Cervical and breast cancer screening uptake among women with serious mental illness: a data linkage study

**This is the Draft Version of the final output.**

1    **Cervical and breast cancer screening uptake among women with serious mental illness: A data**

2    **linkage study**

3    Charlotte Woodhead[1†], Ruth Cunningham[2†], Mark Ashworth[3], Elizabeth Barley[4] Robert Stewart[1*],

4    Max Henderson[1]

5    [†]Joint first authors [*]Corresponding author: robert.stewart@kcl.ac.uk

6    [1]Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, UK

7    [2]Department of Public Health, University of Otago, Wellington, New Zealand

8    [3]Department of Primary Care and Public Health Sciences, King's College London, London, UK

9    [4]Facility of Nursing and Midwifery, King's College London, London, UK

10   **Author e-mail addresses:**

11   c.woodhead@ucl.ac.uk

12   ruth.cunningham@otago.ac.nz

13   mark.ashworth@kcl.ac.uk

14   Elizabeth.Barley@uwl.ac.uk

15   robert.stewart@kcl.ac.uk

16   max.j.henderson@kcl.ac.uk

17

18

19

20

21 **Abstract**

22 **Background:** Breast and cancer screening uptake has been found to be lower among women with

23 serious mental illness (SMI).This study aims to corroborate these findings in the UK and to identify

24 variation in screening uptake by illness/treatment factors, and primary care consultation frequency.

25 **Methods**: Linked population-based primary and secondary care data from the London borough of

26 Lambeth (UK) were used to compare breast and cervical screening receipt among linked eligible SMI

27 patients (n=625 and n=1393), to those without SMI known only to primary care (n=106,554 and

28 n=25,385) using logistic regression models adjusted first for socio-demographic factors and second,

29 additionally for primary care consultation frequency.

30 **Results:** Eligible SMI patients were less likely to have received breast (adjusted odds ratio (OR) 0.69,

31 95% confidence interval (CI), 0.57 - 0.84, p<0.001) or cervical screening (adjusted OR 0.72, CI: 0.60 -

32 0.85, p<0.001). Schizophrenia diagnosis, depot injectable antipsychotic prescription, and illness

33 severity and risk were associated with the lowest odds of uptake of breast (adjusted ORs 0.46 to

34 0.59, all p<0.001) and cervical screening (adjusted ORs 0.48 - 0.65, all p<0.001). Adjustments for

35 consultation frequency further reduced effect sizes for all subgroups of SMI patient, in particular for

36 cervical screening.

37 **Conclusions:** Women with SMI are less likely to receive breast and cervical cancer screening than

38 comparable women without SMI. Higher primary care consultation rates among SMI patients is likely

39 a mediating factor between SMI status and uptake, particularly for cervical screening - a service

40 organised in primary care. To tackle health disparities linked to SMI, efforts at increasing screening

41 uptake are key and should be targeted at women with other markers of illness severity or risk,

42 beyond SMI status alone.

43

44 **Keywords:** cancer screening; breast cancer; cervical cancer; mammography; psychoses; serious

45 mental illness; data linkage.

46 **Background**

47 People with serious mental illness (SMI), including schizophrenia and bipolar disorder, have higher

48 cancer mortality than others of the same age in the same population without SMI, and there is some

49 evidence that this excess disproportionately affects women.[1-3]Cancer screening reduces cancer

50 mortality; reducing cancer incidence and improving survival.[4] Three recent systematic reviews

51 have found suboptimal cancer screening rates in people with mental disorders. These reviews have

52 included a range of diagnoses, ranging from emotional distress to diagnosed SMI. Where evidence

53 has been disaggregated by type of mental disorder, those with SMI are found to have the lowest

54 odds of screening compared to those without mental ill health.[5-7] Further, the majority of studies

55 reviewed originate from the United States so it is not clear how these results translate into the

56 United Kingdom (UK) context with universal free access to healthcare and organised population-

57 based screening programmes. Absence of cost barriers, and organised screening, have been shown

58 to reduce inequalities in screening coverage,[8,9] hence more equitable coverage for people with

59 SMI might be expected in the UK.

60 The Quality and Outcomes Framework (QOF) is a primary care reward and incentive programme

61 which annually records general practice (GP) achievement against clinical and organisational targets

62 and was introduced in 2004.[10] Targets include measures aimed at improving the physical health

63 care of people with SMI, such as blood pressure monitoring and cervical cancer screening. It is

64 unclear whether such incentivisation results in more widespread uptake of screening.

65 Barriers to participation in screening programmes among people with experience of mental illness

66 include factors at the service, practitioner, and service user level.[11] Routinely available clinical data

67 sources can be used on a larger scale to investigate specific barriers to screening such as lack of

3

68    contact with a primary care provider, social deprivation, and factors related to the type and severity

69    of mental illness. The ability to investigate these processes has previously been restricted as data on

70    physical health diagnoses, monitoring and management are mainly recorded in primary care, while

71    detailed classification of SMI diagnosis and mental state is mainly recorded in secondary mental

72    health care records.

