Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: a global and regional analysis on reduction of cardiovascular-disease risk


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Different health interventions to reduce the risks associated with high cholesterol concentrations and high systolic blood pressure (SBP) were examined. A total of 17 non-personal and personal health interventions or combinations were assessed. Details of these are reported in the original paper.

Type of intervention
Primary prevention and treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Different study populations were modelled, according to age, gender and epidemiological profiles, from 14 epidemiological sub-regions of the world. Results of the cost-effectiveness analysis were discussed in detail for three sub-regions:

Southeast Asia, with high rates of adult and child mortality;

Latin America, with low adult and child mortality; and

Europe, with very low adult and child mortality.

Setting
The setting was not stated. The economic analysis was conducted at the World Health Organization (WHO) in Geneva, Switzerland.

Dates to which data relate
The effectiveness data were gathered from literature published between 1991 and 2003. The price year was 2000.

Source of effectiveness data
The effectiveness data were derived from a review of the literature.

Modelling
A model was constructed to combine the costs and effectiveness for each intervention. A standard multi-state modelling tool, PopMod, was used to translate changes in the risk of cardiovascular disease events, specific for age and gender, into changes in population health quantified by disability-adjusted life-years (DALYs). PopMod simulates the
evolution, with and without each intervention, of a stable population partitioned into four distinct health states. More specifically, people who have the disorder under study, people with some other disorder, people who have both conditions, and those with none of these (but who are susceptible). The annual transition rates between health states, such as incidence, remission and mortality, are needed and should be assessed from the review. The modelling was conducted over 100 years.

The side-effect relation of the consequences of bleeding associated with the use of aspirin was included.

**Outcomes assessed in the review**
The outcomes assessed in the review and used as model inputs were the relative risks of cardiovascular disease events for unit changes in SBP, total blood cholesterol, body mass index and prevalence of long-term smokers, according to age and gender.

**Study designs and other criteria for inclusion in the review**
The authors reported that randomised trials and meta-analyses were included in the review.

**Sources searched to identify primary studies**
Not reported.

**Criteria used to ensure the validity of primary studies**
Not reported.

**Methods used to judge relevance and validity, and for extracting data**
Not reported.

**Number of primary studies included**
Approximately 24 studies were included in the review.

**Methods of combining primary studies**
Not reported.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
The relative risks of cardiovascular disease events for unit changes in SBP, total blood cholesterol, body mass index and prevalence of long-term smokers, according to age and gender, were reported in full in webtable 5 on the Lancet website (accessed July 2005, URL: http://image.thelancet.com/extras/02art9368webtable5.pdf)

**Methods used to derive estimates of effectiveness**
Several authors' assumptions were used to derive estimates of effectiveness.

**Estimates of effectiveness and key assumptions**
The authors’ assumptions were reported in webtable 3 on the Lancet website (accessed July 2005,
Measure of benefits used in the economic analysis
The measure of benefits used was the number of DALYs. Discounting at an annual rate of 3% was performed.

Direct costs
The categories of direct costs assessed in the study included programme-level costs (e.g. administration, training and media) and patient-level costs (e.g. primary-care visits, diagnostic tests and medicines). The costs were based on a standard ingredients-approach developed by the WHO. The quantities of resources used were identified from publications, with additional details provided by programme staff in various parts of the world. The unit costs were obtained from a review of relevant publications, supplemented by primary data from programme staff. The drug costs were based on the price of off-patent drugs from the vendor selling high-quality drugs at the lowest prices. The costs were discounted at an annual rate of 3%. The price year was 2000.

Statistical analysis of costs
No statistical analysis of the costs was carried out.

Indirect Costs
No indirect costs were included in the analysis.

Currency
International dollars (Int$). The conversion rate was Int$1 = 1 US$. Costs in local currency units were converted to Int$ using purchasing power parity (PPP) exchange rates rather than official exchange rates.

Sensitivity analysis
A multivariate sensitivity analysis was performed on the levels of risks and on effect sizes. At the same time, the price of medicines was allowed to vary from half to double the base estimate.

Estimated benefits used in the economic analysis
The numbers of DALYs averted for each of the 17 interventions (in 14 regions with differing levels of adult and child mortality and different patterns of risks to health) were reported in full in webtable 2 on the Lancet website (accessed July 2005, URL: http://image.thelancet.com/extras/02art9368webtable2.pdf)

The health benefits of all interventions followed a roughly bell-shaped curve when plotted against age. The curve reached its maximum at around 60 years of age.

Personal health-service strategies were more effective than non-personal strategies in each region.

The less effective intervention was voluntary agreements on salt content (N1). The more effective intervention was the treatment of individuals based on their absolute risk of a cardiovascular event at the threshold of 5% (P9).

For example, in Europe (very low rates of adult and child mortality), strategy N1 resulted in 7 x10^5 DALYs averted, strategy N4 in 24 x10^5 DALYs averted, strategy P1 in 73 x10^5 DALYs averted, strategy P9 in 114 x10^5 DALYs averted, strategy C1 in 91 x10^5 DALYs averted, and strategy C4 in 116 x10^5 DALYs averted.

