern Ireland (NI) and, with linkage to prescription records, followed them over
50 one three-year screening cycle to determine whether mental illness reduced the odds of attending
51 screening. The study was approved by the Office for Research Ethics Committee Northern
52 Ireland (ORECNI no: 07/NIR01/90+5). Consent was not required as data were de-identified and
53 made available only to the approved research team. Data were analyzed in 2019.

54

55 Data Sources and Measures:

56 Breast screening records for those invited from 1st April 2011-31st March 2014 (plus an
57 additional 6 months to account for organisational delays) were extracted from the National
58 Breast Screening System (NBSS), the system utilised to manage and record the outcomes of
59 invitations to the NHS Breast Screening Programme. Information on date of invitation, whether
60 an individual attended, and date of screening (where applicable) were as recorded on the NBSS.
61 An encrypted Health and Care number (a unique health service identifier) was also included in
62 the dataset which functioned as the linkage key.

63

64 Mental illness was identified by psychotropic medication records. Pharmacological treatment
65 represents the most common avenue of treatment for mental illness in the UK⁷, and prescribing
66 data is readily available, cost-effective, and can be linked to external databases for research
67 purposes. The correlational and predictive validity of psychotropic medication uptake as an

68 indicator of mental illness has been demonstrated in previous studies.^{8,9} Individual-level data on
69 diagnosis or non-pharmacological treatment pathways are not available for research purposes in
70 NI. Prescribing data was obtained from the Enhanced Prescribing Database (EPD), the central
71 electronic repository of prescriptions dispensed by pharmacies in NI since 2008. Data on the
72 monthly uptake of psychotropic medication, recorded as monthly defined daily dose (DDD),
73 between January 2011-December 2014 were extracted. Psychotropic medication was identified
74 by British National Formulary (BNF) classifications 4.3 (antidepressants), 4.1.2 (anxiolytics),
75 4.2.1 and 4.2.2 (antipsychotics), 4.1.1 (hypnotics), and 4.1.3 and 4.2.3 (other psychotropic
76 medications).

77
78 Covariates were derived from 2011 Census returns contained within the Northern Ireland
79 Longitudinal Study (NILS) database, a large-scale, representative dataset containing information
80 on approximately 28% of the population of NI (~508,000 individuals). The NILS has been
81 described in greater detail previously.¹⁰ Covariates were selected on the basis of previous
82 association with screening uptake.^{11,12} Age was defined at the time of the Census, categorised
83 into five-year age bands from 50-70, with the inclusion of an 'under 50' group as some
84 individuals aged under 50 on Census day reached eligibility for screening in the following three
85 years. Marital status was defined as 'currently married', 'separated, widowed or divorced', or
86 'never married'. The social gradients in screening uptake are well recognised^{11,12} and were
87 defined according to (i) National Statistics-Socioeconomic Classification (NS-SEC)¹³;
88 (ii) housing tenure; (iii) educational attainment, and (iv) number of cars in the household which
89 functioned both as a measure of affluence and means of access to screening units. An indicator
90 of urban-rural residence based on the Northern Ireland Statistics and Research Agency (NISRA)
91 classification of Settlements¹⁴ (grouped as living within the Belfast Metropolitan Area (BMA) or

92 elsewhere in NI) was included as previous research has demonstrated significantly reduced
93 uptake of breast screening in the BMA.¹⁵

94

95 Breast screening records were linked to prescribing records within the host health services
96 organisation and subsequently to the NILS database within NISRA. Linkage was based on exact
97 matching via encrypted Health and Care Numbers (Figure S1).

98

99 Statistical analysis:

100 Mental illness was defined as having received at least one prescription for a psychotropic
101 medication in the three months preceding screening invitation, though additional analyses were
102 conducted to identify variations in uptake by duration of medication receipt (1-3 months).

103

104 Descriptive statistics were used to compare the socio-demographic characteristics of individuals
105 who were and were not prescribed psychotropic medication. Crude breast screening uptake rates
106 were calculated to enable comparison of uptake for individuals by psychotropic medication
107 receipt. This was calculated as the percentage of women who attended breast screening of the
108 total number of women invited.

109

110 Logistic regression was employed to calculate age-only and fully-adjusted ORs and 95% CIs of
111 attendance at screening for individuals prescribed any psychotropic medication in the three
112 months preceding screening invitation compared to those not prescribed psychotropic
113 medication. Individual models were generated to examine the ORs of attendance by type of
114 psychotropic medication, and subsequently by duration of prescription.