73    This study uses data from a population-based linkage between primary and secondary care records

74    in the London borough of Lambeth (UK) to extend previous knowledge about the uptake of breast

75    and cancer screening in the SMI population; addressing the following questions:

76        1.  Is breast and cervical cancer screening uptake lower for people registered in primary care

77            with SMI compared to those without SMI?

78        2.  Does frequency of contact with primary care explain differences in screening rates between

79            those with and without SMI?

80        3.  Are there psychological factors that predict lower screening uptake within the SMI group?

81

82    **Methods**

83    **Setting& data sources**

84    Lambeth is an ethnically diverse borough, with a greater number of Black Caribbean and Black

85    African residents, although fewer South Asian residents than most other areas of London.[12] and

86    has high levels of deprivation overall.[13] Pseudonymised primary care data were extracted on 31st

87    October 2013 from the computerised medical records of all except one GP practice (n=48;the

88    missing GP practice had an incompatible IT system) within Lambeth, as part of Lambeth DataNet

89    (LDN).  LDN collects demographic data and data on GP consultations, prescriptions, and (QOF)

90    clinical target achievement, as well as clinical information about non-QOF conditions. LDN thus

91    contributed a population of 366,317 registered patients. Secondary care data came from the Clinical

92 Record Interactive Search (CRIS),[14]  an application allowing research access to pseudonymised

93 electronic health record data from the South London and the Maudsley NHS Foundation Trust

94 (SLaM).  CRIS additionally provides searchable access to de-identified text (unstructured data) from

95 the clinical record, and a range of natural language programming (NLP) applications have been

96 developed to auto-extract structured data from text fields.[15]

97 **Data linkage**

98 CRIS and LDN data were linked and stored by the SLaM Clinical Data Linkage Service (CDLS), which

99 provides a safe haven environment with strict governance arrangements. Data were linked using

100 encrypted NHS numbers, which were subsequently removed and destroyed such that the linked

101 dataset became fully anonymised.

102 **Ethical approval**

103 Approvals for the database linkage were obtained via a Section 251 application to the Health

104 Research Authority (reference: CAG 6-07(f)/2013), from the Lambeth Clinical Commissioning Group

105 Information Governance committee, and as a component of ethical approval for CRIS as a database

106 (Oxford REC C 08/H0606/71+5).

107 **Measures**

108 Primary care data from Lambeth DataNet (LDN)

109 Data extracted from LDN included 2012/13 QOF-defined SMI status (recorded on the QOF Mental

110 Health register with a diagnosis of schizophrenia, bipolar affective disorder and other

111 psychoses),[10] gender, year of birth, ethnicity, and 2011 defined lower super output area (LSOA).

112 These are geographic areas designed to improve the reporting of small area statistics in England and

113 Wales, and include a mean population of 1500.[16] Approximate age was calculated by subtracting

114 year of birth from the year of data extraction; information on the LSOA of each patient was used to

determine the level of social deprivation in their area using the Index of Multiple Deprivation (IMD-2010) and a conversion from 2001 LSOA to 2011 LSOA values.[17] Frequency of primary care consultation was calculated as the mean number of primary care consultations (including GP, nurse, face-to-face, and telephone) over the three years between October 2010 and 31 October 2013. A binary variable was created to distinguish low (median or below) and high (above median) mean annual number of consultations. Consultation data were coded as missing for two practices which had incorrectly entered data for 2013 GP face-to-face appointments and for numbers entered as negative values. Lastly, data were extracted to identify those who had ever been recorded as having received breast cancer screening (mammography) and cervical cancer screening. The population eligible for mammography was defined as females aged 50 to 70 years inclusive, while that eligible for cervical cancer screening was defined as females aged 25 to 64 years inclusive. To assess adherence to QOF guidelines, those who had received a mammography screen any time in the last three years were identified as recently screened and distinguished from those who had been recorded as being screened outside of the guideline period. Similarly, those who had received a cervical cancer screen any time in the last three years for those aged up to 49 years, or any time in the last five years for those aged 50-64 were identified as recently screened as per recommended guidelines. For both cervical and breast screening, those with a recent screen were coded as 1, while those never screened were coded as 0.

