Development of the Health Economic Assessment Tool (HEAT) for walking and cycling: seventh consensus meeting

Meeting report: 8 March and 5 April 2023
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Abstract

The project on the Health Economic Assessment Tool (HEAT) for Walking and Cycling,\(^1\) coordinated by WHO, steered by a coordinating team of multidisciplinary experts and supported by relevant international experts invited ad hoc, hold advisory group and consensus meetings to discuss and agree upon methodological updates and new features of the HEAT. The seventh meeting was convened to achieve scientific consensus on a new functionality for assessing the effects of e-biking.

Twenty participants attended the meeting, comprising members of the HEAT coordinating team, the HEAT advisory group and invited experts, seven participants from WHO regions (five from the European Region and two from the Region of the Americas), and two from WHO headquarters.

Participants discussed and adopted eight recommendations and provided comments, which will be taken into account in finalizing an updated version of the HEAT that includes e-biking.

**Keywords**

BICYCLING  
WALKING  
HEALTH ECONOMICS  
COST-BENEFIT ANALYSIS  
DATA COLLECTION METHODS

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Acknowledgements

The Health Economic Assessment Tool (HEAT) was developed in collaboration with the Transport, Health and Environment Pan-European Programme, with the WHO Regional Office for Europe, the United Nations Economic Commission for Europe and the Urban Health Initiative (Department of Environment, Climate Change and Health, WHO headquarters). The work of the consensus group of multidisciplinary experts was supported by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of Germany; the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology of Austria; the French Ministry of Health and Prevention; and the Ministry of Environmental Protection of Serbia.
1 Introduction and background

WHO has long recognized the importance of integrating health and economic considerations into transport policies and interventions. A project was started in 2005, coordinated by the WHO Regional Office for Europe, steered by a coordinating team and an advisory group of multidisciplinary experts and supported by relevant international experts invited ad hoc,2 to develop guidance and practical tools for economic assessment of the health effects of cycling and of walking. The main outcome is the Health Economic Assessment Tool (HEAT) for walking and cycling, a harmonized method for economic evaluation of the health effects of cycling and walking, which is based on the best available evidence and consensus among international experts. The tool allows calculation of the following: if $x$ people cycle or walk $y$ distance on most days, what is the economic value of changes in the all-cause mortality rate? It also accounts for the health impacts of cyclists’ and pedestrians’ exposure to air pollution and traffic crashes and effects on carbon emissions. The HEAT version 5.0 was launched in November 2021;3 the current online version, 5.0.6, includes subsequent updates.

The HEAT is designed primarily for use by transport planners, traffic engineers, economists and certain special interest groups. As these users do not necessarily have ready access to epidemiological and economic expertise and modelling tools, the HEAT is intended to be scientifically robust yet easy to use. It is not meant to allow comprehensive health impact assessments but to provide estimates of the direction and order of magnitude of the health effects (currently only mortality) of regular walking and cycling and changes in carbon emissions. It is based on minimal data input for the different uses, including cost–benefit analyses of transport and/or land use planning. Experience shows, however, that the tool is also used in the health sector and by advocacy groups for transport, climate change, health and physical activity and for training in academic contexts.

The HEAT is being developed by a collaborative team of researchers, policy-makers and practitioners. Despite its initial focus on Europe, it has also been used in Africa, the Americas, Asia and Australia. In response to growing international interest in walking and cycling for transport, sustainability and physical activity and in the HEAT in particular, as part of WHO’s Urban Health Initiative, the HEAT prototype for global use has been developed, which was officially launched in 2021.

The objective of this seventh consensus meeting was to achieve scientific consensus on methodological aspects of e-biking in the tool modules.

