Breast cancer screening programme participation and socioeconomic deprivation in France

Thérèse Deborde, Edouard Chatignoux, Cécile Quintin, Nathalie Beltzer, Françoise F. Hamers, Agnès Rogel*

French National Public Health Agency, Non-communicable diseases and trauma directorate, 12 rue du Val d'Osne, 94410 Saint Maurice, France

A B S T R A C T

The objective was to quantify the relationship between deprivation and national breast cancer screening programme (NBCSP) participation at an ecological level in mainland France.

Data from 4,805,390 women—living in 36,209 municipalities within 95 departments—participating in the 2013–2014 NBCSP were analysed using the French Deprivation Index (FDep). FDep population quintiles by municipality were computed to describe NBCSP participation according to deprivation. To better examine the relationship between continuous value of deprivation index and participation rates at the municipality level, we built a generalized linear mixed model.

Geographical variations in participation rates were marked. The national standardized participation rate was higher in the intermediate quintiles (55%), 45% for the least deprived one and 52% for the most deprived one. Using our model, we also obtained an inverted U-curve for the relationship between NBCSP participation and municipality deprivation: participation was lower for both the least and most deprived municipalities. This relationship was also observed for each of the two subpopulations—urban municipalities and rural ones—considered separately. Introducing the FDep in the model reduced slightly the unexplained variations in participation rates between departments and between municipalities (with a proportional change in variance of 14% and 12% respectively).

We highlight major disparities in departmental participation rates and FDep/participation profiles. However, deprivation appears to have only little influence on geographical variation in participation rates. There is a need to further understand the factors affecting geographical variation in participation rates, in particular the use of opportunistic screening.

1. Introduction

In France, breast cancer incidence has increased significantly in recent decades, with a break in the trend from 2005. Breast cancer mortality rate is declining since 1995 and survival improves over time (Binder-Foucard et al., 2014). French national breast cancer screening programme (NBCSP) was fully rolled out nationwide in 2004, with main objective to reduce breast cancer mortality through early detection of cancer (International Agency for Research on Cancer, 2015). It is framed by national recommendations (Ministère de la santé et des solidarités, 2006), based on European guidelines (European Commission, 2006). Women aged 50 to 74 are invited every 2 years to perform a screening mammography in accredited radiological centres,

consisting in double reading of each negative mammography and immediate further assessment in case of suspicious results. Management centres implement the programme at departmental level. The French national public health agency (Santé publique France) is in charge of evaluating the NBCSP. After rising from 45% to 51% between 2005 and 2007, the NBCSP participation rate has levelled off at around 52% since 2008 although it varies markedly across French departments (Santé publique France, 2017). However, the NBCSP coexists with a substantial level opportunistic screening, which does not offer the same level of process warranty, like accreditations and double reading, and is not subject to monitoring and evaluation (European Commission, 2006). It was estimated that around 10% of women are screened opportunistically (Hirtzlin et al., 2012) and this proportion is likely to be

higher in some urban areas, like the Paris area. Nevertheless even when taking into account opportunistic screening, the participation rate is well below the European recommendations' screening coverage target of 70% (European Commission, 2006). It is thus essential to understand the factors influencing screening uptake.

Though various factors may influence screening uptake, several studies in France and other countries have shown that women of low individual socioeconomic status are less likely to get screened (Carrozzi et al., 2015; Damiani et al., 2015; Damiani et al., 2012; Duport, 2012; Duport and Ancelle-Park, 2006; Duport et al., 2008; Esteva et al., 2008; Fedewa et al., 2017; Jensen et al., 2012; Lagerlund et al., 2000; Luengo-Matos et al., 2006; Menvielle et al., 2018; Menvielle et al., 2014; Sandoval et al., 2017; Sicsic and Franc, 2014; von Euler-Chelpin et al., 2008; Willems and Bracke, 2018; Zackrisson et al., 2004). In addition to individual factors (e.g. education, income, employment), women's immediate social neighbourhood may also have an impact. This refers to the concept of deprivation defined by Townsend (Townsend, 1987) as a "state of observable and demonstrable disadvantage relative to the local community or the wider society or nation to which an individual, family or group belongs". As a result of both individual and contextual factor, NBCSP participation is likely to be low in geographical areas with high proportion of inhabitants with low socioeconomic status. Such associations at a geographical level are commonly estimated via ecological studies using deprivation indices. Ecological indices of deprivation have been built for France (Pornet et al., 2012; Rey et al., 2009). These indices are commonly used in ecological studies to assess the relationship between deprivation and health on the level of geographical units. Such ecological studies have been carried out in some French departments to determine the relationship between the socioeconomic neighbourhood of women's place of residence and breast cancer screening uptake (Guillaume et al., 2017; Ouedraogo et al., 2014; Pornet et al., 2010). However, no study has examined this relationship at a national level.

