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Utilisation of mammography by women with mobility impairments in the United Kingdom: a secondary analysis of cross-sectional data

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-024571
Article Type:	Research
Date Submitted by the Author:	02-Jun-2018
Complete List of Authors:	Rotarou, Elena; Universidad de Chile, Department of Economics Sakellariou, Dikaios; Cardiff University, School of Healthcare Sciences
Keywords:	United Kingdom, women with mobility impairment, mammography, preventive services, cancer screening

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3 **Title: Utilisation of mammography by women with mobility impairments in the**
4 **United Kingdom: a secondary analysis of cross-sectional data**
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10 Elena S. Rotarou¹ and Dikaios Sakellariou²
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13

14 ¹ Elena S. Rotarou
15

16 University of Chile, Department of Economics,
17

18 Diagonal Paraguay 257, Office 1506, Santiago, 8330015, Chile
19

20 Email: erotarou@fen.uchile.cl
21

22 Telephone number: (56-2) 978-3455
23
24
25
26

27 ² Dikaios Sakellariou
28

29 Corresponding author: Cardiff University, School of Healthcare Sciences,
30

31 Eastgate House, Newport Road 35-43, Cardiff, CF24 0AB
32

33 Email: sakellarioud@cardiff.ac.uk
34

35 Telephone number: 02920687744
36
37
38
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40 **Keywords:** women with mobility impairment; mammography; preventive services;
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42 cancer screening; United Kingdom
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46 **Word count:** 3483
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3 **Utilisation of mammography by women with mobility impairments**
4 **in the United Kingdom: a secondary analysis of cross-sectional data**
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9 **ABSTRACT**
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11 **Objectives:** Research has shown that people with physical disabilities report worse
12 lower utilisation of preventive services. The aim of this study was to examine whether
13 women with mobility impairments have lower odds of utilising mammography
14 compared to women with no such impairment, and explore the factors that are
15 associated with lower utilisation.
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21 **Setting and Participants:** We performed secondary analysis, using logistic
22 regressions, of de-identified cross-sectional data from the European Health Interview
23 Survey, Wave 2. The sample included 9,491 women from across the UK, 2,697 of
24 whom had a mobility impairment. The survey method involved face-to-face and
25 telephone interviews.
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33 **Outcome measures:** Self report of the last time a mammogram was undertaken.
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35 **Results:** Adjusting for various demographic and socioeconomic variables, women
36 with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a
37 mammogram than women without mobility impairment. Concerning women with
38 mobility impairment, married women had more than twice the odds of having a
39 mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-
40 2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of
41 undertaking the test than women from England. Women with upper secondary
42 education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than
43 women with primary or lower secondary education. Also, women from higher
44 quintiles (third and fifth quintiles) had higher odds of utilising mammography, with
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3 the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than
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5 women from the first quintile.

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7 **Conclusions:** In order to achieve equitable access to mammography for all women, it
8
9 is important to acknowledge the barriers that impede women with mobility
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11 impairment from using the service. These barriers can refer to structural disadvantage,
12
13 such as lower income and employment rate, transportation barriers, or previous
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15 negative experiences, among others.
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17 18 19 20 **Strengths and limitations of this study**

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23 • This study is based on a nationally-representative sample of community-
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25 dwelling women.
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27 • We use various demographic and socioeconomic variables to investigate the
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29 association between these factors and mammography for women with mobility
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31 impairment in the UK.
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33 • Outcome measures were self-reported, which might have introduced response
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35 bias.
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37 • We cannot establish any causal links, due to the study's cross-sectional design.
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INTRODUCTION

Research has shown that people with physical disabilities generally report worse access and utilisation of healthcare services, including preventive and screening services.[1-5] Several studies have evidenced how access to some cancer screening services can be compromised due to the presence of pre-existing physical disability.[6-11] A recent study in the UK showed that women with disabilities – including women with physical limitations – report worse access to healthcare compared to any other group, perhaps illustrating how gender and disability intersect to create structural disadvantage for disabled women.[3]

There are several reasons that have been associated with lower utilisation of healthcare services by people with disabilities, and for women in particular. These include, among other reasons, inaccessible healthcare facilities and/or equipment, lack of appropriate parking, lack of social support, and financial constraints, and the intersection of all these factors with gender-based structural disadvantage.[1,5, 8]

There are also several intangible barriers that negatively affect utilisation of healthcare service by disabled women; past negative experiences with healthcare professionals, being treated like a low-priority patient, not being adequately informed, or having their impairments ignored, are some of the reasons women give for the low utilisation of services, including mammography.[5-6]

Mammography is an important screening tool for breast cancer.[12] In well-resourced settings, which include most high-income countries, the World Health Organisation position paper on mammography recommends population-based screening every two years for all women aged 50-69 years.[12] Several countries, including the US, Norway, Denmark, and the UK implement such national screening programmes.[13-17] The evidence shows that population-wide screening could lead

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3 to an increase of early-cancer diagnosis, with a concomitant decrease of late-stage
4 diagnosis, hence leading to a mortality decrease.[12,18] However, a Cochrane
5 systematic review showed that the benefits of mortality decrease might be outweighed
6 by over-diagnosis rates and higher rates of aggressive treatment, both of which were
7 attributed to mammography.[19]
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13 Most of the existing evidence suggests that women with disabilities have
14 lower utilisation rates and worse access to mammography compared to women
15 without disabilities.[8,10,20-23] Transportation, quality of the experience, and lack of
16 appropriate information, are among the reasons given for this.[6,24] Several of these
17 studies are small-scale studies, which although they give important insights into the
18 experiences of women as they navigate the healthcare system, they do not allow any
19 conclusions regarding utilisation of preventive services at a population level. A recent
20 large prospective study showed that women with disabilities in England have lower
21 odds of having a mammogram compared to women without a disability.[25] It is
22 important to know which are the factors that affect the utilisation of preventive
23 services across the United Kingdom, so that policies and targeted interventions can be
24 implemented to address any inequalities.
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39 In the United Kingdom, women between the ages of 50 and 70 are invited to
40 undertake a mammogram every three years, as part of a national screening
41 programme by the National Health Service (NHS).[26] While there is evidence for
42 women in England,[25] little is known regarding mammography utilisation by women
43 with physical impairments across the UK; it is not known whether there is a
44 difference in the utilisation rates between them and women without any mobility
45 impairments, nor which are some of the factors associated with these utilisation rates.
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3 In this article, we examine the utilisation of mammography by women with
4 lower limb mobility impairments in the UK. We use this term to refer to women who
5 report difficulty or inability to walk or climb stairs, as per the available data from the
6 European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether
7 women with lower limb mobility impairments have lower odds of utilising
8 mammography compared to women with no such impairment, and explore the factors
9 that are associated with lower utilisation.
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18 This study seeks to add to the current body of evidence regarding utilisation of
19 mammography by disabled women, by producing population-level evidence, and
20 examining the association of a variety of demographic and socioeconomic factors –
21 such as low income or lack of social support – with utilisation of mammography. This
22 knowledge can inform policy and lead to the design of comprehensive support
23 systems to enable real access to services, addressing not only the availability of
24 services but also their utilisation.
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35 **METHODOLOGY**

36 **Survey**

37 We performed secondary analysis, using logistic regressions, of de-identified cross-
38 sectional data from the European Health Interview Survey, Wave 2. The EHIS
39 collects health data across European Union member states, providing thus the
40 possibility to compare health indicators between countries. It is administered every
41 five years.[27]
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50 The survey consists of four modules: a) demographic and socioeconomic
51 variables, such as age, sex, marital status, employment, education, etc.; b) variables
52 on health status, for example self-perceived general health, chronic conditions,
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3 accidents, functional limitations in daily activities, etc.; c) variables on health care
4 use, such as consultations, unmet healthcare needs, preventive services, etc.; and d)
5 health determinants, for instance weight, smoking, alcohol consumption, exercise,
6 social support, etc.[28] The survey analyses 21 areas of health concerns and health-
7 related behaviours, and 81 specific item-questions. All measures are self-reported.[29]

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9 For more information on the EHIS questionnaire, please see:

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11 [http://ec.europa.eu/health/ph_information/implement/
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60](http://ec.europa.eu/health/ph_information/implement/wp/systems/docs/ev_20070315_ehis_en.pdf)
wp/systems/docs/ev_20070315_ehis_en.pdf.

The United Kingdom did not participate in the first EHIS wave (2006-2009), but it did take part in the second wave. Data was collected for residents in private households, over 16 years of age, residing in England, Wales, Scotland, and Northern Ireland. For Great Britain, data was collected between April 2013 and March 2014 by the Office for National Statistics. Data for Northern Ireland was collected between April and September 2014 by the Northern Ireland Statistics and Research Agency. In Great Britain, the survey was conducted as a follow-up to the Labour Force Survey; individuals who did not object in their final wave of contact, in the sampled households, completed the EHIS Wave 2 questionnaire. In Northern Ireland, a simple random sample of households on the Land and Property Services Agency property gazetteer was used. In total, the UK survey included 20,161 observations.[30]

The interviews involved both face-to-face (20%) and telephone interviews (80%). For the face-to-face interviews, the interviewers conducted Computer-Assisted Personal Interviews (CAPI) using laptops at the address of the respondents, while for the telephone interviews, Computer-Assisted Telephone Interviews (CATI) were conducted. The CAPI and CATI questionnaires were generally similar, with only minor changes to account for the different mode of interviewing.[30]

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3 The microdata did not contain any personal information, such as names or
4 addresses, which would allow direct identification. In order to ensure confidentiality,
5 a set of anonymisation rules was applied.[31] Access to microdata is granted only for
6 scientific purposes; we were granted access by the UK Data Service
7 (www.ukdataservice.ac.uk).
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13 14 15 **Data and variables**

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17 There are two questions in the EHIS that measure mobile difficulty: a) variable PL6,
18 “Difficulty in walking half a km on level ground without the use of any aid”, and b)
19 variable PL7, “Difficulty in walking up or down 12 steps”. These two variables were
20 merged into a new variable, called ‘mobility impairment’, with answers ‘without
21 difficulty’ (women that answered that they had no difficulty in performing either
22 tasks), and ‘with difficulty’ (women that replied that they had some difficulty in
23 performing or were unable to do at least one of the tasks).
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33 Our dependent variable, “up to date with mammography”, was recoded and
34 was binary, that is, ‘Yes’ (included the answers “within the last 12 months”, “1 to less
35 than 2 years”, and “2 to less than 3 years”), and ‘No’ (“more than 3 years” and
36 “never”). This recoding was done according to the NHS guidelines on
37 mammography.[26] Previous research has also employed this variable, looking at
38 women being up to date with mammography.[10]
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46 In total, we had 9,995 observations for women that answered the question on
47 mammography. Due to case-deletion (default in STATA), our total sample size is
48 9,491 observations (6,794 observations for women without mobility impairment, and
49 2,697 for women with mobility impairment). Since only a very small percentage of
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3 observations was deleted, we decided not to proceed to maximum likelihood or
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5 multiple imputation.[32]
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7 The control variables included the following: a) *age*: 20-49 / 50-69 / 70+
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9 (while the target group is 50-69-year-old women, the survey showed a significant
10 amount of women that for various, unspecified reasons decided to undertake a
11 mammogram, despite being outside the target group); b) *civil status*: never married /
12 married / widowed / divorced; c) *region*: England / Wales / Scotland / Northern
13 Ireland; d) *urbanisation*: thinly-populated area / moderate-populated area / densely-
14 populated area; e) *education*: primary and lower secondary / upper secondary / post-
15 secondary and tertiary, short / tertiary; f) *income quintiles* (net monthly equivalised
16 household income): 1st quintile / 2nd quintile / 3rd quintile / 4th quintile / 5th quintile; g)
17 *employment*: unemployed / employed / inactive; h) *health self-assessment*: bad
18 (answers 'bad' and 'very bad') / fair (answer 'fair') / good (answers 'good' and 'very
19 good'); and i) *help from neighbours* (how easy it is to get help from neighbours in
20 case of need): difficult / possible / easy.
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35 All analyses were performed using STATA/MP version 14.2.
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40 RESULTS