Secondary mental health care measures from CRIS

ICD-10 diagnostic codes[18] for any primary or secondary diagnosis of schizophrenia, bipolar affective disorder, and schizoaffective disorder or other non-organic psychoses were extracted (ICD-10 codes F20-29, F25, F31). A binary indicator of higher SMI severity was created which ascertained and coded as 1, any patients with a recorded mental health inpatient stay, treatment under the Mental Health Act, difficulty managing their physical health as recorded in a clinical risk assessment; or contact with Assertive Outreach, Crisis team or A&E liaison team. A separate SMI indicator of 'risk'

140    was developed, identifying patients with a history of violent or offending behavior using data from a

141    risk assessment violence and aggression subscale. This coded SMI patients as 1 if had ever had a

142    recorded history of violence, non-compliance, or a forensic history – and as 0 if none of these issues

143    were recorded. In addition, data were extracted on whether or not the patient had ever been

144    recorded with a prescription of antipsychotics - including a marker of depot injectable medication

145    (Table 1). Figure 1 illustrates a summary of variables, variable descriptions and data sources

146                                **[Figure 1]**

147    Statistical analyses

148    Primary care records were used to define SMI status. Those identified in primary care with QOF-

149    defined SMI were compared to those without QOF-defined SMI, who were not linked to secondary

150    care records. Those identified in primary care with SMI but who were not linked, and those who

151    were linked but not recorded in primary care with SMI, were not included in these analyses, as the

152    study aimed to extend prior research by examining SMI characteristics recorded in secondary care

153    associated with screening uptake (see Figure 2). Descriptive analyses including Pearson's chi squared

154    tests were used to compare socio-demographic characteristics and consultation frequency between

155    patients with and without SMI patients who were eligible for mammography and/or cervical cancer

156    screening. Separate logistic regression models were run to compare the likelihood of being recorded

157    with a recent breast or cervical screen (versus those never screened) among patients with SMI

158    overall, among patients recorded with specific SMI characteristics and among non-SMI patients.

159    Including non-SMI patients as the comparator in analyses was designed to ease interpretation across

160    analyses. Unadjusted models and models adjusting for socio-demographic characteristics and

161    additionally for primary care consultation frequency were run. Separate analyses were run, but are

162    not presented, to include those who had ever been screened in the numerator (not necessarily

163    within the guideline period) to examine any differences in patterns of association**.** P-values,

164    unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) are shown. All analyses

165    were conducted using STATA v12.[19]

166

167    **Results**

168    Linkage sample

169    Overall, data were obtained for LDN patients aged 16 or over on 31st October 2013 (N=295,301); of

170    these, 8.1% (n=23,919) were known to secondary mental health care. Among those patients with

171    linked primary and secondary care records, n=4056 (16.9% of linked sample, 1.37% of LDN

172    population aged 16+ years overall) were recorded as having SMI by their GP in LDN and were

173    denoted as the SMI group. Overall, 270,669 patients (91.7% of LDN population) were not recorded

174    with SMI in primary care or linked to secondary care, comprising the group identified without SMI.

175                                    **[FIGURE 2]**

176    Study sample

177    *Patients eligible for cancer screening.*

178    Study sample derivation is illustrated in Figure 2. We identified 26,010 women in LDN eligible for

179    mammographic screening and 107,947 women eligible for cervical screening, of whom 625 (2.4%)

180    and 1393 (1.3%) respectively were recorded in primary care records as having SMI and were also

181    known to secondary mental health services (Figure 2). Among the eligible populations for breast and

182    cervical cancer screening, SMI status was associated with belonging to an ethnic minority group,

183    greater deprivation, and more frequent primary care consultations. Among those eligible for cervical

184    cancer screening, SMI status was also associated with older age, although this association was not

185    observed for patient eligible for breast screening (Table 1).

186 **[TABLE 1]**

187 Cancer screening uptake by SMI status

188 As illustrated in Figure 1; of the eligible population for cancer screening, n=17,981 (70.8%) and

189 n=405 (64.8%) of non-SMI and SMI patients respectively had ever been screened for breast cancer

190 while n=87,196 (65.7%) and n=1184 (85.0%) of non-SMI and SMI patients respectively had ever been

191 screened for cervical cancer. The proportion of eligible patients who had received a recent screen

192 was lower among both SMI and non-SMI patients (Table 2).

193 Comparison of screening according to QOF guidelines indicated that SMI patients were less likely to

194 have a record of recent mammography screening compared to those without SMI (Table 2).

195 Adjustments for socio-demographic characteristics, and additionally, for primary care consultation

196 frequency increased the strength of the negative association such that the odds of recent screening

197 were almost 40% lower among those identified with SMI.

198 In unadjusted models SMI status was positively associated with recent cervical screening according

199 to guidelines (Table 2). Adjustment for socio-demographic differences between the groups reversed

200 this association - such that being recorded with SMI was associated with reduced odds of recent

201 cervical cancer screening, and adjustment for primary care consultation rate further increased the

202 negative effect size such that the odds of cervical screening were almost 60% lower among SMI

203 patients.

