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Best practice for prevention and treatment of cardiovascular disease through an equity lens: a review

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ABSTRACT

Background: Despite declining rates of cardiovascular disease (CVD) mortality in developed countries, lower socioeconomic groups continue to experience a greater burden of the disease. There are now many evidence-based treatments and prevention strategies for the management of CVD and it is essential their impact upon the more disadvantaged is understood if socioeconomic inequalities in CVD are to be reduced.

Aims: To determine whether key interventions for CVD prevention and treatment are effective among lower socioeconomic groups, to describe barriers to their effectiveness and the potential or actual impact of these interventions on the socioeconomic gradient in CVD.

Methods: Interventions were selected from four stages of the CVD continuum. These included smoking reduction strategies, absolute risk assessment, cardiac rehabilitation, secondary prevention medications, and heart failure self-management programs. Electronic searches were conducted using terms for each intervention combined with terms for socioeconomic status (SES).

Results: Only limited evidence was found for the effectiveness of the selected interventions among lower SES groups and there was little exploration of socioeconomic-related barriers to their uptake. Some broad themes and key messages were identified. In the majority of findings examined, it was clear that the underlying material, social and environmental factors associated with disadvantage are a significant barrier to the effectiveness of interventions.

Conclusion: Opportunities to reduce socioeconomic inequalities occur at all stages of the CVD continuum. Despite this, current treatment and prevention strategies may be contributing to the widening socioeconomic-CVD gradient. Further research into the impact of best-practice interventions for CVD upon lower SES groups is required.

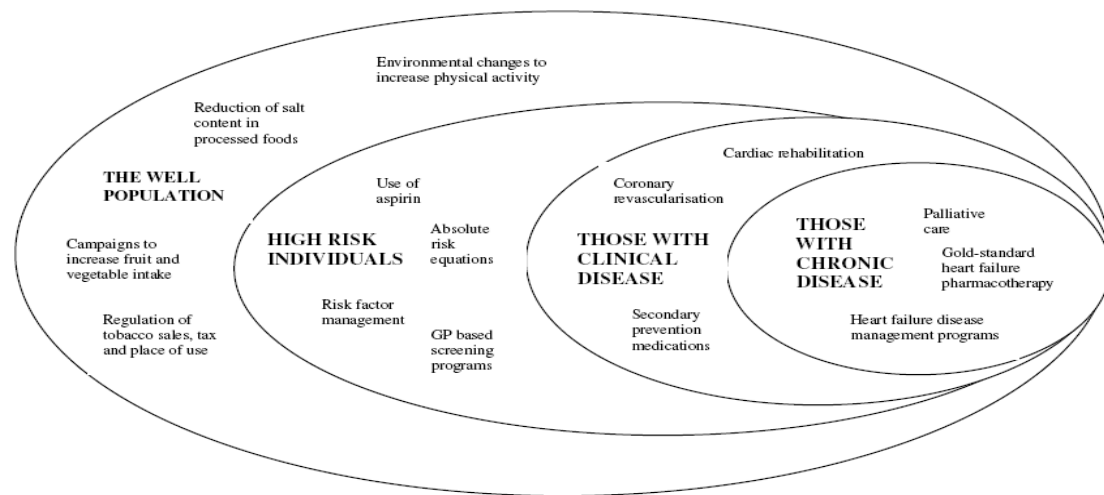
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BACKGROUND

Cardiovascular disease (CVD) is the leading health problem for most countries of the world, accounting for 30% of the global burden of disease in 2005.⁽¹⁾ Socioeconomic inequalities in CVD are well established, and many studies report a gradient in the disease from the most to the least disadvantaged.⁽²⁾ Despite recent declines in age-adjusted CVD mortality rates in many developed countries, evidence suggests that this gradient is widening so that lower socioeconomic groups carry an increasingly disproportionate burden of disease.⁽³⁻⁵⁾

The evidence-base to support interventions to prevent or treat CVD is arguably as robust as in any area of health. These interventions are implemented across all stages of the disease continuum from those who are well through to those with chronic heart failure, and include population-based measures, those based on systems of care, and medical therapies (Figure 1). Many of these interventions underpin current global strategies to stem the burden associated with CVD, and are described in numerous national and international position statements and guidelines as being “gold-standard” or best-practice.⁽⁶⁻⁹⁾

Figure 1: The Stages of the Cardiovascular Disease Continuum, with Examples of Key Interventions for Prevention and Treatment of CVD



It is known that some population-based prevention strategies are more accessible to the better educated⁽¹⁰⁾ and that there are disparities in access to health care.⁽¹¹⁾ However, the combined and cumulative effect of these inequalities across the CVD continuum is largely unknown.⁽¹²⁾ It is vital that the impact of CVD interventions upon lower SES groups is fully understood. Unless they are at least equally effective among disadvantaged groups they will not reduce inequalities, and may indeed contribute to the widening socioeconomic gradient in CVD.