2 See full lists at www.heatwalkingcycling.org.


3 Kahlmeier S et al. Health economic assessment tool (HEAT) for walking and for cycling. Methods and user guide on physical activity, air pollution, road fatalities and carbon impact assessments: 2022 update. Copenhagen: WHO Regional Office for Europe; forthcoming.
3 Main discussion points

3.1 Proposed general approach to the HEAT e-bike functionality

Dr Thomas Götschi, University of Oregon, United States of America (USA) (the HEAT coordinating team), briefly explained the general approach and workflow of the HEAT and integration of an e-biking functionality into the basic user interface. He noted that the flexible and/or advanced user interface of the HEAT would provide more options to amend the HEAT default values according to the preferences and availability of local data by users, with the same mathematical approach as in the basic version. E-biking would be included as an additional active travel mode. The values of all parameters are to be reviewed and adjusted for e-biking. The following recommendation was presented to the participants:

- An e-bike functionality, which is analogous to cycling, will be added to the HEAT. By default, the features for the mode “cycling” will be duplicated for the mode “e-biking”. For refined assessments, distinction of the two categories of e-biking is recommended. These are currently “slow” and “fast” e-biking, with different categories of electrical assistance (e.g. maximum speed, engine power). The definitions of these two subgroups could be changed.

There was general consensus that the current tool could be enhanced by incorporating the mode of e-biking. While many of the experts agreed that a distinction between e-bike categories, such as “slow” and “fast”, would be desirable, this was considered less of a priority than introducing e-biking overall. In addition, different subtypes of e-bikes are available, with different levels of electrical assistance, and more work is necessary to differentiate the sub-categories to avoid misunderstanding by less experienced users.

The recommendation was partly adopted by participants, as follows:

- to develop the e-bike functionality, analogous to cycling, in the HEAT. By default, features presented for the mode “cycling” will be duplicated for the mode “e-biking”.

Further work on functionalities and on clarifying definitions for a user-friendly distinction between sub-categories of e-bikes was conducted after finalization of a basic version with one category of “e-biking”, which was launched at the 7th Ministerial Conference on Environment and Health in early July 2023. The benefits of providing flexibility with sub-categories should be carefully weighed against possible overcomplicating of use of this HEAT functionality.

3.2 Approach to deriving benefits

Dr Götschi gave a short overview of the benefits of e-biking for mortality rates associated with physical activity, which were described in detail in a background document made available to participants before the meeting. There is strong evidence that most of the benefits of (non-occupational) physical activity are independent of the type of activity, and there is no reason to expect any major physiological difference between cycling and e-biking. He emphasized that, to date, no cohort studies are available specifically on e-biking, nor are any to be expected soon.

The following recommendation was proposed to participants:

- Physical activity during e-biking is equivalent to physical activity during normal cycling in terms of health benefits, in accordance with the relative risk estimates of Kelly et al. (2014).  

The recommendation to use the same risk estimates as for cycling was adopted. One expert pointed out that only e-bikes on which at least some active pedalling is required should be included in the HEAT assessments in view of the proposal to define sub-categories of e-biking.

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3.3 Intensity of e-biking

Dr Göttschi briefly presented the conceptual model for assessing the impact of physical activity in the HEAT (Fig. 1).

Fig. 1. Conceptual model for assessing effects of physical activity in the HEAT

In the actual calculation in the HEAT, a reference duration in minutes is used in accordance with an assumed metabolic equivalent of task (MET) value for intensity.


EE: energy expenditure, HR: heart rate, MET/h: metabolic equivalents of task per hour, PA: physical activity, PO: power output, RR: relative risk, VO2: volume of oxygen (O2); $, i.e. maximal aerobic capacity.

Of interest for expert input are:

- the value of the metabolic equivalent of task (MET) for the intensity of physical activity during e-biking, as this has been considered a hardcoded background value\(^5\) that cannot be changed by users;
- the default values for trip length and speed provided in the HEAT, which users can overwrite as they see fit (e.g. according to local data); and
- the age range on which the baseline relative risk estimate is based.\(^6\)

In the HEAT, intensity parameters are measured in METs, which, for walking and cycling, are obtained from the Compendium of Physical Activities.\(^7\) The compendium does not, however, yet include estimates for e-biking or a single, general estimate for the broad activity categories used in the HEAT (e.g. walking, cycling).

