The influence of district level characteristics on the participation rate of breast cancer screening in the city of Antwerp, Belgium

by

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Abstract

Objectives: *To analyse whether or not there is a relationship between participating in the breast cancer screening programme in the city of Antwerp (Flanders, Belgium) and the socio-economic status of the neighbourhood the women reside in.*

Methods: *Social and demographic characteristics that might explain the variance in the participation rate at the district level were listed and a multiple linear regression analysis was performed.*

Results: *In general, 13,415 women (37.8%) took part in the screening programme in Antwerp. The difference in participation rate of women living in privileged and underprivileged areas is 9.3%. Statistical sectors with a high percentage of people above 65 years and couples with children tend to have a higher attendance, whereas the percentage of*

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foreigners has a negative influence. The linear regression model including these three independent variables, explains 30% of the variance in attendance.

Conclusions: *There is a need to discover the specific causes of the lower participation rate in the underprivileged areas and how one can cope with this problem. Further research is also needed on the assessment of the socio-economic status.*

Keywords: *social gradient, breast cancer screening, Belgium, participation rate, socio-economic status*

Introduction

Breast cancer is a major cause of morbidity and mortality among Flemish women. The cumulative incidence of breast cancer is 11% for Flemish women aged 0-74 years in 1999 (1) and even 12% in the province of Antwerp, in 2000 (2). Women who die from the disease, die at a relatively low age. From the age category of 30-34 years on, breast cancer is the main cause of death where cancer is concerned (3). In 2002, the potential years of life lost with regard to the life expectancy at birth because of breast cancer in women in Flanders, amounted to 7.70 years per 1 000 person years (4).

Hitherto, primary prevention of breast cancer seems not feasible and therapeutic interventions have not led to overwhelming results. On the other hand, different studies have shown the usefulness of secondary prevention by means of mammography in women of 50-69 years of age every 2 years (5-13). There is a substantial reduction in breast cancer mortality due to breast cancer screening, as reported by several authors (14-18). Moreover, the European Community insisted on the introduction of national breast cancer screening programmes in its member states (19). A high participation rate, an optimal quality of the mammography and a good follow-up when necessary are essential for an effective population screening (19).

Since the 15th of June 2001, a screening programme for breast cancer is in place in Flanders for women aged 50-69.

The organisation of the health care system in Belgium has some specific characteristics such as fee for service, no compulsory registration with a GP, almost no restrictions on medical consumption, free access to specialists and a split power on health care matters according to the administrative level. Due to these specific characteristics, a

very particular kind of screening has been established (20). Women can participate in the screening programme by two possible "tracks". Track 1 is by means of a GP, a gynaecologist or another physician who refers women to an acknowledged radiographic unit. Women who are not referred by a physician are invited by means of a personal letter from the responsible Regional Screening Centre. This is track 2. In this invitation letter, women receive an appointment with date, hour and place where they are expected to have a mammography performed. This kind of invitation letter has proven to be the most important predictor of attendance at mammographic screening programmes (21-22). This phenomenon was also observed in pilot projects in Flanders (23). Of course, it is always possible for the women to change the timing of the appointment or not to accept the invitation at all.

Since it is also possible for a woman to go to her GP to be more informed before attending the screening programme, even after receiving an invitation letter, there is not always a sharp distinction between track 1 and track 2.

To reduce potential barriers to participate as much as possible, the screening mammography is free of charge for the women. A high participation rate is necessary for a mammographic screening programme to achieve its maximal potential for breast cancer control. To obtain a substantial mortality reduction at population level, a participation rate of at least 60-70% is necessary, as Vainio et al. reported in 2002 (24).

Pilot studies in Flanders showed a participation rate between 20 and 50% (23). One of the explanations for the low participation rate in Flanders is the existence of mammographic examinations outside the official screening programme (25). When 'outside programme screening' is taken into account, the potential participation rate seems to be at least 66%, as Van Hal and colleagues found out in 1997 (26).

In this study, we investigated the participation rate in one screening round of the Flemish breast cancer screening programme in the city of Antwerp, a port with about 460,000 inhabitants, which makes it the largest city of Flanders.

