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ABSTRACT

Objectives: Research has shown that people with physical disabilities report worse lower utilisation of preventive services. The aim of this study was to examine whether women with mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

Setting and Participants: We performed secondary analysis, using logistic regressions, of de-identified cross-sectional data from the European Health Interview Survey, Wave 2. The sample included 9,491 women from across the UK, 2,697 of whom had a mobility impairment. The survey method involved face-to-face and telephone interviews.

Outcome measures: Self report of the last time a mammogram was undertaken.

Results: Adjusting for various demographic and socioeconomic variables, women with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a mammogram than women without mobility impairment. Concerning women with mobility impairment, married women had more than twice the odds of having a mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of undertaking the test than women from England. Women with upper secondary education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than women with primary or lower secondary education. Also, women from higher quintiles (third and fifth quintiles) had higher odds of utilising mammography, with

the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than women from the first quintile.

Conclusions: In order to achieve equitable access to mammography for all women, it is important to acknowledge the barriers that impede women with mobility impairment from using the service. These barriers can refer to structural disadvantage, such as lower income and employment rate, transportation barriers, or previous negative experiences, among others.

Strengths and limitations of this study

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

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

to an increase of early-cancer diagnosis, with a concomitant decrease of late-stage diagnosis, hence leading to a mortality decrease.[12,18] However, a Cochrane systematic review showed that the benefits of mortality decrease might be outweighed by over-diagnosis rates and higher rates of aggressive treatment, both of which were attributed to mammography.[19]

Most of the existing evidence suggests that women with disabilities have lower utilisation rates and worse access to mammography compared to women without disabilities.[8,10,20-23] Transportation, quality of the experience, and lack of appropriate information, are among the reasons given for this.[6,24] Several of these studies are small-scale studies, which although they give important insights into the experiences of women as they navigate the healthcare system, they do not allow any conclusions regarding utilisation of preventive services at a population level. A recent large prospective study showed that women with disabilities in England have lower odds of having a mammogram compared to women without a disability.[25] It is important to know which are the factors that affect the utilisation of preventive services across the United Kingdom, so that policies and targeted interventions can be implemented to address any inequalities.

In the United Kingdom, women between the ages of 50 and 70 are invited to undertake a mammogram every three years, as part of a national screening programme by the National Health Service (NHS).[26] While there is evidence for women in England,[25] little is known regarding mammography utilisation by women with physical impairments across the UK; it is not known whether there is a difference in the utilisation rates between them and women without any mobility impairments, nor which are some of the factors associated with these utilisation rates.

In this article, we examine the utilisation of mammography by women with lower limb mobility impairments in the UK. We use this term to refer to women who report difficulty or inability to walk or climb stairs, as per the available data from the European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether women with lower limb mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

This study seeks to add to the current body of evidence regarding utilisation of mammography by disabled women, by producing population-level evidence, and examining the association of a variety of demographic and socioeconomic factors – such as low income or lack of social support – with utilisation of mammography. This knowledge can inform policy and lead to the design of comprehensive support systems to enable real access to services, addressing not only the availability of services but also their utilisation.

METHODOLOGY

Survey

We performed secondary analysis, using logistic regressions, of de-identified cross-sectional data from the European Health Interview Survey, Wave 2. The EHIS collects health data across European Union member states, providing thus the possibility to compare health indicators between countries. It is administered every five years.[27]

The survey consists of four modules: a) demographic and socioeconomic variables, such as age, sex, marital status, employment, education, etc.; b) variables on health status, for example self-perceived general health, chronic conditions,

accidents, functional limitations in daily activities, etc.; c) variables on health care use, such as consultations, unmet healthcare needs, preventive services, etc.; and d) health determinants, for instance weight, smoking, alcohol consumption, exercise, social support, etc.[28] The survey analyses 21 areas of health concerns and health-related behaviours, and 81 specific item-questions. All measures are self-reported.[29] For more information on the EHIS questionnaire, please see: http://ec.europa.eu/health/ph_information/implement/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]

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

Data and variables

There are two questions in the EHIS that measure mobile difficulty: a) variable PL6, "Difficulty in walking half a km on level ground without the use of any aid", and b) variable PL7, "Difficulty in walking up or down 12 steps". These two variables were merged into a new variable, called 'mobility impairment', with answers 'without difficulty' (women that answered that they had no difficulty in performing either tasks), and 'with difficulty' (women that replied that they had some difficulty in performing or were unable to do at least one of the tasks).

Our dependent variable, "up to date with mammography", was recoded and was binary, that is, 'Yes' (included the answers "within the last 12 months", "1 to less than 2 years", and "2 to less than 3 years"), and 'No' ("more than 3 years" and "never"). This recoding was done according to the NHS guidelines on mammography.[26] Previous research has also employed this variable, looking at women being up to date with mammography.[10]

In total, we had 9,995 observations for women that answered the question on mammography. Due to case-deletion (default in STATA), our total sample size is 9,491 observations (6,794 observations for women without mobility impairment, and 2,697 for women with mobility impairment). Since only a very small percentage of

observations was deleted, we decided not to proceed to maximum likelihood or multiple imputation.[32]

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 a significant amount of women that for various, unspecified reasons decided to undertake a mammogram, despite being outside the target group); 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.

RESULTS

Table 1 summarises the characteristics of the study sample.

