Chapter 14. Assessing the impact of a public health intervention to reduce social inequalities in cancer

Gwenn Menvielle, Ivana Kulhánová, and Johan P. Mackenbach

Summary of key points

- Determining whether inequalities are increasing or decreasing is not only a mathematical but also a normative exercise.
- Opposing trends can be observed in relative and absolute inequalities as the consequence of differences in the speed of health change among individuals with lower and higher socioeconomic status.
- A decrease in social inequalities in health does not necessarily mean that health has improved in all socioeconomic groups.
- Prevention policies should combine a population-based and a vulnerable-population approach, also known as proportionate universalism.
- The more the strategy relies on the characteristics and actions of an individual, the more likely it is to increase social inequalities in health.

Introduction

Reducing social inequalities in health is one of the main public health challenges of our times. However, it is still not well understood which interventions and preventive strategies are the most effective to achieve this goal. Having knowledge of which interventions and strategies are the most effective implies that the target population and the relevant determinants in which to intervene have been identified, and that the types of inequalities that we aim to decrease have been clearly specified. This chapter discusses how these aspects are important considerations when assessing the effect of public health approaches to reducing social inequalities in cancer. Examples in the field of social inequalities in cancer are used to illustrate how the effect of an intervention (its magnitude and direction of change) will depend on how inequalities are measured as well as how the choice of the target population and target determinants will have an impact on the magnitude of health inequalities.

What inequalities do we aim to reduce?

Relative and absolute inequalities

Inequalities can be measured using relative or absolute measures. The most frequently used are described in Chapter 4. An increasing number of studies report that relative and absolute measures of inequalities lead to different conclusions in terms of whether inequalities are increasing or decreasing over time, which population (sex, age groups, ethnic groups, geographical areas, time periods, health status) shows the largest inequalities, and whether interventions widen or narrow inequalities (Mackenbach et al., 2015, 2016a; Platt et al., 2016). Fig. 14.1 illustrates this concept with a schematic example, in which mortality risk is determined for people with both low and high socioeconomic status (SES) over two different periods.

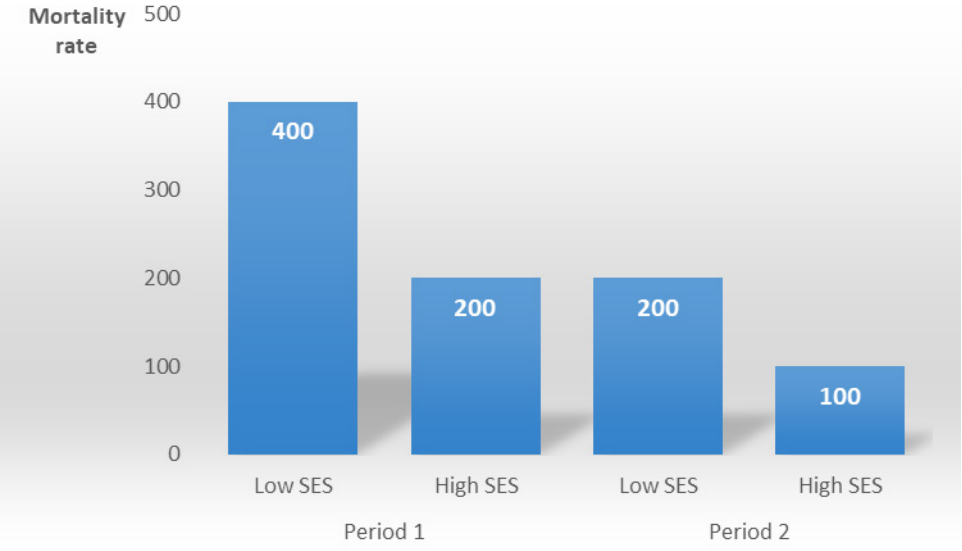

Fig. 14.1. Schematic illustration of trends in relative and absolute inequalities: mortality rates for two periods and for two different levels of socioeconomic status (SES). In period 1, the relative risk of mortality for people with low versus high SES is 2 and the rate difference is 200; in period 2, the relative risk is 2 and the rate difference is 100. Therefore, relative inequalities have remained the same, whereas absolute inequalities have decreased.