The social gradient strongly influences health behaviour, for example breast cancer screening attendance. This not only seems to be the case in Belgium (27) but also in other countries, such as Germany (28), the USA and Canada (29). With this perspective, we tried to find out whether women living in underprivileged areas in the city of Antwerp take less part in the screening programme compared to women living in

areas with a higher socio-economic status. We also tried to find out which social and demographic characteristics of their neighbourhood influence their participation. The results of our study can be of interest to adjust the health promotion campaigns to the specific needs of the deprived, so that a higher participation rate can be reached and breast cancer mortality can be reduced in the end.

Methods

A database was made with all the women of the target group for the screening programme in the city of Antwerp from 1/1/2003 until 31/12/2004. This is the duration of one screening round.

In this database was listed whether a woman participated in the programme and if she did, by which track. Women consulting their GP after having received an invitation letter, were included in the track 2 group, basing ourselves on the assumption that without the invitation letter they would not have participated.

A first analysis takes into account the social status of the area the women live in.

The city of Antwerp is divided in 295 statistical sectors. A statistical sector is defined as a more or less homogeneous quarter in social respect, based on official statistics (27). From the population list with women eligible for breast cancer screening, it is possible to allocate each woman to a specific statistical sector of the city by means of her address. The eligible population list is generated by the Crossroads Bank for Social Security ('Kruispuntbank van de Sociale Zekerheid'), containing only those women who are insured by means of the compulsory social security system. Only these women can receive a free mammography within the Flemish breast cancer screening programme.

Each statistical sector has a level of underprivilegedness/poverty from 3-15. The score for this poverty level is based on 3 indicators, the median income, the percentage of unemployed and percentage of people needing the help of the social welfare department (OCMW). In every sector the score on each indicator was calculated and scored from 1-5. Then the three scores were added. When a sector has a total score of 3, this means it is privileged, while a 15 means deprived (30).

To make it easier structured, 4 classes of (under)privilegedness were formed, going from privileged to underprivileged: 1 (grade 3-6), 2 (grade 7-9), 3 (grade 10-12) and 4 (grade 13-15). We calculated the attendance in each statistical sector, first per class, then by grade to give an answer

to the following question: does the participation decline by class or grade?

Furthermore, we divided the target group into 4 age categories in order to find out whether age has an influence on attendance. Statistical results were calculated using 95% confidence intervals around the differences in participation rate according to different neighbourhoods (privileged – under-privileged) and different ways of inviting (track 1 – track 2).

Finally, a multiple linear regression analysis was performed. We listed several social and demographic characteristics that might explain the variance in the participation rate at the level of the statistical sector. In table 1 the available social and demographic characteristics are presented.

TABLE 1:
Available social and demographic characteristics

1. % people above 65 in comparison with the total population (2005)
2. % people under 25 in comparison with the total population (2005)
3. % people from 18-64 years in comparison with the total population (2005)
4. % habitants with the Belgian nationality in comparison with the total population (2005)
5. % habitants without the Belgian nationality in comparison with the total population (2005)
6. % habitants with a nationality outside the European Union (2005)
7. % autochthones in comparison with the total population (2005)
8. % allochthones in comparison with the total population (2005)
9. % women aged 50-69 years in comparison with the total number of women (2005)
10. average number of family members = number of habitants / number of families (2005)
11. % singles in comparison with families (2005)
12. % single parents families in comparison with the total number of families (2005)
13. % couples with children in comparison with the total number of families (2005)
14. % couples without children in comparison with the total number of family house-holds (2005)
15. % unemployed (18-64 years) in comparison with the total population aged 18-64 (2005)
16. % unemployed (18-64 years) longer than 1 year in comparison with the total population aged 18-64 (2005)
17. % people on welfare or minimum of existence (18-64 years) in comparison with the total population aged 18-64 (2005)
18. average income (2002)
19. % buildings who are neglected or empty (2005)
20. grade of employment (2003)
21. % social houses (2004) in comparison with the number of families (2005)
22. index owners/renters (2001)
23. % renters paying less than 250 euro/month in comparison with the total numbers of renters (2001)
24. poverty-index (grade 1-15)
25. class of underprivilegedness (class 1-15)

A regression analysis enables us to identify a model that shows us which of the selected independent variables maximally explain the variance in the dependent variable. Each sector with less than 100 inhabitants was excluded. Finally 237 sectors were included.

Statistical results were calculated by means of SPSS.

Results

Between January 1st, 2003 and December 31st, 2004, there were 35,506 women aged 50-69 years, who were living in the city of Antwerp. During this period, 13,415 women took part in the screening programme (37.8% of the target group).