Table 1: Comparison between women with and without mobility impairment

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	$p < 0.0001$
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	$p < 0.0001$
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	$p < 0.0001$
Northern Ireland (n=353)	234	3.4	119	4.4	
Urbanisation					
Thinly-populated are (n=1,322)	945	13.9	377	14.0	
Moderate-populated area (n=2,575)	1,842	27.1	733	27.2	p = 0.992
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	$p < 0.0001$
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					
1st quintile (n=1,962)	1,108	16.3	854	31.7	
2nd quintile (n=2,008)	1,336	19.7	672	24.9	
3rd quintile (n=1,932)	1,352	19.9	580	21.5	$p < 0.0001$
4th quintile (n=1,852)	1,493	22.0	359	13.3	
5th 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	$p < 0.0001$
Inactive (n=4,827)	2,687	39.6	2,140	79.4	
Health self-assessment					
Bad (n=797)	90	1.3	707	26.2	
Fair (n=1,896)	774	11.4	1,122	41.6	$p < 0.0001$
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)						
2nd quintile			1.11	.88-1.40	1.09	.86-1.38
3rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4th quintile			1.18	.87-1.59	1.18	.87-1.60
5th 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 R^2	0.1636	0.1908	0.1923
Chi^2 (21)	631.29	722.80	718.04
Prob>Chi^2	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

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 utilisation. The results showed a statistically significant difference between women with and without mobility impairment, with women with mobility impairment having 1.3 times lower odds of undertaking a mammogram than women without mobility problems. Furthermore, the results showed a positive association between married civil status, high income, educational attainment, and living in Scotland, and being up to date with mammography.

One of the strengths of the study is that it is based on data from a nationally-representative sample. It also adds to the body of literature by examining the association of several factors with mammography utilisation for women with mobility impairment, an issue that has been generally little explored, particularly in the UK. One of the limitations of the study is that while we have established associations between various factors and utilisation of mammography by women with mobility impairment, we cannot infer causality due to the cross-sectional nature of the data. Another limitation of the study is that there is no information in the EHIS on the reasons that influence utilisation of mammography. Furthermore, the EHIS relies on self-reporting information, which leaves the instrument open to response bias; however, there is no relevant information on this aspect. Another limitation of the study is the way mobility impairment was defined, which potentially included women with only short-term impairment, together with women with longer-term impairment; this might have had an impact on external validity.

The findings showed that women with mobility impairment had 1.3 lower odds of being up to date with mammography. This is consistent with previous

research that shows that in the UK, there are long-standing inequalities between people's cancer experiences.[33] This finding is also consistent with research findings from a study in England. [25] Bone et al. performed an analysis of data from the National Cancer Patient Experience Survey.[34] They analysed data from 71,793 cancer patients and found evidence that cancer patients with long-standing conditions in England, including people with physical conditions and disabilities, reported poorer care. These inequalities persisted even when controlling for other factors. Further to this, people with pre-existing disability diagnosed with cancer report low satisfaction and use of services.[7-8, 35] As Liu and Clark have shown, quality of the experience matters;[36] previous negative experiences with mammography might deter women with physical impairments from undertaking the test in the future.

These inequalities in the experiences of patients with cancer in the UK conflict with several of the recommendations of recent strategic documents, including 'Achieving world-class cancer outcomes: a Strategy for England 2015-2020' and the Cancer Delivery Plan for Wales.[37,38] Both documents call for access to equitable care, achieving the best experience, and promoting delivery of cancer care responsive to individual needs.

The findings also showed that married women had higher odds of having a mammogram than women that had never been married. This result is in accordance with evidence demonstrating the protective role of married civil status.[23,39] Indeed, married people tend to have more fixed residence, regular doctors, and fixed healthcare places, and therefore are more likely to be informed and accept preventive health services than unmarried people.[39] They have also a stronger social network (for example, family members, relatives, and friends) that can offer them more

emotional and practical support (for instance, transportation) to attend such screenings, as well as help them adopt healthier behaviours.

Our study also revealed that there are differences in the utilisation rates of mammography between women living in different regions in the United Kingdom, with women with mobility impairment living in Scotland having higher odds of undertaking the test than women in England. The reason behind this might be the usage of mobile screening units in Scotland, which appears to enable access to mammography for underserved populations.[40]

Furthermore, our study showed that women with mobility impairments with a higher education had higher odds of having a mammogram than women with primary or lower secondary education. Women with mobility impairment that belonged to higher quintiles had also higher odds of having a mammogram than women belonging to the first quintile. This result agrees with previous research that found that disabled women with higher education and an overall higher socioeconomic status were more likely to undertake preventive exams.[41-42] Educational attainment beyond upper secondary did not seem to have any further positive effect on the update of mammography.

Overall, taking into account the global demographic, epidemiological, and socioeconomic changes – including ageing, urbanisation, reduction in morbidity and mortality rates, and increase in chronic diseases – it is essential that preventive health services are better promoted and reach all people, especially disadvantaged groups, such as people with disabilities, women, and the poor. The WHO position paper on mammography states that:

> "Population-based screening programmes identify and individually invite each person in the eligible population to attend each round of screening so that each

person in the eligible population has an equal chance of benefiting from screening." (p.23).[12]

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

Contributors

ESR and DS jointly conceived the final research question and aims and objectives, reviewed the literature, produced the analysis plan and carried out the analysis, and drafted the manuscript.

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Competing interests

None declared.

Ethics approval

None required.

Data sharing statement

Technical appendix and dataset available from the UK Data Service.

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.

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

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Word count: 3770

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

ABSTRACT

Objectives: Research has shown that people with physical disabilities report lower utilisation of preventive services. The aim of this study was to examine whether women with mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

Setting and Participants: We performed secondary analysis, using logistic regressions, of de-identified cross-sectional data from the European Health Interview Survey, Wave 2. The sample included 9,491 women from across the UK, 2,697 of whom had mobility impairment. The survey method involved face-to-face and telephone interviews.