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\(^5\) For a full list of hardcoded background and changeable default values, see https://heatwalkingcycling.org/#generic_data.


although it lists a number of categories of cycling. The HEAT currently uses a MET value of 6.8 for “bicycling, to/from work, self-selected pace” or “bicycling, 10–11.9 mph, leisure, slow, light effort” (for comparison, “bicycling, general” is listed at 7.5 METs). The situation is similar for walking.

There is a growing body of research on the intensity of e-biking, which has been reviewed thoroughly in preparing the e-biking functionality. McVicar et al.\(^8\) identified 14 studies on the intensity of e-biking in one form or another, which suggest that, overall, e-biking is 0.83 METs less intense than cycling. Dr Götschi also outlined the scientific evidence on e-biking, including fast technological development, differences in travel behaviour between categories of e-bikes and normal bikes, the often small samples used in e-biking studies and therefore the lack of comparability of findings. Derivation of summary estimates to be used as default or background values in the HEAT is therefore a challenge and cannot be based on a purely analytical approach (i.e. a meta-analysis) but requires substantial well-balanced expert judgement.

The following recommendation was presented to the experts:

- The MET values to be used for e-biking are:
  - average (for a single category of e-biking): 5.5
  - “slow” (category with less electric assistance): 6
  - “fast” (category with more electric assistance): 5.

- The values to reflect the limited precision of estimates in rounded numbers (whole or 0.5) and the option for advanced users (i.e. flexible or full user interface) to adjust these values within a given range are:
  - e-biking: 4–6
  - cycling: 6–8
  - walking: 3–5.

The experts acknowledged the complexity of providing a single default value in view of differences in topography, speed and intensity of e-biking and expressed a preference for some flexibility in the tool, for example through a slider. Concern was expressed, however, about providing too much flexibility, as it is unlikely that many users would have access to better data and/or the necessary background for an informed decision on where to place a slider on a given range for their particular use case.

Therefore, participants agreed to adopt the average of 5.5 METs for a single category of e-biking. More work should be conducted on providing flexibility and sub-categories.

### 3.4 Handling of age in the HEAT

Some evidence suggests that e-biking attracts more older users than cycling. This is to be expected if physical effort is a barrier to cycling and as physical fitness and strength decrease with age.

After the relative risk for effects of physical activity and determination of exposure to physical activity, handling of age is among the most influential factors in the HEAT results. Age also determines the baseline risk for all-cause mortality, which is central to the calculations (see Fig. 1). Currently, the HEAT allows users to modify the age range, which determines the baseline mortality risk, only crudely by offering the choices of “Adult population”, “Younger adult population” and “Older adult population”, which correspond to age ranges of 20–74, 20–44 and 45–74 years, respectively, for walking, and 20–64, 20–44 and 45–64 years, respectively, for cycling.

These age range inputs were created from a methodological perspective to acknowledge the fact that users of the HEAT are not expected to know the average age of the walking, cycling or e-biking population or their exact age distribution. Instead, users can roughly categorize the population that uses active transport. The HEAT uses the age groups to calculate a weighted average mortality rate according to the age distribution of the general population in the respective country. Thereby, the HEAT assumes that the age distribution of active use is the same as in the general population. This would appear to be applicable for walking but should be considered thoroughly for cycling modes. Upper age limits were adopted at the HEAT consensus meetings in

2007 and 2010 in response to evidence that the prevalence of cycling tends to decrease with higher ages and, even more importantly, to prevent inflation of benefits by overestimating active mode use in elderly age groups because of their significantly higher baseline risk for mortality. The limitations of this approach are well understood and could introduce substantial inaccuracy. Refinements could, however, increase the burden on users substantially.9

In light of these considerations, the following recommendations were made to participants:

- a short-term option (i.e. first version by mid-2023) for selecting an age range for e-biking: choice of older or younger age range for all current options for walking or cycling (20–64, 20–74, 20–44, 45–64 or 45–74 years); and
- a long-term option for selecting an age range for e-biking: specification of mean age and distribution with a visual tool or slider for all active modes in the HEAT.