204 Variation in screening receipt by mental illness characteristics

205 The odds of screening receipt varied across different sub-groups of women with SMI in adjusted

206 models (Table 3). Those with schizophrenia, those ever prescribed depot injectable medication and

207 those ever identified with any indicator of risk or severity, were the least likely to have been

208 screened for breast cancer. Similarly, a diagnosis of schizophrenia and receipt of depot injectable

209    antipsychotic medication were associated with the lowest odds of cervical cancer screening in

210    adjusted models.

211                                        **[TABLE 2]**

212    **Discussion**

213    After accounting for sociodemographic differences (particularly differences in age), women recorded

214    in primary care as having SMI and also known to secondary mental health services were substantially

215    less likely (with 22-28% lower odds) to have been screened for breast or cervical cancer than other

216    women in the same population. Unlike previous studies, we were able to explore how SMI

217    characteristics beyond diagnosis were differentially associated with screening, and to explore any

218    potential impact on primary care consultation frequency on screening uptake. For cervical cancer

219    (but not breast cancer) screening uptake, the frequency of primary care contact is a potential

220    mediating factor in the relationship between SMI and screening receipt and so the best estimates of

221    screening frequency and inequality are those in the models adjusted for sociodemographic factors.

222    However, when the higher rates of primary care consultation for women with SMI were taken into

223    account, the difference in cervical screening receipt between women with and without SMI

224    appeared even greater.

225    The negative effect sizes found in models adjusted for sociodemographic factors were similar for

226    both breast and cervical screening. However, adjusting for frequency of primary care contact had a

227    much greater impact on estimates of cervical than breast screening. This indicates that frequency of

228    primary care contact has a stronger effect on cervical screening rates than mammographic screening

229    rates, as consultation frequency was elevated in the SMI group eligible for both types of screening.

230    This is consistent with differences in the organisation of both national screening programmes,

231    cervical screening being organised within primary care whereas breast screening being organised via

232    a national invitation system. Further, unlike breast screening, cervical screening is incentivised as

233    part of the QOF guidelines for those recorded with SMI. It is unclear whether this has impacted the

234    likelihood of screening uptake, though the adjusted effect size is similar to that reported for women

235    with schizophrenia in a Canadian context without such incentivisation.[20] Nonetheless, breast

236    screening rates were positively associated with frequency of primary care contact suggesting that

11

237 contact in primary care may promote mammography uptake – perhaps via verbal reminder or

238 encouragement from practitioners. Kodl[21]  noted that it is important to take frequency of

239 outpatient care contact into account when assessing screening uptake in people with SMI, as not

240 doing so may obscure differences in screening uptake, although we report reduced screening even

241 without accounting for contact frequency.

242 Although not presented here, we re-ran analyses to assess the possibility that the difference in

243 screening uptake may be less apparent if the comparison included those ever screened in the

244 numerator. However, the odds associated with SMI status of ever receiving a screen for either

245 cancer remained very similar to analyses including just those with a recent screen, and the pattern

246 by SMI characteristics was also very similar (data available from authors upon request).

247 In their review of breast and cervical screening among women with a range of mental disorders,

248 Aggarwal et al.[7] identified a need to examine what impact illness severity and treatment have on

249 the relationship between mental illness and screening uptake. Our data linkage allowed us to

250 examine these factors by assessing predictors of screening rates within the SMI group, including

251 diagnosis, receipt of depot medication, and markers of severity. We found that women with

252 schizophrenia had the lowest screening rates, in keeping with other studies that have found that

253 women with more severe mental illness are less likely to be screened.[22,23] Characterising people

254 with SMI on dimensions other than diagnosis provides a richer understanding of which patients may

255 be most at risk of reduced healthcare including poorer uptake of screening.

256 Receipt of depot medication can be a more specific indicator of severity of mental illness and

257 engagement with health services. This group had the lowest receipt of screening, which may relate

258 to reluctance to engage with health services leading independently to low screening uptake and the

259 need for depot medication, but may equally relate to difficult engagement with mental health

260 services making people less likely to seek out other care such as cancer screening. Further, those

261 prescribed depot injectable medication may comprise a more unwell group which may hinder

12

262  uptake of screening for other unmeasured reasons. Other markers of risk and severity were also

263  associated with being less likely to attend screening. Markers of risk and severity were more strongly

264  predictive of uptake of mammographic screening than cervical screening. After adjustment for

265  sociodemographic factors, women without indicators of severity or risk and not on depot medication

266  were not significantly less likely than women without SMI to be screened for breast or cervical

267  cancer. When frequency of primary care visits was taken into account, women without these

268  indicators remained not significantly less likely to receive mammographic screening (with the

269  exception of those with no indicators of risk), but were less likely to receive cervical cancer

270  screening. This difference may be related to mammographic screening being offered at an unfamiliar

271  location with unfamiliar staff, factors which may make attendance more difficult for those with more

272  severe illness.

