Active Travel England

Active Travel Portfolio Research and Evaluation Programme

Evidence assessment: The Health and Wellbeing Impacts of Active Travel

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Sheffield Hallam University, NatCen and Mosodi Ltd

ACTIVE TRAVEL PORTFOLIO RESEARCH AND EVALUATION PROGRAMME

Title: Evidence assessment: The Health and Wellbeing Impacts of Active Travel

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Executive Summary

About this evidence assessment

Sheffield Hallam University, NatCen, and Mosodi Ltd were commissioned by the Department for Transport (DfT) and Active Travel England (ATE) to carry out an evidence assessment on health and wellbeing outcomes generated through active travel. Whilst active travel evidence and policy often refers to cycling and walking, a broader and more inclusive definition refers to any travel that is powered, partially or fully, by the sustained physical exertion of the traveller (Cook et al., 2022). As such, the definition also includes wheeling (wheelchair use as well as a variety of other modes such as skateboarding or scooting).

In England, the government has an ambition to make walking, wheeling, and cycling the natural choices for shorter journeys or as part of a longer journey. The second cycling and walking investment strategy[1] (CWIS2) aims, by 2025, to increase the percentage of short journeys in towns and cities that are walked or cycled to 46%; increase walking activity to an average of one walking stage per person per day; double cycling activity to 1.6 billion journey stages; and increase the percentage of children aged 5 to 10 who usually walk to school to 55%. Over the longer term, the ambition is that half of all short journeys in towns and cities will be walked or cycled by 2030, and that England will have a 'world-class' cycling and walking network by 2040.

Impact on health and wellbeing

CWIS2 recognises the impact of active travel on health and wellbeing. However, the extent of this impact is influenced by moderators and contextual factors that need to be factored into the policy making process.

To this end, this evidence assessment explores the body of research on the relationship between active travel and physical health, and also with mental health. It unpicks the conditions and determinants underlying this relationship that can be used to inform the design of interventions aimed at incentivising active travel. As this theme is focused on outcomes as a result of active travel, any type of active travel intervention, or combination of active travel interventions, was in scope.

Structure of this report

The findings are split into two chapters. The first chapter discusses evidence of the impact active travel on physical health, with a focus on outcomes related to exercise, physical health conditions and air pollution. The second chapter explores the evidence of the impact active travel on mental health and wellbeing outcomes, with a focus on general mental health and wellbeing; stress; quality of life and/or life satisfaction; commute satisfaction; depression; and anxiety.

Methodology

The report presents findings from 25 studies that were selected following a process of systematic searching, screening, prioritising, and evidence extraction. The evidence reviewed predominantly comprises review studies or evaluation papers that either assessed a specific intervention in depth or synthesised evidence on a range of interventions. Supplementing this are a small number of relevant reports from government and other non-academic sources.

1 ATE and Department for Transport (2023) The second cycling and walking investment strategy (CWIS2), 10 March 2023.

It is important to note that the evidence assessment had a tightly defined scope. Therefore, more extensive and systematic research into the evidence base would be required to produce exhaustive findings.

Key findings

This report has attempted to answer the following research questions:

- **RQ1.** What impacts does active travel have on people's health? Including:
  - Physical health.
  - Mental health and wellbeing.
- **RQ2.** How do the health impacts of active travel vary? Including by:
  - The transport mode taken (i.e. walking or cycling).
  - Demographic group.

This section summarises the key findings of this evidence assessment. Key findings were also synthetised in the Key Findings Tables shown at the end of this section.

Impact of active travel on physical health

The evidence base reviewed in this research explored the impact of active travel on physical health through the lens of three outcome categories: impact on exercise-related outcomes; impact on outcomes related to physical health conditions; and impact of air pollution on physical health.

Impact on exercise-related outcome

Active travel was found to contribute towards improvements in physical activity levels and towards meeting recommended levels of physical activity. The literature drew attention on two key moderators that may affect such outcome. Firstly, some people became less physically active overall, where the increases in physical activity that resulted from active travel were accompanied by compensatory decreases in leisure-time physical activity. Secondly, the overall levels of physical activity were influenced by the mode of active travel, e.g. e-bike involves at least a moderate intensity of physical activity, but this is lower than that of conventional cycling but higher than that of walking.

The sources reviewed indicated that active travel positively impacted physical fitness and highlighted the factors that can influence this outcome. Age may mediate or confound the impact of active travel on physical fitness. For example, active travel was found to improve cardiorespiratory fitness in adults but evidence exploring the same effect in younger people was inconclusive. There was evidence indicating that the mode of active travel may affect the intensity of impact on physical fitness. For example, cycling had a stronger impact on physical fitness than walking. Moreover, improvements in physical fitness were greater in those with lower starting fitness levels, when compared with those who already had higher levels of physical performance. However, none of the studies measured long-term effects of active travel on physical fitness.

Impact on outcomes related to physical health conditions

Active travel was found to contribute towards a lower risk and/or incidence of various physical health conditions. For example, the reviewed evidence consistently showed that active travel can reduce the risk and/or incidence of cardiovascular disease. Similarly, active travel was found to be positively associated with lower risk of diabetes. However, findings investigating the association with lower risk of obesity and hypertension and/or blood pressure were inconclusive and, in some cases, based on weak measurement tools, e.g. self-reported questionnaires. Lastly, there was broadly consistent evidence to suggest that active travel was associated with lower risk and/or incidence of mortality. This varied by mode of active travel, that is benefits of cycling were greater than those of walking. However, there was was disagreement on which types of mortality were reduced by active travel.

Impact of air pollution on health outcomes

The evidence reviewed looked at exposure to pollutants in an environment or inhalation of pollutant doses while active travelling. Levels of exposure were greatest among those commuting by car and lowest among pedestrians, when compared with bus and bicycle. However, train/subway/metro were found to have the lowest levels of exposure. Engagement in active travel led to higher inhalation rates than other modes of transport, as a result of increased minute ventilation rates (i.e. the volume of gas inhaled or exhaled from a person's lungs per minute) and trip duration. However, this was not sufficient to offset the physical health benefits of active commuting.

Impact of active travel on mental health and wellbeing

The evidence on the impact of active travel on mental health and wellbeing can be summarised according to two categories: impact on mental health and wellbeing, e.g. general mental health and wellbeing; stress; quality of life and/or life satisfaction and commute satisfaction; impact on depression and anxiety.

Impact on mental health and wellbeing.

Active travel was found to positively impact general mental health and wellbeing. However, there were multiple factors moderating such impact. Firstly, active travel positively impacted mental health when taking place in natural environments. Secondly, age and whether active travel was a choice were also found to play a role. For example, evidence indicated a positive association between active commuting and better mental health among adults but less so among adolescents. This was attributed to the fact that adolescent engaging in active school travel were less likely to do so out of personal choice. However, findings across the reviewed studies were inconsistent and the exact relationships between active travel and different dimensions of mental health and subjective wellbeing were unclear.

This research found inconsistent evidence about whether active travel had a positive impact on stress. This ranged from non-significant relationship between active travel and stress to an inverse association between the two. The mode of active commuting was found to act as a moderator of this relationship. For example, commuting by cycling or walking was associated with the lowest risk of experiencing stress when compared with other modes.

Evidence on the relationship between active travel and quality of life, and life satisfaction was mixed and inconclusive. For example, walking to work was found to be associated with higher life satisfaction than driving to work, but not cycling. By contrast, another source determined that cycling to work was positively related to perception of good quality of life. Such variation could be due to differing measures and methodologies used, which makes it difficult to draw clear conclusions.

There was consistent evidence suggesting that active travel positively affected commute satisfaction. This is because active travel was the least stressful mode of commuting, followed by public transport. The benefits of active commuting included physical exercise, being less affected by disruption/delay and greater control over commute, particularly when compared to drivers. However, there was an overall lack of evidence on how this relationship varies by mode of active commuting, particularly cycling and walking.

Impact on depression and anxiety

Evidence on the impact of active travel on the symptoms of anxiety were limited and/or inconsistent. Findings ranged from non-significant relationship or non-association to a negative association, i.e. some individuals who active travelled reported higher levels of anxiety, particularly if their journeys were longer than 15 minutes. Similarly, evidence on the relationship between active travel and depressive symptoms was mixed and inconclusive. Some sources found that switching to more active modes of travel and walking long distances were associated with the likelihood of developing new depressive symptoms, other data suggested the opposite. Whilst some sources found no significant association between active travel and depression. There is evidence within wider physical activity literature to suggest a positive association between activity levels and reduced depression. Such inconsistency is likely to be due to the differing methodologies of the reviewed studies, and the differing contexts in which the studies were conducted. The reviewed literature also highlighted several factors that could affect the extent to which active travel impacted depressive symptoms. This included the characteristics of the neighbourhood and the built environment in which active travel takes place.

Limitations and suggestions for further research

The evidence identified was drawn from a variety of sources, including other evidence reviews and quantitative (including cross-sectional and longitudinal studies). Publication types included academic literature and grey literature (including a number of evaluation reports).

A range of evidence on the health promoting and preventative impacts of active travel and how these impacts vary was identified in the reviewed body of literature. However, this evidence varied considerably in terms of consistence, conclusiveness, and robustness. Moreover, there was significant lack of examination of how the association between active travel and health varies according to social group.

To grow and strengthen the evidence base, future research should seek to:

1. Develop more robust and consistent methodological approaches:
    - **Apply consistent definitions and measurements of active travel.** There was considerable variation in the definitions and measurements applied to active travel across studies, e.g. modes, duration, intensity, and frequency of active travel. More standardisation, including shared definitions, are recommended to enable more rigorous comparability between studies.

- **Strengthened measurement – objective measures and common metrics.** The reviewed studies indicated a strong reliance on cross-sectional studies and self-reported/subjective health outcome measures. Further randomised control trials are recommended to produce more definitive conclusions, particularly in relation to the causal effects of active travel on health, alongside the use of more robust assessments of an individual's physiological state.
- **Measure the long-term impacts of active travel.** The existing evidence predominantly addresses the short-to-medium term impacts of active travel. Additional longitudinal research is recommended to better explore whether and how such impacts are sustained over time (i.e. in the years and decades following behaviour change).