In Southeast Asia (high rates of adult and child mortality), strategy N1 resulted in 5 x10^5 DALYs averted, strategy N4 in 24 x10^5 DALYs averted, strategy P1 in 44 x10^5 DALYs averted, strategy P9 in 133 x10^5 DALYs averted, strategy C1 in 82 x10^5 DALYs averted, and strategy C4 in 137 x10^5 DALYs averted.
Cost results
Personal health-service strategies were more costly interventions than non-personal strategies in each region.

For example, the total costs (in $millions) of non-personal interventions ranged from $81 to $163 in Latin America, from $202 to $499 in Europe, and from $199 to $403 in Southeast Asia.

The total costs (in $millions) of personal interventions ranged from $3,122 to $11,232 in Latin America, from $14,777 to $56,572 in Europe, and from $1,570 to $10,183 in Southeast Asia.

The total costs (in $millions) of combined interventions ranged from $1,365 to $6,394 in Latin America, from $11,045 to $35,095 in Europe, and from $1,829 to $10,173 in Southeast Asia.

Synthesis of costs and benefits
All 17 interventions in all three regions were cost-effective according to the Commission on Macroeconomics and Health criterion (the cost-effectiveness ratios ranged from $13/DALY averted to $516/DALY averted).

In all regions, the four non-personal interventions had cost-effectiveness ratios that were lower than those for personal interventions.

Considering the personal interventions, the absolute-risk approach at a threshold of 35% was more cost-effective than treatment based on either SBP or cholesterol concentration.

Although the total costs, total effectiveness, and cost-effectiveness ratios varied across regions, the sequence of intervention strategies that could be purchased according to the available resources was similar. The expansion path joined the following interventions: N1, N3, N2, N4, P6, C1, C2, C3 and C4.

The results were robust to changes in assumptions.

Authors’ conclusions
In all regions, the selected personal and non-personal health interventions to lower blood pressure and cholesterol concentration were very cost-effective.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparators was clear. They represented health interventions, and viable combinations of such health interventions, to lower SBP and cholesterol. However, a standard approach for the management of SBP and cholesterol was not defined, and a status quo strategy (i.e. no intervention) was not included in the study. You should decide whether the comparators are widely used health interventions in your own setting.

Validity of estimate of measure of effectiveness
The analysis of effectiveness was based on a systematic review of the literature. However, the authors did not clearly report the methods used to derive the estimates of effectiveness (e.g. the sources searched, the criteria used, the validity of the data, or an investigation of the differences). Hence, one cannot be sure that the best available evidence has been used. When effectiveness estimates were derived from authors’ assumptions, the estimates were investigated using sensitivity analyses. The ranges used appear to have been appropriate. The results were presented as relative risks, but no confidence intervals were reported.

Validity of estimate of measure of benefit
The estimation of the benefits was modelled. The decision analysis model used to derive the measure of health benefit was appropriate. The health benefit was discounted at an appropriate rate given the time horizon of the model.
Validity of estimate of costs
The authors did not explicitly state the perspective adopted in the study and, although they chose to include both programme- and patient-level costs, the indirect costs were not included. The authors stated that they did not include cost-savings associated with the prevention of cardiovascular disease events, because the major interest was in identifying the costs of improving population health by preventing these events. The unit costs were not presented separately from the quantities of resources used. The costs were treated deterministically. The prices of the medicines were varied in the sensitivity analysis. Discounting was appropriately performed. The price year was implicitly stated, which makes reflation exercises in other settings possible.

Other issues
The authors compared the effectiveness results with those from another meta-analysis that reached different conclusions about the possibility of additional benefits (e.g. benefits relating to dementia and renal failure, or a reduction in the risk of coronary disease). The issue of the generalisability of the study results to other settings was partially addressed and appropriate sensitivity analyses were carried out. The authors did not report any further limitations of their study. The results were not reported selectively and the conclusions reflected the scope of the study. However, a more detailed costing exercise and resource use description would have been more informative to the decision-maker and would aid transferability to other settings.

Implications of the study
The authors suggested that the implementation of risk screening should be tailored to the resource levels of national health systems. In high-income countries, risk assessment on the basis of age, gender, measured blood pressure, cholesterol concentration, body mass index, diabetes, tobacco use, and clinical history of cardiovascular disease events would be practical. In low-resource settings, adequate risk screening could be based simply on age, gender, measured blood pressure, body mass index, tobacco use, and past cardiovascular disease events. A "risk pill" of antihypertensive drugs, statin and aspirin could also be packaged as a single compound, facilitating compliance.

Source of funding
None stated.

Bibliographic details

PubMedID
12620735

DOI
10.1016/S0140-6736(03)12655-4

Indexing Status
Subject indexing assigned by NLM

MeSH
Adolescent; Adult; Aged; Aged, 80 and over; Blood Pressure; Cardiovascular Diseases /economics /prevention & control; Child; Cost-Benefit Analysis; Developing Countries; Global Health; Health Expenditures /standards; Health Promotion /economics; Humans; Hypercholesterolemia /economics /prevention & control; Hypertension /economics /prevention & control; Middle Aged; Quality-Adjusted Life Years

AccessionNumber
22003008049