Studies documenting social inequalities in Europe have provided several examples of these discrepancies. For instance, trends in social inequalities in mortality have shown contradictory findings depending on whether relative or absolute inequalities were considered. Relative inequalities are being observed to increase in both men and women in many western European countries, whereas absolute inequalities are decreasing (Mackenbach et al., 2015, 2016a; de Gelder et al., 2017). This situation can be illustrated with measures of both absolute (rate difference) and relative (rate ratio) inequalities in cancer mortality in men with a low versus a high education level over two

separate periods in the 1990s and the 2000s in three European populations (Table 14.1). Whereas Norway experienced an increase in both relative and absolute inequalities, the other populations showed contradictory trends in relative and absolute inequalities. More specifically, absolute inequalities between men with a low versus a high education level in France decreased (the difference in age-standardized mortality rates declined from 242.9 deaths per 100 000 in the 1990s to 229.5 deaths per 100 000 in the 2000s), whereas relative inequalities increased (the rate ratio increased from 1.81 in the 1990s to 1.87 in the 2000s). In contrast, in Turin, Italy, absolute inequalities remained stable overall, but relative inequalities were observed to increase. In a context of recent declines in cancer mortality rates in all social strata in these three countries, these opposing trends are the consequence of differences in the speed of the decline in cancer mortality rates among individuals with lower and higher SES.

Table 14.1. Differences between cancer mortality rates by education level in three populations in Europe during the 1990s and the 2000s in men

Location	Rate difference[a]		Rate ratio[b]	
	1990s	2000s	1990s	2000s
Norway	125.4	180.4	1.38	1.67
France	242.9	229.5	1.81	1.87
Turin, Italy	172.6	169.3	1.55	1.70

[a] Difference between the age-standardized mortality rate of men with a low (up to lower secondary) and high (tertiary) education level, per 100 000 person years.
[b] Ratio of the age-standardized mortality rate of men with a low (up to lower secondary) to a high (tertiary) education level.
Source: compiled from de Gelder et al. (2017)

The need to compute both absolute and relative measures is increasingly stressed in the scientific literature (and discussed in Chapter 4). However, a recent review (King et al., 2012) pointed out that, at the time of its publication, far too many studies were still quantifying social inequalities in health on a relative scale only. Because relative and absolute measures can lead to different conclusions, providing both measures is important to evaluate interventions aimed at reducing social inequalities in health. However, when the types of measures give contradictory conclusions, determining whether inequalities are increasing or decreasing is not only a mathematical but also a normative exercise. More generally, although measurement of the magnitude, direction, and rate of change of health inequalities has long been seen as a value-neutral process, this is not only a mathematical and technical issue but also implies judgements about

what is fair or acceptable. Value judgements are closely embedded in inequality measurements (Harper et al., 2010). A relative measure of inequality will quantify inequalities regardless of the absolute level of the health outcome considered. Therefore, a preference for relative measures of inequalities implies that equality matters more than any other consideration, which corresponds to a strictly egalitarian normative position. In contrast, equality is not the only factor that matters for absolute measures of inequalities, because an absolute measure of inequality also takes into account the overall level of the health outcome.

Low and Low (2006) argued that it is better to use relative inequalities when the aim is to assess progress in reducing inequalities in the context of overall health improvement. Indeed, absolute inequalities are likely to decrease, whereas decreasing relative inequalities will be observed only if health is improving faster among the most deprived people (Mackenbach et al., 2016b). Nevertheless, others may argue that a reduction in relative inequalities requires larger relative improvements in health in groups with lower SES than in groups with higher SES, which is a challenging task for policy-makers. However, a relative measure using the most advantaged group as a reference is appropriate for assessing trends in social inequalities when this most advantaged group has already reached the best achievable health outcome. In our opinion, in the general current context of average health improvement, a reduction in absolute but not relative inequalities, although it is not the ideal situation, should be seen as a first and important step towards the elimination of social inequalities in health (Mackenbach, 2015).