2. Focus on addressing specific research gaps:

   - **Examine how the health impacts of active travel vary by social group.** This was a clear and consistent gap in the literature. Future research could explore, for example, how the health impact vary by socio-economic background and ethnicity.
   - **Account for the range of mediating factors.** The available evidence indicates that the health impacts of active travel can vary considerably according to sociodemographic factors. Furthermore, different mediating factors can affect the impacts of active travel for different groups. Future research should seek to more consistently identify and control for such factors.

Key Findings Tables

This section provides summary tables on the key findings from the evidence assessment.

Table 1: Key findings – Impact on exercise-related outcomes

Evidence found	Source/method/sample/country
Physical activity	
E-cycling as a form of active travel can contribute towards meeting physical activity recommendations. It elicits an intensity of physical activity that is higher than walking but lower than conventional cycling. As such, it may be a mode of active travel best suited to increasing physical activity levels of those who face barriers to conventional cycling.	Bourne et al., 2018 Systematic review. 17 studies covering 300 participants. International
The likelihood of meeting weekly physical activity recommendations increased for those who met the recommended levels of active travel.	Frömel et al., 2020 Questionnaire survey. 36 Czech and 39 Polish schools, 1110 boys and 1695 girls aged 15–19. Czechia and Poland.
Physical activity levels generally increased as a result of active travel, especially for previously inactive participants. However, some people became less physically active overall, where the increases in physical activity that resulted from active travel were accompanied by compensatory decreases in leisure-time physical activity.	Schäfer et al., 2020 Systematic review. Eight studies covering 555 participants. Finland, Netherlands, Sweden, Belgium, Denmark.

Evidence found	Source/method/sample/country
Physical fitness	
Active commuting significantly improved cardiorespiratory fitness. Measures of VO_2 max increased in all four studies (delta % pre vs. post = 0.4%-13%, Cohen's d effect size (ES) IG vs. CG = 0.488-2.118). Three studies included in the review showed significant increase in maximal power and duration of the exercise test respectively (4.9%-11.0% pre vs. post; ES = 0.857-1.792 IG vs. CG). For previously untrained participants (i.e. those who did not already engage in formal exercise or active travel), the improvements in exercise capacity had a comparable effect to that of taking up moderate exercise training. Improvements in physical fitness were greater in those with lower starting fitness levels, when compared with those who already had higher levels of physical performance. However, none of the studies reviewed by Schäfer, et al. (2020) measured long-term effects of active travel on physical fitness.	Schäfer et al., 2020 Systematic review. Eight studies covering 555 participants. Finland, Netherlands, Sweden, Belgium, Denmark.
Active travel was positively associated with various measures of physical fitness, including adult cardiorespiratory fitness. However, the evidence on how active travel impacted child and adolescent fitness was inconsistent. This indicates a need for further research, that more conclusively identifies and controls for mediators in the impact of active travel on physical fitness among young people.	Henriques-Neto et al., 2020 Systematic review. 16 studies. Global.
Active travel was strongly associated with greater cardiovascular health and physical fitness and cycling appeared to generally have a stronger positive impact on physical fitness than walking. However, there is a need for further research – especially longitudinal research – to conclusively examine this relationship.	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland. Henriques-Neto et al., 2020 Systematic review. 16 studies. Global.

Table 2: Key findings – Impact on outcomes related to physical health conditions

Evidence found	Source/method/sample/country
Risk of cardiovascular disease	
Active commuting significantly lowered the risk of cardiovascular disease (including coronary heart disease, stroke and heart failure).	Dinu et al., 2019 Systematic review. 23 studies covering 531,333 participants. International
Active travel reduced the risk of cardiovascular disease regardless of the mode or dose of active travel for certain individuals – including those with sedentary work lifestyles, inconsistent exercise routines, a history of being overweight or obese, and low physical fitness levels.	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.
Cycling had stronger preventative effects on cardiovascular disease than walking.	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.
Active travel lowered the risk of cardiovascular disease and this effect appeared to be stronger in women than men, but it was unclear why. There is a need for further research to identify the mechanisms that influence this and to determine the importance of active commuting intensity.	Hamer & Chida, 2008 Meta analysis. 8 studies covering 173,146 participants. Global.

Evidence found	Source/method/sample/country
Risk of obesity	
No robust conclusions on the association between, and impact of, active travel on risk of obesity. This was because the available findings were inconsistent and relied on weak measurement tools such as self-reported questionnaires.	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.
Active travel by walking appears to be related to a smaller waist circumference and/or lower risk of abdominal obesity, but the quality of the available evidence is low. This demonstrates a need for more randomised controlled trials that use objective measures of walking at different intensities, to determine the causal effects of walking on cardiometabolic health. Future examination of this relationship should also conduct analysis by gender.	Lorenzo et al., 2020 Systematic review. 13 studies. Japan, China, USA, Colombia, Canada, India, Finland and Norway.
Active travel generated significant changes in waist circumference for previously untrained participants (i.e. those who did not already engage in formal exercise or active travel), independent of the type of active commuting.	Schäfer et al., 2020 Systematic review. 8 studies covering 555 participants. Finland, Netherlands, Sweden, Belgium, Denmark.
Active travel by walking or cycling decreased obesity risk and there was a linear association between the two. When compared with inactive commuting, active commuting reduced the risk of obesity (RR=0.88, 95% CI 0.83 to 0.94, I2=69.1%), hypertension (RR=0.95, 95% CI 0.87 to 1.04, I2=82.2%) and diabetes (RR=0.82, 95% CI 0.76 to 0.90, I2=44.5%). The strength of this effect increased for those engaged in higher volumes of active travel.	Wu et al., 2021 Systematic review and meta-analysis of 28 articles. Global.

Evidence found	Source/method/sample/country
Diabetes	
Active travel by walking or cycling was associated with lower risk for diabetes, but risk was significantly lower for cycling. The authors speculated that this effect was the result of increases in glucose tolerance and insulin sensitivity that may accompany an uptake in active travel.	Dinu et al., 2019 Systematic review. 23 studies covering 531,333 participants. International
Active travel by walking or cycling decreased risk of diabetes. When compared with inactive commuting, active commuting reduced the risk of obesity (RR=0.88, 95% CI 0.83 to 0.94, I2=69.1%), hypertension (RR=0.95, 95% CI 0.87 to 1.04, I2=82.2%) and diabetes (RR=0.82, 95% CI 0.76 to 0.90, I2=44.5%). The strength of this effect increased for those engaged in higher volumes of active travel. The authors speculated that this effect was the result of increases to insulin resistance that may follow reductions in sedentary time achieved by an uptake in active travel.	Wu et al., 2021 Systematic review and meta-analysis of 28 articles. Global.

Evidence found	Source/method/sample/country
Hypertension and/or blood pressure	
Active travel by walking was related to lower prevalence of hypertension and/or blood pressure, but quality of the available evidence is low. This demonstrates a need for more randomised controlled trials that use objective measures of walking at different intensities, to determine the causal effects of walking on hypertension and/or blood pressure. Future examination of this relationship should also conduct analysis by gender.	Lorenzo et al., 2020 Systematic review. 13 studies. Japan, China, USA, Colombia, Canada, India, Finland and Norway.
Active travel by walking or cycling decreased risk of hypertension. When compared with inactive commuting, active commuting reduced the risk of obesity (RR=0.88, 95% CI 0.83 to 0.94, I2=69.1%), hypertension (RR=0.95, 95% CI 0.87 to 1.04, I2=82.2%) and diabetes (RR=0.82, 95% CI 0.76 to 0.90, I2=44.5%). The strength of this effect increased for those engaged in higher volumes of active travel. However, this association requires further testing, with greater consistency in the definitions of active travel applied and methods used.	Wu et al., 2021 Systematic review and meta-analysis of 28 articles. Global.

Table 3: Key findings – Impact on mortality/mortality risk

Evidence found	Source/method/sample/country
All-cause mortality	
Active commuting was associated with a significant risk reduction for all-cause mortality (defined as death from any cause) in relation to cycling but not walking. The authors speculated that this was attributable to the higher intensity with which cycling is typically performed, when compared with walking.	Dinu et al., 2019 Systematic review. 23 studies covering 531,333 participants. International
Active travel lowered risk of all-cause mortality (defined as death from any cause) when cycling or walking, but to a much greater extent when cycling. Existing longitudinal studies notably showed that cycling reduced risks of mortality from all-cause 20%, CVD 24% and cancer 16% Reduction for walking as active travel was considerably lower (all-cause mortality 8%, CVD 9%, cancer 7%).	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.
There was a dose response relationship between active travel and reductions in all-cause mortality[2] (i.e. increasing intensities of active travel resulted in increasing mortality risk reduction), especially for walking.	Dutheil et al., 2020 Systematic review and meta-analysis 17 studies representing 829,098 workers. Global.

2 Defined as death from any cause.

Evidence found	Source/method/sample/country
Cardiovascular disease mortality	
There was little evidence for any association between active commuting and cardiovascular disease mortality.	Dinu et al., 2019 Systematic review. 23 studies covering 531,333 participants. International
There was a dose response relationship between active travel and reductions in cardiovascular mortality, especially for walking (i.e. increasing intensities of active travel resulted in increasing mortality risk reduction).	Dutheil et al., 2020 Systematic review and meta-analysis 17 studies representing 829,098 workers. Global.
Active travel lowered risk of cardiovascular disease mortality when cycling or walking, but to a much greater extent when cycling. Existing longitudinal studies notably showed that cycling reduced risks of mortality from all-cause 20%, CVD 24% and cancer 16% Reduction for walking as active travel was considerably lower (all-cause mortality 8%, CVD 9%, cancer 7%).	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.

Evidence found	Source/method/sample/country
Cancer mortality	
Active commuting was associated with a significant risk reduction in cancer mortality in relation to cycling but not walking. The authors speculated that this was attributable to the higher intensity of cycling, when compared with walking.	Dinu et al., 2019 Systematic review. 23 studies covering 531,333 participants. International
Active travel was not associated with decreases in cancer mortality.	Dutheil et al., 2020 Systematic review and meta-analysis 17 studies representing 829,098 workers. Global.
Active travel lowered risk of cancer mortality when cycling or walking, but to a much greater extent when cycling. Existing longitudinal studies notably showed that cycling reduced risks of mortality from all-cause 20%, CVD 24% and cancer 16% Reduction for walking as active travel was considerably lower (all-cause mortality 8%, CVD 9%, cancer 7%).	Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.