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43 Table 1 summarises the characteristics of the study sample.
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47 **Table 1:** Comparison between women with and without mobility impairment
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Parameter	Women without mobility impairment (n=6,794)		Women with mobility impairment (n=2,697)		p value, chi-squared test
	n	%	n	%	

Age groups						
	20-49 (n=3,270)	2,919	43.0	351	13.0	$p < 0.0001$
	50-69 (n=3,971)	2,839	42.8	1,132	42.0	
	70+ (n=2,250)	1,036	15.3	1,214	45.1	
Civil status						
	Never married (n=1,515)	1,259	18.5	256	9.5	$p < 0.0001$
	Married (n=5,386)	4,097	60.3	1,289	47.8	
	Widowed (n=1,324)	604	8.9	720	26.7	
	Divorced (n=1,266)	834	12.3	432	16.0	
Region						
	England (n=7,895)	5,695	83.8	2,200	81.6	$p < 0.0001$
	Wales (n=421)	269	4.0	152	5.6	
	Scotland (n=822)	596	8.8	226	8.4	
	Northern Ireland (n=353)	234	3.4	119	4.4	
Urbanisation						
	Thinly-populated area (n=1,322)	945	13.9	377	14.0	$p = 0.992$
	Moderate-populated area (n=2,575)	1,842	27.1	733	27.2	
	Densely-populated area (n=5,594)	4,007	59.0	1,587	58.8	
Education						
	Primary / lower secondary (n=3,040)	1,699	25.0	1,341	49.7	$p < 0.0001$
	Upper secondary (n=3,223)	2,394	35.2	829	30.7	
	Post secondary / tertiary, short (n=1,495)	1,156	17.0	339	12.6	
	Tertiary (n=1,733)	1,545	22.7	188	7.0	
Income quintiles						
	1 st quintile (n=1,962)	1,108	16.3	854	31.7	$p < 0.0001$
	2 nd quintile (n=2,008)	1,336	19.7	672	24.9	
	3 rd quintile (n=1,932)	1,352	19.9	580	21.5	
	4 th quintile (n=1,852)	1,493	22.0	359	13.3	
	5 th quintile (n=1,737)	1,505	22.2	232	8.6	
Employment						
	Unemployed (n=360)	271	4.0	89	3.3	$p < 0.0001$
	Employed (n=4,304)	3,836	56.5	468	17.4	
	Inactive (n=4,827)	2,687	39.6	2,140	79.4	
Health self-assessment						
	Bad (n=797)	90	1.3	707	26.2	$p < 0.0001$
	Fair (n=1,896)	774	11.4	1,122	41.6	
	Good (n=6,798)	5,930	87.3	868	32.2	
Help from neighbours						
	Difficult (n=1,312)	805	11.9	507	18.8	

Possible (n=1,923)	1,426	21.0	497	18.4	$p < 0.0001$
Easy (n=6,256)	4,563	67.2	1,693	62.8	

Some of the points presented in Table 1 are of particular interest. Firstly, concerning education, about half of women with mobility impairment had only primary or lower secondary education, as opposed to only a quarter of women without any mobility impairment; a much higher percentage of women from the latter group had also attended tertiary education. Secondly, more women with mobility impairment (32%) belonged to the first income quintile than women with no mobility impairment (16%). Less than 9% of women from the former group belonged to the richest segment; this percentage was more than 22% for women without any mobility impairment. Thirdly, the percentage of women with mobility impairment that were inactive was double (i.e. almost 80%) than that of women without any mobility problems. All these points underline the structural disadvantage faced by women with mobility impairment in the UK: lower education and lower income, coupled with a much higher likelihood of being inactive employment-wise.

Next, we performed logistic regressions to see whether there was any difference in utilisation rates of mammography between women with and without mobility impairment in the UK, and to investigate the factors associated with such rates. The first logistic regression – which included all the variables of Table 1 – showed that women with mobility impairment had 1.3 times lower odds of undertaking a mammogram than women without mobility problems (OR: .80, 95% CI = .70-.92, $p=.002$) (full results not presented here but available upon request).

Next, Table 2 presents possible factors associated with having a mammogram for women with mobility impairment in the UK. Model (1) presents age-adjusted odds

ratios. Model (2) incorporates other demographic and socioeconomic variables, while Model (3) presents the fully-adjusted odds ratios (includes all variables of Table 1).

Table 2: Factors associated with utilisation rates of mammography by women with mobility impairment in the UK

Variables	Model (1)		Model (2)		Model (3)	
	OR	95% CI	OR	95% CI	OR	95% CI
Age groups (20-49 as reference)						
50-69	11.57***	8.67-15.44	11.99***	8.78-16.38	12.12***	8.85-16.61
70+	1.69***	1.27-2.25	1.96***	1.39-2.75	1.94***	1.37-2.74
Civil status (never married as reference)						
Married			2.05***	1.48-2.85	2.07***	1.49-2.88
Widowed			.934	.65-1.34	.95	.66-1.37
Divorced			1.44	1.00-2.08	1.46*	1.01-2.12
Regions (England as reference)						
Wales			1.00	.68-1.48	1.01	.68-1.49
Scotland			1.48*	1.06-2.05	1.51*	1.08-2.10
Northern Ireland			.91	.58-1.41	.90	.57-1.40
Urbanisation (thinly-populated as reference)						
Intermediate-populated area			.89	.67-1.19	.90	.67-1.20
Densely-populated area			.77	.59-1.01	.77	.59-1.01
Education (primary/lower secondary as ref.)						
Upper secondary			1.33**	1.08-1.64	1.36**	1.10-1.67
Post secondary and tertiary, short			1.20	.91-1.58	1.21	.91-1.60
Tertiary			.88	.61-1.28	.88	.60-1.28
Employment (unemployed as reference)						
Employed			.94	.54-1.66	.93	.53-1.63
Inactive			1.29	.76-2.20	1.30	.76-2.22
Income (1st quintile as reference)						
2 nd quintile			1.11	.88-1.40	1.09	.86-1.38
3 rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4 th quintile			1.18	.87-1.59	1.18	.87-1.60
5 th quintile			1.46*	1.01-2.11	1.49**	1.02-2.15
Health self-assessment (bad as reference)						
Fair					1.14	.91-1.42
Good					1.11	.87-1.42
Support from neighbours (difficult as ref.)						

	Possible		1.08	.81-1.45
	Easy		1.07	.85-1.35
Observations	2,790	2,738		2,697
Pseudo R²	0.1636	0.1908		0.1923
Chi² (21)	631.29	722.80		718.04
Prob>Chi²	0.0000	0.0000		0.0000
McFadden R²	0.162	0.179		0.180
Deviance	3228.188	3066.311		3015.368
AIC	3234.188	3106.311		3063.368
BIC	3251.989	3224.610		3204.965

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

Due to a higher Mac Fadden R², and lower deviance, and AIC and BIC values, Model (3) provided a better fit than the previous two models. There was no collinearity affecting the results, with mean variance inflation factor (VIF) of 2.21.

As it can be seen in Table 2, the target group for having a mammogram (i.e. the 50-69 group) was the one with the highest odds of undertaking it: women in this age subgroup had 12 times higher odds of having this screening than women in the 20-49 subgroup. Regarding civil status, married women had more than twice the odds of having a mammogram than women that had never been married; divorced women had 1.5 higher odds. Women with mobility impairment in Scotland had 1.5 times higher odds of having the mammogram than women in England. Women with upper secondary education were 1.4 times more likely to have a mammogram than women with primary or lower secondary education. Also, women from higher quintiles (third and fifth quintiles) had higher odds of undertaking the mammogram, with the women in the fifth quintile having 1.5 times higher odds than women from the first quintile.

DISCUSSION

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3 In this study, we investigated whether women with mobility impairment in the UK
4 were less likely to be up to date with mammography compared to women with no
5 mobility impairment, and explored some of the factors associated with lower
6 utilisation. The results showed a statistically significant difference between women
7 with and without mobility impairment, with women with mobility impairment having
8 1.3 times lower odds of undertaking a mammogram than women without mobility
9 problems. Furthermore, the results showed a positive association between married
10 civil status, high income, educational attainment, and living in Scotland, and being up
11 to date with mammography.
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22 One of the strengths of the study is that it is based on data from a nationally-
23 representative sample. It also adds to the body of literature by examining the
24 association of several factors with mammography utilisation for women with mobility
25 impairment, an issue that has been generally little explored, particularly in the UK.
26 One of the limitations of the study is that while we have established associations
27 between various factors and utilisation of mammography by women with mobility
28 impairment, we cannot infer causality due to the cross-sectional nature of the data.
29 Another limitation of the study is that there is no information in the EHIS on the
30 reasons that influence utilisation of mammography. Furthermore, the EHIS relies on
31 self-reporting information, which leaves the instrument open to response bias;
32 however, there is no relevant information on this aspect. Another limitation of the
33 study is the way mobility impairment was defined, which potentially included women
34 with only short-term impairment, together with women with longer-term impairment;
35 this might have had an impact on external validity.
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52 The findings showed that women with mobility impairment had 1.3 lower
53 odds of being up to date with mammography. This is consistent with previous
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3 research that shows that in the UK, there are long-standing inequalities between
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5 people's cancer experiences.[33] This finding is also consistent with research findings
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7 from a study in England. [25] Bone et al. performed an analysis of data from the
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9 National Cancer Patient Experience Survey.[34] They analysed data from 71,793
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11 cancer patients and found evidence that cancer patients with long-standing conditions
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13 in England, including people with physical conditions and disabilities, reported poorer
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15 care. These inequalities persisted even when controlling for other factors. Further to
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17 this, people with pre-existing disability diagnosed with cancer report low satisfaction
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19 and use of services.[7-8, 35] As Liu and Clark have shown, quality of the experience
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21 matters;[36] previous negative experiences with mammography might deter women
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23 with physical impairments from undertaking the test in the future.
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27 These inequalities in the experiences of patients with cancer in the UK conflict
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29 with several of the recommendations of recent strategic documents, including
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31 'Achieving world-class cancer outcomes: a Strategy for England 2015-2020' and the
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33 Cancer Delivery Plan for Wales.[37,38] Both documents call for access to equitable
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35 care, achieving the best experience, and promoting delivery of cancer care responsive
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37 to individual needs.
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40 The findings also showed that married women had higher odds of having a
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42 mammogram than women that had never been married. This result is in accordance
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44 with evidence demonstrating the protective role of married civil status.[23,39] Indeed,
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46 married people tend to have more fixed residence, regular doctors, and fixed
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48 healthcare places, and therefore are more likely to be informed and accept preventive
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50 health services than unmarried people.[39] They have also a stronger social network
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52 (for example, family members, relatives, and friends) that can offer them more
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3 emotional and practical support (for instance, transportation) to attend such
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5 screenings, as well as help them adopt healthier behaviours.
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8 Our study also revealed that there are differences in the utilisation rates of
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10 mammography between women living in different regions in the United Kingdom,
11
12 with women with mobility impairment living in Scotland having higher odds of
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14 undertaking the test than women in England. The reason behind this might be the
15
16 usage of mobile screening units in Scotland, which appears to enable access to
17
18 mammography for underserved populations.[40]
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20
21 Furthermore, our study showed that women with mobility impairments with a
22
23 higher education had higher odds of having a mammogram than women with primary
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25 or lower secondary education. Women with mobility impairment that belonged to
26
27 higher quintiles had also higher odds of having a mammogram than women belonging
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29 to the first quintile. This result agrees with previous research that found that disabled
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31 women with higher education and an overall higher socioeconomic status were more
32
33 likely to undertake preventive exams.[41-42] Educational attainment beyond upper
34
35 secondary did not seem to have any further positive effect on the uptake of
36
37 mammography.
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40 Overall, taking into account the global demographic, epidemiological, and
41
42 socioeconomic changes – including ageing, urbanisation, reduction in morbidity and
43
44 mortality rates, and increase in chronic diseases – it is essential that preventive health
45
46 services are better promoted and reach all people, especially disadvantaged groups,
47
48 such as people with disabilities, women, and the poor. The WHO position paper on
49
50 mammography states that:
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52
53 “Population-based screening programmes identify and individually invite each
54
55 person in the eligible population to attend each round of screening so that each
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2
3 person in the eligible population has an equal chance of benefiting from
4
5 screening.” (p.23).[12]
6