The experts agreed with the proposed staged approach and the short-term option to provide all five current selection options for e-biking. Although the long-term option was supported in general, it was agreed that more work and exchanges are necessary and that, when this aspect is addressed, consistency should be ensured for all active travel modes (i.e. walking, cycling and e-biking).

3.5 Travel parameters

The HEAT includes several parameters related to travel, such as average trip distance, frequency, speed and mode shifts.10 These can vary substantially according to the context of an assessment, and it is thus inherently difficult to provide general default values. Therefore, all these parameters can be edited by users who have local data. The HEAT is, however, often used by users who do not have access to such data and may not be aware of realistic average figures for these parameters. The evidence for a currently relevant travel parameter was briefly summarized, and the recommendation in Table 1 was proposed.

<table>
<thead>
<tr>
<th>Default parameter</th>
<th>Current default value for bikes</th>
<th>Default average value for e-bikes</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion changed from car to e-bike</td>
<td>30</td>
<td>33</td>
<td>%</td>
</tr>
<tr>
<td>Proportion changed from public transport to e-bike</td>
<td>50</td>
<td>33</td>
<td>%</td>
</tr>
<tr>
<td>Proportion changed from bike to e-bike</td>
<td>–</td>
<td>33</td>
<td>%</td>
</tr>
<tr>
<td>Distance assigned to a count unit/trip distance (km)</td>
<td>4.1</td>
<td>6</td>
<td>km</td>
</tr>
<tr>
<td>Average e-bike speed</td>
<td>14</td>
<td>17</td>
<td>km/h</td>
</tr>
</tbody>
</table>

The experts agreed with the proposed approach and values. One expert suggested inclusion of a shift from walking to e-biking, which was supported by others. The participants discussed amendments to the proposed values and adopted the final version shown in Table 2.

10 For a full list of background and default values see https://heatwalkingcycling.org/#generic data.
Table 2. Final version of travel parameters

<table>
<thead>
<tr>
<th>Default parameter</th>
<th>Current default value for bikes</th>
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<tr>
<td>Proportion changed from bike to e-bike</td>
<td>–</td>
<td>30</td>
<td>%</td>
</tr>
<tr>
<td>Proportion changed from walking to e-bike</td>
<td>20</td>
<td>10</td>
<td>%</td>
</tr>
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<td>Distance assigned to a count unit/trip distance (km)</td>
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<td>6</td>
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<td>Average e-bike speed</td>
<td>14</td>
<td>17</td>
<td>km/h</td>
</tr>
</tbody>
</table>

The experts also agreed with the current approach for handling “newly induced trips”, i.e. trips that had not been taken previously, such as new leisure-related travel instead of staying at home or going to the office instead of working at home because of more convenient infrastructure, as an option for the use case of project-based assessments only, with a default value of 0.

As for the previously discussed parameters, additional work is necessary to derive travel parameters for sub-categories of e-bikes.

3.6 Handling of crash risk

Crash risk is an important issue with regard to e-biking. While e-biking is becoming increasingly popular in many parts of the world, the increased speed and the greater weight of e-bikes, attraction of new groups of cyclists with little cycling experience or greater vulnerability (e.g. older users) and more direct contact with traffic increase the risk of crashes.11

For a general assessment such as that provided by the HEAT, the challenge is not so much to identify the contribution of particular factors to the overall crash risk (e.g. individual, vehicle, traffic, travel attribute) but rather to estimate the overall risk due to all contributing factors. The factors may vary substantially among different assessments, depending on the context and population studied. Default values for crash rates can therefore be only approximate estimates, only for flexible and full user interfaces and only for municipal, national and regional levels. As the HEAT addresses only mortality, fatality rates are used to quantify crash risks.

Data on crash risk for e-biking are difficult to obtain, as for cycling. Calculation of rates of exposure “per kilometre” require representative estimates of distances travelled by e-bike and e-bike-specific crash reports.12 Because of methodological challenges, these data are typically derived from separate, national data sources, such as household travel surveys and crash registries. As few travel surveys and crash registries distinguish cycling from e-biking, no such findings have been published in the peer-reviewed literature. Dr Götschi presented limited evidence from the few studies on these issues from the Swiss Microcensus on Transport and Mobility.

