Prioritizing risk factors to identify preventive interventions for economic assessment

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Objective To explore a risk factor approach for identifying preventive interventions that require more in-depth economic assessment, including cost-effectiveness analyses.

Methods A three-step approach was employed to: (i) identify the risk factors that contribute most substantially to disability-adjusted life years (DALYs); (ii) re-rank these risk factors based on the availability of effective preventive interventions warranting further cost-effectiveness analysis (and in some instances on evidence from existing cost-effectiveness analyses); and (iii) re-rank these risk factors in accordance with their relative contribution to health inequalities. Health inequalities between the Māori and non-Māori populations in New Zealand were used by way of illustration.

Findings Seven of the top 10 risk factors prioritized for research on preventive interventions in New Zealand were also among the 10 risk factors most highly ranked as contributing to DALYs in high-income countries of the World Health Organization's Western Pacific Region. The final list of priority risk factors included tobacco use; alcohol use; high blood pressure; high blood cholesterol; overweight/obesity, and physical inactivity. All of these factors contributed to health inequalities. Effective interventions for preventing all of them are available, and for each risk factor there is at least one documented cost-saving preventive intervention.

Conclusion The straightforward approach to prioritizing risk factors described in this paper may be applicable in many countries, and even in those countries that lack the capacity to perform additional cost-effectiveness analyses, this approach will still make it possible to determine which cost-effective interventions should be implemented in the short run.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Most countries seek to improve the health of their populations while reducing health inequalities. They must therefore deploy their health sector resources, which are often scarce, in a manner that maximizes both goals. Preventive interventions are often highly cost-effective[1] and they sometimes promote equity.[2,3] Recent work in Australia has demonstrated that many preventive interventions are cost-effective, and quite a few are actually cost-saving over the long-term. The Australian Assessing Cost-Effectiveness of Prevention (ACE-Prevention) Project reported 23 preventive interventions as being cost-saving or "dominant"; 20 as being "very cost-effective" and 31 as being simply "cost-effective" (i.e. within the range of 10 000 to 50 000 Australian dollars [i.e. 9895 to 49 465 United States dollars (US$)] per disability-adjusted life year [DALY] averted).[1]

In light of the above and based on the fact that many preventive interventions work through risk factor modification, we sought to develop a systematic approach for identifying those interventions that should be prioritized for more extensive cost-effectiveness analysis (CEA) based on risk factor prioritization. We implicitly sought to identify not only risk factors for which (highly) cost-effective interventions are feasible, but also risk factors that contribute substantially to the burden of disease and whose reduction through effective interventions is therefore more likely to contribute to substantial improvements in health.

We propose a three-step approach: (i) identifying the top priority risk factors, namely those that contribute the greatest number of DALYs; (ii) re-ranking these risk factors based on evidence of the availability of effective interventions that warrant CEA (and, in some instances, on evidence stemming from existing CEAs); and (iii) a final re-ranking based on the extent to which these risk factors contribute to health inequalities. By way of illustration we use health inequalities between Māori and non-Māori population groups in New Zealand.

Methods

Disease burden contributed by risk factors

Comparative risk assessment methods make it possible to compare to what extent different risk factors contribute to the disease burden. Briefly, a burden of disease study is performed to quantify the DALYs contributed by all selected disease conditions. The DALY is a composite of years of life lost due to a particular disease or disability and a morbidity component represented by the number of years lived in a state of disability (e.g. if living with stroke has a disability weight of 0.4 and the average number of years lived with stroke is 10, this amounts to a loss of 4 years of life).

With this information in hand, one can then calculate the disease burden attributable to specific risk factors. For example, in a comparative risk assessment of the burden of disease attributable to tobacco, all diseases that are caused by tobacco smoking are identified, the relative risks for the association between smoking and each disease are assembled, and the population distribution of smoking is determined from surveys. One then posits a counterfactual (but theoretically feasible) distribution for each risk factor. Such a counterfactual distribution would be nil in the case of a dichotomous variable such as smoking, but for a continuous variable such as blood

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pressure, the counterfactual would be a shifted and compressed distribution with a low mean that is associated with a minimal risk of disease. These data are then combined using population-attributable risk analyses to calculate the percentage of DALYs that a given factor contributes to a particular condition, for instance, the percentage of ischaemic heart disease DALYs contributed by smoking. Finally, one compares the number of DALYs attributable to various risk factors and ranks these factors accordingly.