7 This statement, however, overlooks the fact that not everyone has an equal chance of
8
9 benefitting from screening; people with mobility impairment may, for example, face
10
11 transportation barriers, which could stop them from accessing screening services,
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13 despite their availability. Women with mobility impairment, and disabilities in
14
15 general, are further disadvantaged, as they also face structural disadvantage – in the
16
17 form of lower education, lower income, and greater poverty – than men, as shown in
18
19 this study and supported by a body of existing research.[43-44] In order to enhance
20
21 the utilisation of mammography (and possibly the use of other preventive services), it
22
23 is important to acknowledge the barriers that stop women from using the service and
24
25 adopt measures that would lead to a more equitable utilisation.
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31 **Contributors**

32
33 ESR and DS jointly conceived the final research question and aims and objectives,
34
35 reviewed the literature, produced the analysis plan and carried out the analysis, and
36
37 drafted the manuscript.
38

39 **Funding**

40
41 None declared.
42
43

44 **Competing interests**

45
46 None declared.
47

48 **Ethics approval**

49
50 None required.
51

52 **Data sharing statement**

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3 Technical appendix and dataset available from the UK Data Service.
4

5 <https://discover.ukdataservice.ac.uk/catalogue/?sn=7881>
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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
Title and abstract	X 1	X p.1 (a) Indicate the study's design with a commonly used term in the title or the abstract
		X p.2 (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	X p.4-5 2	Explain the scientific background and rationale for the investigation being reported
Objectives	X p.6 3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	X p.2, p.6 4	Present key elements of study design early in the paper
Setting	X p.6-7 5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	X p. 7-8 6	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	X p. 8-9 7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	X p. 8-9 8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	X p. 14 9	Describe any efforts to address potential sources of bias
Study size	X p. 8-9 10	Explain how the study size was arrived at
Quantitative variables	X p. 8-9 11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	X 12	X p. 6-8 (a) Describe all statistical methods, including those used to control for confounding
		(b) Describe any methods used to examine subgroups and interactions
		X p.8-9 (c) Explain how missing data were addressed
		(d) If applicable, describe analytical methods taking account of sampling strategy
		(e) Describe any sensitivity analyses
Results		
Participants	X 13*	X p. 8 (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	X 14*	X p.9-10 (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	X p. 8 15*	Report numbers of outcome events or summary measures
Main results	X p.12, p. 13 16	X (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

		X p.9 (b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	X p.14 18	Summarise key results with reference to study objectives
Limitations	X p.14 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	X p. 16-17 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	X p.14 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	X p.17 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Utilisation of mammography by women with mobility impairments in the United Kingdom: a secondary analysis of cross-sectional data

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-024571.R1
Article Type:	Research
Date Submitted by the Author:	25-Nov-2018
Complete List of Authors:	Sakellariou, Dikaios; Cardiff University, School of Healthcare Sciences Rotarou, Elena; Universidad de Chile, Centre of Environmental and Natural Resource Economics, Faculty of Economics and Business
Primary Subject Heading:	Oncology
Secondary Subject Heading:	Public health, Epidemiology, Health services research, Patient-centred medicine
Keywords:	United Kingdom, women with mobility impairment, mammography, preventive services, cancer screening

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Manuscripts

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3 **Title: Utilisation of mammography by women with mobility impairments in the**
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5 **United Kingdom: a secondary analysis of cross-sectional data**
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11 Dikaios Sakellariou¹ and Elena S. Rotarou²
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16 ¹Dikaios Sakellariou

17
18 Corresponding author: Cardiff University, School of Healthcare Sciences,
19

20 Eastgate House, Newport Road 35-43, Cardiff, CF24 0AB, UK
21

22
23 Email: sakellarioud@cardiff.ac.uk
24

25 Telephone number: 02920687744
26
27

28
29
30 ² Elena S. Rotarou

31
32 University of Chile, Centre of Environmental and Natural Resource Economics,
33

34 Faculty of Economics and Business,
35

36 Diagonal Paraguay 257, Office 1506, Santiago, 8330015, Chile
37

38
39 Email: erotarou@fen.uchile.cl
40

41 Telephone number: (56-2) 978-3455
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46 **Keywords:** women with mobility impairment; mammography; preventive services;
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48 cancer screening; United Kingdom
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52 **Word count:** 3770
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3 **Utilisation of mammography by women with mobility impairments**
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10 **ABSTRACT**

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12 **Objectives:** Research has shown that people with physical disabilities report lower
13 utilisation of preventive services. The aim of this study was to examine whether
14 women with mobility impairments have lower odds of utilising mammography
15 compared to women with no such impairment, and explore the factors that are
16 associated with lower utilisation.
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24 **Setting and Participants:** We performed secondary analysis, using logistic
25 regressions, of de-identified cross-sectional data from the European Health Interview
26 Survey, Wave 2. The sample included 9,491 women from across the UK, 2,697 of
27 whom had mobility impairment. The survey method involved face-to-face and
28 telephone interviews.
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35 **Outcome measures:** Self-report of the last time a mammogram was undertaken.

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37 **Results:** Adjusting for various demographic and socioeconomic variables, women
38 with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a
39 mammogram than women without mobility impairment. Concerning women with
40 mobility impairment, married women had more than twice the odds of having a
41 mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-
42 2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of
43 undertaking the test than women from England. Women with upper secondary
44 education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than
45 women with primary or lower secondary education. Also, women from higher
46 quintiles (third and fifth quintiles) had higher odds of utilising mammography, with
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3 the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than
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5 women from the first quintile.
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8 **Conclusions:** In order to achieve equitable access to mammography for all women, it
9
10 is important to acknowledge the barriers that impede women with mobility
11
12 impairment from using the service. These barriers can refer to structural disadvantage,
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14 such as lower income and employment rate, transportation barriers, or previous
15
16 negative experiences, among others.
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19 20 21 **Strengths and limitations of this study** 22

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24 • This study is based on a nationally-representative sample of community-
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26 dwelling women.
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29 • We use various demographic and socioeconomic variables to investigate the
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31 association between these factors and mammography for women with mobility
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33 impairment in the UK.
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36 • Outcome measures were self-reported, which might have introduced response
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38 bias.
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41 • We cannot establish any causal links, due to the study's cross-sectional design.
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INTRODUCTION

Research has shown that people with physical disabilities generally report worse access and utilisation of healthcare services, including preventive and screening services.[1-5] Several studies have evidenced how access to some cancer screening services can be compromised due to the presence of pre-existing physical disability.[6-11] A recent study in the UK showed that women with disabilities – including women with physical limitations – report worse access to healthcare compared to any other group, perhaps illustrating how gender and disability intersect to create structural disadvantage for disabled women.[3]

There are several reasons that have been associated with lower utilisation of healthcare services by people with disabilities, and for women in particular. These include, among other reasons, inaccessible healthcare facilities and/or equipment, lack of appropriate parking, lack of social support, and financial constraints, and the intersection of all these factors with gender-based structural disadvantage.[1,5, 8]

There are also several intangible barriers that negatively affect utilisation of healthcare services by disabled women; past negative experiences with healthcare professionals, being treated as a low-priority patient, not being adequately informed, or having their impairments ignored, are some of the reasons women give for the low utilisation of services, including mammography.[5-6]

Mammography is an important screening tool for breast cancer.[12] In well-resourced settings, which include most high-income countries, the World Health Organisation's position paper on mammography recommends population-based screening every two years for all women aged 50-69 years.[12] Several countries, including the US, Norway, Denmark, and the UK implement such national screening programmes.[13-17] A Cochrane systematic review showed that the benefits of

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3 mortality decrease might be outweighed by over-diagnosis rates and higher rates of
4 aggressive treatment, both of which were attributed to mammography.[18] However,
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6 there is strong evidence showings that population-wide screening could lead to an
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8 increase of early-cancer diagnosis, with a concomitant decrease of late-stage
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10 diagnosis, hence leading to a mortality decrease.[12,19]
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15 In the United Kingdom, women between the ages of 50 and 70 are invited to
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17 undertake a mammogram every three years, as part of a national screening
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19 programme by the National Health Service (NHS).[20] While there is evidence for
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21 women in England,[21] little is known regarding mammography utilisation by women
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23 with physical impairments across the UK; it is not known whether there is a
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25 difference in the utilisation rates between women with and without any mobility
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27 impairments, nor which are some of the factors associated with these utilisation rates.
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32 Most of the existing evidence suggests that women with disabilities have
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34 lower utilisation rates and worse access to mammography compared to women
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36 without disabilities.[8,10,22-25] Transportation, quality of the experience, and lack of
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38 appropriate information, are among the reasons given for this.[6,26] Several of these
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40 studies are small-scale studies, which although they give important insights into the
41
42 experiences of women as they navigate the healthcare system, they do not allow any
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44 conclusions regarding utilisation of preventive services at a population level. A recent
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46 large prospective study showed that women with disabilities in England have lower
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48 odds of having a mammogram compared to women without a disability.[21].
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52 In this article, we examine the utilisation of mammography by women with
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54 lower limb mobility impairments in the UK. We use this term to refer to women who
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56 report difficulty or inability to walk or climb stairs, as per the available data from the
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58 European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether
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3 women with lower limb mobility impairments have lower odds of utilising
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5 mammography compared to women with no such impairment, and explore the factors
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7 that are associated with lower utilisation.
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10 This study seeks to add to the current body of evidence regarding utilisation of
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12 mammography by disabled women, by producing population-level evidence, and
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14 examining the association of a variety of demographic and socioeconomic factors –
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16 such as low income or lack of social support – with utilisation of mammography. This
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18 knowledge can inform policy and lead to the design of comprehensive support
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20 systems and target interventions that would enable real access to services, addressing
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22 not only the availability of services but also their utilisation.
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28 **METHODOLOGY**

29 **Survey**

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31 We performed secondary analysis, using logistic regressions, of de-identified cross-
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33 sectional data from the European Health Interview Survey, Wave 2. The EHIS
34
35 collects health data of representative samples of population across European Union
36
37 member states, providing thus the possibility to compare health indicators between
38
39 countries. It is administered every five years.[27]
40
41
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44

45 The survey consists of four modules: a) demographic and socioeconomic
46
47 variables, such as age, sex, marital status, employment, education, etc.; b) variables
48
49 on health status, for example self-perceived general health, chronic conditions,
50
51 accidents, functional limitations in daily activities, etc.; c) variables on health care
52
53 use, such as consultations, unmet healthcare needs, preventive services, etc.; and d)
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55 health determinants, for instance weight, smoking, alcohol consumption, exercise,
56
57 social support, etc.[28] The survey analyses 21 areas of health concerns and health-
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3 related behaviours, and 81 specific item-questions. All measures are self-reported.[29]

4
5 For more information on the EHIS questionnaire, please refer to the survey

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7
8 website.[27,28]