115 **Results**

116 **Breast screening uptake in women prescribed any psychotropic medication**

117 30.6% of women were prescribed psychotropic medication in the three months preceding
118 screening invitation. Women prescribed medication were more likely to be older, divorced,
119 separated or widowed, and to come from a less affluent background (as measured by NS-SEC,
120 number of cars in the household, housing tenure, and educational attainment) (Table 1).
121 Additionally, prescription of medication was higher in women living in the BMA compared to
122 the rest of NI (32.2% vs 29.7%).

123

124 Table 2 demonstrates that the crude screening uptake rate for individuals prescribed
125 psychotropic medication was just under 7% lower than those not prescribed psychotropic
126 medication (80.7% vs 73.8%). In age-only adjusted analyses, the odds of attending were 33%
127 lower in those prescribed psychotropic medication (OR=0.67; 95% CI 0.64–0.70, $p<0.001$). In
128 the fully-adjusted analyses, the odds of attending were 15% lower in women prescribed
129 psychotropic medication (OR=0.85; 95% CI 0.81–0.88, $p<0.001$).

130

131 **Breast screening uptake by type of psychotropic medication prescribed**

132 Antidepressants were the most prescribed psychotropic medication, with approximately one in
133 four individuals prescribed this medication in the three months preceding screening invitation.
134 Approximately one in twelve individuals were prescribed anxiolytics and hypnotics, whilst 2.4%
135 were prescribed hypnotics, and 0.5% were prescribed another form of psychotropic medication
136 (Table 3).

137 The odds of attendance varied by type of psychotropic medication prescribed. In age-only
138 adjusted models, the prescription of antipsychotics was associated with the greatest reduction in
139 attendance (OR=0.40; 95% CI 0.36–0.45, $p<0.001$), followed by anxiolytics (OR=0.45; 95% CI
140 0.42–0.48, $p<0.001$), and hypnotics (OR=0.51; 95% CI 0.48–0.55, $p<0.001$). Adjustment for
141 socio-demographic attributes attenuated the associations observed for all medication types yet
142 remained statistically significant. In fully-adjusted analyses, the prescription of anxiolytics
143 contributed to the greatest disparity in attendance (OR=0.61; 95% CI 0.57–0.66, $p<0.001$). The
144 odds of attendance were 37% lower in women who were prescribed antipsychotics (OR=0.63;
145 95% CI 0.56–0.70, $p<0.001$), and 32% lower in those prescribed hypnotics (OR=0.68; 95% CI
146 0.63–0.72, $p<0.001$). The prescription of antidepressants was associated with the smallest
147 reduction in the odds of attending screening (OR=0.90; 95% CI 0.85–0.94, $p<0.001$).

148

149 **Duration of psychotropic medication use and breast screening uptake**

150 Figure 1 demonstrates that gradients in the odds of attending screening were generally evident
151 with increasing duration of prescription. In the fully-adjusted analyses, there were no significant
152 differences in the odds of attending for those prescribed any psychotropic medication for just
153 one month compared to those not prescribed psychotropic medication (OR=1.00; 95% CI 0.93–
154 1.07). However, the prescription of any psychotropic medication for two or three months
155 contributed to a respective 16% (OR=0.84; 95% CI 0.78–0.90, $p<0.001$), and 26% (OR=0.74;
156 95% CI 0.70–0.79, $p<0.001$) reduction in the odds of attending.

157

158 Stratified analyses revealed the same trend for individuals who were prescribed antidepressants.

159 For individuals who were prescribed anxiolytics or hypnotics, the fully-adjusted OR of attending

160 screening reduced considerably from one to two-month prescriptions (from OR=0.77; 95% CI
161 0.69–0.86, $p<0.001$ to OR=0.53; 95% CI 0.47–0.61, $p<0.001$ for anxiolytics, and OR=0.80; 95%
162 CI 0.70–0.90, $p<0.001$ to OR=0.65; 95% CI 0.57–0.73, $p<0.001$ for hypnotics). However, further
163 reductions in the odds of attending were not evident with three-month prescriptions of
164 anxiolytics (OR=0.52; 95% CI 0.46–0.58, $p<0.001$) or hypnotics (OR=0.62; 95% CI 0.56–0.68,
165 $p<0.001$). Although the odds of attending screening reduced considerably from one to two-
166 month prescription of antipsychotics (from OR=0.70; 95% CI 0.55–0.88, $p=0.003$ to OR=0.57;
167 95% CI 0.47–0.70, $p<0.001$), the odds of attending were greater for individuals prescribed this
168 medication in all three months preceding screening invite compared to those prescribed
169 antipsychotics for two out of the three months (OR=0.64; 95% CI 0.53–0.76, $p<0.001$).