Our study aims to quantify the relationship between socioeconomic deprivation of women's municipality of residence and NBCSP participation at an ecological level in mainland France, using the French Deprivation Index (FDep) (Rey et al., 2009).

2. Materials and methods

2.1. Study population

Study population consisted of all women who participated in the NBCSP in mainland France during 2013–2014. In all departments of France, management centres record standardized information for all women participating in the programme. These data are transmitted to Santé publique France, where they are checked for validity and consistency, processed and compiled into the NBCSP evaluation database. For the 2013–2014 period this database included data for nearly 5 million women participating in the programme.

The data for screened women between the ages of 50 and 74 were analysed. The ages and municipalities of residence of screened women were extracted from the NBCSP 2013–2014 dataset. Note that the NBCSP database does not contain socioeconomic data for individual participants.

2.2. Participation rate

The 2013–2014 participation rate by municipality was calculated as the ratio of the number of women screened to the number of women aged 50–74 residing in the municipality during this period, according to the 2013 French National Institute of Statistics and Economic Studies (INSEE) population estimates. In accordance with INSEE method for age assignment, participants were assigned the age reached on 31st December of the year before screening. Participation rates were calculated overall and by 5-year age groups.

2.3. French Deprivation Index

The FDep is an ecological deprivation index computed at the municipality level using the four following variables: the percentage of unemployed individuals aged 15–64 in the active population, the percentage of workers aged 15–64 in the active population, the percentage of individuals aged 15 and over with high-school certificates, and the median income per consumption unit (Rey et al., 2009). The values of these four variables were derived from the 2013 census. The FDep is calculated for mainland France by the national health insurance administration. This index is not appropriate for the French overseas departments. The FDep was used as an indicator of deprivation of participants' place of residence on the municipality level. Levels of deprivation were used to define national population quintiles. The first quintile (Q1) corresponds to the 20% of the population living in the least deprived municipalities, while the fifth quintile (Q5) corresponds to the 20% living in the most deprived municipalities.

2.4. Urban/rural status of municipalities

INSEE has classified each municipality as rural or urban on the basis of 2012 census data. To define the degree of urbanisation, the INSEE developed the concept of urban unit. An urban unit is a municipality or group of municipalities comprising a zone of continuous construction (≤ 200 m between two buildings) inhabited by at least 2000 people. We will refer to municipalities with such urban units as "urban municipalities" and to other municipalities as "rural municipalities".

2.5. Scope of the study

All mainland departments were included in the study, except one for which the 2013–2014 screening data could not be included in the NBCSP database. Municipalities with unknown or erroneous administrative codes as well as those with (implausible) attributed participation rates exceeding 100% were excluded.

2.6. Statistical analyses

For a national and departmental description, participation rate was calculated for the 2013–2014 period for mainland France and according to FDep population quintiles. These rates were age-standardized (directly), using the population of women aged 50 to 74—according to 2013 population estimates for mainland France—as a reference. For a municipality description and modelling, screening rates were standardized with reference to age using an indirect method—by calculating the ratio of observed (O) number of screened women to the expected (E) number. The number of expected participants for a given age group equalled the participation rate for mainland France in that age group multiplied by the number of women living in the municipality in that age group. These ratio were multiplied by the general participation rate for our target population to yield indirect adjusted participation rates (IAPR) (Spiegelhalter, 2005). Municipality-level geographical variations in the IAPR and the FDep were mapped.

For a more accurate analysis, we modelled the relationship between the continuous FDep values and the IAPR at the municipality level, using a generalized linear mixed model (McCulloch et al., 2008). The model is defined as follows:

$$O_{ij} \sim P(\mu_{ij})$$

$$Log(\mu_{ij}) = \log(E_{ij}) + f(FDep_{ij}) + u_j + v_j * FDep_{ij} + \varepsilon_{ij}$$

$$u_j \sim N(0\sigma^2_u), \; v_j \sim N(0\sigma^2_v), \; \varepsilon_{ij} \sim N(0\sigma^2_\varepsilon)$$

The dependent variable was the number of observed participants from municipality i and department j (O_{ij}), assumed to follow a Poisson distribution with mean μ_{ij}. The value of μ_{ij} was adjusted for age by