9
10 The United Kingdom did not participate in the first EHIS wave (2006-2009),
11
12 but it did take part in the second wave. Data was collected for residents in private
13
14 households, over 16 years of age, residing in England, Wales, Scotland, and Northern
15
16 Ireland. For Great Britain, data was collected between April 2013 and March 2014 by
17
18 the Office for National Statistics. Data for Northern Ireland was collected between
19
20 April and September 2014 by the Northern Ireland Statistics and Research Agency. In
21
22 Great Britain, the survey was conducted as a follow-up to the Labour Force Survey;
23
24 individuals who did not object in their final wave of contact, in the sampled
25
26 households, completed the EHIS Wave 2 questionnaire. In Northern Ireland, a simple
27
28 random sample of households on the Land and Property Services Agency property
29
30 gazetteer was used. In total, the UK survey included 20,161 observations, a sample
31
32 size which was much higher than the estimated minimum effective size for the
33
34 country, which was 13,085.[30]

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38
39 The interviews involved both face-to-face (20%) and telephone interviews
40
41 (80%). For the face-to-face interviews, the interviewers conducted Computer-Assisted
42
43 Personal Interviews (CAPI) using laptops at the address of the respondents, while for
44
45 the telephone interviews, Computer-Assisted Telephone Interviews (CATI) were
46
47 conducted. The CAPI and CATI questionnaires were generally similar, with only
48
49 minor changes to account for the different mode of interviewing.[30]

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53
54 The microdata did not contain any personal information, such as names or
55
56 addresses, which would allow direct identification. In order to ensure confidentiality,
57
58 a set of anonymisation rules was applied.[31] Access to microdata is granted only for
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3 scientific purposes; we were granted access by the UK Data Service
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5 (www.ukdataservice.ac.uk).
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10 **Data and variables**

11
12 There are two questions in the EHIS that measure mobile difficulty: a) variable PL6,
13
14 “Difficulty in walking half a km on level ground without the use of any aid”, and b)
15
16 variable PL7, “Difficulty in walking up or down 12 steps”. These two variables were
17
18 merged into a new variable, called ‘mobility impairment’, with answers ‘without
19
20 difficulty’ (women that answered that they had no difficulty in performing either
21
22 tasks), and ‘with difficulty’ (women that replied that they had some difficulty in
23
24 performing or were unable to do at least one of the tasks).
25
26
27

28
29 Our dependent variable, “up to date with mammography”, was recoded and
30
31 was binary, that is, ‘Yes’ (included the answers “within the last 12 months”, “1 to less
32
33 than 2 years”, and “2 to less than 3 years”), and ‘No’ (“more than 3 years” and
34
35 “never”). This recoding was done according to the NHS guidelines on
36
37 mammography.[26] Previous research has also employed this variable, looking at
38
39 women being up to date with mammography.[10]
40
41

42
43 In total, we had 9,995 observations for women that answered the question on
44
45 mammography. Since STATA, by default, performs listwise-deletion and displays
46
47 calculations that have non-missing values on all variables listed, our total sample size
48
49 was 9,491 observations (6,794 observations for women without mobility impairment,
50
51 and 2,697 for women with mobility impairment). Since only a very small percentage
52
53 of observations was deleted, we decided not to proceed to maximum likelihood or
54
55 multiple imputation.[32] The sample is representative of the target population (test
56
57 results available upon request).
58
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3 The control variables included the following: a) *age*: 20-49 / 50-69 / 70+
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5 (while the target group is 50-69-year-old women, the survey showed that almost 30%
6
7 of women outside the target group have undertaken a mammogram); b) *civil status*:
8
9 never married / married / widowed / divorced; c) *region*: England / Wales / Scotland /
10
11 Northern Ireland; d) *urbanisation*: thinly-populated area / moderate-populated area /
12
13 densely-populated area; e) *education*: primary and lower secondary / upper secondary
14
15 / post-secondary and tertiary, short / tertiary; f) *income quintiles* (net monthly
16
17 equivalised household income): 1st quintile / 2nd quintile / 3rd quintile / 4th quintile / 5th
18
19 quintile; g) *employment*: unemployed / employed / inactive; h) *health self-*
20
21 *assessment*: bad (answers ‘bad’ and ‘very bad’) / fair (answer ‘fair’) / good (answers
22
23 ‘good’ and ‘very good’); and i) *help from neighbours* (how easy it is to get help from
24
25 neighbours in case of need): difficult / possible / easy.
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30 All analyses were performed using STATA/MP version 14.2.
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32
33

34 **Patient and Public Involvement**

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37 Patients were not directly involved in the design or conduct of this study. However,
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39 the research question and outcome measures were informed by patients’ priorities,
40
41 and experiences, as these were communicated through patient and public involvement
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43 in a previous study (the Challenges of Cancer and Disability Study, Tenovus
44
45 TIG2017-05).
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50 **RESULTS**

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53 Table 1 summarises the characteristics of the study sample.
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56

57 **Table 1:** Comparison between women with and without mobility impairment
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Parameter	Women without mobility impairment (n=6,794)		Women with mobility impairment (n=2,697)		p value, chi-squared test
	n	%	n	%	
Age groups					
	20-49 (n=3,270)	2,919	43.0	351	13.0
	50-69 (n=3,971)	2,839	42.8	1,132	42.0
	70+ (n=2,250)	1,036	15.3	1,214	45.1
Civil status					
	Never married (n=1,515)	1,259	18.5	256	9.5
	Married (n=5,386)	4,097	60.3	1,289	47.8
	Widowed (n=1,324)	604	8.9	720	26.7
	Divorced (n=1,266)	834	12.3	432	16.0
Region					
	England (n=7,895)	5,695	83.8	2,200	81.6
	Wales (n=421)	269	4.0	152	5.6
	Scotland (n=822)	596	8.8	226	8.4
	Northern Ireland (n=353)	234	3.4	119	4.4
Urbanisation					
	Thinly-populated area (n=1,322)	945	13.9	377	14.0
	Moderate-populated area (n=2,575)	1,842	27.1	733	27.2
	Densely-populated area (n=5,594)	4,007	59.0	1,587	58.8
Education					
	Primary / lower secondary (n=3,040)	1,699	25.0	1,341	49.7
	Upper secondary (n=3,223)	2,394	35.2	829	30.7
	Post secondary / tertiary, short (n=1,495)	1,156	17.0	339	12.6
	Tertiary (n=1,733)	1,545	22.7	188	7.0
Income quintiles					
	1 st quintile (n=1,962)	1,108	16.3	854	31.7
	2 nd quintile (n=2,008)	1,336	19.7	672	24.9
	3 rd quintile (n=1,932)	1,352	19.9	580	21.5
	4 th quintile (n=1,852)	1,493	22.0	359	13.3
	5 th quintile (n=1,737)	1,505	22.2	232	8.6
Employment					
	Unemployed (n=360)	271	4.0	89	3.3
	Employed (n=4,304)	3,836	56.5	468	17.4
	Inactive (n=4,827)	2,687	39.6	2,140	79.4
Health self-assessment					

	Bad (n=797)	90	1.3	707	26.2	<i>p</i> < 0.0001
	Fair (n=1,896)	774	11.4	1,122	41.6	
	Good (n=6,798)	5,930	87.3	868	32.2	
Help from neighbours						
	Difficult (n=1,312)	805	11.9	507	18.8	<i>p</i> < 0.0001
	Possible (n=1,923)	1,426	21.0	497	18.4	
	Easy (n=6,256)	4,563	67.2	1,693	62.8	

Note: For more information on the variables, please see the EHIS Wave 2 methodological manual.[28]

Some of the points presented in Table 1 are of particular interest. Firstly, concerning education, about half of women with mobility impairment had only primary or lower secondary education, as opposed to only a quarter of women without any mobility impairment; a much higher percentage of women from the latter group had also attended tertiary education. Secondly, more women with mobility impairment (32%) belonged to the first income quintile than women with no mobility impairment (16%). Less than 9% of women from the former group belonged to the richest segment; this percentage was more than 22% for women without any mobility impairment. Thirdly, the percentage of women with mobility impairment that were inactive was double (i.e. almost 80%) than that of women without any mobility problems. All these points underline the structural disadvantage faced by women with mobility impairment in the UK: lower education and lower income, coupled with a much higher likelihood of being inactive employment-wise.

Figure 1 shows the percentage of women (total sample, including both women with and without mobility impairment) that have undertaken mammography, by age group.

[Please place Figure 1 here]

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3 As it can be seen in Figure 1, 71% of all women who undertook mammography were
4 in the target group, i.e. 50-69 years of age. Almost 30% of all women that underwent
5 the test were outside the target group. In certain parts of England, women younger
6 than 50 and older than 70 years are invited for mammograms, [33], while a systematic
7 review has shown that women out of the target group also undergo
8 mammography.[18]
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16
17 Figure 2 shows women with and without mobility impairments that have
18 undertaken mammography, by age group.
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22 [Please place Figure 2 here]
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26 Figure 2 shows that almost 30% of women with mobility impairment that undertook
27 mammography were 70+ years-old, i.e. outside the target group; this percentage is
28 less than half of that for women without mobility impairment.
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33 We performed logistic regressions to see whether there was any difference in
34 utilisation rates of mammography between women with and without mobility
35 impairment in the UK, and to investigate the factors associated with such rates. The
36 first logistic regression – which included all the variables of Table 1 – showed that
37 women with mobility impairment had 1.3 times lower odds of undertaking a
38 mammogram than women without mobility problems (OR: .80, 95% CI = .70-.92,
39 p=.002) (full results not presented here but available upon request).
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50 Next, Table 2 presents possible factors associated with having a mammogram
51 for women with mobility impairment in the UK. Model (1) presents age-adjusted odds
52 ratios. Model (2) incorporates other demographic and socioeconomic variables, while
53 Model (3) presents the fully-adjusted odds ratios (includes all variables of Table 1).
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Table 2: Factors associated with utilisation rates of mammography by women with mobility impairment in the UK

Variables	Model (1)		Model (2)		Model (3)	
	OR	95% CI	OR	95% CI	OR	95% CI
Age groups (20-49 as reference)						
50-69	11.57***	8.67-15.44	11.99***	8.78- 16.38	12.12***	8.85-16.61
70+	1.69***	1.27-2.25	1.96***	1.39-2.75	1.94***	1.37- 2.74
Civil status (never married as reference)						
Married			2.05***	1.48-2.85	2.07***	1.49-2.88
Widowed			.934	.65-1.34	.95	.66-1.37
Divorced			1.44	1.00-2.08	1.46*	1.01-2.12
Regions (England as reference)						
Wales			1.00	.68-1.48	1.01	.68-1.49
Scotland			1.48*	1.06-2.05	1.51*	1.08-2.10
Northern Ireland			.91	.58-1.41	.90	.57-1.40
Urbanisation (thinly-populated as reference)						
Intermediate-populated area			.89	.67-1.19	.90	.67-1.20
Densely-populated area			.77	.59-1.01	.77	.59-1.01
Education (primary/lower secondary as ref.)						
Upper secondary			1.33**	1.08-1.64	1.36**	1.10-1.67
Post secondary and tertiary, short			1.20	.91-1.58	1.21	.91-1.60
Tertiary			.88	.61-1.28	.88	.60-1.28
Employment (unemployed as reference)						
Employed			.94	.54-1.66	.93	.53-1.63
Inactive			1.29	.76-2.20	1.30	.76-2.22
Income (1st quintile as reference)						
2 nd quintile			1.11	.88-1.40	1.09	.86-1.38
3 rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4 th quintile			1.18	.87-1.59	1.18	.87-1.60
5 th quintile			1.46*	1.01-2.11	1.49**	1.02-2.15
Health self-assessment (bad as reference)						
Fair					1.14	.91-1.42
Good					1.11	.87-1.42
Support from neighbours (difficult as ref.)						
Possible					1.08	.81-1.45
Easy					1.07	.85-1.35
Observations	2,790		2,738		2,697	
Pseudo R²	0.1636		0.1908		0.1923	

Chi² (21)	631.29	722.80	718.04
Prob>Chi²	0.0000	0.0000	0.0000
McFadden R²	0.162	0.179	0.180
Deviance	3228.188	3066.311	3015.368
AIC	3234.188	3106.311	3063.368
BIC	3251.989	3224.610	3204.965

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

Due to a higher Mac Fadden R², and lower deviance, and AIC and BIC values, Model (3) provided a better fit than the previous two models. There was no collinearity affecting the results, with mean variance inflation factor (VIF) of 2.21.

