

# Does a national screening programme reduce socioeconomic inequalities in mammography use?

Marina Puddu, Stefaan Demarest and Jean Tafforeau

*Scientific Institute of Public Health, Epidemiology Unit, Brussels, Belgium*

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## Abstract

**Objectives:** To investigate possible changes in socioeconomic inequalities in mammography use among women aged 50–69 years between the start of the Belgian national screening programme in 2001 and three years later (2004), and to assess if the implementation of an organised screening programme has been successful in reducing socioeconomic inequalities in the uptake of mammography.

**Methods:** Data was obtained from the 2001 and 2004 Health Interview Survey. Data were analysed by logistic regression with educational level as proxy for the socioeconomic status. The gradient of socioeconomic inequalities was estimated with the relative index of inequality.

**Results:** Despite a substantial increase in the use of mammography from 59% in 2001 to 71% in 2004, a variation in the coverage according to educational level was detected: women with lower education were less likely to undergo mammography than those with higher education [(OR 1.93 (95% CI 1.21–3.09 in 2001 and 2.21 (95% CI 1.37–3.56) in 2004)].

**Conclusions:** Socioeconomic inequalities in breast screening uptake seem to persist 3 years after the implementation of the national screening programme. Although the national programme improved the coverage, it could not counteract the socioeconomic gradients in the use of mammography. Additional work is needed to identify effective methods of decreasing socioeconomic inequalities in mammography use.

**Keywords:** Mass screening – Breast cancer – Mammography – Socioeconomic inequalities – Survey.

## Introduction

Breast cancer is the most deadly and frequent cancer among women worldwide. In Belgium some 9 053 new cases were registered in 2003, accounting for 37.9% of all female cancers. In 1997 it was the leading cause (21.2%) of female cancer deaths. Belgium ranks among the most affected countries in the world<sup>1</sup>.

Nowadays early detection of breast cancer through mammographic screening is the only option available to women. A mammography is an effective secondary prevention technique which can reduce morbidity<sup>2</sup> and mortality due to breast cancer. In particular, an organised breast cancer screening programme is the only preventive measure at the moment that has proven to reduce breast cancer mortality by 20–30% among women aged 50 to 69 years<sup>3–5</sup>.

Nevertheless, one of the major performance indicators is that at least 70% of women take part in the breast screening programme<sup>3</sup>. Although participation rates have generally increased in recent years, especially in countries with population-based screening programmes – in Europe most programmes have intermediate to high rates of use (50–89%)<sup>6,7</sup>, they are still strongly inversely correlated to socioeconomic status<sup>8</sup>.

Participation in breast cancer screening programmes has been shown to depend on income and education, social support, health insurance and type of health service<sup>9,10</sup>. Women in low social classes tend to have lower screening participation rates than those in higher classes<sup>11,12</sup>. Socioeconomic disparities in screening practices tend to decrease when participation is promoted, cultural and economic barriers are removed, access to health care is improved and social support is offered<sup>13,14</sup>.

In Belgium, since 2001, an organised breast cancer screening programme in line with the European guidelines for quality assurance in mammography screening<sup>3</sup> offers free systematic screening every 2 years to all women aged 50 to 69 years. The federal government reimburses the mammography screening and covers the cost of the evaluation of the programme at national level. The regional authorities are responsible for the promotion, organisation, management and the local evaluation of the programme. Although there are differences in the management of the programme at the regional level, the major characteristics are the same: mammography is provided in radiological units preliminarily approved for quality assurance; two views are offered with double reading to improve the quality of the interpretation and to increase sensitivity and specificity; invitations are sent to women by post; the result, whether negative or positive, is sent to the referring physician who communicates it to the women<sup>15</sup>.

This study investigates the evolution of the magnitude of socioeconomic inequalities in using mammography among women aged 50–69 at the beginning of the nationally organised screening programme in 2001 and 3 years later in 2004. The purpose is to assess if the implementation of an organised screening programme has been a successful intervention in reducing socioeconomic inequalities in the uptake of mammography.

## Methods

### *Design, sample, study population and data collection*

The data for this study were drawn from the national Health Interview Survey (HIS) carried out in Belgium by the Scientific Institute of Public Health every 3–4 years since 1997. HIS is a cross-sectional survey based on a multistage stratified sample. The complete methodology has been described previously and published<sup>16,17</sup>.