Reference point used to assess inequalities

Historically, social epidemiological studies first quantified social inequalities in health using measures that compared two groups (rate difference, rate ratio, or similar measures) and disregarded what was happening in the rest of the population. It was then suggested that measures that account for the entire population would produce a more accurate measure of social inequalities in health, because they would include all socioeconomic groups (Mackenbach and Kunst, 1997). Such measures would also be more adapted to comparisons between different populations (sex, age groups, ethnic groups, geographical areas, time periods, health status), because they would account for possible differences in their distribution by SES. Measures differ not only according

to the population groups compared but also according to the reference point used to assess inequalities.

Some measures assess inequalities using a specific group as a reference point, usually the least deprived group or the group with the best health outcomes (which often happens to be the same group). These measures conclude that there is no inequality when everybody has the same level of health as this specific group. Among these types of measures are the rate ratio and the relative version of the population-attributable risk (PAR) (both are relative measures, and the latter includes the entire population), as well as the rate difference and the absolute version of the PAR, or the number of attributable cases (both are absolute measures, and the latter includes the entire population).

Other measures do not use a specific group as a reference point and conclude that there is no inequality when everybody has the same level of health, whatever the level achieved. Among these types of measures are the relative index of inequality (RII), which is a relative measure, and the slope index of inequality (SII), which is an absolute measure; both of these measures include the entire population.

All of these measures (RII, SII, and PAR) are defined in Chapter 4. It is important to note that PAR is different from the population-attributable fraction methodology. When interpreting PAR, a causal effect is not necessarily assumed between SES and health. As mentioned in Chapter 4, the absolute version of PAR corresponds to the number of cases that could be avoided if everybody had the same level of health as a specific group, usually the least deprived. However, this reduction may not be achievable in reality; if it is achievable, it may be by means other than changing the socioeconomic stratification in the population. For instance, when assessing social inequalities in participation in cancer screening, PAR can be decreased by implementing organized screening.

As for relative and absolute inequalities, different conclusions about the magnitude and the trends in social inequalities in health could be observed with measures that used different reference points. In a study that investigated changes in inequalities in cancer mortality by education level in France between 1990–1998 and 1999–2007 (Menvielle et al., 2013), several measures were used to quantify social inequalities in health. Although all of the measures used were relative, they yielded contrasting conclusions. Among women, social inequalities remained stable over time when quantified with RII; RII decreased from 1.45 to 1.28, although the temporal change was

not statistically significant. In contrast, an increase in social inequalities was observed when using hazard ratio; compared with women with a tertiary education, hazard ratio was observed to increase from 0.92 (95% confidence interval [CI], 0.72–1.18) to 1.33 (95% CI, 1.09–1.63) in women with a general secondary education. When quantified with PAR, social inequalities increased strongly, from 9% to 24%. The contradictory results observed when using different measures of inequalities were explained by different trends in cancer mortality between groups of different education level. As shown in Table 14.2, between 1990–1998 and 1999–2007 cancer mortality decreased among women with the lowest and highest education levels, but remained stable or even increased among the largest group, that of women with a medium education level (lower and vocational upper secondary). Cancer mortality was therefore similar between groups of different levels of education during 1999–2007, with the exception of women with a tertiary education, who had lower cancer mortality. This specific situation explains the decrease in RII, although it was not statistically significant (cancer mortality became similar for the majority of the population), whereas inequalities as assessed by other measures increased (only women with the highest education level experienced a decrease in cancer mortality over time).