As it can be seen in Table 2, the target group for having a mammogram (i.e. the 50-69 group) was the one with the highest odds of undertaking it: women in this age subgroup had 12 times higher odds of having this screening than women in the 20-49 subgroup. Regarding civil status, married women had more than twice the odds of having a mammogram than women that had never been married; divorced women had 1.5 times higher odds. Women with mobility impairment in Scotland had 1.5 times higher odds of having the mammogram than women in England. Women with upper secondary education had 1.4 times higher odds to have a mammogram than women with primary or lower secondary education. Also, women from higher income quintiles (third and fifth quintiles) had higher odds of undertaking the mammogram, with the women in the fifth quintile having 1.5 times higher odds than women from the first quintile.

DISCUSSION

In this study, we investigated whether women with mobility impairment in the UK were less likely to be up to date with mammography compared to women with no mobility impairment, and explored some of the factors associated with lower

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3 utilisation. The results showed a statistically significant difference between women
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5 with and without mobility impairment, with women with mobility impairment having
6
7 1.3 times lower odds of undertaking a mammogram than women without mobility
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9 impairment. Furthermore, the results showed a positive association between married
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11 civil status, high income, educational attainment, and living in Scotland, and being up
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13 to date with mammography.
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17 One of the strengths of the study is that it is based on data from a nationally-
18
19 representative sample. It also adds to the body of literature by examining the
20
21 association of several factors with mammography utilisation for women with mobility
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23 impairment, an issue that has been generally little explored, particularly in the UK.
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25

26
27 One of the limitations of the study is that while we established associations
28
29 between various factors and utilisation of mammography by women with mobility
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31 impairment, we cannot infer causality due to the cross-sectional nature of the data.
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33 Another limitation of the study is that there is no information in the EHIS on the
34
35 reasons that influence utilisation of mammography. Furthermore, the EHIS relies on
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37 self-reporting information, which leaves the instrument open to response bias;
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39 however, there is no relevant information on this aspect. Another limitation of the
40
41 study is the way mobility impairment was defined, which potentially included women
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43 with only short-term impairment, together with women with longer-term impairment;
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45 this might have had an impact on external validity.
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50 The findings showed that women with mobility impairment had 1.3 lower
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52 odds of being up to date with mammography. This is consistent with previous
53
54 research that shows that in the UK, there are long-standing inequalities between
55
56 people's cancer experiences.[34] This finding is also consistent with research findings
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58 from a study in England. [25] Bone et al. performed an analysis of data from the
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2
3 National Cancer Patient Experience Survey.[35] They analysed data from 71,793
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5 cancer patients and found evidence that cancer patients with long-standing conditions
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7 in England, including people with physical conditions and disabilities, reported poorer
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9 care. These inequalities persisted even when controlling for other factors. Further to
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11 this, people with pre-existing disability diagnosed with cancer report low satisfaction
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13 and use of services.[7-8, 36] As Liu and Clark have shown, quality of the experience
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15 matters;[37] previous negative experiences with mammography might deter women
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17 with physical impairments from undertaking the test in the future.
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21 The findings also showed that married women had higher odds of having a
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23 mammogram than women that had never been married. This result is in accordance
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25 with evidence demonstrating the protective role of married civil status.[23,38] Indeed,
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27 married people tend to have more fixed residence, regular doctors, and fixed
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29 healthcare places, and therefore are more likely to be informed and accept preventive
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31 health services than unmarried people.[38] They have also a stronger social network
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33 (for example, family members, relatives, and friends) that can offer them more
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35 emotional and practical support (for instance, transportation) to attend such
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37 screenings, as well as help them adopt healthier behaviours.
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41 Our study also revealed that there are differences in the utilisation rates of
42
43 mammography between women living in different regions in the United Kingdom,
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45 with women with mobility impairment living in Scotland having higher odds of
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47 undertaking the test than women in England. The reason behind this might be the
48
49 usage of mobile screening units in Scotland, which appears to enable access to
50
51 mammography for underserved populations.[39]
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55 Furthermore, our study showed that women with mobility impairments with
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57 higher education had higher odds of having a mammogram than women with primary
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3 or lower secondary education. Women with mobility impairment that belonged to
4
5 higher income quintiles had also higher odds of having a mammogram than women
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7 belonging to the first quintile. This result agrees with previous research that found
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9 that disabled women with higher education and an overall higher socioeconomic
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11 status were more likely to undertake preventive exams.[40-41] Educational attainment
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13 beyond upper secondary did not seem to have any further positive effect on the uptake
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15 of mammography.
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19 These inequalities in the experiences of patients with cancer in the UK conflict
20
21 with several of the recommendations of recent strategic documents, including
22
23 ‘Achieving world-class cancer outcomes: a Strategy for England 2015-2020’ and the
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25 Cancer Delivery Plan for Wales.[42,43] Both documents call for access to equitable
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27 care, achieving the best experience, and promoting delivery of cancer care responsive
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29 to individual needs.
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33 Overall, taking into account the global demographic, epidemiological, and
34
35 socioeconomic changes – including ageing, urbanisation, reduction in morbidity and
36
37 mortality rates, and increase in chronic diseases – it is essential that preventive health
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39 services are better promoted and reach all people, especially disadvantaged groups,
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41 such as people with disabilities, women, and the poor. The WHO position paper on
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43 mammography states that:
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47 “Population-based screening programmes identify and individually invite each
48
49 person in the eligible population to attend each round of screening so that each
50
51 person in the eligible population has an equal chance of benefiting from
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53 screening.” (p.23).[12]
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56 This statement, however, overlooks the fact that not everyone has an equal chance of
57
58 benefitting from screening; people with mobility impairment may, for example, face
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1
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3 transportation barriers, which could stop them from accessing screening services,
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5 despite their availability. Women with mobility impairment, and disabilities in
6
7 general, are further disadvantaged, as they also face structural disadvantage – in the
8
9 form of lower education, lower income, and greater poverty – than men, as shown in
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11 this study and supported by a body of existing research.[44-45] In order to enhance
12
13 the utilisation of mammography (and possibly the use of other preventive services), it
14
15 is important to acknowledge the barriers that stop women from using the service and
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17 adopt measures that would lead to a more equitable utilisation. The wide adoption of
18
19 mobile screening units might be a way to improve access for this population. This
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21 needs to be complemented by increased disability-awareness for healthcare
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23 professionals, making them sensitive to addressing impairment-specific needs in order
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25 to achieve inclusive services for all.
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33 **Acknowledgments**

34
35 We wish to thank Gill Tyrer for her contribution as a patient and public representative
36
37 in a previous project (Tenovus, TIG2017-05), which offered the stimulus to explore
38
39 barriers to cancer screening for this population.
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45 **Contributors**

46
47 DS and ESR jointly conceived the final research question and aims and objectives,
48
49 reviewed the literature, produced the analysis plan and carried out the analysis, and
50
51 drafted the manuscript.
52
53

54 **Funding**

55
56 None declared.
57

58 **Competing interests**

1
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3 None declared.
4

5 **Ethics approval**

6
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8 None required.
9

10 **Data sharing statement**

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12 Technical appendix and dataset available from the UK Data Service.
13

14 <https://discover.ukdataservice.ac.uk/catalogue/?sn=7881>
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For peer review only

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3 **Figure legends**
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8 **Figure 1:** Women having undertaken mammography, by age group (%)
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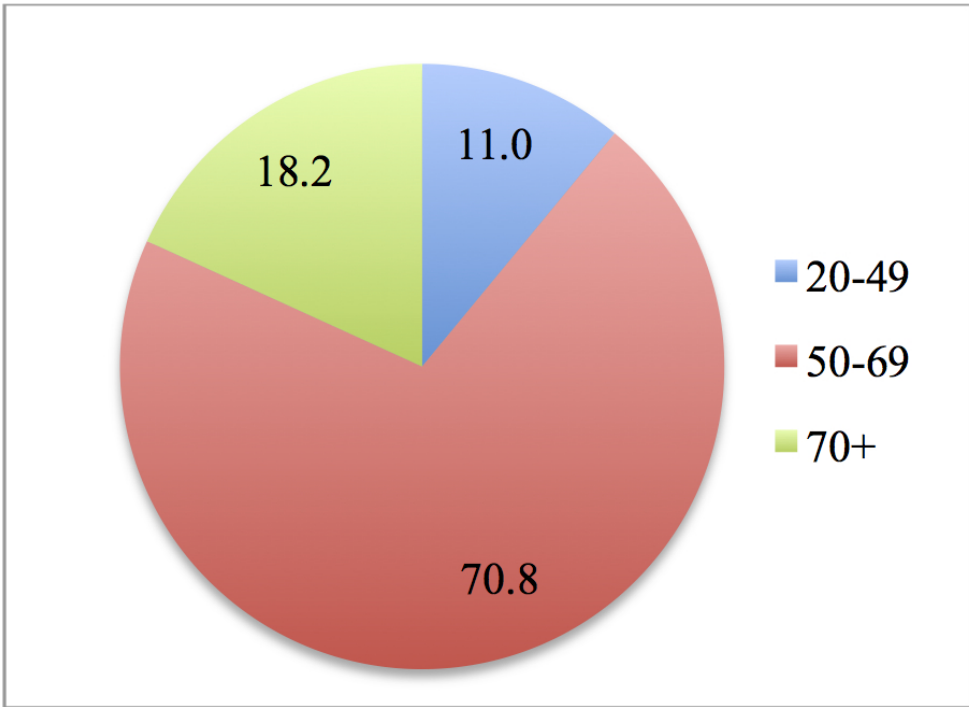
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12 Note: 4,433 women in total.
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17 **Figure 2:** Women with and without mobility impairment having undertaken
18 mammography, by age group (%)
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23 Note 1: 3,145 women without mobility impairment and 1,288 women with mobility
24 impairment.
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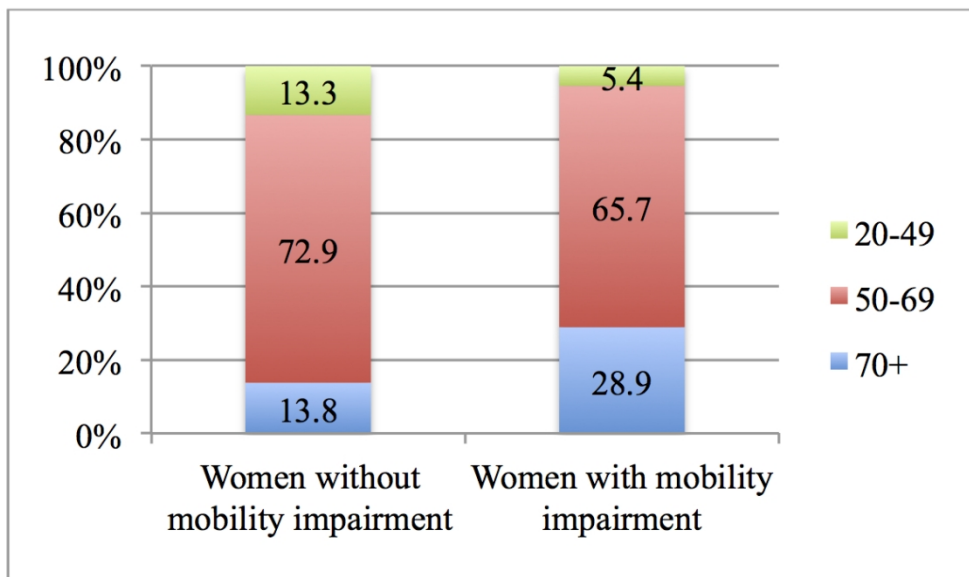
27 Note 2: Differences are statistically significant.
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Women having undertaken mammography, by age group (%)