There were 1 216 women (9% of the participants, this means 3.4% of the target group) who participated after a referral (track 1), whereas 34.4% of the target group attended after an invitation letter (track 2).

When divided into 4 age categories, we can see that the participation was the highest in the age-category 60-64 years: 2 676 women in a total of 5 688 women (46.1%). The lowest participation rate is seen in the category under 55. In each age category, women took overwhelmingly more part by track 2 in comparison with track 1. These results are summarised in table 2.

According to their address all of these women could be located in one of the 237 distinguished statistical sectors of Antwerp. Since the sectors with less than 100 inhabitants were excluded, 84 women were not

TABLE 2:
Participation rate by age[a] and by track

age	Track 1		Track 2		Total participation		Total number eligible women
	number	%	number	%	number	%	
-55 years	401	2.8	4 370	30.6	4 771	33.4	14,277
55 - 59 years	315	3.9	2 857	35.4	3 172	39.3	8 061
60 - 64 years	288	5.1	2 388	42.0	2 676	47.0	5 688
65 - 69 years	212	3.1	2 584	37.4	2 796	40.5	6 905
Total (n)	1 216	3.4	12,199	34.4	13,415	37.8	35,506

Chi^2: 22.22, 3 degrees of freedom, p< 0.001

[a] Of 575 women, the exact age could not be retrieved.

included in this part of the study. Only 35,422 women were taken into account for the sector analysis. Among the sectors, the variation in participation ranged from 0 to 86.2%, with an average of 40.5%. The map of Antwerp shows the participation rates for each sector (Figure 1). In figure 2, the poverty level for each statistical sector is depicted. The results for each class are summarised in table 3. The participation declines linearly per class. This result is statistically significant (p< 0.001). The difference in attendance between class 1 and 4 is 9.3%. This is a statistically significant result (95% CI around the difference: 7.82%-10.7%). The difference in attendance per class remains statistically significant for each age category.

TABLE 3:
Participation rate by class[a] and by track

Class of the (under)privileged		Track 1		Track 2		Total participation		Total number eligible women
		number	%	*number*	%	*number*	%	
privileged	1	444	4.2	4 030	38.0	4 474	42.2	10,604
	2	342	3.8	3 240	36.0	3 582	39.8	9 005
	3	199	2.3	2 774	31.9	2 973	34.2	8 683
deprived	4	228	3.2	2 120	29.7	2 348	32.9	7 130
Total		1 213	3.4	12,164	34.3	13,377	37.8	35,422

Chi^2: 26.48, 3 degrees of freedom, p< 0.001
[a]For 84 women, no class could be assigned.

When the participation rate per grade is calculated, we can see that between grade 10-15, there is an attendance of 32.2-36.7% and between grade 1-9, from 39.2 to 43.5%, with a remarkable gap of 3% between grade 9 and 10 (Table 4). However, there is no linear decrease all the time.

Finally, the best fitting linear regression model was selected, based on the characteristics mentioned in table 1. To select this model we took into account the R^2, which tells us how much of the variance in the dependent variable is explained by the given model. Also taken into account to choose the best model, were the conditions by which a regression analysis is performed. Especially problems of multicollinearity and heteroscedasticity were to be avoided (31). Within the regression models that were produced, 6 demographic and social characteristics