273  The finding of a 22-28% reduction in screening uptake in women with SMI after accounting for

274  demographic factors is in keeping with the international literature.[6,5,7] For example, a pooled

275  meta-analysis of studies of mammography uptake in the context of mental illness found a 29%

276  reduction in the odds of mammography in women with mental illness, and a 46% reduction in

277  women with SMI.[5] However, as noted in the introduction, the majority of studies on which this

278  meta-analysis and other reviews are based were conducted in the United States, where there are no

279  population based organised screening programmes. In a previous UK study,[22] breast screening

280  registrations were linked to mental health service use and no difference in mammography receipt

281  for women known to mental health services was found overall, but women with a psychosis

282  diagnosis (OR 0.33) or a history of compulsory treatment (OR 0.40) had reduced screening receipt.

283  This study focused on mammography and dates from nearly a decade prior to ours, suggesting that

284  the situation has not changed markedly over this time. Other UK evidence suggests that late

285  diagnosis of cancers may not be a significant factor in poor cancer survival people with SMI, but this

286  evidence comes from a study which examined all cancers combined, and all ages, and so it is not

287     possible to draw conclusions about stage at diagnosis of breast or cervical cancers in screening age

288     populations from these results.[24]

289     Strengths and limitations

290     This study is strengthened by the availability of linked primary and secondary care data, which

291     provides information on mental health symptom severity, mental health service receipt, and

292     diagnosis to enable investigation of differences within the group of people with SMI. Further, linkage

293     with population-based primary care records allowed the identification of a direct comparison

294     population. Information held by general practice on cervical screening is likely to be complete.  Since

295     mammography is not performed in primary care, information may be less complete, particularly for

296     those who consult less often, although we were able to adjust for consultation frequency.

297     This study did not include all those who were identified as having SMI in primary care data, but was

298     restricted to those who were also known to secondary mental health services. This group may fare

299     better (because of higher rates of health service contact providing more opportunities for reminders

300     about screening) or worse (because of having more severe illness or more fragmented care) than

301     those not in current contact with secondary services, and so these findings may not apply to the

302     entire group registered with SMI in general practice. However, the decision to compare just those

303     with SMI known to secondary care was made in order to extend currently available knowledge by

304     enabling us to examine the role of illness/secondary mental health care factors not available for

305     those known only to primary care. Whether screening rates are different for SMI patients known

306     only to primary care may be explored in a later study. Lastly, while our findings are representative of

307     a limited geographic area characterised by high levels of deprivation – potentially limiting

308     generalisability – our effect sizes are consistent with those reported in studies internationally, and

309     indicate that screening uptake is reduced for SMI patients even in a setting where screening, primary

310     care and secondary care are provided free at the point of access.

311    Conclusions

312    This study provides up to date information about cancer screening in adults using mental health

313    services in the UK, showing that breast and cervical cancer screening receipt is lower in women with

314    SMI than other women even in the context of free primary care, organised screening and incentives

315    to provide screening, and despite more frequent contact with primary care.  It also demonstrates

316    that individual and treatment related factors beyond diagnosis are associated with reduced

317    likelihood of screening. Efforts to improve screening coverage for women with SMI will be important

318    for improving cancer survival for this group. If we are to tackle health disparities linked to SMI status

319    then increasing uptake of cancer screening for women with SMI must be a key element. Our findings

320    indicate the potential benefits of incorporating policies which target efforts at encouraging greater

321    screening uptake among women with other markers of severity or risk, beyond SMI status alone.

322    **Declarations**
323
324    **Ethics approval and consent to participate**
325    The linkage was a service evaluation and did not require ethical approval. Approvals for the database
326    linkage were obtained via a Section 251 application to the Health Research Authority (reference:
327    CAG 6-07(f)/2013)and from the Lambeth Clinical Commissioning Group (CCG) Information
328    Governance committee.
329
330    **Consent to publish**
331    Not applicable
332
333    **Availability of data and materials**
334    The terms of access to the data are governed by a Data Sharing Agreement with the Data Controllers
335    (the GP practices) which does not permit wider access to the data. However, the codes used and
336    syntax would be available to researchers.
337
338    **Competing interests**
339    The authors declare that they have no competing interests.

340    **Funding**
341    The data linkage used in the study was funded by the MRC MPHiL grant (MR/J013471/1).
342
343    **Authors' Contributions**
344    RC, CW, MA and MH conceived and designed the study. CW analysed the study data. CW and RC
345    wrote the draft manuscript. MA, EB, RS and MH commented on and critically revised the manuscript.
346    All authors read and approved the final manuscript.