Table 4: Key findings – Impact of air pollution on health outcomes

Evidence found	Source/method/sample/country
Exposure to air pollution	
When measured by inhaled dose,[3] levels of air pollution exposure were generally greatest for car drivers and lowest among pedestrians (when compared with cyclists and bus users).	De Nazelle et al., 2017 Literature review. Europe.
Air pollution exposure was generally highest for car drivers, followed by bus users, those driving cars with controlled ventilation settings, cyclists, pedestrians and finally mass-motorised transport (train/subway/metro).	Cepeda et al., 2017 Systematic review of 39 studies. European, West Pacific, American and southeast Asian countries.

3 Inhaled dose was defined as the product of pollutant concentration and minute ventilation.

Evidence found	Source/method/sample/country
Inhalation of air pollution	
Engagement in active travel led to higher inhalation rates than other modes of transport, as a result of increased minute ventilation rates (i.e. the volume of gas inhaled or exhaled from a person's lungs per minute) and trip duration. However, this was not sufficient to offset the physical health benefits of active commuting.	Cepeda et al., 2017 Systematic review of 39 studies. European, West Pacific, American and southeast Asian countries.

Evidence found	Source/method/sample/country
Physical health outcomes	
Mode shift from motorised to active transport generally resulted in slightly elevated health risks, as a result of increased air pollution exposure and/or inhalation, particularly when cycling. However, this was not sufficient to offset the physical health benefits of taking up active travel.	Cepeda et al., 2017 Systematic review of 39 studies. European, West Pacific, American and southeast Asian countries. De Nazelle et al., 2017 Literature review. Europe. Raza et al., 2018 Systematic review. 18 Studies. Developed countries.
When examining exposure to PM2.5, the harm caused by air pollution only outweighed the physical health benefits of active travel in the most extreme air pollution scenarios.	Raza et al., 2018 Systematic review. 18 Studies. Developed countries.
Those commuting by motorised transport lost up to one more year in estimated life expectancy than those commuting by bicycle.	Cepeda et al., 2017 Systematic review of 39 studies. European, West Pacific, American and southeast Asian countries.
The trade-off between the physical health benefits of active travel and the elevated physical health risks that resulted from being more exposed to air pollution varied greatly (range not provided in the evidence). This variation resulted from differences in a wide range of geographical factors between populations studied, such as variation in the design of transport infrastructure and local air pollution levels.	De Nazelle et al., 2017 Literature review. Europe. Raza et al., 2018 Systematic review. 18 Studies. Developed countries.

Table 5: Impact on mental health and wellbeing

Evidence found	Source/method/sample/country
General mental health and/or wellbeing	
Active travel benefitted wellbeing. Improved wellbeing was positively associated with commuting by active travel; switching from commuting by car or public transport to active travel; and time spent walking. It was negatively associated with time spent driving.	Martin et al., 2014 British household panel survey data, 17,985 adult commuters. Great Britain.

Evidence found	Source/method/sample/country
General mental health and/or wellbeing	
Evidence of the impact of active travel on general mental health was limited or inconsistent. To establish definitive conclusions, Liu et al. (2022) recommended more longitudinal research that replaces retrospective, self-measurement tools with GPS-enabled, physiological measurement tools.	Frömel et al., 2020 Questionnaire survey. 36 Czech and 39 Polish schools, 1110 boys and 1695 girls aged 15–19. Czechia and Poland. Liu et al., 2022 Systematic review. 45 studies. Tittlbach et al., 2024 Scoping review. UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland.
Though active travel had no overall association with better mental health, daily commuting through natural environments did, especially for active commuters. Natural environments were defined as any public and private outdoor space that contained 'green' and/or 'blue' natural elements such as street trees, forests, city parks and natural parks/reserves, and also included any type of waterbody.	Zijlema et al., 2018 Cross-sectional study, questionnaires. 3,599 adults. Spain, Netherlands, Lithuania, and UK.
Active commuting was positively associated with better mental health among adults but not adolescents. The findings did not directly support an explanation for why, but the authors speculated (in line with self-determination theory) that active school travel is less likely to benefit mental health as it is less likely to be conducted out of personal choice.	White et al., 2017 Systematic review. 98 studies with combined sample of 648,726. Global.

Evidence found	Source/method/sample/country
Stress	
It appears that active travel can have a positive impact on stress. However, the available evidence is inconsistent and inconclusive about both the circumstances under which active travel has an impact and why it has an impact.	Liu et al., 2022 Systematic review. 45 studies. Scrivano et al., 2024 Scoping review. 55 articles. Global.
Commuting by bicycle was associated with increased stress for men in 'blue-collar' jobs but not for those 'white-collar' jobs (NB these are terms used by the source authors). The findings did not support a direct explanation for why, but the authors speculated that blue-collar workers are in general more likely to cycle for the reason that alternative commuting modes are unaffordable to them, whereas white-collar workers are more likely to cycle for the enjoyment of cycling.	Asztalos et al. (2009, cited in White et al., 2017).

Evidence found	Source/method/sample/country
Quality of life and life satisfaction	
No conclusions could be drawn about the impact of active travel on quality of life and life satisfaction. This was because there was considerable variation in both the methodology and the findings.	Bourne et al., 2018 Systematic review. 17 studies covering 300 participants. International. Liu et al., 2022 Systematic review. 45 studies. Scrivano et al., 2024 Scoping review. 55 articles. Global. White et al., 2017 Systematic review. 98 studies with combined sample of 648,726. Global.

Evidence found	Source/method/sample/country
Commute satisfaction	
Active travel was positively associated with higher commute satisfaction, but more research is warranted to examine how impact occurs.	Liu et al., 2022 Systematic review. 45 studies. Scrivano et al., 2024 Scoping review. 55 articles. Global. Sustrans, 2017 Grey literature review.

Table 6: Impact on depression and anxiety

Evidence found	Source/method/sample/country
Likelihood of having the symptoms of depression/anxiety	
No conclusions could be drawn about the overall impact of active travel on the likelihood of having symptoms of depression/anxiety. This was because the available evidence was limited and/or inconsistent. Further research is warranted to examine this outcome more conclusively. Future studies should measure active travel by frequency and volume; be more specific in their analyses of the context in which active travel is conducted; and apply more consistent methods to enable the robust comparison of results from different studies.	Marques et al., 2020 Systematic review of 7 articles. Global. Scrivano et al., 2024 Scoping review. 55 articles. Global.
Active commuting reduced the risk of being depressed, but only when conducted over short distances.	Knott et al. (2018, cited in Liu et al., 2022).
Undertaking active travel at a higher intensity and over longer distances resulted in the development of worsening of depressive symptoms.	Marques et al., 2020 Systematic review of 7 articles. Global.
Certain built environments and lower socioeconomic neighbourhoods were more strongly associated with screening positively for depression.	Marques et al., 2020 Systematic review of 7 articles. Global.

Evidence found	Source/method/sample/country
Likelihood of a mental health prescription	
When compared with other modes of transport, cycling to work was causally associated with a decreased likelihood of having a prescription to antidepressants or anxiolytics (which are used to treat the symptoms of anxiety).	Berrie et al., 2024 Census data, data linkage with health records, instrumental variable. 378,253 adults. Scotland.

1. Introduction

1.1 Active travel policy context

Active travel can be defined as travel that is powered – either partially or fully – by the sustained physical exertion of the traveller. Whilst active travel evidence and policy often refers to cycling and walking, a broader and more inclusive definition refers to any travel that is powered, partially or fully, by the sustained physical exertion of the traveller (Cook et al., 2022). As such the definition also includes wheeling (wheelchair use as well as a variety of other modes such as skateboarding or scooting). In recent years, active travel has received increasing recognition for its potential to help facilitate a range of environmental, public health and economic policy outcomes (Hirst, 2020).

In England, the government has an ambition to make walking, wheeling and cycling the natural choice for shorter journeys or as part of a longer journey. The government's original Cycling and Walking Investment Strategy (CWIS) published in 2017 set out specific, measurable aims and provided the financial resource to help achieve them.

The second cycling and walking investment strategy[4] (CWIS2), published in 2022 and updated in March 2023, aims, by 2025, to increase the percentage of short journeys in towns and cities that are walked or cycled to 46%; increase walking activity to an average of one walking stage per person per day; double cycling activity to 1.6 billion journey stages; and increase the percentage of children aged five to ten who usually walk to school to 55%. The latter is set out as a specific target. Over the longer term, the strategy is that half of all short journeys in towns and cities will be walked or cycled by 2030, and that England will have a 'world-class' cycling and walking network by 2040. CWIS2 also introduced a more inclusive definition of active travel to include wheeling.

To support the implementation of projects that deliver its active travel aims, the Government has made an investment projected to be £3.6 billion from 2021 to 2025, and established ATE. ATE's role is to administer the funding whilst working with local authorities to ensure the delivery of high-quality active travel infrastructure for walking, wheeling and cycling, provide tools to deliver ambitious active travel programmes, and support children and other people to cycle.

1.2 Background to the evidence assessment

In 2022, the Department for Transport (DfT) commissioned Sheffield Hallam University in partnership with the National Centre for Social Research (NatCen) and Mosodi Ltd to undertake a portfolio evaluation of active travel. Overall management of this evaluation programme was transferred to ATE in September 2023. The overall aims of the evaluation are to understand how active travel interventions are being delivered; what impact they are having on uptake of active travel; whether they represent value for money; and how they are contributing to the government's walking and cycling objectives.

4 ATE & Department for Transport (2023). The second cycling and walking investment strategy (CWIS2), 10 March 2023.

To support the development of evaluation activities, ATE commissioned a suite of evidence assessments across a range of research and policy priority areas to help assemble evidence of 'key facts' and identify research gaps. The complete list of these evidence assessments is:

1. Enabling adult cycling.
2. Walking and wheeling.
3. Early consideration of active travel via planning and design.
4. Economy.
5. Health and wellbeing.
6. Journey times, congestion, and resilience.
7. Active school travel.