In previous work in New Zealand, comparative risk assessment methods were used to identify and rank major risk factors for the year 1996,[4] but rankings were based on numbers of deaths rather than DALYs. Furthermore, such work is now somewhat outdated, as more recent meta-analyses and syntheses of relative risk data have become available. We therefore used the global burden of disease data published more recently by the World Health Organization (WHO) for high-income countries in the Western Pacific Region: Australia, Brunei Darussalam, Japan, New Zealand, the Republic of Korea and Singapore.[5]

Risk factor selection criteria

As a starting point we decided that all the risk factors to be initially considered had to be among the top 15 causes of DALYs in the six aforementioned high-income countries.[5] That is, we were interested not just in cost-effectiveness, but also in the effect of interventions on population health overall. We then assessed and re-ranked the selected risk factors in terms of: (i) current or predictable future availability of effective preventive interventions targeting the risk factor (and, in some instances, with evidence of cost-effectiveness as well); and (ii) the extent to which the factor contributes to health inequalities. For the first ranking we required the availability of at least one preventive intervention addressing the risk factor for which evidence of cost-effectiveness also existed. For our example of health inequalities drawn from New Zealand, we required that the risk factor contribute substantially to inequalities between the Māori (indigenous) and non-Māori populations (including European, Pacific peoples and Asian people), on the premise that any intervention addressing the risk factor would also reduce these inequalities. Although inequalities exist among other ethnic groups and different socioeconomic strata in New Zealand, the gap between the Māori and non-Māori populations is especially large and of particular concern to health sector policy-makers. In this paper we focus on inequalities between the Māori and non-Māori populations to illustrate how health inequalities can be incorporated into the method we have developed for prioritizing risk factors for future research on the cost-effectiveness of preventive interventions.

Literature search

To inform the above process we searched Medline and Google Scholar to identify articles on interventions targeting all 15 initially selected risk factors. We also searched for reports on the New Zealand Ministry of Health web site (www.moh.govt.nz). These searches also served to identify the role played by each risk factor in the health inequalities between the Māori and non-Māori people (e.g. by comparing the hospitalization rates, the mortality rates or other disease burden estimates from epidemiological studies).

Results

The 15 risk factors initially considered from the work of the WHO on burden of disease at the regional level showed good overlap with the risk factors previously prioritized for study in New Zealand (Table 1). Of the 10 risk factors identified by WHO as being the leading contributors to lost DALYs, seven had been previously identified by the New Zealand Ministry of Health as being among the 10 most important risk factors for death in the country (i.e. albeit using a different metric from DALYs).

The last five risk factors listed in Table 1 are not likely to rank higher than the factors appearing higher on the list in terms of the potential benefits of interventions to prevent them. This is because these factors were also ranked lower in the previous burden of disease study conducted in New Zealand, and the difference between them and the top seven in terms of their contribution to DALYs is too large to be plausibly attributable to error. In light of this, we focused on the top 10 risk factors.

The preventive interventions targeting each risk factor are listed in Table 2. Cost-effective preventive interventions (some of which have also been reported as cost-saving)[1] were identified for each factor. We dropped the "occupational risk" category from further consideration because it involved a multitude of interventions specific to certain occupational settings.

It became apparent that most (8/9) of the risk factors in our revised list contributed to health inequalities between Māori and non-Māori people (Table 3). Data on DALYs were not available from previous New Zealand studies, but data on each risk factor's contribution to years-of-life-lost (YLL) in the Māori population were available for six out of nine risk factors (albeit from 1996–1997 and hence somewhat outdated). So we used these data to rank "high blood cholesterol" above "physical inactivity" in our final revisions to the ranking (Table 4). We excluded air pollution from further investigation because of lack of clarity around the importance of environmental interventions for reducing health inequalities between Māori and non-Māori populations.

Table 4 shows additional factors that we considered in the final priority ranking of the eight selected risk factors. Certain areas were assigned lower priority particularly because the strength of the evidence around intervention effectiveness and cost-effectiveness was uncertain.

Inequalities other than those between Māori and non-Māori populations should ideally be included in the risk factor priority-setting process, although not explicitly considered part of it in this paper. The six risk factors we identified as having the highest priority (Table 4) are also relevant for reducing health inequalities affecting the Pacific peoples of New Zealand, and disease burden by age group (i.e. in children or youth and older adults).[32] Furthermore, four of the six risk factors are relevant to reducing health inequalities affecting socioeconomically deprived New Zealanders, given that this population group has more adverse risk factor profiles in terms of smoking, alcohol abuse, physical inactivity and overweight or obesity.[32]

Discussion

Interpretation of major findings

Our study results, based on WHO regional data on DALYs by risk factor for the New Zealand setting, were fairly consistent with the findings of past work on risk factor prioritization in this country.[4]

Table 1. **Risk factors that contributed most to the burden of disease in 2004, as measured in disability-adjusted life years (DALYs), in high-income countries of the Western Pacific Region of the World Health Organization (WHO)**