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180 Discussion

181 This study demonstrates that nearly a third of women of eligible breast screening age were
182 prescribed psychotropic medications and this was associated with significantly reduced
183 participation in screening. After adjustment for variations in socio-demographic characteristics,
184 the odds of attending screening were 15% lower in women prescribed psychotropic medication
185 despite the availability of universal healthcare. There was also evidence that the degree of
186 disparity varied according to the type of medication prescribed, with the largest reductions in
187 attendance observed in those prescribed anxiolytics and antipsychotics.

188
189 Although the observed proportion of individuals receiving psychotropic medication was high,
190 the nature of the cohort examined, in terms of their gender and age distribution, have been
191 shown to exhibit increased help-seeking behaviour compared to the general population.^{16,17}
192 Additionally, whilst medication uptake appears to be higher than that observed in other
193 countries, this finding is in keeping with the increased prevalence of mental illness in NI, and
194 with the findings of other studies utilising psychotropic prescribing data in NI.^{9,18}

195
196 The findings of the current study compare favourably with the international literature. A meta-
197 analysis by Mitchell et al revealed that receipt of mammography was 29% lower in individuals
198 with mental illness.⁵ Although the magnitude of association observed in that study was larger,
199 there are several reasons for this finding. As noted by the authors themselves, the vast majority
200 of the studies used to estimate the pooled value were conducted in the US and, given the
201 extensive disparities in healthcare organisation, particularly the additional financial barriers to
202 accessing mammography, it is plausible that the observed disparities would be magnified.

203 Furthermore, it is conceivable that the alleviation of psychiatric symptoms associated with the
204 use of psychotropic medication may lessen the psychological and physical barriers to accessing
205 screening, thus contributing to increased participation in pharmacologically treated individuals.
206 Additionally, it is possible that the help-seeking behaviour characterised by individuals
207 receiving treatment is indicative of increased engagement in other positive health behaviours,
208 including routine cancer screening.

209

210 Woodhead et al attempted to corroborate these findings in the UK, and although the authors
211 observed a 31% reduction in the odds of receiving breast screening, these findings were limited
212 to individuals with SMI known to both primary and secondary care, limiting the generalisability
213 of these findings to the wider population of individuals with mental illness.⁶ Whilst the
214 restriction of this study to individuals with SMI (for whom the more severe psychological
215 manifestations of their illness would likely create additional obstacles to accessing screening)
216 would largely explain the greater effect magnitude compared to the current study, the authors
217 were also unable to adjust for socio-demographic factors which have been previously identified
218 as key determinants of screening uptake.^{11,12}

219

220 The findings of the current study provide novel evidence of variation in the magnitude of
221 disparity in screening attendance according to the type of psychotropic medication prescribed.
222 Notably, the inequality in uptake was greatest in individuals prescribed anxiolytics, for whom a
223 39% reduction in the odds of attending was observed. Although the underlying relationship
224 between anxiety and screening attendance is yet to be elucidated, it is plausible that the
225 avoidance behaviours which commonly develop as a coping mechanism in individuals with
226 anxiety disorders predominantly explain this reduced participation.¹⁹ This hypothesis reflects the

227 qualitative evidence which suggests that anxiety and fear of pain associated with mammography,
228 and with potentially receiving a cancer diagnosis are deterrents to attendance.^{20,21} In keeping
229 with the available literature, considerable disparities in attendance were also observed for those
230 with SMI, as identified by the receipt of antipsychotics.^{5,6} In their meta-analysis, Mitchell et al
231 observed a 45% reduction in the odds of mammography for individuals with SMI, and in the
232 UK, Woodhead et al observed a 31% reduction in the receipt of mammography for women with
233 SMI.^{5,6} The large effect size observed for individuals with SMI most likely reflects the
234 manifestation of more life-limiting symptoms, such as psychosis, which would impede an
235 individual's ability to participate in screening, and in severe cases may contribute to
236 circumstantial barriers to attendance e.g. hospitalisation. Interestingly, the disparities were
237 similar for those prescribed antipsychotics, anxiolytics, and hypnotics. This finding is not
238 unexpected as the identification of those with mental illness based on pharmacological treatment
239 would select for those with more severe or life-limiting anxiety. It is also important to note that
240 individuals with SMI are characteristically more socially disadvantaged therefore the disparity
241 observed for antipsychotics may be overadjusted.²²

242
243 The disparity in attendance observed for individuals prescribed antidepressants was considerably
244 lower than other types of medication. The mechanism through which depression is associated
245 with reduced participation in screening, and why the magnitude of association is lower than that
246 observed for other types of mental disorder is unclear but it is possible that the high rates of
247 successfully treated individuals and the management of symptoms lessened the inequalities. The
248 current study findings suggest that the association between depression and attendance at
249 screening may be driven by the severity of the disorder and the affiliated symptom profile, as

250 demonstrated by the increasing magnitude of effect with increasing duration of antidepressant
251 prescription.