In this review, key interventions from each stage of the CVD continuum recommended by international policy or clinical guidelines are examined. A specific aim was to review evidence for the effectiveness of each of these interventions among lower SES groups. We also aimed to determine whether socioeconomic barriers to their effectiveness have been identified; and to describe the potential or actual impact of these interventions on the social gradient in CVD. In addition, we identify key messages from the evidence that provide direction for future research or public health policies so that they might contribute towards decreasing health inequalities.

The specific interventions reviewed are:

1. *Smoking reduction strategies among the well population:* Cigarette smoking is a major risk factor for CVD, and the World Health Organisation recommends a number of interventions to reduce its prevalence.⁽¹³⁾ Of these, we have reviewed: (i) raising the price of tobacco through increased taxation, considered an effective deterrent to smoking at a population level,⁽¹⁴⁾ and (ii) nicotine replacement therapy (NRT), shown to be moderately effective in supporting smoking cessation within the general population.⁽¹⁵⁾ Because the cost of NRT is a potential barrier to its use, particularly among lower-income groups,^(16, 17) only studies of free or subsidised NRT were reviewed.
2. *Absolute risk assessment to identify those who are asymptomatic but at most risk:* Most guidelines for the prevention of CVD currently recommend the use of absolute (or “global”) risk equations to identify asymptomatic people at high risk of CVD events. These equations are based on levels of the range of important cardiovascular risk factors, rather than a single elevated risk factor in isolation.⁽¹⁸⁾
3. *Secondary prevention medications and cardiac rehabilitation:* We reviewed two evidence-based interventions known to be highly effective at reducing morbidity and mortality following acute myocardial infarction (AMI): (i) secondary prevention pharmacotherapy, the combination of aspirin, beta-blockers, angiotensin-converting enzyme inhibitors and HMGCoA reductase inhibitors (statins), estimated together to potentially reduce the relative risk of subsequent major events after AMI by up to 75%;⁽¹⁹⁾ and (ii) cardiac rehabilitation (CR), shown to reduce all-cause mortality by up to 47% following a cardiac event.⁽²⁰⁾
4. *Heart failure self-management programs:* In the end-stages, interventions target those with chronic disease such as heart failure. The aim of treatment is to reduce symptoms as well as hospitalisation rates and mortality. One important intervention is heart failure self-management programs.⁽²¹⁾ These are generally delivered in the hospital or home and led by nurses, with

most utilising a multi-disciplinary team approach. The majority emphasise self-management strategies such as daily recording of body weight and self-adjustment of diuretic dose.

METHODS

Search Strategy

For each selected intervention we searched Medline and Cochrane Libraries for studies published in English between 1 January 1996 and 31 October 2008, conducted in adult populations. Our search was limited arbitrarily to studies published after 1996 in order to include only contemporary evidence.

Additional studies were identified through reference lists and citation searches.

Keywords and Medical Subject Headings (MeSH) for each specific intervention were combined with keywords and MeSH terms for SES. The latter included (but was not limited to) social class, education level, low-income, poverty, occupation, and health disparities. Selected terms were considered to capture most approaches to the measurement of SES. ⁽²⁾

Study selection and inclusion criteria

Titles and abstracts were examined for relevance by two independent reviewers. Potentially relevant studies were assessed against the inclusion criteria, and disagreement resolved through discussion. Studies were included if they used quantitative outcomes to examine the effectiveness of the particular intervention among groups or individuals according to SES. These outcomes were: a) For the two smoking interventions, changes in rates of smoking prevalence or consumption; b) For absolute risk equations, their predictive performance or changes in the proportion of people assessed at being at high risk of CVD; c) For secondary prevention medications, cardiac rehabilitation and heart failure programs, outcomes included changes in mortality rates, further CVD events or hospital readmissions, changes in cardiovascular risk factors, or behavioural modification.

Studies were also examined for any description or exploration of barriers to the uptake or effectiveness of the particular interventions among lower SES groups or individuals.