The following recommendations were proposed to the participants:

- The HEAT should use a ratio relative to “road fatality rate for cycling” to derive “road fatality rates for e-biking”.
- The proposed value for the fatality rate ratio of e-biking to cycling is 2.
- The ratio may differ for the two e-bike categories (presumably higher for faster e-bikes).

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- Fatality rates should be editable by users of the flex and full user interface.

During a lively discussion, the experts agreed with the approach of using a ratio relative to the fatality rate for cycling but did not initially agree on the proposed value, and continuation of the discussion was deferred to the second day of the meeting. On the second day, a more detailed presentation was made of the available studies, and the group amended the proposal to “provide an adjustable ratio (e.g. a slider), with a default value of 1.5”, adding that the rate should be editable only in flex and full user interface.

After further discussion, the participants agreed on the following recommendations:
- The crash module will be provided only in the flex and full user interface.
- The overall approach is to use the ratio relative to cycling.
- The default value will be set at 1.5.
- A slider feature with a range up to 2.5 will be provided.

It was deemed important to provide guidance to users to ensure that they have the basis for an informed decision to change the default value, such as comparisons between similar cities and contexts with realistic fatality rates, while relying on users to consider their local situation. One participant pointed out that data from insurance companies could provide a basis for deriving crash rates for sub-categories of e-bikes in the future. Additional data might be obtained from Netherlands (Kingdom of the) and Sweden.

3.7 Carbon emissions

A feature for assessing the impact of mode shifts on carbon emissions was introduced into the HEAT in 2017, with three components (vehicle life-cycle emissions, energy supply emissions and operational emissions\(^{13}\)). The HEAT data on carbon emission factors already include estimates for a single category of e-biking but do not yet distinguish sub-categories, as discussed for the HEAT e-bike module.

The following recommendations were made to the meeting:
- Adopt the same method as for other carbon-emitting modes (in a life-cycle assessment approach).
- Extend the background data to distinguish three e-bike categories (all, slow, fast).
- Update the data on emission factors as new data become available (mainly through the European Union-funded ELEVATE project\(^{14}\)).

Dr Christian Brand, the HEAT Advisory Group expert on the carbon module, referred to data already available on the HEAT website. He noted that electricity generation will be different in 10–20 years and is location specific, as some countries have very high carbon emissions and others low emissions. It was noted that any dietary effect of shifting from passive to active modes was not considered in the carbon module.

The participants agreed to the recommendation on assessing carbon emissions in the HEAT except for distinguishing three e-bike categories, which will require further work. As the aspiration of the HEAT is to allow a robust assessment with as few input data by non-experts and policy-makers as possible, the current approach of using average rather than marginal emissions and limiting the number of parameters (e.g. leaving out parameters such as car occupancy rate) shall be pursued.

3.8 Exposure of active travellers to air pollution

The air pollution module in the HEAT is used to estimate the health impact of increased exposure to air pollution during active travel, which results in an increased ventilation rate. The module takes into account

\(^{13}\) See [https://heatwalkingcycling.org/#how_does_carbon_work](https://heatwalkingcycling.org/#how_does_carbon_work).

\(^{14}\) Enabling and leveraging climate action towards net-zero emissions, more information [here](https://heatwalkingcycling.org).
where travel occurs (in or away from traffic) and adjusts the assumed air pollution concentration accordingly. Furthermore, it includes mode-specific ventilation rates.\textsuperscript{15}

The recommendations proposed to the meeting were as follows:

- The approach used for exposure to air pollution while cycling is used for e-biking.
- The ventilation rate while e-biking is adjusted analogously (i.e. linearly) to the difference in intensity between cycling and e-biking.
- A rate of 50\%:50\% is used as the default value for the parameter “in traffic” vs “away from traffic” (slider).