Risk factor	DALYs (thousands)	Percentage of total DALYs	Deaths (thousands)	Percentage of total deaths	Previous New Zealand ranking[a]
1. Tobacco use[b]	1871	8.4	261	17.7	2nd
2. Alcohol use	1541	6.9	52	3.5	13th (with other drugs)[c]
3. High blood pressure[b]	1273	5.7	200	13.5	5th
4. High blood glucose[b]	1077	4.8	86	5.8	8th (pre-diabetes)
5. Overweight and obesity[b]	839	3.8	56	3.8	6th
6. Physical inactivity[b]	806	3.6	87	5.9	7th
7. High blood cholesterol[b]	570	2.6	52	3.5	4th
8. Occupational hazards	462	2.1	22	1.5	19th
9. Low fruit and vegetable intake[b]	299	1.3	40	2.7	10th
10. Urban outdoor air pollution	231	1.0	47	3.2	12th (all air pollution)
11. Iron deficiency	210	0.9	1	0.1	Not listed
12. Childhood sexual abuse	197	0.9	3	0.2	14th (all violence)
13. Illicit drug use	155	0.7	3	0.2	See alcohol use.
14. Unsafe medical injections	126	0.6	9	0.6	Not listed
15. Unsafe sex	125	0.6	6	0.4	20th

[a] Previous ranking by New Zealand's Ministry of Health (but note that this ranking was based on cause of death and not DALYs, the metric used by WHO).[4]
[b] For all risk factors in this table, WHO analyses considered joint effects to avoid double counting (i.e. in cases in which multiple risk factors underlie the same disease contributing to DALYs). In addition, for all of the top 10 leading risk factors in this list (other than alcohol use and occupational hazards), DALY estimates took into account factors such as: (i) mediated effects on cardiovascular disease (CVD) (e.g. two thirds of the effect of body mass index being mediated by blood cholesterol, blood pressure and high blood glucose); (ii) effect modification of cardiovascular disease risk factors (high blood pressure and high blood cholesterol); (iii) joint effects of smoking and other risk factors (e.g. high blood cholesterol). Further details are provided in the WHO report[5] and supporting material, available at: http://image.thelancet.com/extras/02art10418webtable2.pdf
[c] The discrepancy between rankings from our study, based on WHO data, and from previous work in New Zealand is likely to reflect improved methods.
Source: World Health Organization.[5]

The evidence from cost-effectiveness analyses in the literature resulted in changes in the priority ranking of some of the risk factors, but not the top three (tobacco, alcohol use and high blood pressure). From the perspective of health inequalities between the Māori and non-Māori populations, this process produced only modest changes in the rankings, since eight of the nine risk factors being considered in the revised list were found to contribute to inequality. This does not obviate the importance of explicitly considering inequalities in the prioritization process. Rather, it suggests that in New Zealand important health inequalities are present in the overall burden of disease, as measured by DALYs. Our final six top priority risk factors for New Zealand were all among the top seven contributors to DALYs as identified by WHO (Table 1).

Can the methods described in this paper be successfully applied in other countries that need to prioritize risk factors for identifying preventive interventions meriting CEA? We believe that they probably can, but this is a research question in its own right. Since global burden of disease data are available at the country level for all WHO regions and are routinely reported by country income level, there should be a reasonable choice of relevant DALY and comparative risk factor assessment data to draw upon for most countries. Also, the global burden of disease study currently in progress will draw on many additional systematic reviews and will further update burden of disease data. Admittedly, however, the quality of the data pertaining to health inequalities varies enormously across countries and will be largely country-specific.

We focused mainly on identifying those risk factors on which to concentrate for more in-depth CEA of interventions. However, a lack of capacity to undertake country-specific CEA or lack of political will may prevent CEAs from being undertaken in some countries. Nonetheless, we still believe in the usefulness of our approach, since the priority-setting exercise itself and the supporting evidence obtained through literature searches will identify those interventions that are highly likely to be cost-effective in a given country. In fact, Beaglehole et al. have essentially used this approach to recommend five priority actions – tobacco control, salt reduction, improved diets and physical activity, reduction in hazardous alcohol intake and development of essential drugs and technologies – to substantially reduce the global burden of non-communicable diseases in a cost-effective manner.[44]

Strengths and limitations

One strength of our approach is its strong reliance on the DALY metric, which captures both morbidity and mortality. The use of WHO regional data has also allowed us to improve on the more limited and somewhat outdated work on disease burden formerly conducted in New Zealand and to develop an approach that other countries can potentially use in the absence of their own national burden of disease studies. Our approach is also relatively simple and hence more likely to be transparent and acceptable to policy-makers in the health sector.