1.3 Health and wellbeing

This report presents the results of health and wellbeing. As this theme is focused on outcomes as a result of active travel, any type of active travel intervention, or combination of active travel interventions, was in scope. This evidence assessment set out to examined evidence on the health impacts of active travel. Originally, it was also intended to examine the impacts of active travel on safety and the secondary health impacts of active travel[5]. However, to ensure that the evidence assessment could yield the most value, its scope was narrowed to the following:

- The health impacts of active travel, including:
  - Impacts on dimensions of physical health (such as physical activity, fitness, energy levels, strength, body weight, preventable illness, and deaths).
  - Impacts on mental health and wellbeing (such as subjective wellbeing, life satisfaction, depression, anxiety, and stress).
  - How the health impacts of active travel vary, both according to the mode of active travel (i.e. whether and how the health impacts of walking differ to those of cycling) and different demographic factors.

1.4 Research questions

This evidence assessment seeks to synthesise available evidence to address the following two research questions.

5 **Safety** would have included: a) quantifiable measures of safety, such as rates of personal injury collision; fatality weighted injury; and killed andseriously injured casualties; and b) measures of perceived safety, and how this in turn impacts levels of active travel. **Secondary impacts** would have included: a) the cost savings of active travel to the NHS and wider health/social care services (including both savings because of the preventative benefits of active travel and costs as a result of road accidents) and; b) the individual cost savings for active travellers. Evidence on the **health benefits of physical activity in general** was also excluded to maintain a clear focus on active travel.

- **RQ1.** What impacts does active travel have on people's health? Including:
  - Physical health.
  - Mental health and wellbeing.
- **RQ2.** How do the health impacts of active travel vary? Including by:
  - The transport mode taken (i.e. walking or cycling).
  - Demographic group.

1.5 Structure of this report

The report is structured as follows:

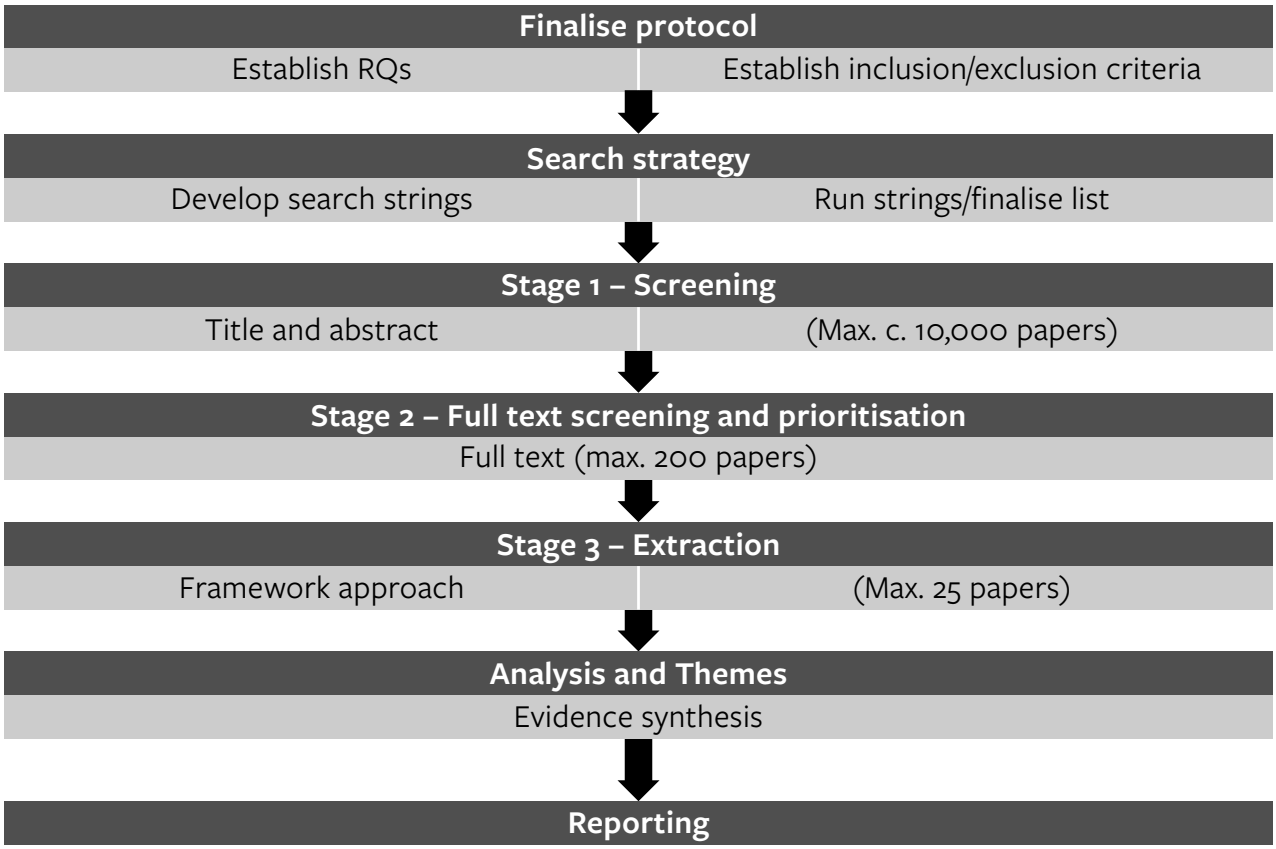
- **Executive summary.** The executive summary provides a high-level summary of the report, as well as a summary of key findings.
- **Introduction.** The first chapter provides background to this evidence assessment.
- **Methodology.** The second chapter provides a summary of the methodology used for identifying and synthesising relevant evidence.
- **Impact of active travel on physical health.** Discusses evidence of the impact active travel has on physical health, with a focus on outcomes related to exercise, physical health conditions and air pollution.
- **Impact of active travel on mental health and wellbeing.** Discusses evidence of the impact active travel has on mental health and wellbeing outcomes, with a focus on general mental health and wellbeing; stress; quality of life and/or life satisfaction; commute satisfaction; depression; and anxiety.
- **Key determinants and barriers to participation.** A brief summary of key evidence of specific determinants and barriers to participation is provided.
- **Conclusion and next steps.** The final chapter provides a summary conclusion of the evidence against the research questions and sets out implications and recommendations in terms of addressing gaps in the evidence base.

2. Methodology

This section outlines the overall methodology and approach to the evidence assessment. It provides further detail about the development of the assessment protocol, each of the specific stages in the identification, screening and extraction of evidence, as well as identifying the limitations of the research design.

The overall design was organised into three key stages and a set of supporting activities, as summarised in Figure 1.

Figure 1: Evidence assessment stages



2.1 Evidence assessment protocol

At the inception of the suite of six evidence assessments, a protocol, outlining the process and method to be followed was developed. This helped to ensure consistency across the six assessments (and with the previous active school travel assessment) and to support the identification of high quality and relevant papers within each assessment, given that there was a finite resource for each.

We determined initial thematic priorities for the evidence assessment with ATE. A stakeholder engagement process was held with key staff within ATE and DfT and other experts to discuss and agree the thematic scope, agree a set of sub-themes to structure the identification and assessment of evidence, research questions and the concepts and terms that would be used to specify the inclusion criteria. Suggestions were also made by stakeholders for specific non-academic studies and reports for consideration in the evidence assessment. Initial scoping was supported by running a series of test searches using generic search strings on bibliographic databases to provide an initial indication of the likely size of the evidence base. This was used to help further refine the thematic scope of the assessment and its sub-themes and provide

initial information on the broad composition of the evidence base (e.g. likely availability of UK-based evidence, types of methods and studies, availability of systematic or meta review studies).

2.2 Search strategy

Academic literature was identified as being potentially relevant to the assessment theme and sub-themes using two database searches: an academic search using the Scopus database and a manual grey literature search across a range of relevant sites (full details of this, including the specific search strings used, can be found in Annex A). In addition to this, evidence identified by experts from ATE and DfT at the stakeholder engagement stage was incorporated into the screening. An additional search pathway used exclusively for this evidence assessment was a manual Google Scholar search. This was conducted once extraction was underway, specifically to supplement the lower volume of evidence that was emerging on the impacts of active travel on mental health and wellbeing.

2.2.1 Inclusion and exclusion criteria

The inclusion criteria were developed to narrow the search to the papers most relevant to the research questions. These criteria were applied to both search pathways but not to the third pathway, which was the suggested evidence from ATE and DfT staff.

- **Language:** Only English language papers.
- **Country:** UK, Europe, North America, New Zealand and Australia (those deemed most relevant to the English context).
- **Year:** Papers published from 2013 onwards (to ensure the most recent evidence was prioritised).
- **Publication status:** Published peer-reviewed academic literature in addition to published grey literature (to prioritise peer-reviewed evidence).
- **Type of studies:** Systematic/evidence reviews, meta-analysis, theoretical paper, or studies using primary data collection or secondary data analysis.

2.2.2 Academic database search and search strings

Joint search strings were developed for the walking and wheeling evidence assessment and the health and wellbeing evidence assessment. This was because both evidence assessments were conducted by NatCen, and due to the thematic overlaps between the two evidence assessments.

These strings were then used to search the Scopus bibliographic database, which is a large and comprehensive database of peer reviewed academic publications. Annex A provides an outline of the search strategies deployed and breaks down the number of results returned for each search string and in each database. The total number of studies identified as being potentially relevant to the two evidence assessments included in the joint search was 2,240.

2.2.3 Grey literature search

To supplement the academic database search, a search of 'grey' literature was conducted across a range of relevant websites using the Google search engine. This applied a standardised set of search strings for all six evidence assessments to identify further sources (these can be viewed in Annex A – Database searches). The results were then manually

screened by each evidence assessment lead to identify relevant evidence for inclusion in the full text screening stage. Leads coordinated to avoid including the same piece of evidence in multiple evidence assessments. 15 additional sources were identified for inclusion in the full text screening on the basis that they were potentially relevant to at least one of the evidence assessments in the joint search. A full list of the websites searched for grey literature is included in Annex A.

