By neglecting deprivation, cardiovascular risk scoring will exacerbate social gradients in disease

H Tunstall-Pedoe, M Woodward, for the SIGN group on risk estimation

Objective: To examine whether the efficiency and equity of cardiovascular risk scores that identify patients at high risk for preventive interventions are compromised by omitting social deprivation, which contributes to risk.

Design: Cohort study.


Participants: 6419 men and 6618 women aged 30–74, free of cardiovascular disease at baseline, followed up with permission for mortality and morbidity to March 1997. Participants were allocated to population fifths of the Scottish index of multiple deprivation (SIMD) and their observed coronary risk was compared with that expected from the Framingham score for all coronary heart disease.

Results: The Framingham score overestimated risk overall and in each SIMD fifth. It seriously underestimated the variation in risk with deprivation. The relative risk of observed 10 year coronary risk (sexes combined) analysed across population fifths had a steep gradient, from least to most deprived, of 1.00, 1.81, 1.98, 2.22, and 2.57. Expected risk, calculated from baseline risk factor values and the Framingham score, had one quarter of that gradient, with relative risks of 1.00, 1.17, 1.19, 1.28, and 1.36.

Conclusion: Cardiovascular risk estimated by the Framingham and related scores is misleading in guiding treatment decisions among people at different levels of social deprivation. Such scores foster relative undertreatment of the socially deprived, exacerbating the social gradients in disease, which national policies seek to minimise. Debate and action are needed to correct this anomaly.

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Methods

The SHHEC (Scottish heart health extended cohort) study’s recruitment and follow up have been described. It included random sample population surveys from 1984 to 1987 across 25 districts of Scotland—the Scottish heart health and baseline MONICA (monitoring trends and determinants in cardiovascular disease) surveys in Glasgow and Edinburgh—and similar repeated MONICA surveys in North Glasgow in 1989, 1992, and 1995, all following the same basic protocol.

Abbreviations: MONICA, monitoring trends and determinants in cardiovascular disease; SHHEC, Scottish heart health extended cohort; SIMD, Scottish index of multiple deprivation
For this analysis we studied 6419 men and 6618 women aged 30–74 years who were free of cardiovascular disease at recruitment. Detailed methods, statistical procedures, and results for different social determinants and cardiovascular end points will be communicated separately (M Woodward et al., unpublished data).

We examined the newly constructed Scottish index of multiple deprivation (SIMD). It is based on 31 indicators, produced by different government agencies for 6505 geographical data zones, based on the six domains: current income; employment; housing; health; education; and skills and training and geographic access to services and telecommunications. Calculated for small areas, it is available by individual postcodes of residence and therefore was linked directly to each SHHEC participant’s home address at recruitment. The SIMD was divided into fifths of the Scottish population from 1, the least, to 5, the most deprived.

We used data from ongoing notification of deaths from the National Health Service Central Register and of hospital inpatient episodes from the Scottish record linkage scheme to March 1997. We calculated the 10 year incidence, by SIMD fifths, of coronary heart disease deaths, hospitalisation for myocardial infarction and other acute coronary disease (with case note review), and coronary artery procedures, by using Kaplan-Meier survival estimates. We compared observed with the risk expected from the individual risk factor data from the baseline surveys, using the version of the Framingham risk score for all coronary heart disease that was adopted into clinical practice for SIGN and other British guidelines.

## RESULTS

Table 1 illustrates the grounds for debate. The SIMD is shown to be a powerful determinant of coronary risk when examined across the population fifths.

Observed risk has a steep gradient by social status. It varied twofold in men between the top (least) and bottom (most deprived) fifth of the population (from 4.9% to 10.0%) and fivefold, although at lower levels, in women (from 1.1% to 5.5%).

Expected (estimated or predicted) risk was based on the Framingham score, which therefore calculated the estimated effect on risk in the SIMD fifths of their differences in conventional cardiovascular risk factors. This also has a social gradient, but it is quite modest and considerably smaller than that observed (from 10.3% to 12.7% in men and from 4.3% to 7.5% in women).

As in many other studies but not all we find lower observed risk than that expected from the Framingham score. However, the variation between fifths in the observed to expected ratio (which can be regarded as the Framingham score standardised ratio) is considerable—nearly two to one when the sexes are combined (from 0.47 to 0.79 in men and from 0.25 to 0.74 in women).