However, the approach has important limitations. The WHO data on which it relies applies to the regional rather than the country level. Thus, high blood cholesterol is probably a more important risk factor in New Zealand than in other high-income countries in the Western Pacific Region because New

Table 2. **Highest contributors to disability-adjusted life years (DALYs) in high-income countries of the Western Pacific Region of the World Health Organization (WHO) and evidence of availability of cost-effective interventions to prevent them**

Risk factor	Evidence of availability of cost-effective preventive interventions[a]	Retain for equity analysis[b]
Tobacco use	Examples: **tobacco tax raises**[1,6]; mass media campaigns; expansion of quitline use; provision of nicotine replacement products for quitting smoking. Australian researchers found that a national tobacco campaign would be cost-saving.[7] There is growing evidence that some tobacco control interventions can promote equity.[3]	Yes
Alcohol use	Examples: **alcohol tax raises; restrictions on alcohol advertising; restriction of the number of sale outlets**.[1,8–10] Systematic reviews report evidence of many cost-effective regulatory interventions.[10,11]	Yes
High blood pressure[c]	Examples: **community heart health programmes**; **reduction of salt in processed foods**[1,12–15] (voluntary and mandated options); improved access to anti-hypertensives; **use of a polypill**[d] (depending on price and risk groups).[1,16]	Yes
High blood glucose	ACE-Prevention researchers in Australia found evidence that 5 out of 7 interventions against "pre-diabetes" were cost-effective (i.e. cost < A$ 50 000 [US$ 49 465] per DALY averted), but all at a median cost of ≥ A$ 21 000 (US$ 20 775) per DALY averted.[1]	Yes
Overweight and obesity	Examples: **a 10% tax on unhealthy foods** (high fat/high sugar foods & drinks); reduction of television advertising**;** traffic light nutrition labelling (colour-coded symbols to indicated healthy vs unhealthy foods); diet and physical activity programmes.[1,17] Of the 13 interventions for children and adolescents considered in work in Australia,[17] 6 were found to be cost-saving (however, the evidence was not strong and assumptions around persisting intervention effects may have been unrealistic).	Yes
Physical inactivity	Examples: **mass-media-based campaigns; community programmes to encourage use of pedometers**; "green prescriptions" from general practitioners; referral by general practitioners to exercise physiologists.[1,18] Modelling work suggests that social and environmental changes conducive to increased active transport (walking and cycling) could achieve health gains.[19]	Yes
High blood cholesterol[c]	Examples: **community heart health programmes**; promotion of food products with plant sterols; expanded use of statins; **use of a polypill**[d] (depending on price and risk groups).[1] Modelling work suggests that reducing agricultural emissions of greenhouse gases (relevant for New Zealand's current Emissions Trading Scheme)[e] can lead to health benefits.[20]	Yes
Occupational risks	While occupational programmes can yield substantial health benefits, they are generally occupation-specific and not easily included in a risk-factor-based modelling approach.[f] A population-wide ***SunSmart* programme** was found to be cost-saving in Australia,[21] but its applicability to outdoor workers in New Zealand is uncertain.	No
Low fruit & vegetable intake	There is evidence favouring certain types of **community-based activities that promote fruit and vegetable consumption** (in Australian work: 1 intervention was cost-saving, 3 cost-effective, but 19 were not cost-effective).[1] Some evidence from New Zealand supports healthy food pricing interventions.[22]	Yes
Urban outdoor air pollution	Evidence suggests that air pollution can be reduced through regulations on industrial emissions (and, in the United States of America[23] and Europe,[24] through emission trading schemes); regulations on domestic fireplaces; regulations on vehicle fuel efficiency and routine vehicle emissions testing. Furthermore, fuel price increases and improved access to public transport have been shown to reduce the use of private vehicles (and therefore probably emissions). A shift from fossil-fuel-powered vehicles to hybrids or electric vehicles would also reduce urban air pollution.	Yes

A$, Australian dollars.

[a] Bold typeface indicates that evidence of the intervention being cost-saving also exists.

[b] The results of this analysis are shown in Table 3.

[c] ACE-Prevention work in Australia combined these topic areas.[1]

[d] A low-cost polypill that combines three blood-pressure-lowering drugs and one cholesterol-lowering drug[1] (or a similar alternative combination that includes aspirin).[16]

[e] This is a national system, first established in law in 2008, for putting a price on greenhouse gas emissions. It allows trading of emissions permits (carbon credits) by industries. Forest planting (a "carbon sink") can be used to earn credits.

[f] Smoke-free workplaces are a possible exception, but there is limited scope for expanding this in New Zealand. Improved control of alcohol use may reduce the risk of occupational injury but is more appropriately considered part of alcohol control interventions.

Zealanders consume relatively large quantities of dairy products and meat.[45] Conversely, the urban air pollution is likely to be a less important risk factor than average in New Zealand, where population density and industrialization are low and where the winds are relatively strong. Furthermore, WHO data on risk factors fail to capture the potential contribution of potential upstream determinants (such as poor education, lack of employment or low socioeconomic status), to risk factors such as smoking or alcohol misuse.