Figure 1:
Participation rate for breast cancer screening for each statistical sector
in the city of Antwerp, Belgium, 2004
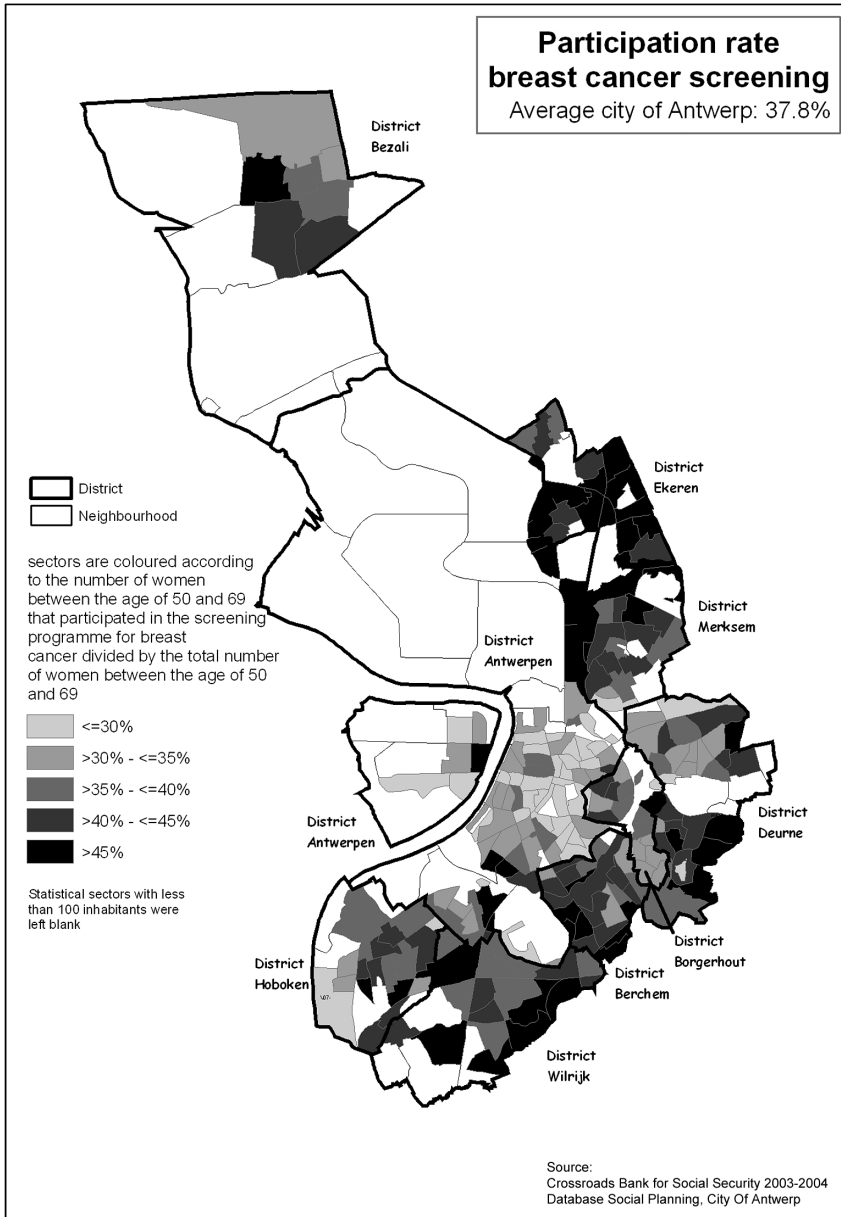(statistical sectors with less than 100 inhabitants are excluded).

Figure 2:
Poverty level for each statistical sector in the city of Antwerp, Belgium, 2004
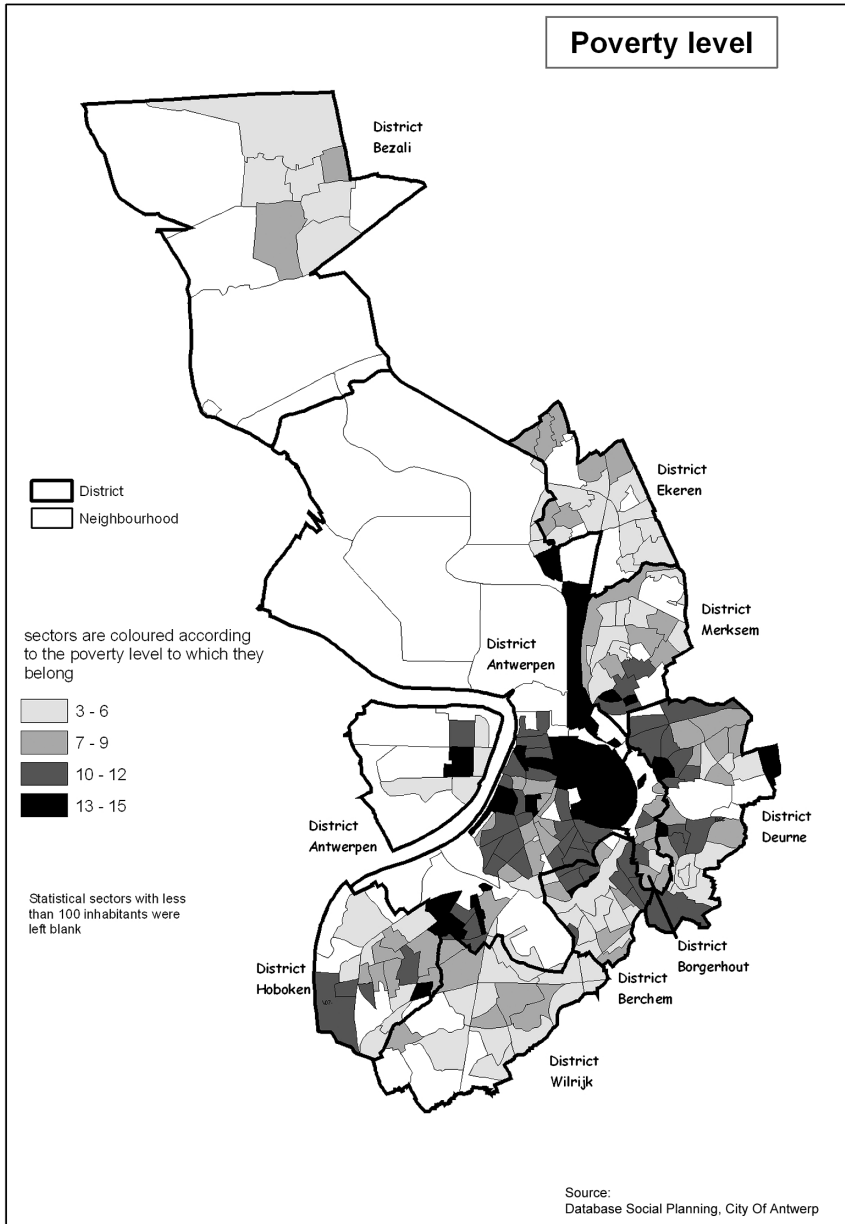(statistical sectors with less than 100 inhabitants are excluded).