The implications of this increasing observed to expected ratio with increasing deprivation are considerable. If the basic Framingham score were to be applied as the universal criterion for deciding treatment, treatment levels would follow the expected and not the observed distribution. The most socially deprived fifth has twice as much observed risk as the least deprived fifth in proportion to the expected or treatment level risk. The most socially deprived would be receiving proportionately half the treatment in relation to their prospective disease burden of that given to the least deprived, a modern day example of Julian Tudor Hart’s inverse care law.

Tested against a social gradient such as the fifths of the SIMD, use of the Framingham score therefore fails to allocate preventive treatment in relation to actual need, resulting in relative overtreatment of the most affluent and relative undertreatment of the most deprived.

Other Framingham risk score end points such as all cardiovascular disease give the same overall results. Removal of the 1992 and 1995 MONICA surveys, which contributed to the excess numbers in the SIMD bottom 20% in the SHHEC studies and had shorter follow up, also made no appreciable difference to the results (M Woodward et al., unpublished data).

## DISCUSSION

Our findings, based on a large, nationwide and nationally representative cohort study and using a modern index of deprivation, categorically and elegantly confirm what was previously observed.

### Table 1

<table>
<thead>
<tr>
<th>Fifth</th>
<th>Number</th>
<th>Observed Risk (%)</th>
<th>Relative Risk</th>
<th>Expected Risk (%)</th>
<th>Relative Risk</th>
<th>Observed:Expected Ratio</th>
<th>Relative Ratio</th>
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<td><strong>Men</strong></td>
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<td></td>
<td></td>
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<td>10.32</td>
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<td>12.66</td>
<td>1.23</td>
<td>0.79</td>
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<td></td>
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<td>1.00</td>
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<tr>
<td>5</td>
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<td>2.57</td>
<td>9.98</td>
<td>1.36</td>
<td>0.77</td>
<td>1.88</td>
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</tbody>
</table>

Fifth 1 is the least deprived 20% of the Scottish population and fifth 5 the most deprived. Repeated surveys for the Scottish MONICA (monitoring trends and determinants in cardiovascular disease) project have led to comparative overrepresentation of the most deprived.
predictable from previous work on risk factors and depriva-
tion. They also corroborate results derived by analysis of data
from the Renfrew-Paisley study mounted in the west of
Scotland in the 1970s at the epicentre and peak of the
Scottish coronary epidemic. This showed, unusually, under-
estimation of coronary risk by the Framingham score but a
similar failure by the score to predict the full social gradient
in relative risk. Results of these two Scottish studies provide
an evidence base for modification of current use of coronary
risk scores.

Risk scores are used firstly to prioritise treatment and
secondly to assess progress. Incorporation of age and sex
means that levels of the modifiable risk factors are not the
sole determinants of treatment. Older men are inherently at
higher risk than others and it is accepted that patients with a
diagnosis of vascular disease or diabetes are also at a higher
level of risk. Because of this they warrant treatment at lower
starting levels of risk factors than others, with the additional
aim of achieving especially low target values through
treatment. Our analyses suggest that the estimated effect of
being in the highest 20% of deprivation rather than the
lowest 20% is equivalent in risk scoring terms to a decade or
more in age or to a diagnosis of diabetes. In a socially mixed
population, deprived people therefore warrant preventive
treatment at lower levels of risk factors than do others, to
counterbalance their disadvantaged health status.

Adding social deprivation as a new risk factor to existing
multifactorial scores would improve the overall efficiency of
discriminating those at greatest risk (M Woodward et al,
unpublished data) but, equally important, would restore
equity between social groups by redressing the existing bias
towards inverse care. Making this correction to current
procedures raises practical and medicopolitical questions in
three major areas.

● Mortality rates for coronary heart disease are declining, so
current risk is lower than that in historical cohorts. Even
in them, many, like this one, show that the Framingham
score overestimates incidence of coronary heart disease.
At the same time the somewhat arbitrary treatment thresh-
holds for risk factor interventions are coming down. If the
score were applied as it is, which of the five groups shown
in table 1, if any, would be receiving the appropriate level
of treatment in relation to their observed risk? If it were
not the least deprived fifth, would redirecting resources for
coronary heart disease prevention towards the most
deprieved be possible without increasing resources overall?
Would doctors apply a modified score comprehensively or
retain the old one so they could use both to maximise the
chances of treatment of each patient?