Suggested evidence

A final pathway through which evidence was identified was suggested evidence provided by experts at ATE and DfT. The stakeholder engagement stage included inviting suggestions of evidence that might be included in the assessment. 27 additional sources were identified for inclusion in the full text screening on the basis that they were potentially relevant to at least one of the evidence assessments in the joint search.

2.3 Screening and extraction

2.3.1 Title and abstract screening

After removing duplicate sources (identified more than once across the different search strings), 1,677 titles were initially screened for relevance to the evidence assessments included in the joint search. This process involved assessment of titles and the publication title against the inclusion criteria. Several rounds of refinement were required to exclude irrelevant articles or publications. All papers were considered against a prioritisation tool and checklist to ensure the final list of papers would address the research questions specifically. The criteria used at this stage were:

- Relevance to the themes and sub-themes of the evidence assessment.
- Geographic focus (aiming to identify UK based studies where possible).
- Paper type[6] (e.g. systematic review paper, primary research paper, literature review, discussion paper).
- Study/data type (aiming to prioritise inclusion of studies which used real-world data as opposed to modelled or synthetic data).
- Coverage across sub-themes (aiming for a pragmatic distribution of studies across the agreed sub-themes).
- Whether the study was specifically recommended at the stakeholder engagement stage for inclusion.
- Age of the study (aiming to include most recent studies where possible).

Following this screening process, 295 studies were accepted for full text review.

6 Systematic review papers were prioritised (where available) as these papers synthesise the available evidence on a topic or the effectiveness of an intervention by drawing on multiple primary research papers. This means that evidence from systematic reviews is more comprehensive and reliable than from individual studies.

2.3.2 Full text screening and prioritisation

Of the 295 sources that underwent full text review, 253 were identified from the academic search, 15 from the grey literature search and 27 were recommended by ATE or the DfT. Following changes to the evidence assessment process, it was no longer possible to carry out full text screening on all 295 sources. Instead, a priority selection was made, which primarily included sources identified as being review papers at title and abstract screening and/or sources recommended by ATE or the DfT.

A Weight of Evidence (WoE) approach was used to score evidence according to the quality of its research design and presentation of findings. This was assessed using the questions and scoring scheme set out in Table 7 to arrive at a final WoE score out of 14 for each candidate source.

Table 7: Weight of Evidence scoring scheme

Question	Score
Is there a clear statement of the aims/objectives or clear research questions?	1-4
Is the sampling strategy (or data selection strategy if not collecting primary data) clearly described and appropriate for the research questions/aims?	1-4
Is the method of data collection and analysis clearly described, and appropriate to answer the aims/research questions?	1-3
Are there any concerns regarding accuracy (e.g. discrepancies within the report)? (high score means no concerns)	1-3
Total Weight of Evidence (WoE) score	**4-7 (low)** **8-11 (medium)** **12-14 (high)**

2.3.3 Data extraction

Using the WoE scoring to prioritise the most robust studies, 23 papers were identified to extract data and evidence from. The full list of papers is shown in the Annex B along with their WoE scores. An extraction framework was developed to organise the evidence extracted. The framework was structured thematically, to ensure a spread of papers across the sub-themes. Once extraction was complete, the evidence was summarised and synthesised for inclusion in this report.

2.4 Limitations of the research design

This was a focused evidence assessment. It drew on a limited number of sources in line with the available resource, to answer the research questions, using a systematic screening and prioritisation process. To draw more exhaustive conclusions a systematic review would be required.

3. Impact of active travel on physical health

This chapter discusses evidence on the impact of active travel on physical health outcomes. Various types of physical health outcomes were examined within the evidence base synthesised by this research. In this chapter, this evidence has been summarised and presented according to the following categories:

- **3.1 Impact on exercise-related outcomes,** including measuring the physical activity involved in active travel and of the impact that active travel had on physical fitness.
- **3.2 Impact on outcomes related to physical health conditions,** including the impact that active travel had on the risk of having various physical health conditions, on the incidence of such health conditions, or of dying from them.
- **3.3 Impact of air pollution on** health outcomes, including air pollution exposure or inhalation. This has been included as a separate category because the association between active travel and air pollution was generally examined independently from other health outcomes.
- **3.4 Evidence gaps identified by this review,** including a summary of how well the evidence identified addresses the research questions.

3.1 Impact on exercise-related outcomes

Exercise-related outcomes were examined by measuring either the levels of physical activity (3.1.1) or physical fitness (3.1.2) associated with active travel. Evidence on these outcomes was drawn from a total of four papers, including:

- Three systematic reviews (Bourne, et al., 2018; Henriques-Neto, et al., 2020; Schäfer, et al., 2020).
- One cross-sectional study (Frömel, et al., 2020).

3.1.1 Impact on physical activity levels

The evidence indicates that active travel can contribute towards increases in physical activity levels and towards meeting recommended levels of physical activity (Bourne, et al., 2018; Frömel, et al., 2020; Schäfer, et al., 2020). This effect was consistent across modes of active transport and demographic groups such as gender and age. However, the extent to which an individual's overall physical activity levels changed as a result of taking up active travel were highly variable. Factors that moderated this included the following:

- **Leisure-time physical activity** – physical activity levels generally increased as a result of active travel, especially for previously inactive participants. However, some people became less physically active overall, where the increases in physical activity that resulted from active travel were accompanied by compensatory decreases in leisure-time physical activity. This was evidenced om Schäfer et al's (2020) systematic review.

- **Mode of active travel** – changes in overall levels of physical activity could depend on the mode of active travel. In their systematic review, Bourne et al. (2018) found that active travel via e-bike involved at least a moderate intensity of physical activity,[7] which was lower than that of conventional cycling but higher than that of walking. This indicated that e-cycling would require more frequent and longer rides to generate the same intensity of physical activity as conventional cycling. However, it still generates an intensity of physical activity sufficient to benefit the individual's health. The authors therefore positioned e-cycling as an active travel mode which is most viable for increasing the physical activity levels of those who face barriers to conventional cycling e.g. as a result of poor health or living in hilly terrain.

3.1.2 Impact on physical fitness

Overall, the evidence suggests that active travel positively impacts physical fitness and there is some evidence to suggest how this can vary. However, the reviewed evidence does not support strong conclusions on its own. Further research is needed to differentiate the impact of cycling from walking more robustly, to investigate the long-term impacts on physical fitness and to more conclusively examine if and how the physical fitness of younger participants (i.e. children and adolescents) is impacted differently to that of adults.

In their systematic revew, Schäfer et al. (2020) found that active commuting generated significant improvements in cardiorespiratory fitness for intervention groups within all reviewed studies. For previously untrained participants (i.e. those who did not already engage in formal exercise or active travel), the effect of taking up active travel was comparable to taking up moderate exercise training. Furthermore, among the untrained participants, improvements in physical fitness were greater among those with the lowest starting fitness levels. While the findings of the reviewed studies were consistent, none measured the long-term effects of active travel, which was highlighted as an area to be further explored in future research.

Henriques-Neto et al's (2020) systematic review examined studies of both adult and younger participants, including children and adolescents. Overall, the results were inconclusive. The majority of studies showed a positive relationship between active commuting and several measures of physical fitness (including cardiovascular fitness). In adults, this included a clear positive effect on cardiorespiratory fitness. The findings also showed that cycling had a more positive impact on several measures of physical fitness than walking. However, in younger participants, four of the 16 reviewed studies did not find that active commuting improved the physical fitness of younger participants. The authors attributed this to the differing methodologies applied to different groups of participants across studies. They also suggested that a different range of factors may mediate or confound the impact of active travel on physical fitness for younger people when compared with adults. This may include factors such as the effect of age or the lower volumes and distances of active travel undertaken by younger people. For stronger conclusions to be drawn, the authors called for further research, that more consistently identifies and controls for such factors.

While most of the studies in Henriques-Neto et al's (2020) systematic review compared the effects of active travel with motorised travel, one experimental investigation compared the effects of active travel via e-cycling and non-electrically assisted cycling. The study found that cycling increased cardiorespiratory fitness in overweight adults even when electrically assisted.

7 Moderate intensity activity was classified as three to six metabolic equivalents (METs), as opposed to vigorous intensity activity, which is classified as six METs or above. METs is an expression of energy cost and is calculated from rest where 1 MET is estimated to equal 3.5 ml/kg/min.

Finally, Tittlbach et al's (2024) scoping review found that active travel was strongly associated with greater cardiovascular and physical fitness. It also found some evidence that cycling had a stronger impact on physical fitness than walking, but there was also inconsistency in the results, which warrants further research. Moreover, all of the reviewed studies were cross-sectional and so the authors strongly recommended further longitudinal research so that stronger conclusions can be drawn.

3.2 Impact on outcomes related to physical health conditions

The association between active travel and physical health outcomes was examined by measuring either the incidence and/or risk of various physical health conditions (3.2.1), or associated mortality rates (3.2.2). Evidence on these outcomes was drawn from a total of eight papers, including:

- Six systematic reviews (Bourne, et al., 2018; Lorenzo, et al., 2020; Schäfer, et al., 2020), including 3 with a meta-analysis (Dinu, et al., 2019; Dutheil, et al., 2020; Wu, et al., 2021).
- One meta-analysis (Hamer & Chida, 2008).
- One scoping review (Tittlbach, et al., 2024).

3.2.1 Impact on risk and incidence of physical health conditions

The evidence indicates that active travel can contribute towards a lower risk and/or incidence of various physical health conditions, including cardiovascular disease, obesity, diabetes, and hypertension. While the available evidence on cardiovascular disease and diabetes was strong, the evidence on obesity and hypertension was relatively inconclusive.

Cardiovascular disease

There was consistent evidence to suggest that active travel reduces the risk and/or incidence of cardiovascular disease (Dinu, et al., 2019; Hamer & Chida, 2008; Tittlbach, et al., 2024).

Dinu et al's (2019) systematic review and meta-analysis indicated that active commuting was associated with significantly lower risk of cardiovascular disease (including coronary heart disease, stroke and heart failure) and this was supported by the results of all five studies that examined this relationship.