TABLE 4:
Participation per grade of deprivation of the statistical sectors[a]

Grade of deprivation of the statistical sector	Participation) (n)	Participation (%)	No Participation (n)	No Participation (%)	Total
3 privileged	1 089	43.1	1 438	56.9	2 527
4	709	43.5	922	56.5	1 631
5	1 101	40.4	1 627	59.6	2 728
6	1 575	42.4	2 143	57.6	3 718
7	1 055	40.4	1 554	59.6	2 609
8	939	40.0	1 410	60.0	2 349
9	1 588	39.2	2 459	60.8	4 047
10	576	36.2	1 015	63.8	1 591
11	1 293	33.1	2 611	66.9	3 904
12	1 104	34.6	2 084	65.4	3 188
13	285	36.7	492	63.3	777
14	362	32.2	761	67.8	1 123
15 deprived	1 701	32.5	3 529	67.5	5 230
Total	**13,377**	**37.8**	**22,045**	**62.2**	**35,422**

Chi^2: 237.9, 12 degrees of freedom, $p < 0.001$
[a]For 84 women, no grade of deprivation could be assigned.

were found which have a significant relation with the attendance, namely the percentage of people above 65 years, the percentage of foreigners, the percentage of single persons, the percentage of couples with children, the percentage of unemployed for longer than one year and finally the percentage of people who receive the bare minimum subsistence level. The other factors show no significant relationship. The best fitting model is the one with the percentage of people above 65, foreigners and couples with children (Table 5). This model explains 30% of the attendance variance. Sectors with a high percentage people above 65 years and couples with children tend to have a higher attendance, whereas the percentage of foreigners has a negative influence.

Using the approach based on variation inflation factors, no problem of multicollinearity or heteroscedasticity between the regression variables was observed.

TABLE 5:
Linear regression model

dependent variable: participation rate
independent variables:
% of people above 65 years (2005)
% of foreigners (2005)
% of couples with children in comparison with the total number of families (2005)

R^2: 0.3
Adjusted R^2: 0.29
F: 33.341
p-value: < 0.001

Variables	Coefficients		
	B	Std. Error	p-value
(Constant)	0.267	0.037	< 0.001
% above 65	0.428	0.092	< 0.001
% couples with children	0.340	0.070	< 0.001
% allochthones	-0.192	0.046	< 0.001