The information is collected through face-to-face interviews as well as by means of a self-administered questionnaire. The average sample size of surveys is around 12 000 individuals (corresponding to 0.1% of the Belgian population). The present study included self-reported data from 3 089 women (1 490, HIS 2001 and 1 599, HIS 2004) aged 50 to 69 years.

### *Dependent variable*

The use of mammography was considered as the dependent variable. Reported use of mammography was measured through a dichotomous indicator (“yes” or “no”): “having received at least one mammography in the past two years”. This indicator is based on two single questions. The first one: “Have you ever had a mammography?”, after which the re-

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spondent may choose between “yes” or “no”; and the second one: “When did you have your last mammography?”, after which the respondent may choose between 1) less than a month ago, 2) more than 1 year but less than 2 years ago, 3) two years ago or more. In the two questions no distinction was made for the purpose of the mammography: this means that screening, diagnostic and follow-up mammographies are all considered together.

### *Independent variables*

Socio-demographic variables such as age (categorised into groups of 5 years), urbanisation level and region were used as independent variables. Age is associated with the outcome. Urbanisation level reflects accessibility, as it is well known that in general women living in urban areas consult preventive services more often than their counterparts<sup>18</sup>. Regions differ in terms of organisation, management, promotion activities as well as culture and prescription behaviour. For these reasons the region variable was added in the model.

### *Socioeconomic status indicator*

Educational level was used as a proxy for the socioeconomic status (SES). This is considered to be related to health outcomes through its influence on lifestyle behaviours (physical activity, diet, smoking), problem-solving capacity and values (importance of preventive health behaviours)<sup>19</sup>. It is also easy to measure in surveys, unlike many other SES indicators<sup>20</sup>. The SES was defined as the highest educational level attained by the reference person and his or her partner. Using the International System of Classification of Education (ISCED)<sup>21</sup>, the national education categories were classified in four classes: no diploma/primary education, lower secondary, higher secondary and tertiary education. When education at individual level was analysed, results showed no significant differences with the results using education at household level; therefore analyses were restricted to education at household level.

Income is another important indicator of socioeconomic status. It is considered to influence opportunities for education and provide access to different lifestyles<sup>22</sup>. Nevertheless, income was not used in the analysis as a predictor of use of mammography as it is correlated with education and because this information was less frequently available than education<sup>23</sup>.

### *Data analysis*

Mammography coverage, defined as the proportion of women aged 50 to 69 years who reported having had a mammography within the past 2 years, was estimated for the two surveys by five-year age groups.

A bivariate analysis was performed cross tabulating the independent variables with the outcome variable. The Chi-

**Table 1.** Proportions of women 50–69 years reporting having had a mammography within the past 2 years by age, educational level, urbanisation level and region, HIS, 2001 and 2004, Belgium.

	2001			2004			Relative change 2004/2001
	n	% (95% CI)	P	n	% (95% CI)	P	
<b>Age</b>							
50–54	377	63.8 (57.1–70.0)	<0.01	379	70.8 (64.3–76.6)	<0.05	1.12
55–59	294	65.3 (58.4–71.6)		354	76.4 (70.4–81.5)		1.17
60–64	293	57.4 (50.1–64.3)		253	72.3 (64.9–78.6)		1.26
65–69	300	47.5 (39.3–55.8)		330	62.6 (55.6–69.1)		1.32
Total	1264	58.9 (55.2–62.5)		1316	71.0 (67.7–74.1)		1.21
<b>Educational level</b>							
No or primary	254	47.5 (39.6–55.5)	<0.01	218	59.5 (50.8–67.7)	<0.01	1.25
Lower secondary	327	59.7 (52.7–66.2)		273	70.5 (63.2–76.9)		1.18
Higher secondary	320	59.6 (52.5–66.2)		379	71.2 (64.8–76.9)		1.19
Tertiary education	333	66.1 (58.1–73.3)		405	77.5 (71.7–82.4)		1.17
Total	1234			1275			
<b>Urbanisation level</b>							
Urban	493	59.3 (53.2–65.1)	0.80	459	70.7 (64.3–76.4)	0.81	1.19
Suburban	441	59.9 (54.4–65.2)		447	72.1 (66.9–76.7)		1.20
Rural	330	56.9 (48.9–64.6)		410	69.7 (63.4–75.2)		1.22
Total	1264			1316			
<b>Region</b>							
Brussels	288	71.5 (65.7–76.7)	<0.001	278	72.3 (66.3–77.5)	0.40	1.01
Flanders	461	54.4 (49.0–59.6)		499	69.6 (64.9–73.9)		1.28
Wallonia	515	63.8 (58.3–68.9)		539	73.2 (67.7–78.1)		1.15
Total	1264			1316			

squared test was used for bivariate comparison of proportions (P-values are two-tailed). To assess changes over time in socioeconomic inequalities in mammography use, we illustrate graphically the age-adjusted mammography rates by educational level and year.