Exclusion Criteria

Because CVD largely occurs in adults, we excluded studies of interventions among children and adolescents, in whom other specific factors may be operative. We also excluded studies of sex or ethnic-related inequalities, unless participants were specifically described as being of lower SES.

Data extraction and synthesis

The studies included in the review had heterogeneous design features, and variable outcome measures. As such, it was not possible to conduct quantitative analyses and a narrative synthesis of the data is presented.

RESULTS

We screened 517 article abstracts, identified 225 potentially eligible papers and included a final total of 49 studies. Further details of included studies are shown in Appendix I.

Interventions aimed to reduce smoking in the well population – increasing cigarette prices through raised taxation, and subsidised NRT

a. Evidence for effectiveness among lower SES groups

Fifteen studies were identified that examined the effectiveness of increasing tobacco taxation as a means of reducing smoking among lower SES groups. Most studies had a cross-sectional design, with the majority reporting that disadvantaged groups in both developed and developing countries are responsive to changes in the price of cigarettes.⁽²²⁻³³⁾ However, evidence from three studies conducted in New Zealand, the United States and Europe suggested that increasing tobacco taxes as a smoking cessation strategy had only a limited effect on lower SES groups,⁽³⁴⁻³⁶⁾ and in Vietnam, smokers with higher education were more likely than those with lower education to quit smoking as cigarette prices increased⁽³⁷⁾.

A further fourteen studies that examined the effect of NRT by SES were identified, including five randomised controlled trials.^(17, 38-41) All studies were conducted within developed countries, primarily the United States. Most studies combined NRT with telephone-based support, and this strategy appeared to be effective at reducing smoking prevalence for up to 12 months in lower socioeconomic groups both at a community level,⁽⁴¹⁻⁴⁴⁾ or when disadvantaged groups were specifically targeted.^(17, 38, 45-50)

b. Barriers to effectiveness among lower SES groups

The ready availability of cheaper tobacco, single cigarettes, or black-market sources.^(32, 33, 51, 52) are described as barriers to the effectiveness of increased tobacco taxation among lower socioeconomic groups in the United States and northern Europe. In Scotland, disadvantaged individuals described themselves as addicted and unable to quit despite higher prices.⁽⁵²⁾

In all of the studies reviewed above, NRT was either free or subsidised, addressing an important barrier to its uptake among lower-income groups. Despite this, qualitative studies from the United States found limited awareness of the availability of subsidised NRT,^(53, 54) and the requirement for a physician

prescription was perceived as a barrier among Canadian Aboriginal participants.⁽⁵⁵⁾ Other studies also found that low-income smokers described NRT as ineffective, primarily because of underlying factors that encouraged long-term smoking, such as anxiety, stress or living in a disadvantaged area.^(53, 56, 57)

c. Potential impact on socioeconomic inequalities in smoking

Evidence shows varying effects of increasing tobacco taxes among lower socioeconomic groups in both developed and developing countries. These differences may be due to the stage of the smoking epidemic in that country, or to the effect of other tobacco reduction interventions,^(34, 58, 59) and suggest that disadvantaged people may be less responsive to increased taxation in certain settings compared to others. Additionally, lower SES groups are described as unfairly burdened by increased taxation, because their greater nicotine dependency means they will continue to smoke even if the cost is increased.^(35, 56) The direct impact of tobacco taxation on socioeconomic inequalities in smoking is therefore unclear.

Further, while the available evidence suggests that subsidised NRT is effective among lower SES groups in the short term, longer-term smoking cessation can be difficult to sustain because of the many underlying factors associated with socioeconomic disadvantage. It is likely that subsidised NRT will be most effective when part of a comprehensive strategy that includes other approaches to support continued cessation. In England, educational differences in smoking rates are decreasing,^(16, 60) and this may be because broader policies such as price increases are supported by measures specifically directed to the disadvantaged, including the provision of subsidised NRT and cessation services in deprived areas.^(16, 61) Use of revenue raised from tobacco taxes to fund such targeted cessation strategies offers a further opportunity to decrease smoking inequalities.⁽⁶²⁾

Interventions targeting those at high risk of CVD – The measurement of absolute risk

a. Evidence for the effectiveness among lower SES groups

The most commonly used absolute risk prediction equations are those derived from the Framingham cohort study, conducted in Massachusetts, USA.⁽⁶³⁾ While these equations are known to perform differently in different populations and ethnic groups, they can be “recalibrated” using local incidence and risk factor distribution data.^(63, 64)