252
253 Despite a high prevalence of hypnotic use in the population, little is understood about the
254 healthcare activities of individuals prescribed these medications. One potentially significant
255 factor which may explain the observed disparities in uptake is the side-effects commonly
256 associated with hypnotics, including drowsiness, memory impairments, and psychomotor
257 limitations which would restrict an individual's ability to attend screening.²³ It is also recognised
258 that hypnotic use is strongly linked to other psychiatric disorders such as depression and
259 schizophrenia, therefore the observed effect may represent those underdiagnosed and
260 undertreated for these conditions.²⁴

261

262 **Limitations**

263 This study represents the first population-wide study examining the impact of mental illness on
264 breast screening uptake in the UK. The strengths of this study include the use of validated breast
265 screening records which eliminates recall bias associated with self-reported measures. Linkage
266 to the 2011 Census provided a wealth of information on cohort members. However, given the
267 decennial nature of the Census and the potential for contextual information to change over time,
268 more recent data could not be examined. The availability of recognised pharmaceutical
269 categories enabled the examination of the impact of receiving different types of psychotropic
270 medication which act as proxy indicators for mental disorders. The primary limitation of this
271 study is the lack of information on the condition for which a prescription was made. Although
272 the majority of psychotropic medications are prescribed for the treatment of mental illness²⁵,

273 there are alternative indications for certain medications. Furthermore, the identification of
274 individuals based on prescriptions excludes those who are undiagnosed or untreated, and those
275 undergoing standalone psychological therapies, thus potentially underestimating the impact of
276 mental illness on screening uptake. However, there remains great difficulty in identifying these
277 individuals among the wider population, and many previously utilised measures have yet to be
278 validated, and/or are subject to the limitations of self-report such as poor response rates, small
279 sample sizes, and responder and recall biases. It is also important to note that medication data
280 was based on prescriptions filled. Although the current study was unable to assess rates of
281 primary adherence, prescriptions in NI are provided free of charge thus eliminating the central
282 barrier to adherence.²⁶ Compliance with medication regimen was not examined in the current
283 study.

284

285 **Conclusion**

286 This study advances the current understanding of the factors contributing to suboptimal breast
287 screening uptake, confirming the existence of disparities in uptake for individuals with mental
288 illness in the UK despite the availability of universal healthcare. This is of particular concern
289 given the increasing global burden of mental illness and the growing body of evidence
290 suggesting disparate cancer mortality rates amongst these individuals.^{27,28} The early detection
291 rates achieved through screening are a central factor contributing to reduced breast cancer
292 mortality, thus targeted interventions are required to ensure equitable access.

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295

296 **Acknowledgements**

297 The help provided by the staff of the Northern Ireland Longitudinal Study (NILS) and the NILS
298 Research Support Unit is acknowledged. The NILS is funded by the Health and Social Care
299 Research and Development Division of the Public Health Agency (HSC R&D Division) and
300 NISRA. The NILS-RSU is funded by the ESRC and the Northern Ireland Government. The
301 authors alone are responsible for the interpretation of the data and any views or opinions
302 presented are solely those of the author and do not necessarily represent those of NISRA/NILS.
303 The authors have no conflicts of interest to declare. This work was funded by a studentship from
304 the Department for Employment and Learning (DEL), Northern Ireland. The funding body had
305 no role in study design; collection, analysis, and interpretation of data; writing the report; and
306 the decision to submit the report for publication. DOR and MD conceptualised the study.
307 AMairs and CH facilitated data extraction. ER and AMaguire obtained and prepared data for
308 analysis. ER conducted the statistical analyses and with support from DOR, interpreted the
309 results and wrote the manuscript. All authors approved the final submitted version. The authors
310 confirm that these findings have not been presented elsewhere. No financial disclosures were
311 reported by the authors of this paper.

312

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414 **Figure Legend**

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416 Figure 1. ORs (95% CIs) of attending breast screening by type and duration of psychotropic
417 medication prescribed. ORs adjusted for age, marital status, National Statistics-Socioeconomic
418 Classification (NSSEC), number of cars, housing tenure, educational attainment, and area of
419 residence. Boldface indicates statistical significance (* $p < 0.01$, ** $p \leq 0.001$)

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438 Table 1: Socio-demographic characteristics of women in the cohort by psychotropic medication
 439 receipt.