197x144mm (120 x 120 DPI)



Women with and without mobility impairment having undertaken mammography, by age group (%)

255x151mm (120 x 120 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
Title and abstract	X 1	X p.1 (a) Indicate the study's design with a commonly used term in the title or the abstract
		X p.2 (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	X p.4-5 2	Explain the scientific background and rationale for the investigation being reported
Objectives	X p.6 3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	X p.2, p.6 4	Present key elements of study design early in the paper
Setting	X p.6-7 5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	X p. 7-8 6	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	X p. 8-9 7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	X p. 8-9 8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	X p. 14 9	Describe any efforts to address potential sources of bias
Study size	X p. 8-9 10	Explain how the study size was arrived at
Quantitative variables	X p. 8-9 11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	X 12	X p. 6-8 (a) Describe all statistical methods, including those used to control for confounding
		(b) Describe any methods used to examine subgroups and interactions
		X p.8-9 (c) Explain how missing data were addressed
		(d) If applicable, describe analytical methods taking account of sampling strategy
		(e) Describe any sensitivity analyses
Results		
Participants	X 13*	X p. 8 (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	X 14*	X p.9-10 (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	X p. 8 15*	Report numbers of outcome events or summary measures
Main results	X p.12, p. 13 16	X (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

		X p.9 (b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	X p.14 18	Summarise key results with reference to study objectives
Limitations	X p.14 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	X p. 16-17 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	X p.14 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	X p.17 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Utilisation of mammography by women with mobility impairments in the United Kingdom: a secondary analysis of cross-sectional data

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-024571.R2
Article Type:	Research
Date Submitted by the Author:	29-Jan-2019
Complete List of Authors:	Sakellariou, Dikaios; Cardiff University, School of Healthcare Sciences Rotarou, Elena; Universidad de Chile, Centre of Environmental and Natural Resource Economics, Faculty of Economics and Business
Primary Subject Heading:	Oncology
Secondary Subject Heading:	Public health, Epidemiology, Health services research, Patient-centred medicine
Keywords:	United Kingdom, women with mobility impairment, mammography, preventive services, cancer screening

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3 **Title: Utilisation of mammography by women with mobility impairments in the**
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5 **United Kingdom: a secondary analysis of cross-sectional data**
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11 Dikaios Sakellariou¹ and Elena S. Rotarou²
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16 ¹Dikaios Sakellariou

17
18 Corresponding author: Cardiff University, School of Healthcare Sciences,
19
20 Eastgate House, Newport Road 35-43, Cardiff, CF24 0AB, UK
21

22
23 Email: sakellarioud@cardiff.ac.uk
24

25 Telephone number: 02920687744
26
27

28
29
30 ² Elena S. Rotarou

31
32 University of Chile, Centre of Environmental and Natural Resource Economics,
33
34 Faculty of Economics and Business,
35
36 Diagonal Paraguay 257, Office 1506, Santiago, 8330015, Chile
37

38
39 Email: erotarou@fen.uchile.cl
40

41 Telephone number: (56-2) 978-3455
42
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44
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46 **Keywords:** women with mobility impairment; mammography; preventive services;
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48 cancer screening; United Kingdom
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52 **Word count:** 3770
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3 **Utilisation of mammography by women with mobility impairments**
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5 **in the United Kingdom: a secondary analysis of cross-sectional data**
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10 **ABSTRACT**

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12 **Objectives:** Research has shown that people with physical disabilities report lower
13 utilisation of preventive services. The aim of this study was to examine whether
14 women with mobility impairments have lower odds of utilising mammography
15 compared to women with no such impairment, and explore the factors that are
16 associated with lower utilisation.
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24 **Sample and Design:** We performed secondary analysis, using logistic regressions, of
25 de-identified cross-sectional data from the European Health Interview Survey, Wave
26 2. The sample included 9,491 women from across the UK, 2,697 of whom had
27 mobility impairment. The survey method involved face-to-face and telephone
28 interviews.
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35 **Outcome measures:** Self-report of the last time a mammogram was undertaken.

36
37 **Results:** Adjusting for various demographic and socioeconomic variables, women
38 with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a
39 mammogram than women without mobility impairment. Concerning women with
40 mobility impairment, married women had more than twice the odds of having a
41 mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-
42 2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of
43 undertaking the test than women from England. Women with upper secondary
44 education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than
45 women with primary or lower secondary education. Also, women from higher
46 quintiles (third and fifth quintiles) had higher odds of utilising mammography, with
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3 the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than
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5 women from the first quintile.
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8 **Conclusions:** In order to achieve equitable access to mammography for all women, it
9
10 is important to acknowledge the barriers that impede women with mobility
11
12 impairment from using the service. These barriers can refer to structural disadvantage,
13
14 such as lower income and employment rate, transportation barriers, or previous
15
16 negative experiences, among others.
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19 20 21 **Strengths and limitations of this study** 22

- 23
24 • This study is based on a nationally-representative sample of community-
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26 dwelling women.
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29 • We use various demographic and socioeconomic variables to investigate the
30
31 association between these factors and mammography for women with mobility
32
33 impairment in the UK.
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36 • Outcome measures were self-reported, which might have introduced response
37
38 bias.
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41 • We cannot establish any causal links, due to the study's cross-sectional design.
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INTRODUCTION

Research has shown that people with physical disabilities generally report worse access and utilisation of healthcare services, including preventive and screening services.[1-5] Several studies have evidenced how access to some cancer screening services can be compromised due to the presence of pre-existing physical disability.[6-11] A recent study in the UK showed that women with disabilities – including women with physical limitations – report worse access to healthcare compared to any other group, perhaps illustrating how gender and disability intersect to create structural disadvantage for disabled women.[3]

There are several reasons that have been associated with lower utilisation of healthcare services by people with disabilities, and for women in particular. These include, among other reasons, inaccessible healthcare facilities and/or equipment, lack of appropriate parking, lack of social support, and financial constraints, and the intersection of all these factors with gender-based structural disadvantage.[1,5, 8]

There are also several intangible barriers that negatively affect utilisation of healthcare services by disabled women; past negative experiences with healthcare professionals, being treated as a low-priority patient, not being adequately informed, or having their impairments ignored, are some of the reasons women give for the low utilisation of services, including mammography.[5-6]

Mammography is an important screening tool for breast cancer.[12] In well-resourced settings, which include most high-income countries, the World Health Organisation's position paper on mammography recommends population-based screening every two years for all women aged 50-69 years.[12] Several countries, including the US, Norway, Denmark, and the UK implement such national screening programmes.[13-17] A Cochrane systematic review showed that the benefits of

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3 mortality decrease might be outweighed by over-diagnosis rates and higher rates of
4 aggressive treatment, both of which were attributed to mammography.[18] However,
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6 there is strong evidence showings that population-wide screening could lead to an
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8 increase of early-cancer diagnosis, with a concomitant decrease of late-stage
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10 diagnosis, hence leading to a mortality decrease.[12,19]
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15 In the United Kingdom, women between the ages of 50 and 70 are invited to
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17 undertake a mammogram every three years, as part of a national screening
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19 programme by the National Health Service (NHS).[20] While there is evidence for
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21 women in England,[21] little is known regarding mammography utilisation by women
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23 with physical impairments across the UK; it is not known whether there is a
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25 difference in the utilisation rates between women with and without any mobility
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27 impairments, nor which are some of the factors associated with these utilisation rates.
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32 Most of the existing evidence suggests that women with disabilities have
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34 lower utilisation rates and worse access to mammography compared to women
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36 without disabilities.[8,10,22-25] Transportation, quality of the experience, and lack of
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38 appropriate information, are among the reasons given for this.[6,26] Several of these
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40 studies are small-scale studies, which although they give important insights into the
41
42 experiences of women as they navigate the healthcare system, they do not allow any
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44 conclusions regarding utilisation of preventive services at a population level. A recent
45
46 large prospective study showed that women with disabilities in England have lower
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48 odds of having a mammogram compared to women without a disability.[21].
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52 In this article, we examine the utilisation of mammography by women with
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54 lower limb mobility impairments in the UK. We use this term to refer to women who
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56 report difficulty or inability to walk or climb stairs, as per the available data from the
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58 European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether
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3 women with lower limb mobility impairments have lower odds of utilising
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5 mammography compared to women with no such impairment, and explore the factors
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7 that are associated with lower utilisation.
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10 This study seeks to add to the current body of evidence regarding utilisation of
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12 mammography by disabled women, by producing population-level evidence, and
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14 examining the association of a variety of demographic and socioeconomic factors –
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16 such as low income or lack of social support – with utilisation of mammography. This
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18 knowledge can inform policy and lead to the design of comprehensive support
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20 systems and target interventions that would enable real access to services, addressing
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22 not only the availability of services but also their utilisation.
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28 **METHODOLOGY**

29 **Survey**

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31 We performed secondary analysis, using logistic regressions, of de-identified cross-
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33 sectional data from the European Health Interview Survey, Wave 2. The EHIS
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35 collects health data of representative samples of population across European Union
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37 member states, providing thus the possibility to compare health indicators between
38
39 countries. It is administered every five years.[27]
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45 The survey consists of four modules: a) demographic and socioeconomic
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47 variables, such as age, sex, marital status, employment, education, etc.; b) variables
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49 on health status, for example self-perceived general health, chronic conditions,
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51 accidents, functional limitations in daily activities, etc.; c) variables on health care
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53 use, such as consultations, unmet healthcare needs, preventive services, etc.; and d)
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55 health determinants, for instance weight, smoking, alcohol consumption, exercise,
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57 social support, etc.[28] The survey analyses 21 areas of health concerns and health-
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3 related behaviours, and 81 specific item-questions. All measures are self-reported.[29]

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5 For more information on the EHIS questionnaire, please refer to the survey

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7 website.[27,28]

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10 The United Kingdom did not participate in the first EHIS wave (2006-2009),
11 but it did take part in the second wave. Data was collected for residents in private
12 households, over 16 years of age, residing in England, Wales, Scotland, and Northern
13 Ireland. For Great Britain, data was collected between April 2013 and March 2014 by
14 the Office for National Statistics. Data for Northern Ireland was collected between
15 April and September 2014 by the Northern Ireland Statistics and Research Agency. In
16 Great Britain, the survey was conducted as a follow-up to the Labour Force Survey;
17 individuals who did not object in their final wave of contact, in the sampled
18 households, completed the EHIS Wave 2 questionnaire. In Northern Ireland, a simple
19 random sample of households on the Land and Property Services Agency property
20 gazetteer was used. In total, the UK survey included 20,161 observations, a sample
21 size which was much higher than the estimated minimum effective size for the
22 country, which was 13,085.[30]

23
24 The interviews involved both face-to-face (20%) and telephone interviews
25 (80%). For the face-to-face interviews, the interviewers conducted Computer-Assisted
26 Personal Interviews (CAPI) using laptops at the address of the respondents, while for
27 the telephone interviews, Computer-Assisted Telephone Interviews (CATI) were
28 conducted. The CAPI and CATI questionnaires were generally similar, with only
29 minor changes to account for the different mode of interviewing.[30]

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31 The microdata did not contain any personal information, such as names or
32 addresses, which would allow direct identification. In order to ensure confidentiality,
33 a set of anonymisation rules was applied.[31] Access to microdata is granted only for
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3 scientific purposes; we were granted access by the UK Data Service
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5 (www.ukdataservice.ac.uk).
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10 **Data and variables**