Three studies from the United Kingdom (UK) and Australia were identified that examined the performance of the Framingham equations among lower SES groups, with overall findings that their use leads to underprediction of risk in those who are socially disadvantaged.⁽⁶⁵⁻⁶⁷⁾ New risk equations from the UK that include area-based SES measures have recently been developed, and it was found that the proportion of lower SES individuals appropriately identified as being at high risk was significantly

increased when using these new equations in comparison to the Framingham equations. ^(18, 68, 69)

Adding a measure of lifetime material disadvantage to the Framingham equation in a Scottish cohort did not significantly improve its ability to discriminate between those at higher and lower risk of CVD, ⁽⁷⁰⁾

b. Barriers to effectiveness among lower SES groups

Few barriers to the effectiveness of absolute risk equations among lower SES groups have been reported, although it is known that such people are less likely to visit their family doctor for preventive reasons. This limits the opportunities for CVD risk factor screening. ⁽⁷¹⁾ Even when those at higher risk are identified, compliance with medications or lifestyle change is difficult because of the many pre-existing financial and social barriers to health associated with disadvantage. ⁽¹⁸⁾ The Framingham equations in particular require diagnostic tests which are not available in all situations, including the poorer rural areas of lower-income countries. Accordingly, simple risk equations have been developed that require only history, blood pressure and urinalysis for use in these settings. ⁽⁷²⁾

c. Potential impact on socioeconomic inequalities in CVD

Lower socioeconomic groups have a greater risk of developing CVD than those with higher SES, ⁽⁶⁵⁾ and the use of absolute risk equations in these populations is an opportunity to effectively identify and treat this risk. However, the Framingham equations, commonly used at present, do not take into account the excess risk associated with disadvantage. New risk equations that include SES are a means of identifying population subgroups in whom the need for preventive treatment is greater and as such, could be considered to be more equitable. ^(18, 73) It is also suggested that lowering the treatment threshold for disadvantaged individuals could help compensate for the extra risk conferred by lower SES. ⁽⁶⁶⁾

Interventions targeting those with clinical manifestations of disease - combination pharmacotherapy for secondary prevention of CVD, and cardiac rehabilitation

a. Evidence for effectiveness among lower SES groups

Three studies were identified that examine the effectiveness of combination pharmacotherapy within different socioeconomic groups. Two European studies found that patients from lower SES classes achieved comparable risk factor control to those in higher classes, ^(74, 75) and in Quebec, an increase in co-payment for cardiac medication among elderly patients did not adversely affect health outcomes, regardless of SES. ⁽⁷⁶⁾

Four studies which examined the effectiveness of cardiac rehabilitation by socioeconomic groups were identified. ⁽⁷⁷⁻⁸⁰⁾ Overall, the evidence points to the potential for CR to be effective at modifying major risk

factors across all socioeconomic strata.^(77, 79) A study from the United States found that medically indigent participants benefited as much from attendance at CR as more affluent patients, with similar improvements in exercise tolerance, and dietary and smoking behaviours.⁽⁷⁹⁾ This study was conducted in a small centre-based program with high staff: patient ratios and pre-arranged transportation.

b. Barriers to effectiveness among lower SES groups

Because of their higher risk of recurrent CVD events, prescribing rates for evidence-based medications should at least be similar and probably higher among disadvantaged populations.⁽⁸¹⁾ However, many studies have shown that even in countries with subsidised medication there is either a negative association,⁽⁸¹⁻⁸⁹⁾ or no association^(74, 90-95) between socioeconomic disadvantage and prescribing of CVD medications. There is limited discussion of the reasons underlying these findings, although physicians may be more reluctant to prescribe if they perceive potential issues with compliance such as the cost of medications.^(83, 87, 96) Disadvantaged patients may also have more co-morbidities, thereby limiting the medications they can be prescribed (for example, beta-blockers are relatively contraindicated in those with reversible airways disease).⁽⁹⁶⁾