Our risk factor prioritization process is further limited by the fact that only one aspect of health inequality in New Zealand was examined, namely, health inequalities between Māori and non-Māori populations. However, the distribution of risk factors in this country is such that a focus on the six top risk factors will undoubtedly benefit Pacific peoples in New Zealand as well as children and youth, older adults and socioeconomically deprived New Zealanders. Furthermore, our analysis did not take into account the potential non-health benefits of preventive interventions, which could enhance their cost-effectiveness from a societal perspective. For example, interventions targeting tobacco and alcohol use could

Table 3. **Risk factors retained for equity analysis and their role in health inequalities between Māori and non-Māori populations in New Zealand**

Risk factor	Relevant? (YLLs for Māori)[a]	Inequalities between Māori and non-Māori populations in nine leading risk factors
Tobacco use	Yes (8321)	Smoking prevalence is much higher among the Māori than non-Māori people (i.e. 45% in Māori vs 21% for European and other ethnic groups),[25] and this contributes to mortality inequalities.[26–28] That is, Māori people have higher age-standardized mortality rates than non-Māori for ischaemic heart disease, cerebrovascular disease, chronic obstructive pulmonary disease and tobacco-related cancers (especially lung cancer, but also cancers of the stomach and uterine cervix).[29–31]
Alcohol, hazardous use	Yes (Unknown)	Hazardous alcohol use tends to be more common among the Māori than among the non-Māori population,[32] although total alcohol consumption appears to be lower among Māori than among New Zealanders of European descent.[33] Hazardous alcohol use increases the risk of motor vehicle crashes, which are major causes of mortality and morbidity among Māori, especially young Māori.[34] Given their high smoking rates, Māori people are at particular risk for cancers involving synergies between smoking and alcohol use (i.e. for cancers of the oral cavity, pharynx, larynx and oesophagus),[35] and individuals who drink heavily on a regular basis have significantly lower cessation rates.[36]
High blood pressure	Yes (4445)	High systolic blood pressure contributes more to avoidable cardiovascular disease mortality (both ischaemic heart disease and stroke) among both Māori men and women than in the non-Māori population.[37] For example, the age-standardized mortality rate from ischaemic heart disease and stroke that is attributed to high systolic blood pressure is around 270 per 100 000 population for Māori males vs 140 for non-Māori males.[37]
High blood glucose	Yes (Unknown)	Diabetes is more prevalent among Māori people than among European New Zealanders (5.8% vs 4.3%, respectively).[32] (In this table see also "physical inactivity" and "overweight and obesity", the latter being a key component of higher mortality rates from diabetes in Māori people.)[37]
Overweight and obesity	Yes (9901)	The age-standardized mortality attributable to a high body mass index is relatively higher among the Māori than among the non-Māori population.[37] Furthermore, the years-of-life-lost attributable to a higher than optimal body mass index are 21–24% in the Māori and 11% in the non-Māori population.[37]
Physical inactivity	Yes (4624)	The prevalence of sedentary behaviour is about 15–20% higher among Māori people than among Europeans and other ethnic groups.[32] Nevertheless, regular physical activity levels are similar between Māori and non-Māori people (i.e. for at least 30 minutes of physical activity per day on 5 or more days of the previous week). Of note is the fact that this risk factor can modify other risk factors in this table (high blood glucose and overweight) that are relevant in terms of health inequalities between the Māori and non-Māori populations.
High blood cholesterol	Yes (5232)	Blood cholesterol levels contribute to more avoidable cardiovascular disease mortality (both ischaemic heart disease and stroke) among both Māori men and Māori women (compared with non-Māori people).[37] E.g. for Māori males the age-standardized mortality rate from ischaemic heart disease and stroke that is attributed to high blood cholesterol is around 300 per 100 000 population, vs 180 for non-Māori males.[37]
Low fruit and vegetable intake	Yes (2407)	Māori women have significantly lower daily vegetable and fruit intake than European women or women of other ethnicity.[32] Earlier survey data indicated lower intakes for Māori men and women.[37] The possible role of green leafy vegetables in reducing the risk of diabetes[38] may also be relevant.
Urban outdoor air pollution	Possibly (Unknown)	No definitive data on the contribution of such air pollution to ethnic inequalities appears to exist, although one recent study found a possibly stronger association of air pollution with mortality in the Māori than in the non-Māori population.[39] Given this uncertainty, the air pollution risk factor was dropped from further consideration in our prioritization process.

YYLs, years of life lost.