Table 14.2. Differences between cancer mortality by education level in women in France during the 1990s and the 2000s

Education level	No. of women (% of total)	No. of deaths	MR	HR (95% CI)	RD
1999–2007: relative version of the PAR, 24%; absolute version of the PAR[a], 37; RII, 1.28 (95% CI, 1.08–1.52)					
No diploma	22 741 (16.5)	425	170	1.41 (1.18–1.69)	49
Primary	29 020 (21.1)	621	162	1.36 (1.14–1.61)	41
Lower and vocational upper secondary	46 108 (33.5)	633	162	1.40 (1.19–1.65)	41
General upper secondary	16 618 (12.1)	195	157	1.33 (1.09–1.63)	36
Tertiary	23 346 (16.9)	180	121	1.00	Reference
Total	137 833 (100.0)[b]	2054	154	–	–
1990–1998: relative version of the PAR, 9%; absolute version of the PAR[a], 15; RII, 1.45 (95% CI, 1.23–1.72); P_{trend}[c] = 0.32					
No diploma	32 359 (24.7)	750	190	1.30 (1.07–1.59)	44
Primary	37 449 (28.6)	716	150	1.05 (0.86–1.28)	4
Lower and vocational upper secondary	33 988 (25.9)	425	155	1.08 (0.88–1.33)	9
General upper secondary	14 043 (10.7)	142	134	0.92 (0.72–1.18)	−12[d]
Tertiary	13 141 (10.0)	118	146	1.00	Reference
Total	130 980 (100.0)[b]	2151	161	–	–

CI, confidence interval; HR, hazard ratio; MR, age-standardized mortality rate (per 100 000 person-years); PAR, population-attributable risk; RD, rate difference; RII, relative index of inequality.
[a] Number of deaths attributable to differences in education (per 100 000 person years): the product of MR and relative PAR.
[b] Percentages may not add up to 100, because of rounding errors.
[c] Comparison of the RII for the two periods.
[d] The negative RD value indicates a higher mortality rate among women with a tertiary education.
Source: Menvielle et al. (2013), © Menvielle et al.; licensee BioMed Central Ltd. 2013

When assessing the impact of public health approaches on social inequalities in cancer, researchers and policy-makers should carefully consider the measure used to quantify social inequalities, because different measures provide information on the achievement of different objectives. Measures such as RII provide information on whether the entire population has reached the same level of health, but without providing information on the level of health achieved, whereas measures such as PAR provide information on whether the entire population has achieved the level of health of a specific group (usually those with the highest SES).

Public health approaches to reducing social inequalities in health can ultimately aim to eliminate social inequalities by improving the level of health of the entire population until it is the same as that of the healthiest group. PAR has several strengths in this

approach: it is a measure that uses a specific reference group; it takes into account the entire population; and it enables assessment of the change in inequalities compared with a hypothetical situation, for example, a target goal set by a public health plan. However, PAR is not free from methodological limitations; in particular, unlike RII, it provides no information on the social gradient. For all these reasons, it is recommended to assess inequalities using both types of measures, to properly evaluate interventions aimed at reducing social inequalities in health. When these types of measures give contradictory conclusions, a value judgement is required to determine whether inequalities are decreasing or increasing. In our opinion, a decrease or a stabilization in the value of RII should be interpreted as progress towards the reduction of inequalities only if measures such as PAR are not increasing. If PAR is observed to be increasing, this would mean that the level of health has equalized within the entire population, but not necessarily to the best possible level.

Target of the intervention

An important aspect of prevention policies is the target population. This discussion started with the well-known article titled “Sick individuals and sick populations” published by Rose in 1985, in which he distinguished between population-based interventions (or a population strategy of prevention) that target the entire population and interventions that target high-risk groups (Rose, 1985). Rose noted that population-based interventions were likely to lead to larger improvements in health in terms of number of health outcomes avoided, because they shifted the risk distribution of the entire population to a lower risk.