Tittlbach et al. (2024) found evidence from a longitudinal study suggesting that active travel reduced the risk of cardiovascular disease, regardless of the mode or dose of active travel for certain individuals. This included those with sedentary work lifestyles, inconsistent exercise routines, a history of being overweight or obese, and low physical fitness levels. The authors also cited evidence from a number of longitudinal studies to suggest that cycling has stronger disease-preventing effects than walking.

Hamer & Chida's (2008) meta-analysis demonstrated an association between active travel and lower cardiovascular risk. The effect appeared to be stronger in women than men, but the reasons for this were unclear, and self-reported data was used to assess commuting activity in all of the included studies. The limitation to this approach is that it can be imprecise, and prone to recall bias. The authors highlighted a need for future studies to determine the specific mechanisms that influenced this relationship, and the importance of active commuting intensity.

Obesity

There was some evidence on the association between active travel and risk of obesity (Lorenzo, et al., 2020; Schäfer, et al., 2020; Tittlbach, et al., 2024; Wu, et al., 2021), but this was inconclusive in a number of cases, warranting further investigation and use of more robust methodologies.

In their scoping review, Tittlbach et al. (2024) were unable to draw any conclusions about how active travel was associated with, or impacted on, obesity prevention. They also could not determine whether walking or cycling had a stronger impact. The authors indicated that this was due to inconsistent findings and weak measurement tools (such as self-reported questionnaires). The majority of studies included in their review showed small positive associations with obesity risk (12 studies), but four showed no clear association.

In their systematic review, Schäfer et al. (2020) drew on measures of waist circumference as an indicator for obesity. They found that active commuting in previously untrained participants led to significant changes in waist circumference, independent of the type of active commuting. In their systematic review, Lorenzo et al. (2020) also found evidence that active travel by walking was related to having a smaller waist circumference and/or lower risk of abdominal obesity. However, the authors noted that the reviewed papers received low scores in their quality assessment. They also noted two limitations of the wider evidence-base surrounding the health impacts of active travel by walking in general. Firstly, the available studies primarily adopt cross-sectional and cohort-based designs and secondly, they tend to use weak measures of walking. They highlighted a need for more randomised controlled trials, that use objective measurement of walking rates for active travel at different intensities to determine the causal effects on cardiometabolic health, and analyses conducted by gender.

Finally, Wu et al's (2021) systematic review and meta-analysis found that risk of obesity decreased for those engaged in active commuting. Furthermore, when compared with inactive commuting, the association between active commuting and obesity risk was found to be linear (i.e. as the amount of time spent active commuting per week increased, the relative risk of obesity decreased). This effect was found for both walking and cycling but – consistent with other outcomes identified in this chapter – risk of obesity was lower for those engaged in higher levels of active commuting.

Diabetes

Two systematic reviews examined diabetes (Dinu et al., 2019; Wu et al., 2021). They consistently found that active travel was associated with lower risk for diabetes. In the case of Dinu et al. (2019), cycling was associated with a statistically significant lower risk of diabetes when compared to walking. In the case of Wu et al. (2021), risk of diabetes was reduced to a greater extent for those engaged in higher volumes of active travel. Dinu et al. (2019) speculated that risk might be reduced through biological mechanisms such as increases in glucose tolerance and insulin sensitivity. Similarly, Wu et al. (2021) speculated that active travel may positively impact insulin resistance by reducing sedentary time.

Hypertension and/or blood pressure

There was some evidence that active travel was associated with lower blood pressure and/or lower risk of hypertension, but further research is warranted to more conclusively examine this relationship (Lorenzo et al., 2020; Wu et al., 2021).

Lorenzo et al. (2020) found evidence that active transport by walking was related to lower prevalence of blood pressure and/or hypertension but highlighted a need for further investigation, as the evidence was of low quality (for the same reasons as highlighted in relation to Obesity). Wu et al's (2021) systematic review and meta-analysis found that risk of hypertension decreased for those engaged in active commuting, when compared with inactive commuting, and the association was found to be linear. Risk was lower for those engaged in higher levels of active commuting. However, to establish more consistent and conclusive evidence, Wu et al. (2021) highlighted a need for further research that applies more consistent definitions of active travel (in terms of the mode, duration, intensity, and frequency), as well as better standardised methods.

3.2.2 Impact on mortality/mortality risk

There was broadly consistent evidence to suggest that active travel is associated with lower risk and/or incidence of mortality, and consensus that the benefits of cycling are greater than those of walking. That said, there was disagreement on which types of mortality were reduced by active travel.

Using a meta-analysis, Dinu et al. (2019) examined the association between active commuting and risk of mortality. This included all-cause mortality (defined as death from any cause), cardiovascular disease mortality and cancer mortality. They found that active commuting was associated with a significant risk reduction for all-cause and cancer mortality in relation to cycling but not walking. The authors speculated that cycling is usually more energy-intensive per unit of time than walking, and thus has greater potential for increasing fitness. By contrast, they found little evidence supporting any association between active commuting and cardiovascular disease mortality.

Dutheil et al. (2020) examined the effects of active commuting on mortality using a systematic review and meta-analysis. They found that active travel decreased all-cause and cardiovascular mortality, but not cancer mortality. The effect was the same regardless of mode, and there was evidence of a dose response relationship[8] especially for walking – the highest intensities of active travel had the greatest benefits.

In Tittlbach et al's scoping review (2024), the available evidence from longitudinal studies and review papers showed that active travel by cycling lowered the risk of all-cause, cardiovascular disease and cancer mortality. This was also true of walking, but the extent of risk reduction was much lower than for cycling.

3.3 Impact of air pollution on health outcomes

The association between active travel and air pollution was examined by measuring either the levels of air pollution exposure[9] and/or inhalation[10] during active travel. Evidence on these outcomes was drawn from a total of three papers, including:

8 A dose response relationship describes a relationship in which the increasing levels of exposure are associated with either increasing or a decreasing risk in a given outcome.

9 Measured as a function of the concentration of pollutants in a microenvironment and the time spent by individuals in that microenvironment.

10 Measured by inhalation dose – the product of pollutant concentration and minute ventilation.

- One systematic review (Cepeda, et al., 2017).
- One scoping review (Raza, et al., 2018).
- One quantitative review (de Nazelle, et al., 2017).

Cepeda et al. (2017) directly examined the association between air pollution exposure and inhalation during active travel and years of life expectancy. De Nazelle et al. (2017) and Raza et al. (2018) calculated exposure but not inhalation. De Nazelle et al. (2017) only examined levels of air pollution exposure, whereas Raza et al. (2018) also discussed the general health impacts associated with this.

The evidence exploring how exposure varied by mode was broadly consistent. De Nazelle et al. (2017) found, in nearly all studies, that levels of exposure were greatest among those commuting by car and lowest among pedestrians, when compared with bus and bicycle. Similarly, Cepeda et al. (2017) showed that exposure was highest for those commuting by car, followed by buses, cars with controlled ventilation settings, then cyclists and pedestrians. However, their comparison also included train/subway/metro, which were found to have the lowest levels of exposure.

In terms of inhalation rates, Cepeda et al's (2017) systematic review found that engagement in active travel led to higher inhalation rates than other modes of transport as a result of increased minute ventilation rates[11] and trip duration. Furthermore, despite the overall trend across studies which suggested that measures of air pollution exposure were highest among car drivers, some studies found that a switch from motorised to active transport (particularly cycling) could result in a slightly increased health risk overall (depending on the air pollutant used as the health indicator as well as the exposure-response function that is used). However, there was consensus that such negative health impacts were not strong enough to offset the positive health effects that come from engaging in physical activity when active commuting. For example, Raza et al. (2018) described this trade-off as being well established in the wider literature and reported that, when examining exposure to PM2.5, the harm caused by air pollution only outweighed the health benefits of active travel in the most extreme air pollution scenarios. Moreover, Cepeda et al. (2017) estimated that those commuting by motorised transport lost up to one year more in life expectancy than cyclists.

Notwithstanding this, the studies also consistently identified considerable variation in the extent of benefit (from physical activity) and harm (from air pollution). This was attributed to a range of geographical factors, such as variation in the design of transport infrastructure (for example, the degree of separation between cyclists/pedestrians and vehicle exhausts) and the level of air pollution within the location studied (de Nazelle et al., 2017; Raza et al., 2018).

3.4 Evidence gaps identified by this review

Overall, this review identified extensive evidence on the impact that active travel has on a range of physical health outcomes, often examining how these impacts varied by mode of active transport. There was also some evidence, albeit less extensive, on how these impacts varied for demographic groups such as gender, age or according to baseline levels of health.

11 Minute ventilation rate is the volume of gas inhaled or exhaled from a person's lungs per minute.

However, there was a distinct lack of examination of how the association between active travel and health varies according to social group. This gap in the literature was also observed by Hansmann et al. (2022). In their scoping review of the distribution of health impacts of active transport interventions according to indicators of race, ethnicity, or socioeconomic status, they concluded that there is a significant and persistent gap in the literature. They highlighted a need for further research to understand how health inequity can be mitigated or addressed through activities that encourage active transport.

4. Impact of active travel on mental health and wellbeing

This chapter discusses evidence on the impact of active travel on mental health and wellbeing outcomes. Various types of mental health and wellbeing outcomes were examined within the evidence base synthesised by this research. In this chapter, the evidence has been summarised and presented according to following categories:

- **4.1 Impact on mental health and wellbeing,** including measures of general mental health and wellbeing; stress; quality of life and/or life satisfaction (i.e. an individual's perception of their overall position in life and/or satisfaction with their own life); and commute satisfaction (i.e. how an individual feels about their commute). These outcomes were all assessed using subjective, self-reported measures, such as self-reported questionnaires that asked respondents to rate their own wellbeing.
- **4.2 Impact on depression and anxiety,** including measures of the likelihood of having symptoms of depression/anxiety or the likelihood of having a mental health prescription.