347
358

359 **References**

360 1. Saha S, Chant D, McGrath J. A Systematic Review of Mortality in Schizophrenia: Is the Differential
361 Mortality Gap Worsening Over Time? ArchGen Psychiat. 2007;64:1123-31.
362 2. Bushe CJ, Hodgson R. Schizophrenia and Cancer: In 2010 Do We Understand the Connection? Can
363 J Psychiat. 2010;55:761-67.
364 3. Kisely S, Crowe E, Lawrence D. Cancer-related mortality in people with mental illness. JAMA
365 Psychiatry. 2013;70:209-17; doi:http://dx.doi.org/10.1001/jamapsychiatry.2013.278.
366 4. Centres for Disease Control and Prevention (CDC). Cancer Screening
367 Tests.http://www.cdc.gov/cancer/dcpc/prevention/screening.htm. Accessed 3 Nov 2015.
368 5. Mitchell AJ, Pereira IES, Yadegarfar M, Pepereke S, Mugadza V, Stubbs B. Breast cancer screening
369 in women with mental illness: comparative meta-analysis of mammography uptake. Br J Psychiat
370 2014;205:428-35; doi:10.1192/bjp.bp.114.147629.
371 6. Lord O, Malone D, Mitchell AJ. Receipt of preventive medical care and medical screening for
372 patients with mental illness: a comparative analysis. Gen Hosp Psychiat. 2010;32:519-43.
373 7. Aggarwal A, Pandurangi A, Smith W. Disparities in Breast and Cervical Cancer Screening in Women
374 with Mental Illness. Am JPrev Med. 2013;44:392-98. doi:10.1016/j.amepre.2012.12.006.
375 8. Espinas JA, Aliste L, Fernandez E, Josep MA, Tresserras R, Borras JM. Narrowing the equity gap:
376 The impact of organized versus opportunistic cancer screening in Catalonia (Spain). J Med Screen.
377 2011;18:87-90. doi:10.1258/jms.2011.010086.
378 9. Siminoff LA, Ross L. Access and equity to cancer care in the USA: a review and assessment.
379 Postgrad Med J. 2005;81:674-79. doi:10.1136/pgmj.2005.032813.
380 10. Health and Social Care Information Centre. Quality and Outcomes Framework (QOF).
381 http://www.hscic.gov.uk/qof. Accessed 15 Aug 2015.
382 11. Barley EA, Clifton A, Burgess C, Clement S, Ohlsen R, Ramluggun P, et al. Identifying barriers and
383 facilitators to cancer screening uptake by people living with a diagnosis of mental illness to inform
384 policy and practice. Dorset Healthcare University NHS Foundation Trust, Kings College London,
385 London; 2015.
386 12. Office of National Statistics. 2011 Census: KS201UK Ethnic group, local authorities in the United
387 Kingdom. http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-
388 327143; 2011.  Accessed 15 August 2015.
389 13. English Indices of Deprivation 2010.  Department of Communities and Local Government.
390 https://www.gov.uk/government/statistics/english-indices-of-deprivation-2010; 2011. Accessed 15
391 August 2015.
392 14. Stewart R, Soremekun M, Perera G, Broadbent M, Callard F, Denis M, et al. The South London
393 and Maudsley NHS foundation trust biomedical research centre (SLAM BRC) case register:
394 development and descriptive data. BMC Psychiatry. 2009;9:51.
395 15. Perera G, Broadbent M, Callard F, Chang C-K, Downs J, Dutta R, et al. Cohort profile of the South
396 London and Maudsley NHS Foundation Trust Biomedical Research Centre (SLaM BRC) Case Register:

397  current status and recent enhancement of an Electronic Mental Health Record derived data
398  resource. BMJ Open (in press).
399  16. Office of National Statistics. Super Output Area (SOA). http://www.ons.gov.uk/ons/guide-
400  method/geography/beginner-s-guide/census/super-output-areas--soas-/index.html; 2015. Accessed
401  15 August 2015.
402  17. Indices of Deprivation 2010: IMD10 Scores for LSOAs 2011. Department for Communities and
403  Local Government. http://data.london.gov.uk/dataset/indices-deprivation-
404  2010/resource/7c1858ae-74b2-46d5-a713-731155b87bed; 2011. Accessed 15 August 2015.
405  18. World Health Organization 2010. International Statistical Classification of Diseases and Related
406  Health Problems - 10th Revision. http://apps.who.int/classifications/icd10/browse/2010/en;
407  Accessed 8 August 2016.
408  19. StataCorp. Stata Statistical Software: Release 12. StataCorp LP, College Station, TX; 2011.
409  20. Martens PJ, Chochinov HM, Prior HJ, Fransoo R, Burland E, Need To Know Team. Are cervical
410  cancer screening rates different for women with schizophrenia? A Manitoba population-based study.
411  Schizophr Res. 2009;113:101-6; doi:10.1016/j.schres.2009.04.015.
412  21. Kodl MM, Powell AA, Noorbaloochi S, Grill JP, Bangerter AK, Partin MR. Mental health, frequency
413  of healthcare visits, and colorectal cancer screening. Med Care.2010;48:934-39.
414  22. Werneke U, Horn O, Maryon-Davis A, Wessely S, Donnan S, McPherson K. Uptake of screening
415  for breast cancer in patients with mental health problems. J Epidemiol Commun H.2006;60:600-5.
416  23. Carney CP, Jones LE. The influence of type and severity of mental illness on receipt of screening
417  mammography. J Gen Intern Med.2006;21:1097-104; doi:10.1111/j.1525-1497.2006.00565.x.
418  24. Chang C-K, Hayes RD, Broadbent MTM, Hotopf M, Davies E, Møller H, et al. A cohort study on
419  mental disorders, stage of cancer at diagnosis and subsequent survival. BMJ Open.2014;4:e004295;
420  doi:10.1136/bmjopen-2013-004295.