Outcome measures: Self-report of the last time a mammogram was undertaken.

Results: Adjusting for various demographic and socioeconomic variables, women with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a mammogram than women without mobility impairment. Concerning women with mobility impairment, married women had more than twice the odds of having a mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of undertaking the test than women from England. Women with upper secondary education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than women with primary or lower secondary education. Also, women from higher quintiles (third and fifth quintiles) had higher odds of utilising mammography, with

the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than women from the first quintile.

Conclusions: In order to achieve equitable access to mammography for all women, it is important to acknowledge the barriers that impede women with mobility impairment from using the service. These barriers can refer to structural disadvantage, such as lower income and employment rate, transportation barriers, or previous negative experiences, among others.

Strengths and limitations of this study

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

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

mortality decrease might be outweighed by over-diagnosis rates and higher rates of aggressive treatment, both of which were attributed to mammography.[18] However, there is strong evidence showings that population-wide screening could lead to an increase of early-cancer diagnosis, with a concomitant decrease of late-stage diagnosis, hence leading to a mortality decrease.[12,19]

In the United Kingdom, women between the ages of 50 and 70 are invited to undertake a mammogram every three years, as part of a national screening programme by the National Health Service (NHS).[20] While there is evidence for women in England,[21] little is known regarding mammography utilisation by women with physical impairments across the UK; it is not known whether there is a difference in the utilisation rates between women with and without any mobility impairments, nor which are some of the factors associated with these utilisation rates.

Most of the existing evidence suggests that women with disabilities have lower utilisation rates and worse access to mammography compared to women without disabilities.[8,10,22-25] Transportation, quality of the experience, and lack of appropriate information, are among the reasons given for this.[6,26] Several of these studies are small-scale studies, which although they give important insights into the experiences of women as they navigate the healthcare system, they do not allow any conclusions regarding utilisation of preventive services at a population level. A recent large prospective study showed that women with disabilities in England have lower odds of having a mammogram compared to women without a disability.[21].

In this article, we examine the utilisation of mammography by women with lower limb mobility impairments in the UK. We use this term to refer to women who report difficulty or inability to walk or climb stairs, as per the available data from the European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether

women with lower limb mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

This study seeks to add to the current body of evidence regarding utilisation of mammography by disabled women, by producing population-level evidence, and examining the association of a variety of demographic and socioeconomic factors – such as low income or lack of social support – with utilisation of mammography. This knowledge can inform policy and lead to the design of comprehensive support systems and target interventions that would enable real access to services, addressing not only the availability of services but also their utilisation.

METHODOLOGY

Survey

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

The survey consists of four modules: a) demographic and socioeconomic variables, such as age, sex, marital status, employment, education, etc.; b) variables on health status, for example self-perceived general health, chronic conditions, accidents, functional limitations in daily activities, etc.; c) variables on health care use, such as consultations, unmet healthcare needs, preventive services, etc.; and d) health determinants, for instance weight, smoking, alcohol consumption, exercise, social support, etc.[28] The survey analyses 21 areas of health concerns and health-

related behaviours, and 81 specific item-questions. All measures are self-reported.[29] For more information on the EHIS questionnaire, please refer to the survey website.[27,28]

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, a sample size which was much higher than the estimated minimum effective size for the country, which was 13,085.[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]

The microdata did not contain any personal information, such as names or addresses, which would allow direct identification. In order to ensure confidentiality, a set of anonymisation rules was applied.[31] Access to microdata is granted only for

scientific purposes; we were granted access by the UK Data Service (www.ukdataservice.ac.uk).

Data and variables

There are two questions in the EHIS that measure mobile difficulty: a) variable PL6, "Difficulty in walking half a km on level ground without the use of any aid", and b) variable PL7, "Difficulty in walking up or down 12 steps". These two variables were merged into a new variable, called 'mobility impairment', with answers 'without difficulty' (women that answered that they had no difficulty in performing either tasks), and 'with difficulty' (women that replied that they had some difficulty in performing or were unable to do at least one of the tasks).

Our dependent variable, "up to date with mammography", was recoded and was binary, that is, 'Yes' (included the answers "within the last 12 months", "1 to less than 2 years", and "2 to less than 3 years"), and 'No' ("more than 3 years" and "never"). This recoding was done according to the NHS guidelines on mammography.[26] Previous research has also employed this variable, looking at women being up to date with mammography.[10]

In total, we had 9,995 observations for women that answered the question on mammography. Since STATA, by default, performs listwise-deletion and displays calculations that have non-missing values on all variables listed, our total sample size was 9,491 observations (6,794 observations for women without mobility impairment, and 2,697 for women with mobility impairment). Since only a very small percentage of observations was deleted, we decided not to proceed to maximum likelihood or multiple imputation.[32] The sample is representative of the target population (test results available upon request).

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 question and outcome measures were 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 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	$p < 0.0001$
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	$p < 0.0001$
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	$p < 0.0001$
Scotland (n=822)	596	8.8	226	8.4	
Northern Ireland (n=353)	234	3.4	119	4.4	
Urbanisation					
Thinly-populated are (n=1,322)	945	13.9	377	14.0	
Moderate-populated area (n=2,575)	1,842	27.1	733	27.2	p = 0.992
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	$p < 0.0001$
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					
1st quintile (n=1,962)	1,108	16.3	854	31.7	
2nd quintile (n=2,008)	1,336	19.7	672	24.9	
3rd quintile (n=1,932)	1,352	19.9	580	21.5	$p < 0.0001$
4th quintile (n=1,852)	1,493	22.0	359	13.3	
5th 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	$p < 0.0001$
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]

As it can be seen in Figure 1, 71% of all women who undertook mammography were in the target group, i.e. 50-69 years of age. Almost 30% of all women that underwent the test were outside the target group. In certain parts of England, women younger than 50 and older than 70 years are invited for mammograms, [33], while a systematic review has shown that women out of the target group also undergo mammography.[18]

Figure 2 shows women with and without mobility impairments that have undertaken mammography, by age group.