● What indicator of social status should be used to typocast
patients, indeed the whole population, given that results
for other measures are similar to those for SIMD? Occu-
pation was long used by doctors to identify suscepti-
bility to disease and by the Registrar Generals’ offices to
derive social class. Place of residence, leading to analysis
by small area statistics, and now postcodes have pre-
cedents dating back to Charles Booth in the 1880s, and
are widely used in commerce—for example, in allocating
credit. Medical administrators may prefer to categorise
patients by their local doctor’s practice population, rather
than individually, but they still need a social index with
which to calculate any differentials.

● Can we get away with continuing to use existing scores
such as Framingham, recognising patients’ adverse or
beneficial cardiovascular risk from deprivation by adjust-
ing their age—that is, adding or subtracting years to the
chronological age, as is done by life insurance actuaries?
Given that the age gradient in risk in the Framingham
score is unexpectedly flat, this adjustment may result in
surprising if not impractical additions, particularly among
women. Alternatively, do we need a new cardiovascular
risk score that incorporates coefficients for social depriva-
tion? Such a score may be derived from the SHHEC and
other similar British cohort studies if the social indicators
they incorporated were compatible. A similar question
arises in relation to differences in risk of cardiovascular
disease in different ethnic groups, but that is outside the
scope of this paper.

These findings and questions are relevant to populations in
many industrialised countries. They warrant discussion and
debate by those concerned with cardiovascular health and
disease in society overall and in the socially deprived in
particular.

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for validation.

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and not of the funding bodies

Competing interests: none declared.

Ethical approval was obtained from all relevant medical research ethics
committees covering the individual populations involved

HTP planned the study in consultation with the SIGN risk estimation
group, obtained the funding, coded the end points, and prepared the
database with staff of the Dundee Unit; is guarantor of the data, and
drafted the paper. MW conducted the statistical analyses and is
authoring a more comprehensive technical report.

APPENDIX
Members of the SIGN (Scottish Intercollegiate Guidelines
Network, 28 Thistle Street, Edinburgh EH2 1EN, UK) risk
estimation group who helped to refine the study proposal and
analyses were Dr James Grant (chair, principal in general
practice, Auchtairder), Dr Moray Nairn (secretary, SIGN
Edinburgh), Dr Adrian Brady (consultant cardiologist,
Glasgow), Dr Peter Brindle (principal in general practice,
Wellcome research fellow, Bristol), Dr Alex McConnachie
(statistician, Robertson Institute, Glasgow), Mr Roger Stableford
(patient representative, Falkirk), Prof Hugh Tunstall-Pedoe
(cardiovascular epidemiologist, Dundee), and Prof Graham
Watt (general practice, Glasgow). Some members of the
group have been involved in earlier studies of cardiovascular
risk scores applied to other populations.

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www.heartnl.com
Shotgun stenting of the left main coronary artery bifurcation

Disease of the left main stem (LMS) coronary artery has traditionally been regarded as an indication for coronary artery bypass surgery rather than angioplasty. When the disease involves the bifurcation into the left anterior descending (LAD) and circumflex (Cx) branches, the technical difficulties of implanting stents, with the accompanying risks of subacute thrombosis and restenosis, have made this almost exclusively a surgical preserve.

A new technique of stent implantation, known as “shotgun” stenting (a variant of “V-stenting”) has made this pattern of disease amenable to angioplasty. In this technique, two separate stents are deployed together, beside each other, one running from the LMS to the LAD and the other from the LMS to the Cx. The proximal portion of each stent extends well into the LMS and the distal ends well into each branch. The appearance is, therefore, like that of a double barrelled shotgun, albeit with the two distal ends of the barrels splayed apart.

The advantages of this technique over previously used bifurcation stent techniques are simplicity of deployment, smoothness of the arterial and stent linings produced, the lack of need to dilate through the sides of the stents (avoiding stent distortion), complete lesion coverage, precise sizing of each stent relative to the distal artery (avoiding undersizing in the left main and oversizing in the LAD or circumflex) and the ability to cover disease in any part of the LMS and the proximal portions of the LAD and Cx with just two stents. The potential disadvantage is the creation of a new metal “carina” in the midline of the left main artery. Until endothelialisation occurs and tissue grows in this area it is important to maintain double antiplatelet treatment.

We present the case of a 62 year old man with chronic stable angina and a severe stenosis of the distal LMS affecting the ostia of both the LAD and Cx. He underwent “shotgun” stenting. Four months later, he remains well and symptom-free, and is taking lifelong aspirin and clopidogrel.

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