421

422

423

424

425

426

427

428

429

430

431

432

433

434 **Table 1 Characteristics of patients eligible for mammography screening for breast and/or cervical screening, by serious**
435 **mental illness (SMI) status**

| | | Mammography eligible population | | | Cervical smear eligible population | | |
|---|---|---|---|---|---|---|---|
| | | Non-SMI (n=25,385) | SMI (n=625) | p | Non-SMI (n=106,554) | SMI (n=1393 ) | p |
| | | *n* (%) | | | *n* (%) | | |
| **Age group (years)**[1] | | | | 0.709 | | | <0.001 |
| **Mammography** | **Cervical smear** | | | | | | |
| - | 25-34 | - | - | | 47449 (44.5) | 261 (18.7) | |
| - | 35-44 | - | - | | 27579 (25.9) | 382 (27.4) | |
| 50-54 | 45-54 | 9035 (35.6) | 218 (34.9) | | 19910 (18.7) | 454 (32.6) | |
| 55-64 | 55-64 | 11616 (45.8) | 296 (47.4) | | 11616 (10.9) | 296 (21.3) | |
| 65-70 | - | 4734 (18.7) | 111 (17.8) | | - | - | |
| **Ethnicity** | | | | <0.001 | | | <0.001 |
| British/mixed British | | 7742 (35.8) | 189 (33.4) | | 30953 (33.7) | 362 (28.8) | |
| Irish | | 528 (2.4) | 24 (4.2) | | 1972 (2.2) | 31 (2.5) | |
| Indian/Bangladeshi/Pakistani | | 1423 (6.6) | 44 (7.8) | | 5870 (6.4) | 75 (6.0) | |
| Caribbean/mixed Caribbean | | 3309 (15.3) | 142 (25.1) | | 8880 (9.7) | 300 (23.9) | |
| African/mixed African | | 2957 (13.7) | 71 (12.5) | | 11382 (12.4) | 227 (18.1) | |
| Chinese/other | | 991 (4.6) | 8 (1.4) | | 4608 (5.0) | 30 (2.4) | |
| Other white | | 3741 (17.3) | 59 (10.4) | | 23848 (25.9) | 135 (10.7) | |
| Other black | | 620 (2.9) | 21 (3.7) | | 2586 (2.8) | 73 (5.8) | |
| Other mixed | | 307 (1.4) | 8 (1.4) | | 1826 (2.0) | 24 (1.9) | |
| **Deprivation quintile** | | | | <0.001 | | | <0.001 |
| Most deprived | | 4706 (19.1) | 165 (26.5) | | 18464 (18.0) | 365 (26.4) | |
| 2 | | 5188 (21.1) | 123 (19.7) | | 21223 (20.7) | 303 (21.9) | |
| 3 | | 4891 (19.8) | 120 (19.3) | | 21544 (21.0) | 272 (19.7) | |
| 4 | | 5024 (20.4) | 118 (18.9) | | 22554 (22.0) | 247 (17.9) | |
| Least deprived | | 4838 (19.6) | 97 (15.6) | | 18904 (18.4) | 197 (14.2) | |
| **Consultations** | | | | <0.001 | | | <0.001 |
| Median/below median | | 7222 (30.8) | 64 (10.5) | | 42642 (44.1) | 184 (13.7) | |
| Above median | | 16238 (69.2) | 545 (89.5) | | 53982 (55.9) | 1158 (86.3) | |

436 [1]Eligible age range for breast screening (mammography) 50-70 years; eligible age range for cervical cancer
437 screening (cervical smear) 25-64 years.