More recently, Frohlich and Potvi (2008) discussed the general framework proposed by Rose from a social inequalities perspective, suggesting the replacement of a high-risk-group approach by a vulnerable-group approach (where a vulnerable group is defined as a group that is at higher risk because of shared socioeconomic conditions). Frohlich and Potvin stressed that population-based prevention policies may lead to a widening in health inequalities, because these policies may affect people with different SES in different ways, and may have a stronger effect among the groups with highest SES. This phenomenon is referred to as the inverse prevention law. To be fully effective in improving the health of the population without increasing social inequalities in health, prevention policies should therefore combine a population strategy of prevention with a vulnerable-group approach to create a so-called proportionate universalism approach.

This type of intervention targets the entire population, but the scale and the intensity of the intervention are proportionate to the level of disadvantage (Marmot, 2010). A schematic illustration of this concept is given in Fig. 14.2, and an example of a proportionate universalism approach for breast cancer screening is given at the end of this section (Table 14.3). From a theoretical point of view, this approach is without any doubt the most appealing one. However, in the current context of budget restrictions, policy-makers may be tempted either to target only the people most in need or to implement population-based strategies (McLaren et al., 2010).

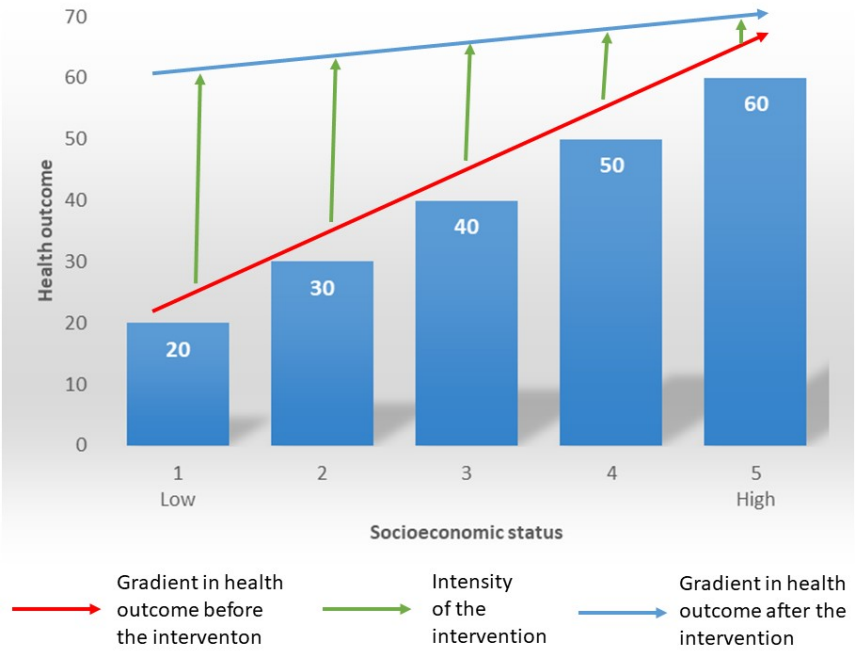

Fig. 14.2. Schematic illustration of the proportionate universalism approach: how a reduced gradient in health outcome by socioeconomic status is achieved after the implementation of an intervention which has a greater effect on those at a greater disadvantage. © Queen's Printer for Ontario, 2015. Adapted and reproduced with permission.

Table 14.3. Individual participation rates[a] in breast cancer screening by deprivation quintile, relative to the least deprived group, for women who could undergo mammography only at radiologists' offices or who had the additional option of being screened at a mobile mammography unit

Deprivation quintile	OR (95% CI)		
	Screening only in radiologists' offices (*n* = 35 804)	Screening in radiologists' offices or in mobile mammography unit (*n* = 28 298)	Total population (*n* = 64 102)
1 (least deprived)	1	1	1
2	0.87 (0.74–1.01)	1.06 (0.90–1.25)	0.92 (0.81–1.04)
3	0.86 (0.71–1.00)	1.11 (0.95–1.30)	0.94 (0.84–1.06)
4	0.83 (0.71–0.96)	1.15 (0.99–1.35)	0.94 (0.84–1.06)
5 (most deprived)	0.81 (0.69–0.95)	1.00 (0.84–1.19)	0.85 (0.75–0.97)

CI, confidence interval; OR, odds ratio.
[a] All models adjusted for age and distance to radiologist's office. ORs for the total population also adjusted for invitation to the mobile mammography unit.
Source: reprinted from Guillaume et al. (2017), Copyright (2017), with permission from Elsevier.