Poor referral and attendance rates at CR are also associated with low income,^(97, 98) low education^(98, 99) and neighbourhood deprivation.^(100, 101) The reasons underlying this gradient have been well explored, and include barriers such as program cost,⁽¹⁰²⁾ and lack of transport.⁽¹⁰³⁾ High levels of depression, common among socially disadvantaged adults⁽¹⁰⁴⁾ are shown to be associated with non-attendance at CR.⁽¹⁰²⁾ Attendance is also influenced by the strength of recommendation from the physician,⁽¹⁰⁵⁾ who may be more reluctant to refer lower SES patients because of scepticism about their ability to make lifestyle changes.⁽¹⁰²⁾ Lack of knowledge about CR has also been seen in Indigenous Australians.⁽¹⁰⁶⁾

c. Potential impact on socioeconomic inequalities in CVD

The available evidence suggests that while CR and combination pharmacotherapy are effective among lower SES groups, access-related barriers to both are significant. Socioeconomic inequalities in rates of coronary revascularisation have also been described,^(107, 108) indicating an overall need for more research into ways to improve uptake of secondary prevention services and therapies among disadvantaged populations. The use of innovative approaches to address barriers to access is warranted. For example, pre-arranged collection or home-based programs can address difficulties with transportation to CR programs.^(79, 102)

The polypill has also been proposed as a measure by which co-formulation of low-cost generic compounds might allow more equitable access to proven medications for primary and secondary prevention of CVD.⁽¹⁰⁹⁾ This is of particular relevance to underdeveloped countries where availability of

medications is limited in poorer rural areas.⁽¹¹⁰⁾ Modelling of findings from a recent randomised controlled trial in India suggested that use of a polypill for primary prevention could potentially reduce cardiovascular heart disease and stroke by 62% and 48% respectively.⁽¹¹¹⁾

Interventions targeting patients with chronic heart failure - Heart failure self-management (HFSM) programs

a. Evidence for effectiveness among lower SES groups

Five studies were identified which examined the effect of HFSM programs among disadvantaged populations in the United States.⁽¹¹²⁻¹¹⁶⁾ When delivered within lower SES groups, these programs were effective in reducing rehospitalisation and mortality rates and improving functional ability. One randomised controlled trial that compared lower with higher educated participants attending the same program found no education-related differences in subsequent cardiac events or rehospitalisation.⁽¹¹⁴⁾

b. Barriers to effectiveness among lower SES groups

Self-management of heart failure is complex, and people with lower levels of education and health literacy may be less able to effectively manage their disease than those who are better educated,⁽¹¹⁷⁾ describing a lack of confidence in their ability to self-manage their condition.⁽¹¹⁸⁾ Financial barriers have also been identified, including costs of medication and visits to health professionals.^(114, 117)

c. Potential impact on socioeconomic inequalities in heart failure outcomes

Evidence from the United States shows that HFSM programs are effective at reducing both mortality and hospital readmission rates among lower SES groups with CHF. It may be that the intensive and regular contact with health professionals reduces the social isolation commonly experienced by disadvantaged people, and encourages their adherence to medication and exercise regimens.^(116, 119) Additionally, the multidisciplinary team approach of HFSM programs allows for a variety of treatment modalities to be utilised, which can be tailored to each patient's lifestyle and resources. Programs that are creative in their approach (such as those that use teaching materials designed for those with lower education) are also likely to be successful.^(112, 117)

DISCUSSION

This review has examined the effectiveness of key evidence-based interventions for the prevention and treatment of CVD within lower SES groups, identified barriers to their utilisation and effectiveness, and highlighted their potential or actual impact upon the socioeconomic gradient in CVD. Overall, only limited evidence was found for the effectiveness of the interventions examined and there was little exploration of SES-related barriers to their uptake. This has significant implications for public health

policy. If these important interventions are not effective among the disadvantaged then these groups will continue to carry a disproportionate burden of CVD, and current best-practice itself may be contributing to the socioeconomic gradient in CVD. Indeed, because CVD imposes a major economic burden in many countries, and much of this relates to hospitalisation or residential care, it can be argued that it makes sound economic sense to implement strategies particularly among those who carry the greatest burden of disease.

What might work at decreasing the SES/CVD gradient? Key messages

Key messages that are pertinent for future efforts to reduce CVD among disadvantaged groups are shown in Table 1.