A logistic regression model was used to assess the independent effect of socioeconomic status on the use of mammography. Socioeconomic inequalities in the use of mammography were estimated by odds ratios (ORs) and 95% Confidence Intervals (CI) with the highest educational level as reference category. Only those variables significant in a bivariate analysis were retained in the multivariate model.

In addition to ORs, the Relative Index of Inequality (RII) was also calculated.

RII is commonly used to measure the extent to which the occurrence of a health outcome varies with socioeconomic status<sup>24</sup>. RII is an index based on the regression of the coverage on a rank measure of education (midpoint socioeconomic ranked variable: edurank), rescaling the socioeconomic status on a scale of between 0 and 1 representing respectively the lowest and highest hypothetical level of education<sup>25</sup>. RII is ob-

tained by dividing the estimated prevalence of mammography of the hypothetical person at the bottom of the educational group distribution by the estimated prevalence mammography at the top of the educational group distribution.

The RII is more like a traditional relative risk that compares the mammography coverage of the theoretical extremes of education distribution, but it is estimated using the data on all educational categories. RII has the advantage of accounting for changes in the underlying population distributions in the social groups over time and of using the entire information across the entire range of social groups; it is sensitive to the direction of the social gradient in health. As the RII used in this paper was defined by Kunst and Mackenbach, it will be indicated as  $RII_{KM}^{24}$ .

The odds ratio and RII of the two different years were compared with the interaction test, according to the method described by Altman D.G. and Bland JM<sup>26</sup>. The test (z in Tab. 3) is the ratio of the differences of the two log odds ratios or relative risks to its standard error. The interpretation of this test is based on the corresponding P value, obtained on the table of the z-distribution. The comparison of the two estimates