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12 There are two questions in the EHIS that measure mobile difficulty: a) variable PL6,
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14 “Difficulty in walking half a km on level ground without the use of any aid”, and b)
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16 variable PL7, “Difficulty in walking up or down 12 steps”. These two variables were
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18 merged into a new variable, called ‘mobility impairment’, with answers ‘without
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20 difficulty’ (women that answered that they had no difficulty in performing either
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22 tasks), and ‘with difficulty’ (women that replied that they had some difficulty in
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24 performing or were unable to do at least one of the tasks).
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29 Our dependent variable, “up to date with mammography”, was recoded and
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31 was binary, that is, ‘Yes’ (included the answers “within the last 12 months”, “1 to less
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33 than 2 years”, and “2 to less than 3 years”), and ‘No’ (“more than 3 years” and
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35 “never”). This recoding was done according to the NHS guidelines on
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37 mammography.[26] Previous research has also employed this variable, looking at
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39 women being up to date with mammography.[10]
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43 In total, we had 9,995 observations for women that answered the question on
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45 mammography. Since STATA, by default, performs listwise-deletion and displays
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47 calculations that have non-missing values on all variables listed, our total sample size
48
49 was 9,491 observations (6,794 observations for women without mobility impairment,
50
51 and 2,697 for women with mobility impairment). Since only a very small percentage
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53 of observations was deleted, we decided not to proceed to maximum likelihood or
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55 multiple imputation.[32] The sample is representative of the target population (test
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57 results available upon request).
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The control variables included the following: a) *age*: 20-49 / 50-69 / 70+ (while the target group is 50-69-year-old women, the survey showed that almost 30% of women outside the target group have undertaken a mammogram); b) *civil status*: never married / married / widowed / divorced; c) *region*: England / Wales / Scotland / Northern Ireland; d) *urbanisation*: thinly-populated area / moderate-populated area / densely-populated area; e) *education*: primary and lower secondary / upper secondary / post-secondary and tertiary, short / tertiary; f) *income quintiles* (net monthly equivalised household income): 1st quintile / 2nd quintile / 3rd quintile / 4th quintile / 5th quintile; g) *employment*: unemployed / employed / inactive; h) *health self-assessment*: bad (answers ‘bad’ and ‘very bad’) / fair (answer ‘fair’) / good (answers ‘good’ and ‘very good’); and i) *help from neighbours* (how easy it is to get help from neighbours in case of need): difficult / possible / easy.

All analyses were performed using STATA/MP version 14.2.

Patient and Public Involvement

Patients were not directly involved in the design or conduct of this study. However, the research aim was informed by patients’ priorities, and experiences, as these were communicated through patient and public involvement in a previous study (the Challenges of Cancer and Disability Study, Tenovus TIG2017-05).

RESULTS

Table 1 summarises the characteristics of the study sample.

Table 1: Comparison between women with and without mobility impairment

Parameter	Women without mobility	Women with mobility	<i>p</i> value, chi-squared
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	impairment (n=6,794)		impairment (n=2,697)		test
	n	%	n	%	
Age groups					
20-49 (n=3,270)	2,919	43.0	351	13.0	$p < 0.0001$
50-69 (n=3,971)	2,839	42.8	1,132	42.0	
70+ (n=2,250)	1,036	15.3	1,214	45.1	
Civil status					
Never married (n=1,515)	1,259	18.5	256	9.5	$p < 0.0001$
Married (n=5,386)	4,097	60.3	1,289	47.8	
Widowed (n=1,324)	604	8.9	720	26.7	
Divorced (n=1,266)	834	12.3	432	16.0	
Region					
England (n=7,895)	5,695	83.8	2,200	81.6	$p < 0.0001$
Wales (n=421)	269	4.0	152	5.6	
Scotland (n=822)	596	8.8	226	8.4	
Northern Ireland (n=353)	234	3.4	119	4.4	
Urbanisation					
Thinly-populated area (n=1,322)	945	13.9	377	14.0	$p = 0.992$
Moderate-populated area (n=2,575)	1,842	27.1	733	27.2	
Densely-populated area (n=5,594)	4,007	59.0	1,587	58.8	
Education					
Primary / lower secondary (n=3,040)	1,699	25.0	1,341	49.7	$p < 0.0001$
Upper secondary (n=3,223)	2,394	35.2	829	30.7	
Post secondary / tertiary, short (n=1,495)	1,156	17.0	339	12.6	
Tertiary (n=1,733)	1,545	22.7	188	7.0	
Income quintiles					
1 st quintile (n=1,962)	1,108	16.3	854	31.7	$p < 0.0001$
2 nd quintile (n=2,008)	1,336	19.7	672	24.9	
3 rd quintile (n=1,932)	1,352	19.9	580	21.5	
4 th quintile (n=1,852)	1,493	22.0	359	13.3	
5 th quintile (n=1,737)	1,505	22.2	232	8.6	
Employment					
Unemployed (n=360)	271	4.0	89	3.3	$p < 0.0001$
Employed (n=4,304)	3,836	56.5	468	17.4	
Inactive (n=4,827)	2,687	39.6	2,140	79.4	
Health self-assessment					
Bad (n=797)	90	1.3	707	26.2	$p < 0.0001$
Fair (n=1,896)	774	11.4	1,122	41.6	

	Good (n=6,798)	5,930	87.3	868	32.2	
Help from neighbours						
	Difficult (n=1,312)	805	11.9	507	18.8	
	Possible (n=1,923)	1,426	21.0	497	18.4	$p < 0.0001$
	Easy (n=6,256)	4,563	67.2	1,693	62.8	

Note: For more information on the variables, please see the EHIS Wave 2 methodological manual.[28]

Some of the points presented in Table 1 are of particular interest. Firstly, concerning education, about half of women with mobility impairment had only primary or lower secondary education, as opposed to only a quarter of women without any mobility impairment; a much higher percentage of women from the latter group had also attended tertiary education. Secondly, more women with mobility impairment (32%) belonged to the first income quintile than women with no mobility impairment (16%). Less than 9% of women from the former group belonged to the richest segment; this percentage was more than 22% for women without any mobility impairment. Thirdly, the percentage of women with mobility impairment that were inactive was double (i.e. almost 80%) than that of women without any mobility problems. All these points underline the structural disadvantage faced by women with mobility impairment in the UK: lower education and lower income, coupled with a much higher likelihood of being inactive employment-wise.

Figure 1 shows the percentage of women (total sample, including both women with and without mobility impairment) that have undertaken mammography, by age group.

[Please place Figure 1 here]

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3 As it can be seen in Figure 1, 71% of all women who undertook mammography were
4 in the target group, i.e. 50-69 years of age. Almost 30% of all women that underwent
5 the test were outside the target group. In certain parts of England, women younger
6 than 50 and older than 70 years are invited for mammograms, [33], while a systematic
7 review has shown that women out of the target group also undergo
8 mammography.[18]
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16
17 Figure 2 shows women with and without mobility impairments that have
18 undertaken mammography, by age group.
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22 [Please place Figure 2 here]
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26 Figure 2 shows that almost 30% of women with mobility impairment that undertook
27 mammography were 70+ years-old, i.e. outside the target group; this percentage is
28 less than half of that for women without mobility impairment.
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33 We performed logistic regressions to see whether there was any difference in
34 utilisation rates of mammography between women with and without mobility
35 impairment in the UK, and to investigate the factors associated with such rates. The
36 first logistic regression – which included all the variables of Table 1 – showed that
37 women with mobility impairment had 1.3 times lower odds of undertaking a
38 mammogram than women without mobility problems (OR: .80, 95% CI = .70-.92,
39 p=.002) (full results not presented here but available upon request).
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50 Next, Table 2 presents possible factors associated with having a mammogram
51 for women with mobility impairment in the UK. Model (1) presents age-adjusted odds
52 ratios. Model (2) incorporates other demographic and socioeconomic variables, while
53 Model (3) presents the fully-adjusted odds ratios (includes all variables of Table 1).
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Table 2: Factors associated with utilisation rates of mammography by women with mobility impairment in the UK

Variables	Model (1)		Model (2)		Model (3)	
	OR	95% CI	OR	95% CI	OR	95% CI
Age groups (20-49 as reference)						
50-69	11.57***	8.67-15.44	11.99***	8.78- 16.38	12.12***	8.85-16.61
70+	1.69***	1.27-2.25	1.96***	1.39-2.75	1.94***	1.37- 2.74
Civil status (never married as reference)						
Married			2.05***	1.48-2.85	2.07***	1.49-2.88
Widowed			.934	.65-1.34	.95	.66-1.37
Divorced			1.44	1.00-2.08	1.46*	1.01-2.12
Regions (England as reference)						
Wales			1.00	.68-1.48	1.01	.68-1.49
Scotland			1.48*	1.06-2.05	1.51*	1.08-2.10
Northern Ireland			.91	.58-1.41	.90	.57-1.40
Urbanisation (thinly-populated as reference)						
Intermediate-populated area			.89	.67-1.19	.90	.67-1.20
Densely-populated area			.77	.59-1.01	.77	.59-1.01
Education (primary/lower secondary as ref.)						
Upper secondary			1.33**	1.08-1.64	1.36**	1.10-1.67
Post secondary and tertiary, short			1.20	.91-1.58	1.21	.91-1.60
Tertiary			.88	.61-1.28	.88	.60-1.28
Employment (unemployed as reference)						
Employed			.94	.54-1.66	.93	.53-1.63
Inactive			1.29	.76-2.20	1.30	.76-2.22
Income (1st quintile as reference)						
2 nd quintile			1.11	.88-1.40	1.09	.86-1.38
3 rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4 th quintile			1.18	.87-1.59	1.18	.87-1.60
5 th quintile			1.46*	1.01-2.11	1.49**	1.02-2.15
Health self-assessment (bad as reference)						
Fair					1.14	.91-1.42
Good					1.11	.87-1.42
Support from neighbours (difficult as ref.)						
Possible					1.08	.81-1.45
Easy					1.07	.85-1.35
Observations		2,790		2,738		2,697
Pseudo R²		0.1636		0.1908		0.1923

Chi² (21)	631.29	722.80	718.04
Prob>Chi²	0.0000	0.0000	0.0000
McFadden R²	0.162	0.179	0.180
Deviance	3228.188	3066.311	3015.368
AIC	3234.188	3106.311	3063.368
BIC	3251.989	3224.610	3204.965

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

Due to a higher Mac Fadden R², and lower deviance, and AIC and BIC values, Model (3) provided a better fit than the previous two models. There was no collinearity affecting the results, with mean variance inflation factor (VIF) of 2.21.

As it can be seen in Table 2, the target group for having a mammogram (i.e. the 50-69 group) was the one with the highest odds of undertaking it: women in this age subgroup had 12 times higher odds of having this screening than women in the 20-49 subgroup. Regarding civil status, married women had more than twice the odds of having a mammogram than women that had never been married; divorced women had 1.5 times higher odds. Women with mobility impairment in Scotland had 1.5 times higher odds of having the mammogram than women in England. Women with upper secondary education had 1.4 times higher odds to have a mammogram than women with primary or lower secondary education. Also, women from higher income quintiles (third and fifth quintiles) had higher odds of undertaking the mammogram, with the women in the fifth quintile having 1.5 times higher odds than women from the first quintile.