Our findings identify opportunities for intervention across all stages of the disease continuum, and illustrate the importance of both primary and secondary prevention strategies in reducing the burden of CVD among lower SES groups. It is important to note that the relative contribution of secondary prevention strategies to the poorer prognosis for lower SES groups is unclear. Some studies from India, the United States and Finland suggest that disparities in evidence-based treatments during and after hospital admission for AMI account for most of the socioeconomic gradient in CVD outcomes.^(82, 85, 120) However, others have shown that these same treatments explain less of the social gradient than do clinical status and CVD risk factor profile on admission.^(88, 121) These findings imply that reducing social disparities in CVD will require more than just improved access to care,^(82, 88) and point to the vital importance of effective primary prevention strategies at earlier stages of the disease continuum so that the cumulative burden of CVD among disadvantaged individuals is reduced. One recommended approach to primary prevention is that of combining of community- or population-based interventions with those directed specifically to “high-risk” individuals.⁽¹²²⁾ If lower SES individuals are seen as “high-risk” because of the extra risk conferred by socioeconomic disadvantage, then this combination approach offers an opportunity to reduce the gradient seen in major CVD risk factors. This strategy has been effective at reducing smoking prevalence in disadvantaged groups in the UK, and could equally be applied to other risk factors. For example, community measures to increase physical activity levels through introducing local walking trails could be made more attractive by enhancing the safety of such trails within disadvantaged neighbourhoods. Although outside the scope of this review, it is also recognised that early life disadvantage plays an important role in the development of the social gradient in CVD.⁽¹²³⁾ Reducing risk factors and environmental exposures in children through population or community-based measures will therefore likely have an impact upon future CVD burden.⁽¹²²⁾

Limitations

While a limited number of interventions have been examined, those selected are known to have a significant impact upon CVD morbidity and mortality. Therefore we consider our findings are important in advancing knowledge and understanding about strategies to reduce CVD among disadvantaged groups.

The available evidence was limited, and studies of poorer quality and small sample size were not excluded. This may restrict the generalisability of our conclusions. We also acknowledge that the focus of this review is on developed countries. This is primarily because evidence from the developing world remains limited, despite these countries carrying the greater burden of CVD.⁽¹²²⁾ Further, while not all underdeveloped countries show an inverse socioeconomic gradient in CVD, this may change as they become more industrialised. For example, in India, there has been a transition over the last decade from a positive association between social advantage and CVD to an inverse one. This shift is thought to be due to several factors including increased urbanisation and greater uptake of health protective behaviours among the higher social classes.⁽¹²⁴⁾ Therefore, while our findings may not have immediate relevance for these countries, they are likely to be important in the future.

Exclusion of ethnic-related inequalities (unless specifically described as lower SES) may have also underestimated the full extent of inequalities in CVD, particularly in the context of increasing multi-ethnicity within cities such as New York and London. The issue of ethnic-related differences in CVD is highly complex, and complicated by cultural and genetic factors.⁽¹²⁵⁾ Migrant groups in particular may be at greater risk because of interactions between genetic susceptibility and their new environment.⁽¹²⁶⁾ However, not all migrants or minority ethnic groups are from a lower SES background. It has also been demonstrated that a substantial portion of the 10yr risk of CVD that was associated with ethnicity in the United States could be attributed to SES or geography.⁽¹²⁵⁾ In view of this complexity, and to limit the scope of the paper, we elected to include only ethnic minorities if they were identified as having low SES.

CONCLUSION

There are significant socioeconomic disparities in the uptake and delivery of key prevention and treatment strategies at all stages of the CVD continuum, and a paucity of evidence for their effectiveness among lower socioeconomic groups. Increasing this evidence-base will require greater research efforts and a concerted and coordinated approach across many sectors of society.⁽¹²⁷⁾ While there will be little impact on CVD inequalities until the underlying determinants of health inequalities are addressed, policy makers and clinicians must recognise the importance of SES as an independent risk factor for disease, and seek ways of incorporating it into current best-practice management of CVD.

Conflicts of interest

None declared

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Table 1 Key messages from this review

Potential successes

1. Combining population-based strategies with those specifically directed to disadvantaged groups may reduce the SES-smoking gradient.
2. Heart failure self-management programs are effective among lower SES groups possibly because they allow for an intensive and personalised approach.

Potential opportunities

1. Creative and innovative approaches to improve uptake of interventions are needed, such as those that increase access (home-based cardiac rehabilitation programs), or those that remove cost (free NRT), or those that are tailored towards lower SES groups (heart failure self-management programs).
2. Lower SES individuals could be more appropriately identified as being at high risk of CVD either through inclusion of SES into absolute risk equations, or by lowering their thresholds for treatment

Future directions for policy makers and researchers

1. Many barriers to the effectiveness and utilisation of CVD interventions in lower SES groups are directly related to the underlying factors associated with disadvantage. More efforts towards identification of these barriers are required.
2. Approaches that have been shown to work among the disadvantaged need further research into the causes of their effectiveness, for example, reasons underlying the declines in educational inequalities in smoking in the UK.
3. The increased burden of CVD associated with lower SES is likely to be cumulative. Emphasis must be on intervening as early as possible within the CVD continuum.

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