The Economics of Climate Change
The Stern Review

NICHOLAS STERN

CAMBRIDGE
HEAT approach http://www.heatwalkingcycling.org/

• Effective public health:
  – action outside as well as within the health sector
  – identify levers
  – working upstream
  – efficient use of public resources

• Recognises importance of economic analysis in transport: benefit-cost ratio is king

• Evidence-based
• Transparent
• Adaptable
• ‘Do once and share’
Collaborative project

Core group
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Contributors
Lars Bo Andersen, Andy Cope, Mark Fenton, Mark Hamer, Max Herry, I-Min Lee, Brian Martin, Markus Maybach / Christoph Schreyer, Marie Murphy, Gabe Rousseau, Candace Rutt / Tom Schmid, Elin Sandberg/Mulugeta Yilma, Daniel Sauter, Peter Schantz, Peter Schnohr, Christian Schweizer, Heini Sommer, Jan Sørensen, Gregor Starc, Wanda Wendel Vos, Paul Wilkinson.
Overview of the approach

- Use economic levers to influence transport appraisal
- Find best format for transport planners
- International advisory group including transport; health economics; practice
- Review the evidence
- Generate a tool based on the evidence
- Test with range of experts and refine
- Disseminate; evaluate; review
Overview of the approach

1. Systematic review
2. Consensus event – cycling
3. Produce HEAT cycling (Excel)
4. Systematic reviews (economics; relative risks)
5. Consensus event – walking
6. Produce combined online tool
Economic analyses of transport infrastructure and policies including health effects related to cycling and walking: A systematic review

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ABSTRACT

We reviewed published and unpublished studies that presented the findings of an economic valuation of an aspect of transport infrastructure or policy, and included data on walking and/or cycling and health effects in the valuation. We included 16 papers, of which three were classified as ‘high’, six as ‘moderate’ and seven as ‘low’ quality. There is a wide variation in the approaches taken for including the health effects of physical activity in economic analyses of transport projects. This is not helped by a lack of transparency of methods in many studies. A more standardised approach is called for, including a clearer description of the applied methods and assumptions taken.
Issues

• Which health benefits?
• Mortality or morbidity or both?
• Physical activity and health relationship: linear or non-linear? Threshold?
• Activity substitution
• Costs applied
• Time periods
Relative risk of all cause mortality for regular cycle commuters

Data from Copenhagen Male study and Glostrup Population Studies
- 6,171 men and 783 women including 2,291 deaths
- RR 0.72 (95% CI: 0.57-0.91)
- adjusted for age, sex, educ. level, BP, BMI, leisure time physical activity, cholesterol and smoking
- Results consistent with other cycling studies and literature on physical activity eg Matthews, Paffenbarger

Number of trips per day × Distance per trip

Days cycled per year × Average speed

Distance cycled per year in study area

Relative risk of death among cyclists =

\[
1 - \left( \frac{\text{Distance cycled in study area}}{\text{Distance cycled in Copenhagen} \times (1 - RR^*)} \right)
\]

Estimate of economic savings based on reduced mortality among cyclists in the study area
Applications

• Project website visited over 6000 times, products downloaded over 600 times
HEAT walking

Systematic review

• PubMed search for keywords ‘Walking’ and ‘Relative risk’ in studies that
  – specified walking as an independent behavior
  – reported a relative risk for mortality or morbidity

• Meta-analysis of 9 studies that controlled for leisure time physical activity

• RR = 0.78 (0.64-.98) for walking 29 mins per day on 7 days/week
HEAT walking

Economic studies

• Updated systematic review of economic studies
• 8 studies included; 5 good quality
• Few methodological advances
• Showed HEAT approach remained valid for walking
What’s new?