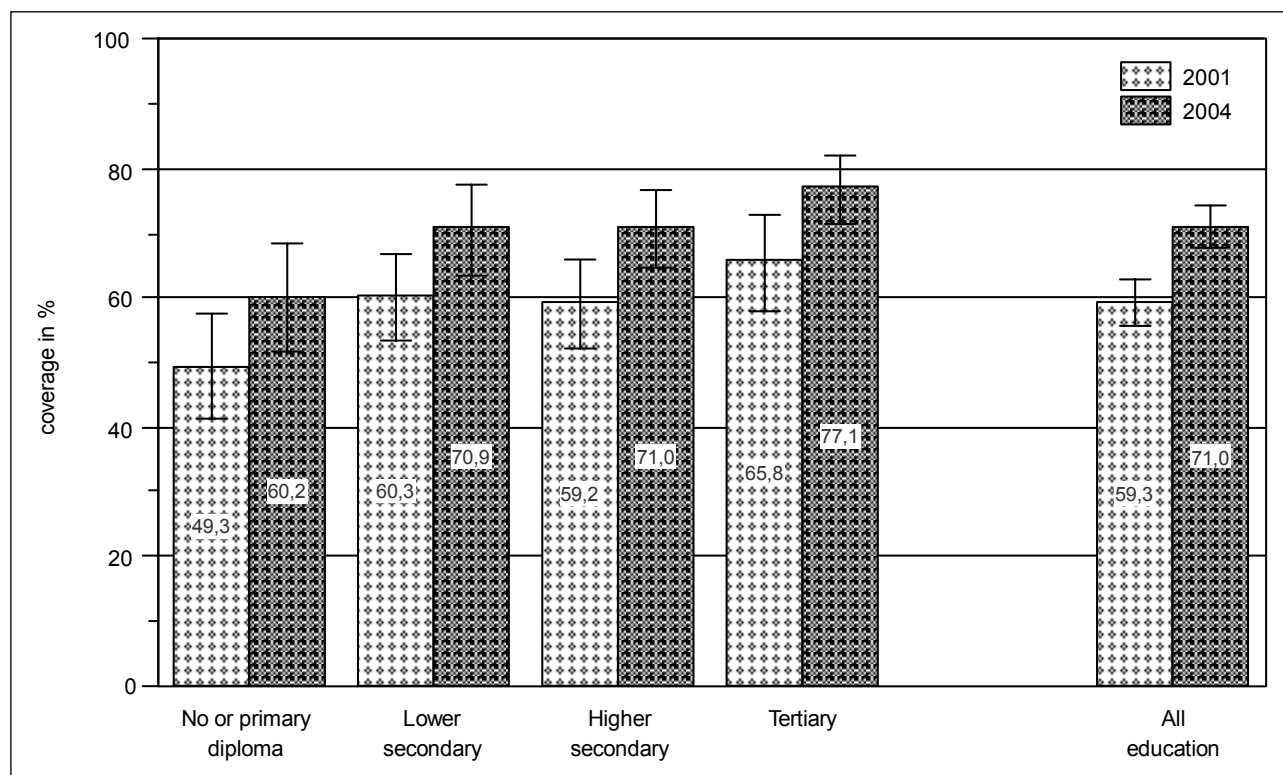


Figure 1. Age-adjusted mammography coverage within the past 2 years by educational level and by year, women 50-69, HIS, 2001 and 2004, Belgium.

is also possible by interpreting the estimated interaction effect and its confidence interval that is simply the ratio of the two estimates. The confidence interval is obtained by transforming the log back to the relative scale of the confidence interval of the difference of the two estimates.

Most analyses were run using the statistical software package STATA release 9 that allows the complex sampling design and weighting factors of the survey to be taken into account. Proportions by education were age-adjusted using a model-based method with the 2004 Belgian population as the reference. The Relative Indices of Inequality (RII) and 95% CI were estimated with a weighted log-binomial regression analysis using the Proc GENMOD procedure of SAS v9.1.

## Results

Among the 3 089 women aged 50 to 69 years included in this study, 2 580 (84%) answered the question: “Did you receive at least one mammography in the past two years?”.

For 2 509 of them the information on education was available (97%).

Table 1 shows the proportion of women aged 50 to 69 years who reported having had a mammography within the past 2

years according to the socio-demographic variables and by year of survey.

Across the study period, mammography coverage among women aged 50 to 69 years increased from 59% in 2001 to 71% in 2004, implying an increase of about 21% on its initial value. This shift was statistically significant ( $P < 0.0001$ ). In particular, it can be noticed that women aged 60 to 69 years had the highest increase in coverage over a three-year period. In 2004 the major contribution to the overall sharp rise was attributable to women aged 60–64 and 65–69 since their rates increased by around 30% against 2001 levels.

In the bivariate analysis the extent of coverage was observed to be significantly different by age and by education. Women with the lowest level of education are less likely to undergo mammography examination (Fig. 1). Figure 1 shows the age-adjusted mammography coverage by educational level and by year of survey. Mammography rates vary by region (at least in 2001), but conversely do not change significantly according to the urbanisation level (Tab. 1).

In a multivariate model adjusted for age and region the educational level was a significant predictor of self-reported use of mammography.

	2001 (n = 1233)	2004 (n = 1275)
<b>Educational level</b>	<b>OR (95% C.I.)</b>	
No diploma/primary education	<b>1.93 (1.21–3.09)</b>	<b>2.21 (1.37–3.56)</b>
Lower secondary	1.22 (0.78–1.90)	1.39 (0.88–2.20)
Higher secondary	1.27 (0.82–1.97)	1.36 (0.89–2.10)
Tertiary education	1	1
* adjusted for age, region		
<b>Calculations for comparing two estimated odds ratios</b>		
**log OR	0.6575 (E <sub>1</sub> )	0.7930 (E <sub>2</sub> )
SE[= width/(2*1.96)]	0.2392	0.2436
d[= E <sub>1</sub> –E <sub>2</sub> ]	0.6575–0.7930 = –0.1355	
SE(d)	$\sqrt{(0.658^2+0.793^2)} = 0.3414$	
Test of interaction	Z = –0.1355/0.3414 = –0.40 (P = 0.34)	

**Table 2.** Odds Ratio\* for not having had mammography within the past 2 years by educational level and by year, women 50–69, HIS, 2001 and 2004, Belgium.