Discussion

In comparison with the Flemish health target of 75 % participation and compared to other European regions, for instance The Netherlands (18) or Scandinavia (32), the participation rate for breast cancer screening in Flanders is low. This has a lot to do with the specific health care structure. Besides of a screening mammography, a Flemish woman can also have a diagnostic mammography performed. This means that usually an annual mammography and also an ultrasound are made. Before the start of the screening programme, diagnostic mammographies were routinely performed in women without any symptoms or complaints. Since the Flemish breast cancer screening programme has been established according to the European guidelines, a screening mammography does not include an ultrasound. Still, diagnostic mammographies are often suggested by their physicians to women belonging to the target group for breast cancer screening. Since radiologists receive a higher fee for performing a diagnostic mammography, the reasons for this physician conduct might have to do with financial incentives, besides of other reasons such as many years' habits, sincere fear of missing the right diagnosis and being wrongly informed. First estimates of the sickness insurance companies, indicate that more than half of the mammographies performed in Flanders, are diagnostic, as reported by De Gauquier et al.

(25). Since diagnostic mammographies fall outside the quality control of the screening programme, they are not registered and thus, not counted as participation. This also means that women, who had a diagnostic mammography performed, can yet receive a personal invitation letter for a screening mammography (track 2 of the screening programme) a short time after their diagnostic mammography. The result is a lot of frustration in the woman concerned and many useless financial and administrative efforts made by the screening centre. Moreover, contrary to a screening mammography, a diagnostic mammography is not free of charge for the woman involved. Of course, for a certain number of women (namely those with complaints), a diagnostic mammography is indicated. For most of them, however, it probably means overscreening.

For all these reasons, an important task to realise is a shift from (so called) diagnostic to screening mammographies. In the meantime, however, it is important to study the limitations of the existing screening programme to attract women.

The low participation rate is very unequally spread according to the deprivation status. It is striking that women living in underprivileged areas take part markedly less in the screening programme than women living in privileged areas. This result is statistically significant. When we subdivide the classes in grades, there is a decrease, which is not linear. The difference in participation rate between privileged and underprivileged women is 9.3%. This is a statistical significant and relevant result, especially because of the overall low participation rates.

Far most of the women (privileged and underprivileged) enter the screening programme after a personal invitation letter (track 2). It seems that a personal invitation letter can be a very important tool for also getting to the most difficult to reach group. Especially for the underprivileged, a 'dedicated' part in the screening programme seems to be necessary. This is all the more the case since it is to be supposed that diagnostic mammographies, which are much more costly for the woman involved, are mainly performed in those women more well-off. When the women who have a diagnostic mammography performed, would also be taken into account, it is to fear that the difference in 'real' participation rate between privileged and underprivileged women, is even much larger than our study results suggest. In this respect, it is important to notice that the results of a study of pilot projects of breast cancer screening in Flanders, recommended to completely organise the breast cancer screening in a 'dedicated' and thus centralised way (23). Due to several pressure groups, the policy makers have taken the decision to organise the breast cancer screening in Flanders according to two tracks, as

described above in detail. A much higher registered participation rate in Flanders is necessary to realise a high quality screening, meeting the European standards. For that reason, more details are needed on so called diagnostic mammographies: what is the number of diagnostic mammographies within the target group for screening and how many of them are in fact screening mammographies? Why does a woman have a diagnostic mammography performed where a screening mammography is indicated? What is the socio-economic status of women having diagnostic mammographies performed? In the meantime, however, the further development of track 2, especially when targeted to the underprivileged, seems very important.

The map of Antwerp shows geographically that the deprived areas, for example the city centre, have a lower participation than the suburbs. Occasionally there is an exception. It is interesting to investigate the reasons herefore. For example, what is the impact of advertising or special activities that have been done to increase the participation rate.

When we compare the participation rate and the age of the women, we can conclude that the participation increases with age, the highest participation rate is found in the age group 60-64 years. The lowest in the age category 50-54 years. These results are statistically significant. A possible explanation is that younger women recently had a diagnostic mammography and therefore do not participate.

The linear regression analysis shows that especially demographic characteristics have a significant relationship with the participation rate. Areas with a high percentage of people above 65 years and a high percentage of couples with children usually show a higher participation rate. In areas with a high percentage of foreigners, the attendance tends to be lower.

We will need to discover the specific causes of the lower participation rate in the underprivileged areas and the areas with a high percentage of foreigners and how we can cope with this problem. In addition, it is also recommended to investigate the factors that cause a higher participation rate in areas with a relatively high concentration of people above 65 years and couples with children. Because of the fact that the demographic characteristics are measured at the level of the statistical sector, ecological fallacy should be considered when conclusions are made. A lower participation rate in underprivileged areas does not necessarily mean that the underprivileged women tend to participate less. It might as well be the privileged women in the underprivileged areas who have a negative influence on the participation rate. Further research

which takes in account the social status of the individual women might deal with this problem.