• Step-by-step online tool
• Assessment of walking data with a brand-new HEAT walking
• More data entry options:
  – (currently: cycling trips only)
  – New:
    – Trips
    – Distance
    – Duration
    – Steps (for walking)
• More explanations, tips and hints on every step
• Print and save results
Scope for the use of HEAT Walking

1) This tool is designed for habitual behaviour, such as walking for commuting, or regular leisure time activities. Do not use it for the evaluation of one-day events or competitions (such as walking days etc.), since they are unlikely to reflect long-term average activity behaviour. HEAT is meant to be applied for walking of at least moderate pace (i.e. about 3 miles/hour or 4.8km/hour). Walking at this speed requires an energy expenditure that is considered to be necessary for health benefits.*

2) HEAT is designed for populations aged approximately 20-74 years. If the age distribution in the assessed population is significantly different (much younger, much older) HEAT may over or under estimate the resulting benefits. In such cases, it is important to adjust the mortality rate which depends strongly on the age of the assessed population. However, HEAT should not be applied to populations of children, very young adults, or older people, since the relative risk used by HEAT does not include these age groups.

3) Studies on the benefits of physical activity for decreasing premature mortality have typically been conducted in the general population where very high levels of physical activity are uncommon. Thus, the exact shape of the dose-response curve is uncertain above physical activity levels that are the equivalent of perhaps 2 hours of brisk walking per day. Therefore, the tool may not be suited for very high levels of occupational walking (e.g. mail personnel) which go beyond activity levels common in an average adult population.

If you have comments on the HEAT please email to info@heatwalkingcycling.org

Next step
- Start new assessment
HEAT for walking

Q1: Your data: amount of walking from a single point in time, or before and after an intervention

- Single
- Before and after

Next step
- Next question
- Back

Hints & Tips
If you select 'Single', you will be asked to enter data on levels of walking only once.

If you select 'Before and after', the tool will prompt you to enter two sets of walking data. The difference in levels of walking between the pre- and post-measures will be used to calculate the health benefits and associated financial savings.
HEAT for walking

Q2: Enter your pre-intervention walking data

The HEAT model requires an estimate of the average duration spent walking in the study population in order to calculate the corresponding health benefit (based on a relative risk from a review of the epidemiological literature on the health benefits of walking). This duration can be entered directly, if available (and this is the most direct data entry route), or calculated based on the distance, number of steps, or number of trips.

- Duration (average time walked per person)
- Distance (average distance walked per person)
- Steps (average number of steps taken per person)
- Trips (average per person or total observed across a population)

Next step
- Next question
- Back
HEAT for walking

Q4: Average distance walked

Enter the average distance walked per person:

[ ] km

Is this for an average day, week, month or year?

[ ] Day

Next step

- Next question
- Back

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HEAT for walking

Q7: How many people are walking?

The tool now requires information on the number of individuals doing the amount of walking you entered in the previous questions.

In most cases, this will also be the number of people who stand to benefit from the reported levels of walking. However, if the trips data you have entered is based on a representative sample of a larger population, you may need to change this number. In this case, you need to enter the total population number, rather than the number in your sample (e.g. in case of a national travel survey that is representative for the whole population, use the total number of population here, not the sample of the travel survey).

In many cases this figure will be the number of walkers in your study area, city or country.

In some cases, walking data may be derived from a survey in a representative sample of the population, but you may wish to apply the findings to a much larger population (e.g. in case of a national travel survey). In this case, enter the size of the total population, not the sample size.

It is important to ensure the right population figure is entered here, as this can substantially affect the resulting calculations.

Number of walkers:

[ ] 2000 persons

Next step

- Next question
- Back
HEAT for walking

Summary of walking data

Review your entered data

Pre-intervention walking data

Average distance walked per person per day in km: 5.00
This level of walking is likely to lead to a reduction in the risk of mortality of: 40.19 %
Total number of individuals regularly doing this amount of walking: 2000

This amount of walking seems very high for a long term daily average that is maintained across a population. Are you sure you want to continue with this value?

Next step
- Next question
- Back
HEAT for walking

Q2: Enter your post-intervention walking data

The HEAT model requires an estimate of the average duration spent walking in the study population in order to calculate the corresponding health benefit (based on a relative risk from a review of the epidemiological literature on the health benefits of walking). This duration can be entered directly, if available (and this is the most direct data entry route), or calculated based on the distance, number of steps, or number of trips.

- Duration (average time walked per person)
- Distance (average distance walked per person)
- Steps (average number of steps taken per person)
- Trips (average per person or total observed across a population)

Next step
- Next question
- Back
HEAT for walking

Q4: Average distance walked

Enter the average distance walked per person:

5 km

Is this for an average day, week, month or year?