The meeting agreed unanimously to adopt the recommendations. One participant mentioned that a prototype had been developed to consider the effects of mode shifts to air pollution for the general population. Participants agreed that this would be useful, especially for demonstrating a positive externality, such as for restricting traffic in a city centre and estimating the effects of an expected increase in cycling. This would be of specific interest in countries in which cycling is to become more popular, as it would provide strong public health reasons for promoting active mobility. Participants looked forward to identifying and securing the necessary funds to address this current gap in the tool.

4 **Recommended actions**

The following recommendations were agreed by the meeting participants.

**General approach to the HEAT e-bike functionality:**
- The e-bike functionality in the HEAT will be analogous to that for cycling. By default, features presented for the mode “cycling” will be duplicated for the mode “e-biking”.

**Approach to deriving benefits:**
- The risk estimates for physical activity during e-biking will be the same as those for physical activity during normal cycling.

**Intensity of e-biking:**
- Adopt the average of 5.5 METs for a single category of e-biking.

**Handling of age in the HEAT:**
- a short-term option (i.e. first version by mid-2023) for selecting an age range for e-biking: choice of older or younger age range for all current options for walking or cycling (20–64, 20–74, 20–44, 45–64 or 45–74 years); and
- a long-term option for selecting an age range for e-biking: specification of mean age and distribution with a visual tool or slider for all active modes in the HEAT.

\textsuperscript{15} For more information, see [https://heatwalkingcycling.org/#how_does_AP_work](https://heatwalkingcycling.org/#how_does_AP_work).
Table 3. Final version of travel parameters

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</table>

Handling of crash risk

- The crash module will be provided only in the flex and full user interface.
- The overall approach is to use the ratio relative to cycling.
- The default value will be set at 1.5.
- A slider feature with a range up to 2.5 will be provided.

Carbon emissions

- Adopt the same method as for other carbon-emitting modes (in a life-cycle assessment approach).
- Update the data on emission factors as new data become available (mainly through the European Union-funded ELEVATE project).

Exposure of active travellers to air pollution

- The approach used for exposure to air pollution while cycling is used for e-biking.
- The ventilation rate while e-biking is adjusted analogously (i.e. linearly) to the difference in intensity between cycling and e-biking.
- A rate of 50%:50% is used as the default value for the parameter “in traffic” vs “away from traffic” (slider).
5 Closing

The Chair, Professor Sonja Kahlmeier, thanked the experts for their valuable contributions and announced that individual experts would be contacted directly with regard to developing the necessary user guidance. Ms Francesca Racioppi also thanked the participants for sharing their expertise, input and offers of support for further development of the HEAT. She thanked Dr Götschi, Dr Brand and Professor Kahlmeier for preparing the meeting, the background documentation and chairing. She brought the experts’ attention to the 7th Ministerial Conference on Environment and Health (5–7 July 2023, Budapest, Hungary), where the new module on e-biking would be showcased. She thanked all the participating experts for providing important, useful support for decision-makers in the context of climate change and energy transition.
## Annex 1. Meeting agendas

### Wednesday, 08 March 2023

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:00–16:10</td>
<td><strong>Welcome, overview and aims of the meeting and election of the chair and rapporteur</strong></td>
<td>Francesca Racioppi, WHO Regional Office for Europe</td>
<td></td>
</tr>
<tr>
<td>16:10–16:15</td>
<td><strong>Methodology and proposed way of working for the consensus meeting</strong></td>
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<tr>
<td>16:15–16:20</td>
<td><strong>Proposed general approach to HEAT E-bike module</strong></td>
<td>Thomas Götschi, University of Oregon, HEAT coordinating team</td>
<td>Recommendation 1 of the background document</td>
</tr>
<tr>
<td>16:20–16:30</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td>16:30–16:35</td>
<td><strong>Proposed approach to physical activity benefits and intensity of e-biking</strong></td>
<td>Thomas Götschi, University of Oregon / HEAT coordinating team</td>
<td>Recommendations 2&amp;3 of the background document</td>
</tr>
<tr>
<td>16:35–16:55</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td>16:55–17:00</td>
<td><strong>Proposed approach to the handling of age</strong></td>
<td>Thomas Götschi, University of Oregon / HEAT coordinating team</td>
<td>Point 4 from the background document</td>
</tr>
<tr>
<td>17:00–17:20</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
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</tr>
<tr>
<td>17:20–17:30</td>
<td><strong>Break</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:30–17:35</td>
<td><strong>Proposed travel parameters</strong></td>
<td>Thomas Götschi, University of Oregon / HEAT coordinating team</td>
<td>Point 5 from the background document</td>
</tr>
<tr>
<td>17:35–17:55</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
<td></td>
</tr>
</tbody>
</table>