[Please place Figure 2 here]

Figure 2 shows that almost 30% of women with mobility impairment that undertook mammography were 70+ years-old, i.e. outside the target group; this percentage is less than half of that for women without mobility impairment.

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)						
2nd quintile			1.11	.88-1.40	1.09	.86-1.38
3rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4th quintile			1.18	.87-1.59	1.18	.87-1.60
5th 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 R^2	0.1636		0.1908		0.1923	

Chi^2 (21)	631.29	722.80	718.04
Prob>Chi^2	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

utilisation. The results showed a statistically significant difference between women with and without mobility impairment, with women with mobility impairment having 1.3 times lower odds of undertaking a mammogram than women without mobility impairment. Furthermore, the results showed a positive association between married civil status, high income, educational attainment, and living in Scotland, and being up to date with mammography.

One of the strengths of the study is that it is based on data from a nationally-representative sample. It also adds to the body of literature by examining the association of several factors with mammography utilisation for women with mobility impairment, an issue that has been generally little explored, particularly in the UK.

One of the limitations of the study is that while we established associations between various factors and utilisation of mammography by women with mobility impairment, we cannot infer causality due to the cross-sectional nature of the data. Another limitation of the study is that there is no information in the EHIS on the reasons that influence utilisation of mammography. Furthermore, the EHIS relies on self-reporting information, which leaves the instrument open to response bias; however, there is no relevant information on this aspect. Another limitation of the study is the way mobility impairment was defined, which potentially included women with only short-term impairment, together with women with longer-term impairment; this might have had an impact on external validity.

The findings showed that women with mobility impairment had 1.3 lower odds of being up to date with mammography. This is consistent with previous research that shows that in the UK, there are long-standing inequalities between people's cancer experiences.[34] This finding is also consistent with research findings from a study in England. [25] Bone et al. performed an analysis of data from the

National Cancer Patient Experience Survey.[35] They analysed data from 71,793 cancer patients and found evidence that cancer patients with long-standing conditions in England, including people with physical conditions and disabilities, reported poorer care. These inequalities persisted even when controlling for other factors. Further to this, people with pre-existing disability diagnosed with cancer report low satisfaction and use of services.[7-8, 36] As Liu and Clark have shown, quality of the experience matters;[37] previous negative experiences with mammography might deter women with physical impairments from undertaking the test in the future.

The findings also showed that married women had higher odds of having a mammogram than women that had never been married. This result is in accordance with evidence demonstrating the protective role of married civil status.[23,38] Indeed, married people tend to have more fixed residence, regular doctors, and fixed healthcare places, and therefore are more likely to be informed and accept preventive health services than unmarried people.[38] They have also a stronger social network (for example, family members, relatives, and friends) that can offer them more emotional and practical support (for instance, transportation) to attend such screenings, as well as help them adopt healthier behaviours.

Our study also revealed that there are differences in the utilisation rates of mammography between women living in different regions in the United Kingdom, with women with mobility impairment living in Scotland having higher odds of undertaking the test than women in England. The reason behind this might be the usage of mobile screening units in Scotland, which appears to enable access to mammography for underserved populations.[39]

Furthermore, our study showed that women with mobility impairments with higher education had higher odds of having a mammogram than women with primary

or lower secondary education. Women with mobility impairment that belonged to higher income quintiles had also higher odds of having a mammogram than women belonging to the first quintile. This result agrees with previous research that found that disabled women with higher education and an overall higher socioeconomic status were more likely to undertake preventive exams.[40-41] Educational attainment beyond upper secondary did not seem to have any further positive effect on the update of mammography.

These inequalities in the experiences of patients with cancer in the UK conflict with several of the recommendations of recent strategic documents, including 'Achieving world-class cancer outcomes: a Strategy for England 2015-2020' and the Cancer Delivery Plan for Wales.[42,43] Both documents call for access to equitable care, achieving the best experience, and promoting delivery of cancer care responsive to individual needs.

Overall, taking into account the global demographic, epidemiological, and socioeconomic changes – including ageing, urbanisation, reduction in morbidity and mortality rates, and increase in chronic diseases – it is essential that preventive health services are better promoted and reach all people, especially disadvantaged groups, such as people with disabilities, women, and the poor. The WHO position paper on mammography states that:

> "Population-based screening programmes identify and individually invite each person in the eligible population to attend each round of screening so that each person in the eligible population has an equal chance of benefiting from screening." (p.23).[12]

This statement, however, overlooks the fact that not everyone has an equal chance of benefitting from screening; people with mobility impairment may, for example, face

transportation barriers, which could stop them from accessing screening services, despite their availability. Women with mobility impairment, and disabilities in general, are further disadvantaged, as they also face structural disadvantage – in the form of lower education, lower income, and greater poverty – than men, as shown in this study and supported by a body of existing research.[44-45] In order to enhance the utilisation of mammography (and possibly the use of other preventive services), it is important to acknowledge the barriers that stop women from using the service and adopt measures that would lead to a more equitable utilisation. The wide adoption of mobile screening units might be a way to improve access for this population. This needs to be complemented by increased disability-awareness for healthcare professionals, making them sensitive to addressing impairment-specific needs in order to achieve inclusive services for all.