4.1 Impact on mental health and wellbeing

Outcomes concerning the impact of active travel on mental health and wellbeing were examined by measuring general mental health and/or wellbeing (4.1.1); stress (4.1.2); quality of life and/or life satisfaction (4.1.3); and commute satisfaction (4.1.4). Evidence on these outcomes was drawn from a total of nine papers, including:

- Two systematic reviews (Bourne et al., 2018; Liu et al., 2022).
- Two scoping reviews (Scrivano et al., 2024; Tittlbach et al., 2024).
- One meta-analysis (White et al., 2017).
- One cross-sectional study (Zijlema et al., 2018).
- One longitudinal study (Martin et al., 2014).
- One retrospective cohort study (Frömel et al., 2020).
- One grey literature report (Sustrans, 2017).

4.1.1 General mental health and/or wellbeing

Overall, there was considerable evidence to suggest that active travel positively impacted general mental health and wellbeing (Frömel et al., 2020; Liu et al., 2022; Martin et al., 2014; Tittlbach et al., 2024). However, this evidence was in some cases limited, and there was a distinct lack of evidence to explain the mechanisms through which impact occurs.

In their longitudinal study, Martin et al. (2014) concluded that choosing to commute by active modes, rather than using the car, had a positive impact on wellbeing. They also found that the potential benefits to car drivers of switching to active travel exceeded any potential benefits of reducing commuting time. Their conclusions were supported by the results of four distinct analyses that found:

- A positive association between wellbeing and use of active travel, rather than travel by car.
- A positive association between wellbeing and time spent walking.
- A negative association between wellbeing and time spent driving.

- A positive association between wellbeing and switching from car or public transport to active commuting, when compared with those who continued to use car or public transport.

In their systematic review, Liu et al. (2022) identified some evidence suggesting that active transport was beneficial for general mental health and subjective wellbeing.[12] However, the results across the reviewed studies were inconsistent and the authors were unable to establish any definitive conclusions. Furthermore, the exact relationships between active travel and different dimensions of mental health and subjective wellbeing were unclear. The authors attributed this to a lack of longitudinal studies. They suggested that further longitudinal research is required to more conclusively examine the mechanisms through which commuting affects short- and long-term subjective wellbeing and mental health. They recommended that such research should substitute traditional, retrospective self-measurement tools with wearable, GPS-enabled devices capable of objectively measuring an individual's physiological state, as well as the environmental factors they are exposed to during their commute.

Tittlbach et al's scoping review (2024) found some cross-sectional and longitudinal evidence that cycling was linked with positive mental health, though the authors did not discuss how active travel was found to impact mental health in these studies. A retrospective cross-sectional study of adolescents also found that active travel was significantly associated with higher wellbeing, but only in girls (Frömel et al., 2020).

It was found that the impact of active travel on general mental health and wellbeing varied according to two factors, including:

- **Whether active travel took place in a natural environment** – regular travel in natural environments positively impacted mental health. Zijlema et al's (2018) cross-sectional study found that active travel did not – on its own – positively impact mental health. However, daily commuting through natural environments[13] did positively impact mental health and the association with mental health was stronger among active commuters compared to non-active commuters. Following this conclusion, the authors suggested that cities should invest in cycling and walking routes that contain features of the natural environment. The authors speculated (in line with the wider literature on the health benefits of the natural environment) commuting through natural environments generated psychological benefits as a result of their restorative qualities.

12 Subjective wellbeing was defined in this study as an individual's experienced wellbeing and satisfaction with life as a whole.

13 Defined as: "all public and private outdoor spaces that contain 'green' and/or 'blue' natural elements such as street trees, forests, city parks and natural parks/reserves, and also included all types of waterbodies" (Frömel, et al., 2020).

- **Age, and whether active travel was a choice** – active school travel may be less likely to benefit the overall health/wellbeing of adolescents as it is less likely to be undertaken out of personal choice. In their meta-analysis, White et al. (2017) found considerable variation in the extent to which physical activity was associated with mental health outcomes across different contexts. This included a positive association between active commuting and better mental health among adults. However, the study did not find a positive association between active school travel and better mental health among adolescents. The authors speculated that this may be explained by 'self-determination theory', which holds that: "behaviours which are undertaken due to autonomous motivation are more likely to be associated with the satisfaction of psychological needs (i.e., autonomy, competence, and relatedness), and that wellbeing is enhanced when an individual's psychological needs are satisfied" (White et al., 2017, p. 14). Accordingly, adults in the study may have been more likely to walk, out of personal choice, and thus their mental health and wellbeing was more likely to have been positively impacted.

4.1.2 Stress

Evidence about whether and how active travel had a positive impact on stress was inconsistent in terms of both whether the association was statistically significant and circumstances under which impact was achieved. Moreover, there was lack of evidence to explain the mechanisms behind this association.

Findings on the general impact of active travel on stress varied across the reviewed evidence. In their scoping review, Scrivano et al. (2024), identified four cross-sectional studies and one longitudinal study which examined the relationship between transport modes and various survey measures of stress levels/factors. Of the cross-sectional studies, one found a non-significant association between active travelling and stress, while the other three reported an inverse relationship between active travel and stress levels. The longitudinal study reported an inverse relationship that was only significant for cycling. Similarly, Liu et al's systematic review (2022) identified three cross-sectional studies and one longitudinal study that examined the risk of experiencing stress by mode. The cross-sectional studies found that commuting by cycling or walking was associated with the lowest risk of experiencing stress when compared with other modes, while the longitudinal study reported that only cycling reduced perceived stress.

In terms of how the impacts varied, a Study by Asztalos et al. (2009), cited in White et al. (2017) found that commuting by bicycle was associated with increased stress for men with 'blue-collar' jobs but not men with 'white-collar' jobs (NB these are terms used by the source authors). Asztalos et al's study did not support a direct explanation for this but White et al. (2017) speculated that, due to differing financial resources, white-collar workers were more likely to own a car yet choose to cycle to work out for personal enjoyment or the heath benefits. By contrast, they suggested that blue-collar workers were less likely to cycle out of choice, thus explaining why cycling was associated with increased stress for this group.

4.1.3 Quality of life and life satisfaction

Evidence about quality of life and life satisfaction was considerably mixed and inconclusive, and there was also significant variation in the measures used.

In their scoping review, Scrivano et al. (2024) identified a range of experimental, cross-sectional, and longitudinal studies that examined the impact of active travel on quality of life or life satisfaction, examined separately and using various measurement systems. The findings of the studies varied considerably, including:

- Whether any associations were found between active travel and quality of life or life satisfaction whether the association was positive or negative.
- Whether the association was significant.
- Which mode (cycling or walking) and for which age groups the association was significant for.

Overall, no clear conclusions could be drawn from the scoping review as the studies identified had produced mixed results.

The results of Liu et al's systematic review (2022) were also inconclusive. They identified two studies that examined the impact of active travel on life satisfaction or quality of life. One cross-sectional study found that those who walked to work reported higher life satisfaction than car users, but not those who cycled. By contrast, a longitudinal study found that cycling to work was positively related to quality of life. Finally, an additional systematic review (Bourne et al., 2018) identified one study, based on a non-randomised control trial, that examined the impact of active travel on quality life. The study found no changes in quality of life following eight weeks of e-cycling.

4.1.4 Commute satisfaction

There was consistent evidence to suggest that active travel positively impacted commute satisfaction.

A grey literature report by Sustrans (2017) summarised evidence about how active commuting impacts mental health. The report indicated that the majority of previous studies which compared the impacts of commuting by different transport modes had found that active travel, followed by public transport, were the least stressful. Furthermore, it indicated that active commutes were more enjoyable as they typically involve desirable physical exercise; took place over shorter distances; were subject to less disruption/delay (which helped to minimise resulting stress and boredom); and offered individuals greater control over their commute, particularly when compared to drivers. Finally, they suggested that the potential benefits of active travel for commute satisfaction – and mental health in general – cannot be fully realised without adequate pedestrian and cycling infrastructure. Without such infrastructure roads can be dangerous and unfriendly, which can exacerbate feelings of community severance.

Sustrans did not outline the methodology of their research, but the key finding of the report – that active travel positively impacted commute satisfaction in previous studies – was supported by the academic evidence identified in this review. Firstly, in their scoping review, Scrivano et al. (2024) identified six cross-sectional studies that used consistent measures of commute satisfaction and were consistent in finding a significant positive correlation between walking and cycling and commute satisfaction. Secondly, in their systematic review, Liu et al. (2022) found that commute satisfaction was mode-dependent, and that active commuting had the highest commute satisfaction, though the available evidence on whether cycling or walking benefits commute satisfaction more was unclear.

4.2 Impact on depression and anxiety

The impact of active travel on depression and anxiety was either examined in relation to the likelihood of having symptoms of depression or anxiety or the likelihood of having a mental health prescription. It should be noted that most of the findings presented in this section measure the impact of active travel on self-reported symptoms of depression and anxiety. It should not be assumed, therefore, that active travel has the same impact on clinical anxiety or depression. Evidence on these outcomes was drawn from a total of four papers, including:

- Two systematic reviews (Liu et al., 2022; Marques, et al., 2020).
- One scoping reviews (Scrivano et al., 2024).
- One instrumental variable analysis (Berrie et al., 2024).

Overall, evidence surrounding the impact of active travel on the symptoms of depression and anxiety were limited and/or inconsistent.

Scrivano et al's scoping review (2024) was the only study identified by this evidence review which examined the impact of active travel on the likelihood of experiencing anxiety. The evidence identified in the study was limited and inconsistent. One cross-sectional study found no significant relationship between walking and anxiety (cycling was not examined). Similarly, an analysis of the Active Lives Survey 2016–2017 data found no association between anxiety levels and active commuting. By contrast, ONS data from the Annual Population Survey 2014 indicated that those who active travelled reported worse anxiety levels, particularly if their journeys were longer than 15 minutes.

There was also no clear evidence surrounding the impact of active travel on depressive symptoms. In their systematic review, Marques et al. (2020) found the evidence to be inconsistent. Two of the studies Marques et al. (2020) reviewed found that switching to more active modes of travel and walking long distances were negatively related to the likelihood of developing new depressive symptoms. By contrast, five other studies found no significant association between active travel (or active commuting) and depression. The authors attributed the inconsistent findings of their systematic review to the differing methodologies of the reviewed studies, and the differing contexts in which the studies were conducted. To enable greater comparability between studies, they highlighted a need for future research to use more consistent methods; to measure active travel by frequency and volume; and to be more specific when analysing the context in which active travel is conducted. Finally, they also recommended that future studies examine whether active travel can function as a suitable mechanism for tackling mental health issues such as depression.