DISCUSSION

In this study, we investigated whether women with mobility impairment in the UK were less likely to be up to date with mammography compared to women with no mobility impairment, and explored some of the factors associated with lower

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3 utilisation. The results showed a statistically significant difference between women
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5 with and without mobility impairment, with women with mobility impairment having
6
7 1.3 times lower odds of undertaking a mammogram than women without mobility
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9 impairment. Furthermore, the results showed a positive association between married
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11 civil status, high income, educational attainment, and living in Scotland, and being up
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13 to date with mammography.
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17 One of the strengths of the study is that it is based on data from a nationally-
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19 representative sample. It also adds to the body of literature by examining the
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21 association of several factors with mammography utilisation for women with mobility
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23 impairment, an issue that has been generally little explored, particularly in the UK.
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27 One of the limitations of the study is that while we established associations
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29 between various factors and utilisation of mammography by women with mobility
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31 impairment, we cannot infer causality due to the cross-sectional nature of the data.
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33 Another limitation of the study is that there is no information in the EHIS on the
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35 reasons that influence utilisation of mammography. Furthermore, the EHIS relies on
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37 self-reporting information, which leaves the instrument open to response bias;
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39 however, there is no relevant information on this aspect. Another limitation of the
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41 study is the way mobility impairment was defined, which potentially included women
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43 with only short-term impairment, together with women with longer-term impairment;
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45 this might have had an impact on external validity.
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50 The findings showed that women with mobility impairment had 1.3 lower
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52 odds of being up to date with mammography. This is consistent with previous
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54 research that shows that in the UK, there are long-standing inequalities between
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56 people's cancer experiences.[34] This finding is also consistent with research findings
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58 from a study in England. [25] Bone et al. performed an analysis of data from the
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3 National Cancer Patient Experience Survey.[35] They analysed data from 71,793
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5 cancer patients and found evidence that cancer patients with long-standing conditions
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7 in England, including people with physical conditions and disabilities, reported poorer
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9 care. These inequalities persisted even when controlling for other factors. Further to
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11 this, people with pre-existing disability diagnosed with cancer report low satisfaction
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13 and use of services.[7-8, 36] As Liu and Clark have shown, quality of the experience
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15 matters;[37] previous negative experiences with mammography might deter women
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17 with physical impairments from undertaking the test in the future.
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21 The findings also showed that married women had higher odds of having a
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23 mammogram than women that had never been married. This result is in accordance
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25 with evidence demonstrating the protective role of married civil status.[23,38] Indeed,
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27 married people tend to have more fixed residence, regular doctors, and fixed
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29 healthcare places, and therefore are more likely to be informed and accept preventive
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31 health services than unmarried people.[38] They have also a stronger social network
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33 (for example, family members, relatives, and friends) that can offer them more
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35 emotional and practical support (for instance, transportation) to attend such
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37 screenings, as well as help them adopt healthier behaviours.
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42 Our study also revealed that there are differences in the utilisation rates of
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44 mammography between women living in different regions in the United Kingdom,
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46 with women with mobility impairment living in Scotland having higher odds of
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48 undertaking the test than women in England. The reason behind this might be the
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50 usage of mobile screening units in Scotland, which appears to enable access to
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52 mammography for underserved populations.[39]
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56 Furthermore, our study showed that women with mobility impairments with
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58 higher education had higher odds of having a mammogram than women with primary
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3 or lower secondary education. Women with mobility impairment that belonged to
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5 higher income quintiles had also higher odds of having a mammogram than women
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7 belonging to the first quintile. This result agrees with previous research that found
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9 that disabled women with higher education and an overall higher socioeconomic
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11 status were more likely to undertake preventive exams.[40-41] Educational attainment
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13 beyond upper secondary did not seem to have any further positive effect on the uptake
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15 of mammography.
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19 These inequalities in the experiences of patients with cancer in the UK conflict
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21 with several of the recommendations of recent strategic documents, including
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23 ‘Achieving world-class cancer outcomes: a Strategy for England 2015-2020’ and the
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25 Cancer Delivery Plan for Wales.[42,43] Both documents call for access to equitable
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27 care, achieving the best experience, and promoting delivery of cancer care responsive
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29 to individual needs.
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33 Overall, taking into account the global demographic, epidemiological, and
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35 socioeconomic changes – including ageing, urbanisation, reduction in morbidity and
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37 mortality rates, and increase in chronic diseases – it is essential that preventive health
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39 services are better promoted and reach all people, especially disadvantaged groups,
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41 such as people with disabilities, women, and the poor. The WHO position paper on
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43 mammography states that:
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47 “Population-based screening programmes identify and individually invite each
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49 person in the eligible population to attend each round of screening so that each
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51 person in the eligible population has an equal chance of benefiting from
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53 screening.” (p.23).[12]
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56 This statement, however, overlooks the fact that not everyone has an equal chance of
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58 benefitting from screening; people with mobility impairment may, for example, face
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3 transportation barriers, which could stop them from accessing screening services,
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5 despite their availability. Women with mobility impairment, and disabilities in
6
7 general, are further disadvantaged, as they also face structural disadvantage – in the
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9 form of lower education, lower income, and greater poverty – than men, as shown in
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11 this study and supported by a body of existing research.[44-45] In order to enhance
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13 the utilisation of mammography (and possibly the use of other preventive services), it
14
15 is important to acknowledge the barriers that stop women from using the service and
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17 adopt measures that would lead to a more equitable utilisation. The wide adoption of
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19 mobile screening units might be a way to improve access for this population. This
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21 needs to be complemented by increased disability-awareness for healthcare
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23 professionals, making them sensitive to addressing impairment-specific needs in order
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25 to achieve inclusive services for all.
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33 **Acknowledgments**

34
35 We wish to thank Gill Tyrer for her contribution as a patient and public representative
36
37 in a previous project (Tenovus, TIG2017-05), which offered the stimulus to explore
38
39 barriers to cancer screening for this population.
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45 **Contributors**

46
47 DS and ESR jointly conceived the final research question and aims and objectives,
48
49 reviewed the literature, produced the analysis plan and carried out the analysis, and
50
51 drafted the manuscript.
52
53

54 **Funding**

55
56 None declared.
57

58 **Competing interests**

1
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3 None declared.
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5 **Ethics approval**

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8 None required.
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10 **Data sharing statement**

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12 Technical appendix and dataset available from the UK Data Service.
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14 <https://discover.ukdataservice.ac.uk/catalogue/?sn=7881>
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For peer review only

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3 **Figure legends**
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8 **Figure 1:** Women having undertaken mammography, by age group (%)
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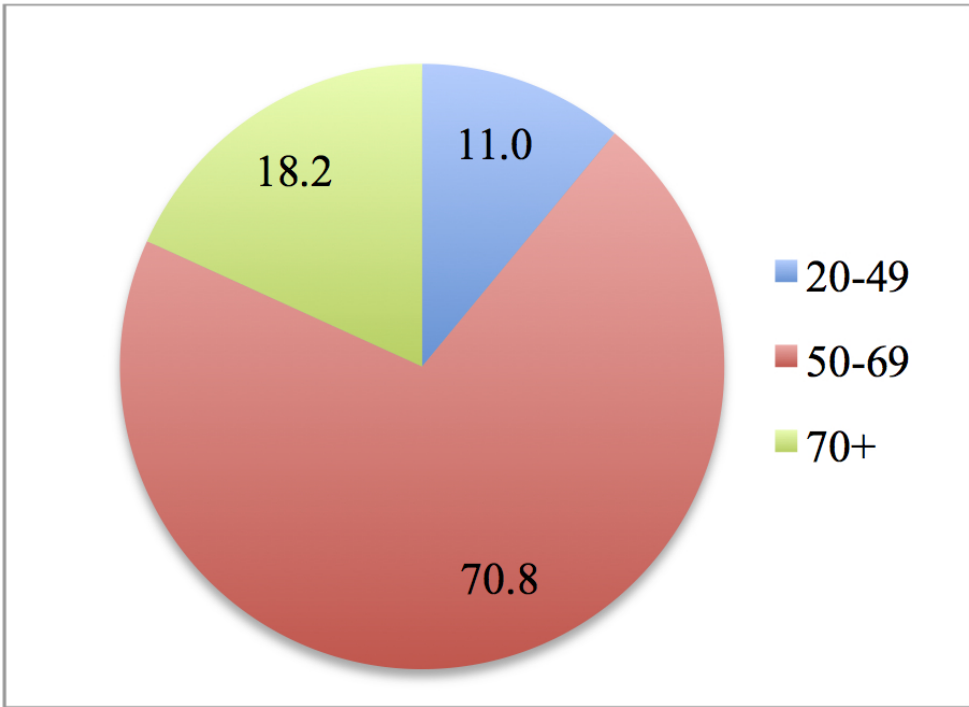
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12 Note: 4,433 women in total.
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17 **Figure 2:** Women with and without mobility impairment having undertaken
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19 mammography, by age group (%)
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23 Note 1: 3,145 women without mobility impairment and 1,288 women with mobility
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25 impairment.
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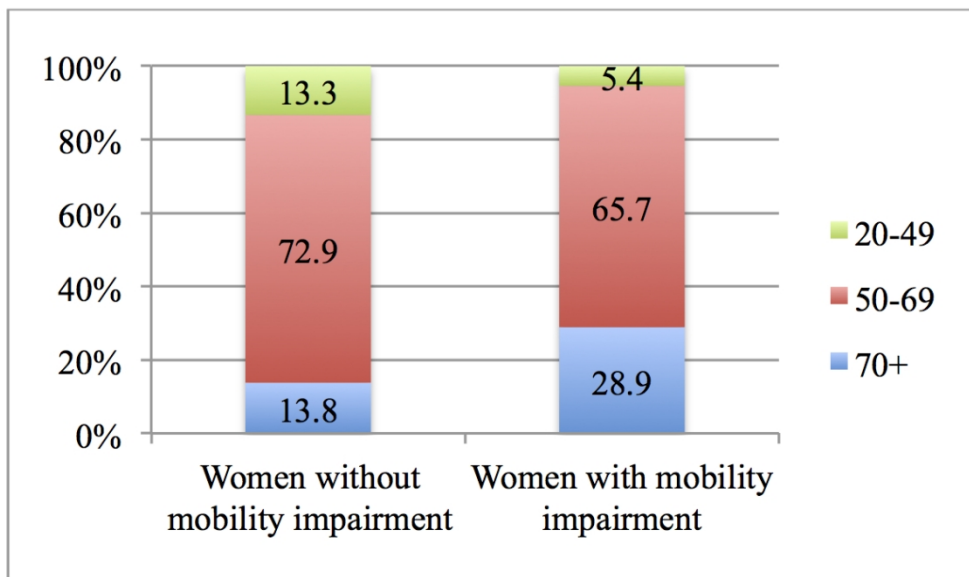
27 Note 2: Differences are statistically significant.
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Women having undertaken mammography, by age group (%)

197x144mm (120 x 120 DPI)



Women with and without mobility impairment having undertaken mammography, by age group (%)

255x151mm (120 x 120 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation
Title and abstract	X 1	X p.1 (a) Indicate the study's design with a commonly used term in the title or the abstract
		X p.2 (b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	X p.4-5 2	Explain the scientific background and rationale for the investigation being reported
Objectives	X p.6 3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	X p.2, p.6 4	Present key elements of study design early in the paper
Setting	X p.6-7 5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	X p. 7-8 6	(a) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	X p. 8-9 7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	X p. 8-9 8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	X p. 14 9	Describe any efforts to address potential sources of bias
Study size	X p. 8-9 10	Explain how the study size was arrived at
Quantitative variables	X p. 8-9 11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	X 12	X p. 6-8 (a) Describe all statistical methods, including those used to control for confounding
		(b) Describe any methods used to examine subgroups and interactions
		X p.8-9 (c) Explain how missing data were addressed
		(d) If applicable, describe analytical methods taking account of sampling strategy
		(e) Describe any sensitivity analyses
Results		
Participants	X 13*	X p. 8 (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	X 14*	X p.9-10 (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data	X p. 8 15*	Report numbers of outcome events or summary measures
Main results	X p.12, p. 13 16	X (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

		X p.9 (b) Report category boundaries when continuous variables were categorized
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	X p.14 18	Summarise key results with reference to study objectives
Limitations	X p.14 19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	X p. 16-17 20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	X p.14 21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	X p.17 22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.