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Contributors

DS and ESR jointly conceived the final research question and aims and objectives, reviewed the literature, produced the analysis plan and carried out the analysis, and drafted the manuscript.

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Competing interests

None declared.

Ethics approval

None required.

Data sharing statement

Technical appendix and dataset available from the UK Data Service.

https://discover.ukdataservice.ac.uk/catalogue/?sn=7881

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Figure legends

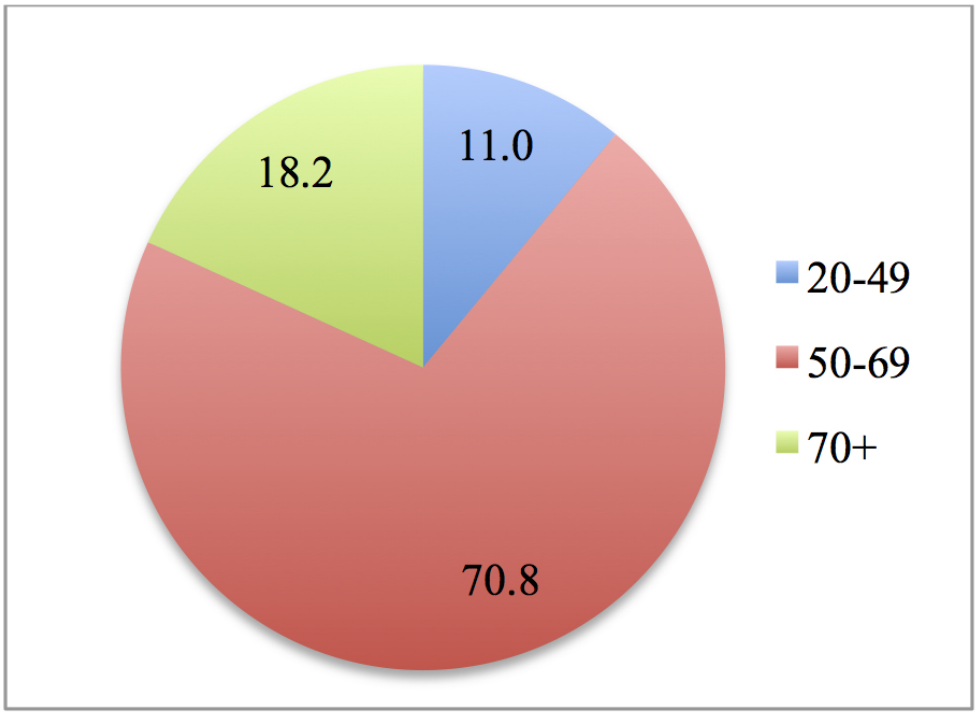
Figure 1: Women having undertaken mammography, by age group (%)

Note: 4,433 women in total.

Figure 2: Women with and without mobility impairment having undertaken mammography, by age group (%)

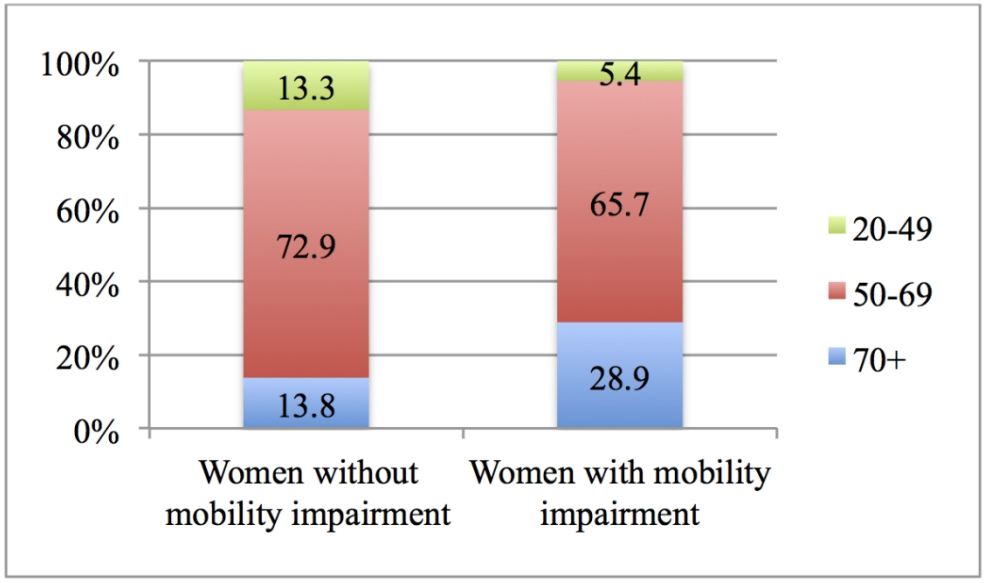
Note 1: 3,145 women without mobility impairment and 1,288 women with mobility impairment.

Note 2: Differences are statistically significant.



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

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

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Word count: 3770

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

ABSTRACT

Objectives: Research has shown that people with physical disabilities report lower utilisation of preventive services. The aim of this study was to examine whether women with mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

Sample and Design: We performed secondary analysis, using logistic regressions, of de-identified cross-sectional data from the European Health Interview Survey, Wave 2. The sample included 9,491 women from across the UK, 2,697 of whom had mobility impairment. The survey method involved face-to-face and telephone interviews.

Outcome measures: Self-report of the last time a mammogram was undertaken.