[a] YLLs for Māori people discounted at 3% per annum based on 1996 data from a Ministry of Health report[40] (for smoking and physical inactivity) and on 1997 data from Lawes et al.[37] (for the other risk factors). We were limited to considering YLLs since none of the previous work in the New Zealand context considered disability-adjusted life years, which are the more appropriate measure.

reduce absenteeism and premature death in the workforce, and interventions targeting physical inactivity, such as walking and cycling as commuting options and reduced use of private vehicles, could reduce greenhouse gas emissions.[19] Similarly, dietary interventions to reduce dairy product and meat consumption (to reduce blood cholesterol levels) would lower greenhouse gas emissions from ruminant-based agriculture (especially the greenhouse gas methane).[20]

Our approach has tended to prioritize those risk factors having a relatively high impact on health and equity. However, other criteria should also be considered in the final process of selecting risk factors and the interventions designed to prevent them. We offer two examples. First, initial scoping of an intervention that is being actively considered for immediate implementation by policy-makers for social or political reasons may suggest that its impact and/or cost-effectiveness will be low. If so, the intervention should be prioritized for a CEA before implementation is decided. Second, policy-makers should ideally get a better sense of the trade-offs through access to information on a wide range of interventions ranked by cost-effectiveness and by their impact on DALYs.

Implications for further work

The process of prioritizing risk factors to select preventive interventions for further CEA should include consultation with stakeholders. We have already started consulting with representatives of major health agencies, local health authorities, the primary care sector and experts in Māori health in New Zealand. We also plan to apply criteria other than the ones described herein for selecting preventive interventions for CEA, as detailed by ACE-Prevention workers in Australia.[17]

Table 4. **Our final prioritized list of major risk factors for further cost-effectiveness research on preventive interventions in New Zealand**

Risk factors	Additional rationale and comment
Six top priority (ranked)	
Tobacco use	A major contributor to disease burden and especially to health inequalities in New Zealand.
Alcohol use	Like tobacco use, this is clearly an important risk factor. Nevertheless, the existence of over 200 three-digit ICD-10 codes for which alcohol is part of a component cause poses a challenge for research.[41] Intervention analyses will therefore need to follow the completion of the New Zealand burden of disease study revision that began in 2010.
High blood pressure	A risk factor that shares many potential interventions with "high blood cholesterol".
High blood cholesterol	This risk factor was upgraded in priority because interventions targeting it appear more promising than those targeting most of the other risk factors we considered. It is also more relevant than physical inactivity in terms of Māori health (as per years-of-life-lost estimates). Additionally, there is overlap with the blood pressure interventions if an absolute risk approach, such as the use of a polypill, is adopted.
Overweight and obesity	An important risk factor (especially for the Māori population), but uncertainty surrounds the persistence of intervention effects.
Physical inactivity	An important risk factor but its possible impact on health inequalities is indirect and uncertainty surrounds the persistence of intervention effects (especially in connection with paediatric interventions).
Lower priority	
Low fruit and vegetable intake	In past work, the benefits of reducing this risk factor may have been overestimated, as suggested by the findings of a recent, very large cohort study.[42]
High blood glucose	This risk factor was assigned relatively lower priority because interventions for blood glucose control do not appear to be particularly cost-effective. Also, this risk factor will be partly covered by interventions targeting other risk factors, such as physical inactivity, overweight and obesity and possibly vegetable intake.[43]

ICD-10, International Classification of Diseases, 10th revision.

Additional research on public attitudes surrounding the importance of risk factors and their preventive interventions should be conducted. There is already evidence that New Zealanders support enhanced tobacco control interventions,[46] yet support can be fairly nuanced. For instance, most smokers in New Zealand support raising tobacco taxes only if the tax revenue is destined specifically to providing support for smokers wishing to quit and for health promotion.[47]

In countries where important health inequalities exist, such as New Zealand, preventive interventions should also be assessed in terms of their ability to reduce health inequalities in a cost-effective way, since there may be trade-offs between achieving overall gains in population health and gains among specific population groups more heavily affected by certain risk factors. The following are possible ways of incorporating inequalities in health between the general population and ethnic minorities when conducting CEA of preventive interventions:

- Presenting the health gains attributable to an intervention by population groups, including ethnic minorities (i.e. DALYs averted [per capita] and cost per DALY averted).
- Presenting the additional resources and intervention coverage required to reduce by a given amount the gap in the number of DALYs between population groups.
- Weighting of the benefits of the intervention in terms of equity by using methods such as the rank-dependent quality-adjusted life year model, which assigns more weight to the health gains attained among those that are worst off.[48]

Although some trade-offs in the benefits afforded by a few preventive interventions are likely to occur, some interventions will result in benefits for all. For instance, higher tobacco prices tend to protect the health of all citizens as well as to reduce health inequalities.[3]

In summary, our risk factor approach to identifying preventive interventions for further CEA may seem somewhat simplistic. However, it is relatively straightforward and transparent and can be applied in both developed and developing countries. We encourage further research on the use of this approach internationally. ■

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الملخص

ترتيب عوامل الخطر لتحديد التدخلات الوقائية للتقييم الاقتصادي

الغرض استكشاف نهج لعوامل الخطر بهدف تحديد التدخلات الوقائية التي تتطلب تقييماً اقتصادياً أكثر تعمقاً بها في ذلك تحليلات المردودية.