Interventions differ in their level of action and the targeted factors, and one can distinguish between upstream and downstream interventions. Upstream policies target distal factors and aim to modify the structural determinants of social inequalities, also called "the causes of the causes", through various policies such as fiscal, environmental, social, or health-care policies (CSDH, 2008). Upstream policies also include policies aimed at changing the social stratification. Downstream interventions more narrowly target clinical or behavioural factors, also called proximal factors, usually at an individual level.

Midstream policies have been defined by some researchers as area-based initiatives or territorial approaches. These policies concentrate resources in the most disadvantaged areas. The underlying idea is that a concentration of problems may hinder the completion of mainstream programmes, and such policies are an easy method of reaching a large number of deprived people. However, these policies have several limitations. The majority of deprived people do not live in deprived areas. Many of the structural problems faced by deprived people are generated at a national or even higher level and may not be solved by local solutions that only attenuate the effects but do not address the roots of these problems. Finally, it has been argued that these policies shift the responsibility for improving health from the state to the community, and ultimately to the individual (Asthana and Halliday, 2006).

Interventions can also differ in the required level of involvement of the individual: interventions can range from providing information to offering incentives, restricting choices, and introducing regulations. Some authors have proposed the categorization of interventions into superficial or radical interventions (McLaren et al., 2010). Superficial interventions are fully agent-based; they aim to change people's health by motivating individuals to change their behaviour (e.g. quitting smoking). In contrast, radical interventions use environmental control methods; they aim to change people's health by changing the context in which people live, independent of an individual's action (e.g. a ban on the use of asbestos and, as adopted in Denmark, legislation on the trans-fatty acid content in food). A real-life intervention, whether population-based or targeted at those most in need, will fall somewhere on the continuum from superficial to radical interventions. Superficial interventions directly target proximal factors and are classified as downstream interventions. Radical interventions act on distal factors and are classified as upstream interventions. However, although upstream policies are aimed at changing the context in which people live, thereby creating an environment more favourable to health, they are not necessarily fully radical interventions, because the outcome may ultimately rely on action taken by a person (e.g. participation in nationwide organized cancer screening).

The effect of an intervention on social inequalities in health depends on its characteristics. We already mentioned that population-based interventions may increase social inequalities in health, because they may have a stronger effect among the least deprived people. This is more likely to be observed if population-based interventions are aimed at modifying social norms through agent-based approaches, instead of changing an individual's exposure through global environmental control methods. More generally, the more the strategy relies on the characteristics and actions of an individual, the more likely it is to increase social inequalities in health. A recent study showed that upstream and/or more radical interventions were more likely to reduce inequalities than are downstream and/or more superficial interventions (Lorenc et al., 2013). The most efficient interventions in reducing social inequalities in various health outcomes were free provision of resources (e.g. free fruit in schools or free folic acid supplements during routine gynaecological visits), fiscal interventions on tobacco price, and structural workplace interventions. In contrast, media campaigns, which are population-based superficial interventions, led to an increase in inequalities. This finding

was supported by many studies on smoking prevention but was also suggested for folic acid intake. However, upstream policies and radical interventions may have unintended consequences that have a greater impact on the least socially disadvantaged groups, thereby increasing social inequalities in health. For instance, although many studies have reported that workplace smoking bans did not have a differential impact across individuals with different SES, several other studies have made the contrasting observation that workplace smoking bans were more effective in reducing smoking among the least disadvantaged, therefore exacerbating social inequalities in smoking (Thomas et al., 2008).