\*\*Values obtained by taking natural logarithms of values on preceding row

Table 2 shows a very steep socioeconomic gradient where the use of mammography goes up with increasing educational level.

In 2001 (OR = 1.93) as well in 2004 (OR = 2.21), women in the lowest educational group have almost two times higher risk of not having mammography compared to the highest group. Both ORs are statistically significant.

Nevertheless, when comparing 2001 to 2004 according to the Altman method<sup>26</sup> we observe no significant change in the association between education and use of mammography (P = 0.34). The calculations for comparing the estimated ORs for 2001 and 2004 are shown at the bottom of Table 2.

The odds ratios and rate differences of the intermediate education categories are similarly intermediate, reflecting the natural ordering of the social groups in question. That is why the relative index of inequality was used in order to verify if indeed there is a gradient of mammography coverage through the educational levels.

The RII were calculated for both years separately and adjusted for age and region. The RII<sub>KM</sub> in 2001 is 1.53 (95% CI: 1.20–1.97) while it is 1.89 (95% CI: 1.37–2.60) in 2004. Both estimates were significantly higher than 1 thus supporting the existence of a socioeconomic gradient in mammography use through educational levels. The RII indicates for those women at the very bottom of the educational distribution a relative risk almost two times higher of not having undergone a mammography when compared to those at the very top. Each increase in educational position improves the likelihood of using mammography. If every woman experienced the rates of the highest educational group, a 10% increase would have been observed in the overall coverage of mammography for both years. The RII was larger in 2004 than in 2001. However, the interaction test shows no significant change between the

2 years (P = 0.16), meaning that the gradient observed is persisting over time but not increasing.

## Discussion

### Summary of findings

The results of this study indicate that in Belgium the use of mammography among women aged 50 to 69 increased steadily and significantly from 2001 to 2004 following the introduction of the national screening programme. In the three years since the implementation of the nationwide screening programme in 2001 the overall coverage increases from 59% to 71% for this population of women. The major contribution to this increase was mostly due to women aged 60 and over as for them alone the increase was in the order of 30%.

This study also shows socioeconomic inequalities in taking up breast cancer screening among women aged 50 to 69 with a significant inverse correlation between socioeconomic status and use of mammography. After multivariate adjustment, women with lower education are less likely to undergo mammography compared to their more educated counterparts. The analysis of the RII shows a clear socioeconomic gradient in the use of mammography: increased level of education is accompanied by an increased chance of having a mammography. Relative inequalities in use of mammography by education were more pronounced in 2004 than 2001. However, this difference is not statistically significant, meaning that 3 years after the start of the screening programme socioeconomic inequalities in the use of mammography had neither widened nor decreased significantly. In other words, so far the programme had not yet shown any impact on health inequalities in mammography use.

### Explanation

The finding that the coverage of mammography increased over a three-year period is not surprising. A similar study in The Netherlands based on HIS data reported a comparable increase in the uptake of mammography as result of the impact of the population-based breast screening programme<sup>27</sup>.

Less expected on the other hand was the higher increase in coverage for women over the age of 60. These results are in line with a French study showing that in France the mammography use was higher among women older than 60 in those districts with organised screening compared to those that did not offer it<sup>28</sup>. These findings are also consistent with the figures reported by the database of the National Institute for Social Security covering the period 2001–2004<sup>29</sup>.

Possibly the most important finding in this study is that the implementation of the nationwide screening programme still did not change the relationship between mammography use and socioeconomic status. On the contrary, the effect of the screening programme is that socioeconomic inequalities persist over time.

It is well known that a good way to address the issue of inequality is to implement an organised screening programme based on equal access<sup>30</sup>. Nevertheless, health inequalities are still a big issue even when efforts are deployed to reduce them. In many studies, women with lower level of education present a smaller likelihood of screening even in the presence of an organised screening programme<sup>10,31</sup>. It has been postulated that new public health interventions initially reach those of higher SES and only later affect the poor with early increases in inequalities for coverage, morbidity and mortality indicators. Inequalities only improve later when the rich have achieved new minimum achievable levels and the poor gain greater access to the interventions<sup>32</sup>.

Organised screening has among its major objectives an increase in global participation making women who never had a screening mammography before more aware of breast screening. Consequently, as a 'blind' programme, one can state that it had success (overall rates of screening were higher in 2004 than in 2001), yet with these higher rates the socioeconomic inequalities seem to persist.