الطرق تم استخدام نهج يتكون من ثلاث خطوات من أجل (أ) تحديد عوامل الخطر التي تسهم بشكل كبير في سنوات العمر المصححة باحتساب مدد العجز (DALYs)، (ب) إعادة ترتيب عوامل الخطر هذه استنادًا إلى توافر التدخلات الوقائية الفعالة التي تضمن إجراء تحليل إضافي للمردودية (وتستند في بعض الحالات على الأدلة الناتجة عن التحليلات الحالية للمردودية)، (ج) إعادة ترتيب عوامل الخطر هذه وفقاً لمساهمتها النسبية في التباينات الصحية. وقد استخدمت التباينات الصحية بين سكان الماوري الأصليين وغيرهم من السكان في نيوزيلندا على سبيل التوضيح.

النتائج كانت سبعة من بين أعلى 10 عوامل خطر من اللاتي تم منحها الأولوية في البحوث المتعلقة بالتدخلات الوقائية في نيوزيلندا أيضاً من بين عوامل الخطر العشرة الأعلى ترتيبًا في الإسهام في سنوات العمر المصححة باحتساب مدد العجز في البلدان ذات الدخل المرتفع لإقليم غرب المحيط الهادئ التابع لمنظمة الصحة العالمية. وشملت القائمة النهائية لعوامل الخطر ذات الأولوية تعاطي التبغ؛ وتعاطي الكحول؛ وارتفاع ضغط الدم؛ وارتفاع الكوليسترول في الدم؛ والوزن المفرط/ السمنة، والخمول البدني. وقد ساهمت كل هذه العوامل في التباينات الصحية. وتتوافر تدخلات فعالة لمنع جميع هذه العوامل، ويوجد تدخل وقائي موثّق واحد على الأقل يحقق وفورات في التكاليف لكل عامل خطر.

الاستنتاج ربما يكون النهج المباشر لترتيب عوامل الخطر المبينة في هذا البحث قابلاً للتطبيق في العديد من البلدان، وحتى في تلك البلدان التي تفتقر إلى القدرة على إجراء تحليلات إضافية للمردودية، فإن هذا النهج سوف يسمح بتحديد التدخلات عالية المردود التي ينبغي تنفيذها على المدى القصير.

摘要

进行经济评估确定预防措施优先考虑的风险因素

目的 探讨确定用于需要进行更深入经济评估的预防性干预的风险因素方法，包括成本效益分析。

方法 采用三个步骤方法（i）确定对伤残调整生命年（DALY）最有影响的风险因素；（ii）以进一步成本效益分析（以及在某些情况下，以现有的成本效益分析为依据）的有效预防性干预的可用性为基础，对风险因素重新排序；并且（iii）按照其对健康不平等的相对贡献，对风险因素重新排序。新西兰的毛利人和非毛利人人群之间的健康不平等仅作举例之用。

结果 在新西兰开展的预防性干预研究中，前10大风险因素中有七个也同样出现在世界卫生组织西太平洋地区高收入国家对伤残调整生命年（DALY）排名最前的10个风险因素当中。优先考虑的风险因素的最终列表包括吸烟；饮酒；高血压；高血脂；超重/肥胖，以及缺乏运动。所有这些因素都会造成健康不平等。存在可用的预防这些因素的有效干预，并且对于每个风险因素，都至少有一种有记录的节约成本的预防性干预。

结论 本文中所描述的确定风险因素的优先顺序的方法简单易懂，适用于许多国家，即使在那些不具备能力进行更多成本效益分析的国家，这种方法依然可以确定在短期内可以进行何种成本效益的干预。

Résumé

Prioriser les facteurs de risque pour identifier les interventions préventives à évaluer économiquement

Objectif Étudier une approche fondée sur les facteurs de risque pour identifier les interventions préventives nécessitant une évaluation économique plus approfondie, y compris des analyses de rentabilité.

Méthodes Une approche en trois étapes a été utilisée pour (i) identifier les facteurs de risque contribuant en grande partie aux années de vie corrigées du facteur invalidité (AVCI), (ii) reclasser ces facteurs de risque en fonction de la disponibilité des interventions préventives efficaces justifiant une analyse supplémentaire de rentabilité (et, dans certains cas, sur la base de preuves provenant d'analyses de rentabilité existantes), et (iii) reclasser ces facteurs de risque en fonction de leur contribution relative aux inégalités de santé. Les inégalités de santé entre les populations maories et non maories en Nouvelle-Zélande ont été utilisées à titre d'illustration.

Résultats Sept des dix principaux facteurs de risque priorisés pour la recherche sur les interventions préventives en Nouvelle-Zélande figuraient également parmi les dix facteurs de risque contribuant le plus aux AVCI dans les pays à revenu élevé de la région du Pacifique occidental de l'Organisation mondiale de la Santé. La liste définitive des facteurs de risque prioritaires incluait le tabagisme, la consommation d'alcool, l'hypertension artérielle, l'hypercholestérolémie, le surpoids/l'obésité et l'inactivité physique. Tous ces facteurs contribuaient à des inégalités de santé. Des interventions efficaces pour prévenir chacun d'eux sont disponibles, et il existe au moins une intervention préventive plus économique connue pour chaque facteur de risque.