Samenvatting

Doelstelling: *Analyseren of er al dan niet een verband bestaat tussen deelname aan het borstkankeropsporingsprogramma in de stad Antwerpen (Vlaanderen, België) en de socio-economische status van de buurt waarin de vrouwen wonen.*

Methoden: *Sociale en demografische karakteristieken die het verschil in variantie in de deelname op het niveau van de statistische sector zouden kunnen verklaren, werden opgelijst en een multiple lineaire regressie-analyse werd uitgevoerd.*

Resultaten: *In totaal namen 13.415 vrouwen (37,8%) deel aan het screeningspro-gramma in Antwerpen. Het verschil in participatiegraad tussen vrouwen uit geprivilegieerde en kansarme buurten is 9,3%. Statistische sectoren met een hoog aandeel inwoners boven de 65 jaar en gezinnen met kinderen, hebben een hogere participatiegraad, terwijl het percentage vreemdelingen een negatieve invloed heeft op de participatiegraad. Het line-aire regressiemodel dat deze drie onafhankelijke variabelen opneemt, verklaart 30% van de variantie in participatie.*

Conclusies: *De specifieke oorzaken van de lagere participatiegraad in de kansarme buurten moeten worden blootgelegd. Daarnaast moet worden nagegaan hoe dit probleem kan worden aangepakt. Verder onderzoek is ook nodig om de socio-economische status nauwkeuriger te bepalen.*

References

1. Flemish Cancer Registry Network. Cancer Incidence in Flanders 1997-1999. Brussels: Flemish League against Cancer, 2002 [Dutch].
2. Antwerp Cancer Registry. Cancer Registration in the Province of Antwerp. Incidence year 2000. Antwerp Cancer Registry: Antwerp, 2003 [Dutch, own calculations].
3. Cloots H., Hooft P, Smets H. Health Indicators 2000. Ministry of the Flemish Com-munity, Department of Welfare, Public Health and Cultural Affairs. Health Care Admin-istration, Policy Support Unit – Policy Evaluation Team. Brussels, 2002 [Dutch].
4. Ministry of the Flemish Community, Unit Policy Support, Health Indicators 2001-2002, http://www.wvc.vlaanderen.be/gezondheidsindicatoren [accessed 8 February 2006] [Dutch].
5. Shapiro S, Strax P, Venet L. Periodic breast cancer screening in reducing mortality from breast cancer. *JAMA* 1971;215:1777-85.
6. Shapiro S, Venet W, Strax PH, Venet L, Roeser R. Ten-to-fourteen-year effect of screening on breast cancer mortality. J Natl Cancer Inst 1982;69:349-55.
7. Tabar L, Fagerberg CJ, Gad A, Baldetorp L, Holmberg LH, Grontoft O, et al. Reduc-tion in mortality from breast cancer after mass screening with mammography: ran-domized trial from the breast cancer screening working group of the Swedish National Board of Health and Welfare. Lancet 1985;1:829-36.
8. Collette HJA, Day NE, Rombach JJ, de Waard F. Evaluation of screening for breast cancer in a non-randomized study (the DOM project) by means of a case-control study. Lancet 1984;1:1224-6.
9. Verbeek ALM, Hendriks JHCL, Holland R, Mravunac M, Sturmans F, Day NE. Reduc-tion of breast cancer mortality through mass screening with modern mammography: first results of the Nijmegen project 1975-1981. Lancet 1984;1:1222-4.

10. De Koning HJ, Fracheboud J, Boer R, Verbeek AL, Collette HJ, Hendriks JH, et al. Nation-wide breast cancer screening in the Netherlands: support for breast-cancer mortality reduction. Int J Cancer 1995;60:777-80.

11. Tabar L, Fagerberg G, Duffy SW, Day NE, Gad A, Grontoft O. Update of the Swedish two-county program of mammographic screening for breast cancer. Radiol Clin N Am 1992;30:187-210.

12. Paci E, Boer R, Zappa M, de Koning HJ, van Oortmarssen GJ, Crocetti E, et al. A model-based prediction of the impact on reduction in mortality by a breast cancer screening programme in the city of Florence, Italy. Eur J Cancer 1995;31A:348-53.