Results: Adjusting for various demographic and socioeconomic variables, women with mobility impairment had 1.3 times (CI 95%: .70-.92) lower odds of having a mammogram than women without mobility impairment. Concerning women with mobility impairment, married women had more than twice the odds of having a mammogram than women that had never been married (OR: 2.07, CI 95%: 1.49-2.88). Women from Scotland had 1.5 times (CI 95%: 1.08-2.10) higher odds of undertaking the test than women from England. Women with upper secondary education had 1.4 times (CI 95%: 1.10-1.67) higher odds of undergoing the test than women with primary or lower secondary education. Also, women from higher quintiles (third and fifth quintiles) had higher odds of utilising mammography, with

the women in the fifth quintile having 1.5 times (CI 95%: 1.02-2.15) higher odds than women from the first quintile.

Conclusions: In order to achieve equitable access to mammography for all women, it is important to acknowledge the barriers that impede women with mobility impairment from using the service. These barriers can refer to structural disadvantage, such as lower income and employment rate, transportation barriers, or previous negative experiences, among others.

Strengths and limitations of this study

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

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

mortality decrease might be outweighed by over-diagnosis rates and higher rates of aggressive treatment, both of which were attributed to mammography.[18] However, there is strong evidence showings that population-wide screening could lead to an increase of early-cancer diagnosis, with a concomitant decrease of late-stage diagnosis, hence leading to a mortality decrease.[12,19]

In the United Kingdom, women between the ages of 50 and 70 are invited to undertake a mammogram every three years, as part of a national screening programme by the National Health Service (NHS).[20] While there is evidence for women in England,[21] little is known regarding mammography utilisation by women with physical impairments across the UK; it is not known whether there is a difference in the utilisation rates between women with and without any mobility impairments, nor which are some of the factors associated with these utilisation rates.

Most of the existing evidence suggests that women with disabilities have lower utilisation rates and worse access to mammography compared to women without disabilities.[8,10,22-25] Transportation, quality of the experience, and lack of appropriate information, are among the reasons given for this.[6,26] Several of these studies are small-scale studies, which although they give important insights into the experiences of women as they navigate the healthcare system, they do not allow any conclusions regarding utilisation of preventive services at a population level. A recent large prospective study showed that women with disabilities in England have lower odds of having a mammogram compared to women without a disability.[21].

In this article, we examine the utilisation of mammography by women with lower limb mobility impairments in the UK. We use this term to refer to women who report difficulty or inability to walk or climb stairs, as per the available data from the European Health Interview Survey (EHIS, Wave 2). Our aim is to examine whether

women with lower limb mobility impairments have lower odds of utilising mammography compared to women with no such impairment, and explore the factors that are associated with lower utilisation.

This study seeks to add to the current body of evidence regarding utilisation of mammography by disabled women, by producing population-level evidence, and examining the association of a variety of demographic and socioeconomic factors – such as low income or lack of social support – with utilisation of mammography. This knowledge can inform policy and lead to the design of comprehensive support systems and target interventions that would enable real access to services, addressing not only the availability of services but also their utilisation.

METHODOLOGY

Survey

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

The survey consists of four modules: a) demographic and socioeconomic variables, such as age, sex, marital status, employment, education, etc.; b) variables on health status, for example self-perceived general health, chronic conditions, accidents, functional limitations in daily activities, etc.; c) variables on health care use, such as consultations, unmet healthcare needs, preventive services, etc.; and d) health determinants, for instance weight, smoking, alcohol consumption, exercise, social support, etc.[28] The survey analyses 21 areas of health concerns and health-

related behaviours, and 81 specific item-questions. All measures are self-reported.[29] For more information on the EHIS questionnaire, please refer to the survey website.[27,28]

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, a sample size which was much higher than the estimated minimum effective size for the country, which was 13,085.[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]

The microdata did not contain any personal information, such as names or addresses, which would allow direct identification. In order to ensure confidentiality, a set of anonymisation rules was applied.[31] Access to microdata is granted only for

scientific purposes; we were granted access by the UK Data Service (www.ukdataservice.ac.uk).

Data and variables

There are two questions in the EHIS that measure mobile difficulty: a) variable PL6, "Difficulty in walking half a km on level ground without the use of any aid", and b) variable PL7, "Difficulty in walking up or down 12 steps". These two variables were merged into a new variable, called 'mobility impairment', with answers 'without difficulty' (women that answered that they had no difficulty in performing either tasks), and 'with difficulty' (women that replied that they had some difficulty in performing or were unable to do at least one of the tasks).

Our dependent variable, "up to date with mammography", was recoded and was binary, that is, 'Yes' (included the answers "within the last 12 months", "1 to less than 2 years", and "2 to less than 3 years"), and 'No' ("more than 3 years" and "never"). This recoding was done according to the NHS guidelines on mammography.[26] Previous research has also employed this variable, looking at women being up to date with mammography.[10]

In total, we had 9,995 observations for women that answered the question on mammography. Since STATA, by default, performs listwise-deletion and displays calculations that have non-missing values on all variables listed, our total sample size was 9,491 observations (6,794 observations for women without mobility impairment, and 2,697 for women with mobility impairment). Since only a very small percentage of observations was deleted, we decided not to proceed to maximum likelihood or multiple imputation.[32] The sample is representative of the target population (test results available upon request).