Conclusion L'approche simple de priorisation des facteurs de risque décrite dans cet article peut être applicable dans de nombreux pays. Même dans les pays qui n'ont pas la capacité d'effectuer des analyses de rentabilité complémentaires, cette approche permettra de déterminer quelles interventions rentables devraient être mises en œuvre à court terme.

Резюме

Выделение приоритетных факторов риска, чтобы определить профилактические меры для экономической оценки

Цель Исследовать подход на основе факторов риска для определения профилактического вмешательства, которое требует углубленной экономической оценки, включая анализ затрат и эффективности.

Методы Для определения (i) факторов риска, которые имеют наибольшее значение в годы потери трудоспособности (DALY); (ii) ранжирования этих факторов риска на основе доступности профилактических мер для гарантии дальнейшего анализа затрат и эффективности (и в некоторых случаях, исходя из доказательств, полученных в ходе уже проведенного анализа затрат и эффективности); и (iii) ранжирования этих факторов риска в соответствии с их относительным вкладом в диспропорции в состоянии здоровья применялся трехстадийный подход. Для иллюстрации использовались диспропорции в состоянии здоровья между популяциями маори и не маори в Новой Зеландии.

Результаты Семь из наиболее распространенных 10 факторов риска, выбранных в качестве приоритетных для разработки профилактических мер в Новой Зеландии, также входили в число 10 факторов риска с наибольшим рангом, имеющих наибольшее значение в период DALY в странах с высокими доходами на западе Тихоокеанского региона согласно данным Всемирной организации здравоохранения. Окончательный перечень приоритетных факторов риска включает в себя употребление табака; употребление алкоголя; высокое давление крови; высокий уровень холестерина в крови; избыточный вес/ожирение и низкую физическую активность. Все эти факторы вносят вклад в диспропорции в состоянии здоровья. Для всех этих факторов имеются эффективные меры профилактики, и для каждого из этих факторов имеется хотя бы одна задокументированная экономически эффективная профилактическая мера.

Вывод Описанный в этой статье непосредственный подход для выявления приоритетных факторов риска может быть применим во многих странах; даже в тех странах, где недостаточно возможностей для проведения дополнительного анализа затрат и эффективности, этот подход все равно позволяет определить, какие экономически эффективные меры следует внедрить в краткосрочной перспективе.

Resumen

Determinación de la prioridad de los factores de riesgo con el fin de identificar las intervenciones preventivas para la evaluación económica

Objetivo Explorar una estrategia en relación con los factores de riesgo que permita la identificación de las intervenciones preventivas que requieran una evaluación económica de mayor profundidad, incluyendo los análisis de rentabilidad.

Métodos Se aplicó una estrategia en tres etapas con el fin de (i) identificar los factores de riesgo que contribuyen de manera más significativa a los años de vida ajustados en función de la discapacidad (AVAD); (ii) volver a clasificar estos factores de riesgo en base a la disponibilidad de intervenciones preventivas eficaces que justifiquen la realización de análisis de rentabilidad adicionales (y, en algunos casos, en base a las evidencias procedentes de los análisis de rentabilidad existentes); y (iii) volver a clasificar estos factores de riesgo de acuerdo con su contribución relativa a las desigualdades sanitarias. A modo de ilustración, se analizaron las desigualdades sanitarias entre las poblaciones maoríes y no maoríes de Nueva Zelanda.

Resultados Siete de los 10 factores de riesgo prioritarios para la investigación sobre las intervenciones preventivas en Nueva Zelanda también se encontraron entre los 10 factores de riesgo con mayor calificación en cuanto a su contribución a los AVAD en países de ingresos altos de la Región del Pacífico Occidental de la Organización Mundial de la Salud. En la lista definitiva de los factores de riesgo prioritarios se incluyeron el tabaquismo, el consumo de alcohol, la presión arterial alta, un nivel elevado de colesterol, el sobrepeso/obesidad y el sedentarismo. Todos estos factores contribuyeron a las desigualdades sanitarias. Se han desarrollado intervenciones eficaces para prevenir todos estos factores, y para cada factor de riesgo se ha documentado al menos una intervención preventiva destinada al ahorro de costes.

Conclusión La sencilla estrategia consistente en establecer la prioridad de los factores de riesgo descritos en este documento puede ser aplicable en muchos países, e incluso en aquellos países que carezcan de la capacidad necesaria para llevar a cabo los análisis de rentabilidad adicionales, esta estrategia también permitirá determinar qué intervenciones rentables se han de aplicar a corto plazo.

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