### Wednesday, 05 April 2023

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:00–16:10</td>
<td><strong>Proposal to handle crash risk–recap and updated proposal</strong></td>
<td>Thomas Götschi, University of Oregon / HEAT coordinating team</td>
<td>Point 6 from the background document</td>
</tr>
<tr>
<td>16:10–17:00</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
<td></td>
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<tr>
<td>17:00–17:10</td>
<td><strong>Proposal to handle carbon emissions and air pollution impact</strong></td>
<td>Thomas Götschi, University of Oregon / HEAT coordinating team</td>
<td>Point 7&amp;8 from the background document</td>
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<tr>
<td>17:10–17:45</td>
<td><strong>Discussion and decisions</strong></td>
<td>Chair</td>
<td></td>
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<tr>
<td>17:45–18:00</td>
<td><strong>Closure of the meeting</strong></td>
<td>Francesca Racioppi, WHO Regional Office for Europe</td>
<td>Summary of decisions, follow-up with experts, next steps</td>
</tr>
</tbody>
</table>
Annex 2. List of participants

Experts
Jessica Bourne, Research Associate, School of Health and Exercise Sciences, The University of British Columbia, Canada
Alex Bigazzi, Associate Professor and Associate Head, Transportation Engineering, The University of British Columbia, Canada
Christian Brand, Associate Professor, Transport Studies Unit, University of Oxford, United Kingdom
Alberto Castro, Senior Scientific Collaborator, Department of Security, Safety and Behaviour, Swiss Tropical Public Health Institute, Switzerland
Aslak Fyhri, Chief Research Psychologist, Institute of Transport Economics, Norway
Thomas Götschi, Researcher, University of Oregon, USA
Sonja Kahlmeier, Head, Department of Health, Swiss Distance University of Applied Sciences, Switzerland
S.M. Labib, Research Associate, Medical Research Council Epidemiology Unit, University of Cambridge, United Kingdom
Jenna McVicar, Research Assistant, School of Exercise and Nutrition Sciences, Faculty of Health, Deakin University, Australia
Ian Philips, Senior Research Fellow, Institute for Transport Studies, University of Leeds, United Kingdom
Patrick Rérat, Professor, Institute of Geography and Sustainability, University of Lausanne, Switzerland
Amund Riiser, Research Project Manager, Department of Sport, Food and Natural Science, Western Norway University of Applied Sciences, Norway
David Rojas, Assistant Professor, Department of Environmental and Radiological Health Sciences, Colorado State University, USA

WHO
Headquarters
Abraham Thiga Mwaura, Project Officer, Air Quality and Health unit
Andreia Santos, Consultant, Department of Health Promotion

European region
Francesca Racioppi, Head of Office, European Centre for Environment and Health, Germany
Nino Sharashidze, Programme manager, European Centre for Environment and Health, Germany
Stephen Whiting, Technical Officer, WHO Noncommunicable Disease Surveillance, Denmark
Jovana Dodos, Consultant, European Centre for Environment and Health, Germany
Philip Baumann, information and communications technology specialist, European Centre for Environment and Health, Germany
Region of the Americas

Karen Polson-Edwards, Adviser, Climate Change and Health, Communicable Diseases and Environmental Determinants of Health, USA
Mahzad Mirzalou, intern, Communicable Diseases and Environmental Determinants of Health, USA
The WHO Regional Office for Europe

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