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	*p* value, chi-squared

	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	
50-69 (n=3,971)	2,839	42.8	1,132	42.0	$p < 0.0001$
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	$p < 0.0001$
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	$p < 0.0001$
Scotland (n=822)	596	8.8	226	8.4	
Northern Ireland (n=353)	234	3.4	119	4.4	
Urbanisation					
Thinly-populated are (n=1,322)	945	13.9	377	14.0	
Moderate-populated area (n=2,575)	1,842	27.1	733	27.2	p = 0.992
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	$p < 0.0001$
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					
1st quintile (n=1,962)	1,108	16.3	854	31.7	
2nd quintile (n=2,008)	1,336	19.7	672	24.9	
3rd quintile (n=1,932)	1,352	19.9	580	21.5	$p < 0.0001$
4th quintile (n=1,852)	1,493	22.0	359	13.3	
5th 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	$p < 0.0001$
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]

As it can be seen in Figure 1, 71% of all women who undertook mammography were in the target group, i.e. 50-69 years of age. Almost 30% of all women that underwent the test were outside the target group. In certain parts of England, women younger than 50 and older than 70 years are invited for mammograms, [33], while a systematic review has shown that women out of the target group also undergo mammography.[18]

Figure 2 shows women with and without mobility impairments that have undertaken mammography, by age group.

[Please place Figure 2 here]

Figure 2 shows that almost 30% of women with mobility impairment that undertook mammography were 70+ years-old, i.e. outside the target group; this percentage is less than half of that for women without mobility impairment.

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)						
2nd quintile			1.11	.88-1.40	1.09	.86-1.38
3rd quintile			1.32*	1.03-1.69	1.29**	1.01-1.66
4th quintile			1.18	.87-1.59	1.18	.87-1.60
5th 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 R^2	0.1636		0.1908		0.1923	

Chi^2 (21)	631.29	722.80	718.04
Prob>Chi^2	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

utilisation. The results showed a statistically significant difference between women with and without mobility impairment, with women with mobility impairment having 1.3 times lower odds of undertaking a mammogram than women without mobility impairment. Furthermore, the results showed a positive association between married civil status, high income, educational attainment, and living in Scotland, and being up to date with mammography.

One of the strengths of the study is that it is based on data from a nationally-representative sample. It also adds to the body of literature by examining the association of several factors with mammography utilisation for women with mobility impairment, an issue that has been generally little explored, particularly in the UK.

One of the limitations of the study is that while we established associations between various factors and utilisation of mammography by women with mobility impairment, we cannot infer causality due to the cross-sectional nature of the data. Another limitation of the study is that there is no information in the EHIS on the reasons that influence utilisation of mammography. Furthermore, the EHIS relies on self-reporting information, which leaves the instrument open to response bias; however, there is no relevant information on this aspect. Another limitation of the study is the way mobility impairment was defined, which potentially included women with only short-term impairment, together with women with longer-term impairment; this might have had an impact on external validity.

The findings showed that women with mobility impairment had 1.3 lower odds of being up to date with mammography. This is consistent with previous research that shows that in the UK, there are long-standing inequalities between people's cancer experiences.[34] This finding is also consistent with research findings from a study in England. [25] Bone et al. performed an analysis of data from the

National Cancer Patient Experience Survey.[35] They analysed data from 71,793 cancer patients and found evidence that cancer patients with long-standing conditions in England, including people with physical conditions and disabilities, reported poorer care. These inequalities persisted even when controlling for other factors. Further to this, people with pre-existing disability diagnosed with cancer report low satisfaction and use of services.[7-8, 36] As Liu and Clark have shown, quality of the experience matters;[37] previous negative experiences with mammography might deter women with physical impairments from undertaking the test in the future.

The findings also showed that married women had higher odds of having a mammogram than women that had never been married. This result is in accordance with evidence demonstrating the protective role of married civil status.[23,38] Indeed, married people tend to have more fixed residence, regular doctors, and fixed healthcare places, and therefore are more likely to be informed and accept preventive health services than unmarried people.[38] They have also a stronger social network (for example, family members, relatives, and friends) that can offer them more emotional and practical support (for instance, transportation) to attend such screenings, as well as help them adopt healthier behaviours.

Our study also revealed that there are differences in the utilisation rates of mammography between women living in different regions in the United Kingdom, with women with mobility impairment living in Scotland having higher odds of undertaking the test than women in England. The reason behind this might be the usage of mobile screening units in Scotland, which appears to enable access to mammography for underserved populations.[39]

Furthermore, our study showed that women with mobility impairments with higher education had higher odds of having a mammogram than women with primary

or lower secondary education. Women with mobility impairment that belonged to higher income quintiles had also higher odds of having a mammogram than women belonging to the first quintile. This result agrees with previous research that found that disabled women with higher education and an overall higher socioeconomic status were more likely to undertake preventive exams.[40-41] Educational attainment beyond upper secondary did not seem to have any further positive effect on the update of mammography.

These inequalities in the experiences of patients with cancer in the UK conflict with several of the recommendations of recent strategic documents, including 'Achieving world-class cancer outcomes: a Strategy for England 2015-2020' and the Cancer Delivery Plan for Wales.[42,43] Both documents call for access to equitable care, achieving the best experience, and promoting delivery of cancer care responsive to individual needs.