13. Collette HJ, de Waard F, Rombach JJ, Collette C, Day NE. Further evidence of benefits of a (non-randomized) breast cancer screening programme: the DOM project. J Epidemiol Community Health 1992;46:382-6.

14. Nyström L, Rutqvist LE, Wall S, Lindgren A, Lindquist M, Ryden S, et al. Breast cancer screening with mammography: overview of the Swedish randomised studies. Lancet 1993;341:973-8.

15. Kerlikowske K, Grady D, Rubin SM, Sandrock C, Ernster VJ. Efficacy of screening mammography: a meta-analysis. JAMA 1995;273:149-54.

16. Miettinen OS, Henschke CI, Pasmantier MW, Smith JP, Libby DM, Yankelevitz DF. Mammographic screening: no reliable supporting evidence? Research letters Lancet 2002;359:404-6.

17. Nyström L, Andersen I, Bjurstam N, Frisell J, Nordenskjöld B, Rutqvist LE. Long-term effects of mammography screening: updated overview of the Swedish randomised trials. Lancet 2002;359:909-19.

18. Otto S, Fracheboud J, Looman CWN, Broeders MJ, Boer R, Hendriks JH, et al. Initiation of population-based mammography screening in Dutch municipalities and effect on breast-cancer mortality: a systematic review. Lancet 2003;361:1411-7.

19. Perry N, Broeders M, de Wolf C, Törnberg S. (eds.). European Guidelines for quality assurance in mammography screening (3rd ed.). Luxembourg: Office for Official Publications of the European Communities, 2001.

20. Flemish government – Health Care Administration. Organization and efficiency of screening. Available from: http://www.wvc.vlaanderen.be/kanker/ accessed January 23, 2004 [Dutch].

21. Hurley SF, Huggins RM, Jolley DJ, Reading D. Recruitment acitivities and socio-demographic factors that predict attendance at a mammographic screening programme. Am J Public Health 1994;84:1655-8.

22. Segnan N, Senore C, Giordano L, Ponti A, Ronco G. Promoting participation in a population screening programme for breast and cervical cancer: a randomized trial of different invitation strategies. Tumori 1998;84:348-53.

23. Weyler, J., Schrijvers, J., Vandermeeren, I., & Vuylsteke de Laps, L. (eds.). Multicenter Study Breast cancer screening Flanders. Brussels: Ministry of the Flemish Community, 1997 [Dutch].

24. Vainio H, Bianchini F. (eds.). Breast Cancer Screening. IARC Handbooks of Cancer Prevention. Volume 7. World Health Organization, International Agency for Research on Cancer. Lyon: IARC Press, 2002.

25. De Gauquier K, Fabri V, Gaussin C. Breast Cancer Screening Campaign. Report number 2 of the Joint Venture of Sickness Funds: second term 2001 (comparison with the second term 2000). Preliminary results. Joint Venture of Sickness Funds, 2004 [Dutch].

26. Van Hal GF, Matthyssen MM, Van Goethem M, Van Bogaert P, De Schepper A, Weyler JJ. Degree of mammographic examination in organized and non-organized screening in Flanders, Belgium. T Soc Gezondheidsz 1997;75(6):315-9 [Dutch].

27. Pelfrene ER, Bleyen LJPM, De Backer G. Uptake in breast cancer screening. A socio-geographical analysis. Eur J Public Health 1998;8(2):146-9.

28. Richter M, Brand H, Rossler G. Sozioökonomische Unterschiede in der Inanspruch-nahme von Fruherkennungsuntersuchungen und Massnahmen der Gesundheits-forderung in NRW. Gesundheitswesen 2002;64(7):417-23.

29. Katz SJ, Zemencuk JK, Hofer TP. Breast cancer screening in the United States and Canada, 1994: socioeconomic gradients persist. Am J Public Health 2000;90: 799-803.

30. Rotthier P. Atlas of deprived and privileged areas in Antwerp. Antwerp: Databank Social Planning, 2005 [Dutch].

31. Lewis-Beck, M.S. Applied regression, an introduction. Newbury Park, Sage publica-tions, 1980.

32. Njor SH, Olsen AH, Bellstrom T, Dyreborg U, Bak M, Axelsson C, et al.. Mammo-graphy screening in the county of Fyn. APMIS 2003;110:1-33.