Among the several factors that may explain such unequal use of mammography, one that has been suggested is that people of very low socioeconomic status may not perceive the utility of asymptomatic screening and that the difference between screening and diagnosis is still tricky for some women<sup>33</sup>.

Moreover, the lack of knowledge about mammography, especially screening mammography, has been presented as an important factor of non-attendance among women with a lower socioeconomic status. More highly educated women may be more informed about screening and therefore more prone to

undergo a mammography. A survey in the Flemish region has shown a positive link between the educational level and the knowledge level of women about breast cancer in general and about the screening programme in particular<sup>34</sup>.

Another possible explanation of the results might be the presence in Belgium of an important opportunistic screening activity. Opportunistic screening is more prone to social inequalities than systematic screening programmes and this could possibly contribute to the persistence of health inequalities in the use of mammography<sup>35</sup>. Organised screening programmes have been shown to increase the participation of lower social groups in comparison with opportunistic screening strategies, a finding that should be taken into account if these inequalities persist<sup>36</sup>.

The fact that the incidence of breast cancer is higher in more highly educated women than in those with lower education, might also explain the higher use of mammography by this group of women<sup>37–39</sup>.

### Limitations

Some limitations of this study must be pointed out. The HIS is a unique opportunity to study in a representative sample of the population the relationship between use of mammography and socioeconomic status. However, as the use of mammography is assessed by self-reporting, recall bias is therefore possible. Self-reported information may lead to an overestimation of the coverage as people tend to underestimate the length of time since they had their last mammography. The overestimation of the coverage rates has been confirmed by the results of the data of the National Institute for Social Security. The overall coverage estimated on the basis of refunding data was 56% in 2004 against 71% as estimated by HIS. However, in our study the aim is not to estimate the absolute coverage but to assess differences in mammography use according to socioeconomic status. We assume that this relationship is independent of the true estimates.

Another weak point of the survey is related to the non-participation bias. Very little information is collected on the non-participants making it difficult to assess bias related to socioeconomic status<sup>40</sup>. A previous study on health interview survey data reported that low socioeconomic groups have a higher non-response rate to the cancer screening and to subjective health items, which may lead to an underestimation of inequalities in utilisation of preventive medicine and overestimation of the rates<sup>33</sup>.

Another limitation of the study is the fact that in 2001 the survey questionnaire did not permit differentiation between mammographies performed for screening purposes within the organised programme and those performed for opportunistic screening, diagnostic or follow-up purposes. The 2004

questionnaire is presented in such a way that it is possible to distinguish between all the different reasons for undergoing a mammography, including screening within the nationwide programme (in 2004, 22.4 % of women aged 50–69 reported having had a breast cancer screening mammography).

### Strengths

Despite these limitations, the present study provides useful insight into the magnitude of inequalities in utilisation of mammography among women in the target group. HIS remains a valid and valuable source of information in this field because the overestimation doesn't change over time and because it allows trends to be monitored over time. Moreover, the HIS allows measurement of the coverage according to several socioeconomic parameters that are quite poor in the Social Security databases.

### Conclusion

Although the national programme in Belgium has improved coverage since its set-up, it could not counteract the socioeconomic gradients in the use of screening mammography. These findings suggest that women who have a lower socioeconomic status are at increased risk of not receiving preventive care, and that screening mammography, although more com-

mon than a decade ago, is still underused by them. To tackle socioeconomic inequalities in participation in breast cancer screening programmes, interventions and policies should be tailored to the needs of lower socioeconomic groups that are less likely to take up the services offered<sup>41</sup>. Identification of risk groups is therefore important for effective interventions and policies<sup>42</sup>. Better knowledge of all factors that increase health inequalities might help to identify groups of women to whom public health messages should be specifically addressed<sup>43</sup>. Health policy-makers should consider the importance of these related factors when developing preventive health programs for women<sup>44</sup>.

Unless there is a move towards creating the social and economic conditions that make it easier for people in all social classes to make healthy choices, there is a danger that, despite all the best efforts of prevention health care programmes, the gap will remain the same or will not improve over time.

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**Address for correspondence**

**Marina Puddu**  
**Scientific Institute of Public Health**  
**Epidemiology Unit**  
**J. Wytsmanstreet 14**  
**1050 Brussels**  
**Belgium**  
**Tel.: +3226425792**  
**Fax: +3226425410**  
**E-mail: Marina.puddu@iph.fgov.be**

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