Cancer screening programmes provide an interesting example of the impact of interventions on social inequalities. Such programmes exist for colorectal cancer (men and women) and for breast cancer and cervical cancer (women). Cancer screening can be opportunistic (i.e. based purely on the will of the patient and/or health professional) or organized. Organized screening mostly relies on directly informing (usually through letters) and inviting the population to screening, while removing (at least partially) the out-of-pocket payment. Compared with opportunistic screening, organized screening is associated with increased participation, smaller inequalities in participation (Palència et al., 2010; Walsh et al., 2011), and, in most settings, reduced inequalities in cancer survival (Louwman et al., 2007; Puliti et al., 2012; Pacelli et al., 2014; Seneviratne et al., 2015). Although organized cancer screening programmes are not fully radical interventions, because the individual must make the decision to attend, well-organized screening programmes can reduce demographic and financial barriers, and therefore address some of the underlying or fundamental causes of non-participation in cancer screening. Although organized cancer screening programmes therefore reduce social inequalities in participation in cancer screening, such programmes do not totally remove social inequalities in cancer screening. This has been illustrated by a study that found that women facing adverse economic conditions (low income, lacking food sometimes or often, financial difficulties) were less likely to participate in breast cancer screening, even when a nationwide organized screening programme exists (Menvielle et al., 2014).

In addition, organized screening programmes can be supplemented by strategies aimed at increasing participation of the most disadvantaged people, such as local interventions in these groups or greater involvement of primary-care physicians. A review compared several interventions implemented to improve participation in breast

cancer and cervical cancer screening in the most disadvantaged groups (Spadea et al., 2010), and found that local interventions in disadvantaged populations, in particular interventions aimed at increasing the involvement of health professionals and decreasing geographical and financial barriers, were the most effective for increasing participation in cancer screening. This review showed that a combination of a population-based and vulnerable-group approach may be the best strategy to improve participation in breast cancer and cervical cancer screening among all women, and therefore decrease social inequalities in cancer screening, supporting the proportionate universalism approach.

An implementation of breast cancer screening provides an example of the proportionate universalism approach (Guillaume et al., 2017). In a rural French region (the Orne department, with an area of 1710 km^2 and 290 015 inhabitants), in addition to the nationwide breast cancer screening programme, a mobile mammography unit has been used since 2003 to increase the participation rate in breast cancer screening. The mobile mammography unit was parked in 109 different places, mostly in rural areas far from radiologists' offices, at different times during each 2-year screening round. Results based on the participation rate in breast cancer screening over the period 2003–2012 are presented in Table 14.3. Socioeconomic differences in participation rates in breast cancer screening were smaller in the group who were offered the additional option of undergoing mammography at the mobile unit compared with those who could only be screened at a radiologist's office. Overall, social inequalities in participation in breast cancer screening were reduced in the total population compared with the population who could only undergo mammography at a radiologist's office. Compared with the least deprived quintile, the odds ratio (OR) in the fourth deprivation quintile increased from 0.83 (95% CI, 0.71–0.96) in the population who could only undergo mammography at the radiologist's office to 0.94 (95% CI, 0.84–1.06) in the total population. However, the odds ratio in the most deprived quintile remained statistically lower than 1 in the total population (OR, 0.85; 95% CI, 0.75–0.97). The study concluded that a proportionate universalism approach could be beneficial in decreasing social inequalities in health.

Conclusions

This chapter has summarized the important challenges for public health interventions that aim to reduce social inequalities in health. From the examples described, it is clear that it may not be sufficient to improve the average level of health of the population to

combat social inequalities. There is no single measure – whether relative or absolute – that is adequate for all public health purposes. The types of measures that are best able to monitor changing social inequalities in health as well as the target population and/or factors differ according to the type of intervention and its policy implications in public health. When interpreting the impact of a public health intervention on health inequalities, clarity is needed about the assumptions made in the use of each measure. The available literature highlights the lack of evaluations that investigate the possible differential effect of interventions according to SES. To advance the fight against social inequalities in health, there is an urgent need for more evaluations of the effect of interventions on social inequalities in health.

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