Day

Next step
- Next question
- Back
HEAT for walking

Q7: How many people are walking?

The tool now requires information on the number of individuals doing the amount of walking you entered in the previous questions.

In most cases, this will also be the number of people who stand to benefit from the reported levels of walking. However, if the trips data you have entered is based on a representative sample of a larger population, you may need to change this number. In this case, you need to enter the total population number, rather than the number in your sample (e.g. in case of a national travel survey that is representative for the whole population, use the total number of population here, not the sample of the travel survey).

In many cases this figure will be the number of walkers in your study area, city or country.

In some cases, walking data may be derived from a survey in a representative sample of the population, but you may wish to apply the findings to a much larger population (e.g. in case of a national travel survey). In this case, enter the size of the total population, not the sample size.

It is important to ensure the right population figure is entered here, as this can substantially affect the resulting calculations.

Number of walkers:

5000 persons

Next step
- Next question
- Back
HEAT for walking

Summary of walking data

Review your entered data

Pre-intervention walking data

Average distance walked per person per day in km: **5.00**
This level of walking is likely to lead to a reduction in the risk of mortality of: **40.19 %**
Total number of individuals regularly doing this amount of walking: **2000**

This amount of walking seems very high for a long term daily average that is maintained across a population. Are you sure you want to continue with this value?

Post-intervention walking data

Average distance walked per person per day in km: **5.00**
This level of walking is likely to lead to a reduction in the risk of mortality of: **40.19 %**
Total number of individuals regularly doing this amount of walking: **5000**

This amount of walking seems very high for a long term daily average that is maintained across a population. Are you sure you want to continue with this value?

The number of individuals walking has **increased** between your pre and post data.
There are now **3000 additional** individuals regularly walking, compared to the baseline.

However, the average amount of walking per person per day has not changed.
The reported level of walking in both your pre and post data gives a reduced risk of mortality of: **40.19 %**, compared to individuals who do not regularly walk.

Next step

- Next question
- Back
HEAT for walking

Q9: Proportion of walking data attributable to your intervention

When assessing the impact of an intervention it is prudent to assume that not all the walking, or increase in walking, observed is newly induced walking that is directly attributable to the intervention.

Data to estimate the proportion of newly induced walking is rarely available. Estimate the proportion of walking which you would like to attribute to the intervention (i.e. you want to value) to the best of your knowledge. For guidance on this estimation, see also Hints & Tips.

Please enter a proportion between 0-100%

[100] percent

If you don't know what proportion of the new walking is attributable to the intervention, then 50% may be an acceptable assumption.

It is strongly advised to calculate various scenarios with higher and lower percentages, as this number significantly affects your results.

Next step
- Next question
- Back
HEAT for walking

Q10: Time needed to reach full level of walking

Important: If you are assessing steady states, and do not want to take into account any build-up times to achieve the level of walking you intend to value, then please select zero.

Please select the time period before maximum uptake is achieved:

- [ ] 1 year
- [ ] 2 years
- [ ] 3 years
- [ ] 4 years
- [ ] 5 years
- [ ] 6 years
- [ ] 7 years
- [ ] 8 years
- [ ] 9 years
- [ ] 10 years

Next step
- Next question
- Back

Hints & Tips

This allows adjustment for the estimated time it will take to reach the full level of walking entered. This can be particularly useful when assessing interventions. For example, if a new footpath is built and it is estimated it will take 5 years for usage to reach a steady state, this figure should be changed to 5. The default value has been set at 1 year.

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HEAT for walking

Q11: Mortality rate

Health benefits are calculated based on a reduced probability of death for people who walk. The mortality rate used in HEAT should reflect the rate of the population being studied. It is recommended to use the local crude mortality rate for the population aged 20-74 years, unless the age range of walkers in your population is substantially different.

The default value is for all adults aged 20-74 years across the WHO European region, calculated using data from the countries and years shown in the drop down menu.

It is possible to use a mortality rate for a different age group, for example one which matches the age range of the population participating in the walking assessed. However, it must be noted that HEAT is not appropriate for populations consisting mainly of children, very young adults, or older people, as the underlying relative risk would not be applicable as it applies to the age range of 20-74.