**Table 2 Associations between serious mental illness (SMI) status and recent receipt of breast and/or cervical screening overall and by SMI characteristic sub-group**

| | Mammography eligible population (N=26,010) | | | | Cervical smear eligible population (N=107,947) | | | |
|---|---|---|---|---|---|---|---|---|
| | Recorded mammography in last 3 years n (%) | Unadjusted OR (95% CI) | Adjusted for socio-demographics OR[a] (95% CI) | Additionally adjusted for consultation rate OR[b] (95% CI) | Recorded cervical smear in last 3/5 yrs n (%) | Unadjusted OR (95% CI) | Adjusted for socio-demographics OR[a] (95% CI) | Additionally adjusted for consultation rate OR[b] (95% CI) |
| **Non-SMI** | **14205 (65.7)** | **1.00** | **1.00** | **1.00** | **67823 (77.8)** | **1.00** | **1.00** | **1.00** |
| **SMI overall** | **305 (58.1)** | **0.72 (0.61 - 0.86)***** | **0.69 (0.57 - 0.84)***** | **0.60 (0.49 - 0.73)***** | **848 (80.2)** | **1.16 (0.99 - 1.35)** | **0.72 (0.60 - 0.85)***** | **0.35 (0.29 - 0.42)***** |
| **SMI by diagnosis** | | | | | | | | |
| Schizophrenia | 136 (55.1) | 0.64 (0.50 - 0.82)*** | 0.59 (0.45 - 0.78)*** | 0.52 (0.40 - 0.69)*** | 270 (76.9) | 0.95 (0.74 - 1.22) | 0.48 (0.36 - 0.63)*** | 0.24 (0.18 - 0.32)*** |
| Bipolar affective disorder | 67 (62.0) | 0.85 (0.58 - 1.26) | 0.89 (0.59 - 1.35) | 0.72 (0.47 - 1.10) | 231 (87.2) | 1.94 (1.35 - 2.78)*** | 1.23 (0.84 - 1.80) | 0.50 (0.33 - 0.74)** |
| Other non-organic psychoses | 34 (50.8) | 0.54 (0.33 - 0.87)* | 0.53 (0.31 - 0.90)* | 0.47 (0.27 - 0.80)** | 153 (74.3) | 0.82 (0.60 - 1.13) | 0.57 (0.40 - 0.80)** | 0.33 (0.22 - 0.47)*** |
| **Depot injectable** | | | | | | | | |
| No | 191 (64.3) | 0.94 (0.74 - 1.20) | 0.97 (0.75 - 1.26) | 0.83 (0.64 - 1.09) | 524 (82.3) | 0.32 (1.08 - 1.62)** | 0.82 (0.65 - 1.02) | 0.36 (0.29 - 0.46)*** |
| Yes | 80 (49.1) | 0.50 (0.37 - 0.68)*** | 0.46 (0.33 - 0.64)*** | 0.39 (0.27 - 0.54)*** | 199 (76.3) | 0.92 (0.69 - 1.22) | 0.48 (0.35 - 0.66)*** | 0.26 (0.18 - 0.36)*** |
| **Any indicator of severity[1]** | | | | | | | | |
| No | 168 (65.6) | 1.00 (0.77 - 1.29) | 0.91 (0.69 - 1.21) | 0.79 (0.59 - 1.06) | 411 (82.2) | 1.32 (1.05 - 1.66)* | 0.82 (0.63 - 1.06) | 0.40 (0.31 - 0.53)*** |
| Yes | 137 (50.9) | 0.54 (0.43 - 0.69)*** | 0.54 (0.42 - 0.70)*** | 0.46 (0.36 - 0.61)*** | 437 (78.5) | 1.04 (0.85 - 1.27) | 0.65 (0.52 - 0.81)*** | 0.31 (0.25 - 0.40)*** |
| **Any indicator of risk[2]** | | | | | | | | |
| No | 205 (61.8) | 0.84 (0.67 - 1.05) | 0.81 (0.63-1.03) | 0.70 (0.55 - 0.90)** | 535 (82.1) | 1.31 (1.07 - 1.60)** | 0.79 (0.63 - 1.00)* | 0.38 (0.30 - 0.49)*** |
| Yes | 100 (51.8) | 0.56 (0.42 - 0.74)*** | 0.53 (0.39 - 0.73)*** | 0.46 (0.34 - 0.63)*** | 313 (77.3) | 0.97 (0.77 - 1.23) | 0.62 (0.48 - 0.80)*** | 0.31 (0.24 - 0.41)*** |

 Eligible population includes non-linked non-SMI and linked SMI group

*p<0.05, **p<0.01, ***p<0.001

1 Includes any of: ever had an inpatient stay, any record of being treated under the Mental Health Act, any record of difficulty managing their physical health, or any record of an Assertive Outreach/Crisis/A&E episode. 2 Includes any of: recorded history of violence, recorded history of non-compliance, and any record of a forensic history.

a Adjusted for age (continuous), ethnicity, and borough-level deprivation; b additionally adjusted for mean annual number of primary consultations