		Not in receipt of psychotropic medication (n = 39,807)	In receipt of psychotropic medication (n = 17,521)	p-value
Age (years)	Under 50	3,993 (10.0)	1,676 (9.6)	0.025
	50-54	11,215 (28.2)	4,789 (27.3)	
	55-59	9,190 (23.1)	4,088 (23.3)	
	60-64	8,945 (22.5)	3,983 (22.7)	
	65-70	6,464 (16.2)	2,985 (17.0)	
Marital Status	Married	28,024 (70.4)	10,027 (57.2)	<0.001
	Divorced/Separated/Widowed	8,486 (21.3)	6,065 (34.6)	
	Never Married	3,279 (8.2)	1,429 (8.2)	
National Statistics-Socioeconomic Classification (NSSEC)	Managerial, Administrative and Professional	11,991 (30.1)	3,582 (20.4)	<0.001
	Intermediate	8,067 (20.3)	2,887 (16.5)	
	Small Employers and Own Account	2,358 (5.9)	725 (4.1)	
	Lower Supervisory and Technical	1,570 (3.9)	787 (4.5)	
	Semi-Routine/Routine	13,783 (34.6)	7,706 (44.0)	
	Never worked/Unemployed/Full-time Student	2,038 (5.1)	1,834 (10.5)	
Number of Cars	Two+	21,282 (53.5)	6,312 (36.0)	<0.001
	One	14,282 (35.9)	7,296 (41.6)	
	None	4,243 (10.7)	3,913 (22.3)	
Housing Tenure	Owner	33,955 (85.3)	12,259 (70.0)	<0.001
	Private Renter	2,577 (6.5)	1,801 (10.3)	
	Social Renter	3,275 (8.2)	3,461 (19.8)	
Educational Attainment	Degree+	10,494 (26.4)	2,837 (16.2)	<0.001
	A-Level	2,996 (7.5)	972 (5.5)	
	GCSE	10,704 (26.9)	3,938 (22.5)	

	None	15,613 (39.2)	9,774 (55.8)	
Area of Residence	Rest of Northern Ireland	26,811 (67.4)	11,309 (64.5)	<0.001
	Belfast Metropolitan Area	12,996 (32.6)	6,212 (35.5)	

440 GCSE: General Certificate of Secondary Education

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443 Table 2: ORs (95% CIs) of attending breast screening by psychotropic medication receipt.
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	No. Invited (% uptake)	Age-Only Adjusted OR (95% CI)	+Marital status	+Socio- economic status ^a	+Area of residence
Not prescribed psychotropic medication	39,807 (80.7)	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Prescribed psychotropic medication	17,521 (73.8)	0.67 (0.64 – 0.70)	0.72 (0.69 – 0.75)	0.85 (0.81 – 0.88)	0.85 (0.81 – 0.88)

445 ^aAdjusted for National Statistics-Socioeconomic Classification (NSSEC), number of cars in the
 446 household, housing tenure, and educational attainment

447 Boldface indicates statistical significance (p<0.001)

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473 Table 3: ORs (95% CIs) of attending breast screening by type of psychotropic medication
 474 prescribed.

	No. Invited (% pop)	No. Attended (% Uptake)	Age-Only Adjusted OR (95% CI)	Fully-Adjusted OR ^a (95% CI)
No Medication	39,807 (69.4)	32,136 (80.7)	1.00 (Ref)	1.00 (Ref)
Medication Type				
Antidepressants	14,175 (24.7)	10,581 (74.7)	0.70 (0.67 – 0.73)	0.90 (0.85 – 0.94)
Anxiolytics	4,229 (7.4)	2,747 (65.0)	0.45 (0.42 – 0.48)	0.61 (0.57 – 0.66)
Antipsychotics	1,388 (2.4)	870 (62.7)	0.40 (0.36 – 0.45)	0.63 (0.56 – 0.70)
Hypnotics	4,716 (8.2)	3,210 (68.1)	0.51 (0.48 – 0.55)	0.68 (0.63 – 0.72)
Other	278 (0.5)	197 (70.9)	0.58 (0.44 – 0.75)	0.76 (0.58 – 0.99)

475 ^aAdjusted for age, marital status, National Statistics-Socioeconomic Classification (NSSEC), number of
 476 cars in the household, housing tenure, educational attainment, and area of residence.

477 Boldface indicates statistical significance (p<0.001)

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490 Appendix Figure S1. Flow diagram to illustrate data linkage procedure.

491 ^aThese individuals were aged <50 at the time of the 2011 Census and did not reach eligible
492 screening age during the study period.

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