Overall, taking into account the global demographic, epidemiological, and socioeconomic changes – including ageing, urbanisation, reduction in morbidity and mortality rates, and increase in chronic diseases – it is essential that preventive health services are better promoted and reach all people, especially disadvantaged groups, such as people with disabilities, women, and the poor. The WHO position paper on mammography states that:

> "Population-based screening programmes identify and individually invite each person in the eligible population to attend each round of screening so that each person in the eligible population has an equal chance of benefiting from screening." (p.23).[12]

This statement, however, overlooks the fact that not everyone has an equal chance of benefitting from screening; people with mobility impairment may, for example, face

transportation barriers, which could stop them from accessing screening services, despite their availability. Women with mobility impairment, and disabilities in general, are further disadvantaged, as they also face structural disadvantage – in the form of lower education, lower income, and greater poverty – than men, as shown in this study and supported by a body of existing research.[44-45] In order to enhance the utilisation of mammography (and possibly the use of other preventive services), it is important to acknowledge the barriers that stop women from using the service and adopt measures that would lead to a more equitable utilisation. The wide adoption of mobile screening units might be a way to improve access for this population. This needs to be complemented by increased disability-awareness for healthcare professionals, making them sensitive to addressing impairment-specific needs in order to achieve inclusive services for all.

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

Contributors

DS and ESR jointly conceived the final research question and aims and objectives, reviewed the literature, produced the analysis plan and carried out the analysis, and drafted the manuscript.

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Competing interests

None declared.

Ethics approval

None required.

Data sharing statement

Technical appendix and dataset available from the UK Data Service.

https://discover.ukdataservice.ac.uk/catalogue/?sn=7881

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Figure legends

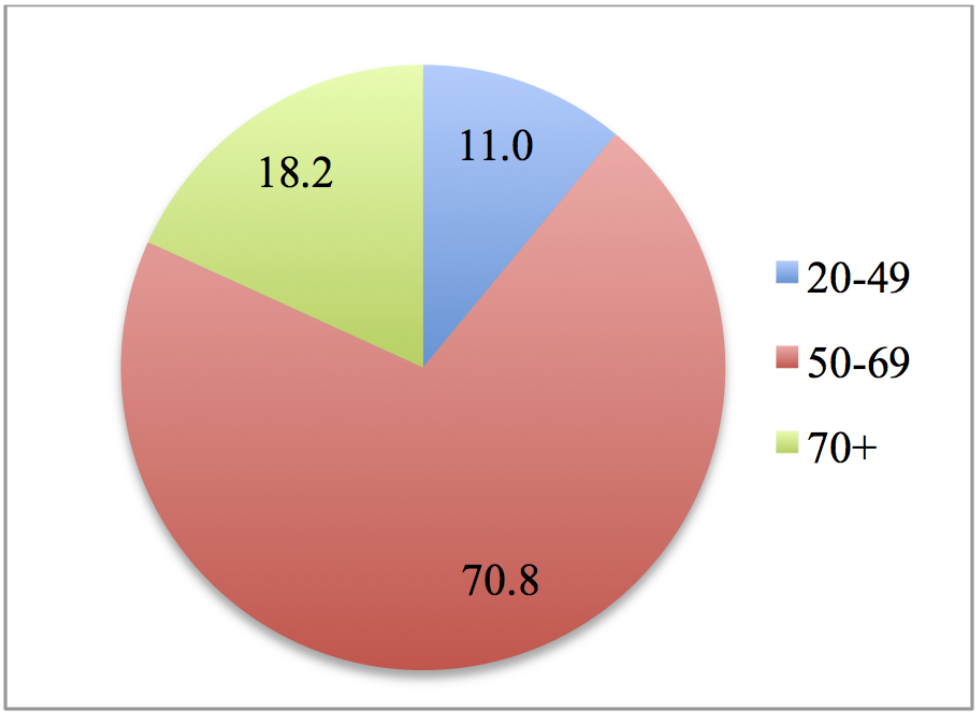
Figure 1: Women having undertaken mammography, by age group (%)

Note: 4,433 women in total.

Figure 2: Women with and without mobility impairment having undertaken mammography, by age group (%)

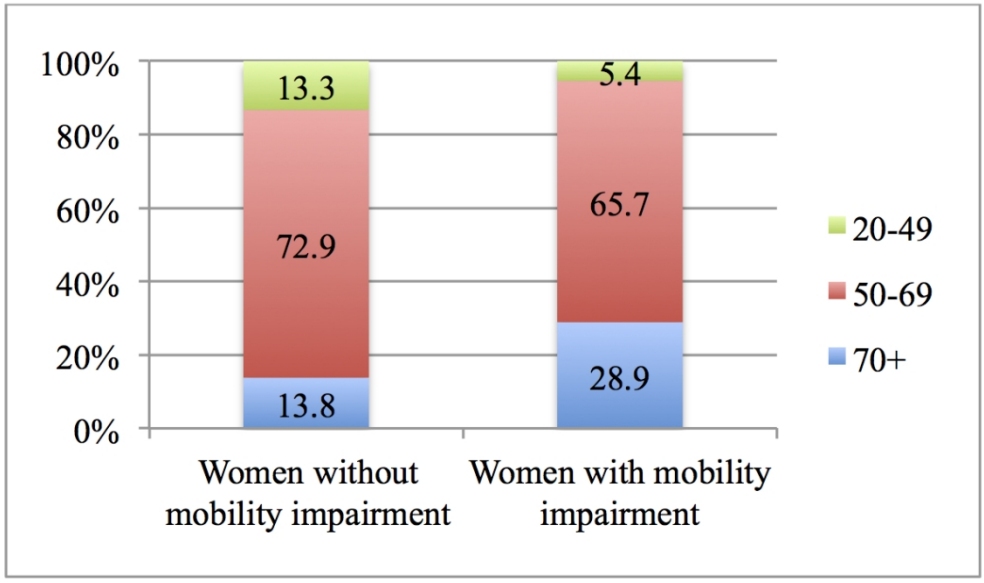
Note 1: 3,145 women without mobility impairment and 1,288 women with mobility impairment.

Note 2: Differences are statistically significant.



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.