Please enter a figure for mortality data either by selecting the value for your country from the WHO Mortality database, or by entering your own value. If your national value is not available, it is suggested to use the WHO European Region average value.

Select mortality data for your country using the drop down menu below:

WHO European region

Your chosen rate is \(727,122,461\) deaths per 100,000 persons per year (crude rate)

Alternatively, you may enter your own value in the cell below:

0 deaths per 100,000 population
HEAT for walking
Q12: Value of statistical life

What is the value of a statistical life?

The value of a statistical life is derived with a methodology called "willingness to pay" to avoid death in relation to the years this person can expect to live according to the statistical life expectancy. The willingness to pay represents how much a representative sample of the population (who in this instance are potential victims) would be willing to pay (in monetary terms) to avoid a specific risk such as the risk of a road crash.

Enter the standard value of a statistical life used in the country of study (and select your currency). This will form the basis of the financial savings shown in the model. If not known, use the default value of €1.5 million, which is the standard value used across Europe.

Please enter the local value of statistical life:

1500000 [European euro (EUR)]

Next step
- Next question
- Back

Sources:

HEAT for walking

Q13: Time period over which benefits are calculated

Please select the time period over which you wish average benefits to be calculated

10 years

The time period should not be longer than you believe the entered amount of walking is being sustained.

Next step
- Next question
- Back

Hints & Tips
This tool shows both total and average benefits over a time period selected by the user.

The time period over which savings should be examined is often standardized within a country, and where possible you should select the time period used locally; the default value has been set at 10 years.
HEAT for walking

Q14: Costs to include a benefit–cost ratio in the HEAT calculation

If you know how much it costs to promote walking in your case (e.g. in case of a specific promotion project or new infrastructure), and would like the tool to calculate a benefit-cost ratio for your local data, please select 'Yes'.

- Yes
Otherwise please select 'No' and continue.
- No

Next step
- Next question
- Back
HEAT for walking

Q16: Discount rate to apply to future benefits

In most cases, the economic appraisal of health effects related to walking will be included as one component into a more comprehensive cost-benefit analysis of transport interventions or infrastructure projects. The final result of the comprehensive assessment would then be discounted to allow the calculation of the present value. In this case, enter “0” here. If the health effects are to be considered alone, however, it is important that the methodology allows for discounting to be applied to this result as well. As default value, a rate of 5% has been set.

Please enter the rate by which you wish to discount future financial savings:

5.0 percent

Next step
- View HEAT calculation
- Back
HEAT estimate

Reduced mortality as a result of changes in walking behaviour

The number of individuals walking has increased between your pre and post data. There are now 3000 additional individuals regularly walking, compared to the baseline. However, the average amount of walking per person per day has not changed. The reported level of walking in both your pre and post data gives a reduced risk of mortality of 40.19%, compared to individuals who do not regularly walk.

Taking this into account, the number of deaths per year that are prevented by this change in walking is: 8.77

Financial savings as a result of walking

*Currency: EUR*

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value of statistical life applied is:</td>
<td>1,500,000 EUR</td>
</tr>
<tr>
<td>The annual benefit of this level of walking, per year, is:</td>
<td>9,798,000 EUR</td>
</tr>
<tr>
<td>The total benefits accumulated over 10 years are:</td>
<td>97,970,000 EUR</td>
</tr>
<tr>
<td>When future benefits are discounted by 5% per year;</td>
<td></td>
</tr>
<tr>
<td>The current value of the average annual benefit, averaged across 10 years is:</td>
<td>7,135,000 EUR</td>
</tr>
<tr>
<td>The current value of the total benefits accumulated over 10 years is:</td>
<td>71,347,000 EUR</td>
</tr>
</tbody>
</table>

It is important to remember that many of the variables used within this HEAT calculation are liable to be estimates, and therefore liable to some degree of error.

In order to be sure of the validity of the figures outlined above, you are advised to rerun the model entering slightly different values for variables where you have provided a ‘best guess’ - for example entering high and low estimates for such variables.
Conclusions

• Identifies a major public health issue and uses effective lever to promote it
• Works outside traditional health care paradigm to achieve health gain
• Addresses needs of the target sector, not health sector
• Highly influential
• Cheap and sustainable
• Effective demonstration of using evidence to drive practice