Similarly, Scrivano et al's systematic review (2024) identified four studies that examined the impact of active travel on depressive symptoms. Of these, Marques et al's systematic review (2020) was one. The three other studies examined the impact of walking on depressive symptoms (each using different measurement approaches), but the findings were also inconsistent. Scrivano et al. (2024) indicated that the impact of active travel on the symptoms of depression and anxiety is a significant gap in the literature.

Despite these limitations, it was found that the impact of active travel on depressive symptoms could vary according to several factors, including:

- **Length of commute** – longer commutes may increase the likelihood of depressive symptoms. Liu et al's systematic review (2022) identified one-cross sectional study that examined the impact of switching from passive to active commuting. The study (Knott et al., 2018) found that active commuting reduced the likelihood of depressive symptoms, but only over short distances.
- **Amount of physical activity** – in contrast to the findings from Knott et al. (2018) Marques et al's systematic review (2020) indicated that undertaking active travel over longer distances may result in greater protection against depressive symptoms, where this is performed at a higher intensity. Furthermore, they identified evidence of a threshold effect, in which few differences were observed in the development of depressive symptoms between intermediate and high walking groups. Another study found that those who switched from inactive to active commuting reported less severe depressive symptoms at follow-up than those who remained inactive.
- **The built environment** – active travel through certain built environments may contribute to the development of depressive symptoms. Marques et al's systematic review (2020) found some evidence to suggest that certain characterisics of the socioeconomic level of the neighbourhood and the built environment where active travel takes place was associated with a higher likelihood of having depression.[14]

Finally, in their instrumental variable analysis,[15] Berrie et al. (2024) took mental health prescription data – which was used as a proxy for depression/anxiety diagnosis data[16] – in combination with commuting data[17] used as an instrumental variable for cycle commuting – to examine the impact of active travel by bicycle on the risk of mental ill-health. They found that cycling to work was causally associated with a decreased likelihood of having a mental health prescription in the five years following the point of travel measurement, when compared with using other modes of transport.

14 Examples of neighbourhood characteristics found to be associated with a higher likelihood of depression included higher prevalence of violent crime, above-average proportions of unemployed individual, proximity to landfills, proximity to abandoned buildings, more than 10-min walk away from the closest hospital.

15 A methodology for identifying causal effects in absence of randomised experiments.

16 Specifically, Berrie et al. (2024) identified whether individuals had received a new prescription to antidepressants and/or anxiolytics (medication typically used to treat the symptoms of anxiety) since the 2011 census, using individual records from the Scottish National Prescription.

17 Commuting data in Edinburgh and Glasgow, taken from the 2011 Scottish population census.

5. Key determinants of and barriers to participation in active travel

In assessing the evidence of the impact on health and wellbeing outcomes, several key determinants of and barriers to active travel participation were noted.

Overall, this review identified extensive evidence on the impact that active travel has on a range of physical health outcomes; however, there was less evidence on how these impacts varied for demographic groups, including by gender, age or according to baseline levels of health. A significant and persistent gap in literature on the association between active travel and health varies according to social group was identified. Studies highlighted a need for further research to understand how health inequity can be mitigated or addressed through activities that encourage active transport.

Some of the identified determinants and barriers are highlighted below.

5.1 Key determinants

- **Mode** – a scoping review (Tittlbach et al., 2024) found that active travel was strongly associated with greater cardiovascular and physical fitness, and that there was some evidence that cycling had a stronger impact on physical fitness than walking. However, the study reported inconsistency in the results, which warrants further research.
- **Active travel in a natural environment** – regular travel in natural environments positively impacted mental health. Zijlema et al.'s (2018) cross-sectional study found that active travel did not – on its own – positively impact mental health. However, daily commuting through natural environments did positively impact mental health and the association with mental health was stronger among active commuters compared to non-active commuters. Following this conclusion, the authors suggested that cities should invest in cycling and walking routes that contain features of the natural environment to generate psychological benefits as a result of their restorative qualities.
- **Active travel as a choice** – better mental health outcomes among children and young people are thought to be generated when active travel was undertaken as a result of personal choice.
- **E-cycles** – evidence suggests that e-cycling may be a mode of active travel which helps people who face barriers to conventional cycling. It elicits an intensity of physical activity that is higher than walking but lower than conventional cycling.

5.2 Key barriers

- **Age** – age may mediate or confound the impact of active travel on physical fitness, due to factors such as the mode, and lower volumes and distances of active travel undertaken amongst young people. For example, active travel was found to improve cardiorespiratory fitness in adults but evidence exploring the same effect in younger people was inconclusive. Four of the 16 reviewed studies did not find that active commuting improved the physical fitness of younger participants. There was evidence indicating that the mode of active travel may affect the intensity of impact on physical fitness. Research exploring the extent to which active travel can positively impact on general mental health and wellbeing also found that age was a factor. For example, evidence indicated a positive

association between active commuting and better mental health among adults but less so among adolescents. This was attributed to the fact that adolescent engaging in active school travel were less likely to do so out of personal choice.

- **Leisure-time physical activity** – physical activity levels generally increased because of active travel, especially for previously inactive participants. However, some people became less physically active overall, where the increases in physical activity that resulted from active travel were accompanied by compensatory decreases in leisure-time physical activity (substitution rather than additionality).

6. Limitations

The evidence identified in this assessment was drawn from a variety of sources, including evidence reviews and quantitative studies, such as cross-sectional and longitudinal research. These sources included both academic literature and grey literature, including several evaluation reports. However, there are several key limitations to this assessment. The evidence varied significantly in terms of consistency, conclusiveness, and robustness. Regarding research on the health impacts of active travel by walking, most available studies relied on cross-sectional and cohort-based designs, often using weak measures of walking. The assessment was also constrained by gaps in the literature. Specifically, evidence on the impact of active travel on symptoms of depression and anxiety was limited and inconsistent, as was evidence on its impact on general mental health.

As a result, no definitive conclusions could be drawn about the overall effect of active travel on the likelihood of experiencing depression or anxiety symptoms. Additionally, there was a significant lack of exploration into how the relationship between active travel and health outcomes varies across different social groups. From this, it can be concluded that variation by social group is a clear and consistent gap in the literature.

7. Conclusions

This report has attempted to answer the following research questions:

- **RQ1.** What impacts does active travel have on people's health? Including:
  - Physical health.
  - Mental health and wellbeing.
- **RQ2.** How do the health impacts of active travel vary? Including by:
  - The transport mode taken (i.e. walking or cycling).
  - Demographic group.

This evidence review identified a range of existing evidence on the health promoting and preventative impacts of active travel, and how these impacts vary. This evidence was divided broadly according to the impacts of active travel on physical health (i.e., impact on exercise-related outcomes; impact on outcomes related to physical health conditions; and impact of air pollution on physical health), and the impacts of active travel on mental health (i.e., general mental health and wellbeing; stress; quality of life and/or life satisfaction and commute satisfaction; impact on depression and anxiety). The Weight of Evidence score for each piece of evidence in the review is given in Annex B.

Impact on exercise-related outcome. Active travel was found to contribute towards improvements in physical activity levels and towards meeting recommended levels of physical activity. The literature drew attention on two key moderators that may affect such outcome. Firstly, some people became less physically active overall, where the increases in physical activity that resulted from active travel were accompanied by compensatory decreases in leisure-time physical activity. Secondly, the overall levels of physical activity were influenced by the mode of active travel, e.g. e-bike involves at least a moderate intensity of physical activity, but this is lower than that of conventional cycling but higher than that of walking.

The sources reviewed indicated that active travel positively impacted physical fitness and highlighted the factors that can influence this outcome. Age may mediate or confound the impact of active travel on physical fitness. For example, active travel was found to improve cardiorespiratory fitness in adults but evidence exploring the same effect in younger people was inconclusive. There was evidence indicating that the mode of active travel may affect the intensity of impact on physical fitness. For example, cycling had a stronger impact on physical fitness than walking. Moreover, improvements in physical fitness were greater in those with lower starting fitness levels, when compared with those who already had higher levels of physical performance. However, none of the studies measured long-term effects of active travel on physical fitness.

Impact on outcomes related to physical health conditions. Active travel was found to contribute towards a lower risk and/or incidence of various physical health conditions. For example, the reviewed evidence consistently showed that active travel can reduce the risk and/or incidence of cardiovascular disease. Similarly, active travel was found to be positively associated with lower risk of diabetes. However, findings investigating the association with lower risk of obesity and hypertension and/or blood pressure were inconclusive and, in some cases, based on weak measurement tools, e.g. self-reported questionnaires. Lastly, there was broadly consistent evidence to suggest that active travel was associated with lower risk and/or incidence of mortality. This varied by mode of active travel, that is benefits of cycling were greater than those of walking. However, there was was disagreement on which types of mortality were reduced by active travel.

Impact of air pollution on health outcomes. The evidence reviewed looked at exposure to pollutants in an environment or inhalation of pollutant doses while active travelling. Levels of exposure were greatest among those commuting by car and lowest among pedestrians, when compared with bus and bicycle. However, train/subway/metro were found to have the lowest levels of exposure. Engagement in active travel led to higher inhalation rates than other modes of transport, as a result of increased minute ventilation rates (i.e. the volume of gas inhaled or exhaled from a person's lungs per minute) and trip duration. However, this was not sufficient to offset the physical health benefits of active commuting

Impact on mental health and wellbeing. Active travel was found to positively impact general mental health and wellbeing. However, there were multiple factors moderating such impact. Firstly, active travel positively impacted mental health when taking place in natural environments. Secondly, age and whether active travel was a choice were also found to play a role. For example, evidence indicated a positive association between active commuting and better mental health among adults but less so among adolescents. This was attributed to the fact that adolescent engaging in active school travel were less likely to do so out of personal choice. However, findings across the reviewed studies were inconsistent and the exact relationships between active travel and different dimensions of mental health and subjective wellbeing were unclear.

This research found inconsistent evidence about whether active travel had a positive impact on stress. This ranged from non-significant relationship between active travel and stress to an inverse association between the two. The mode of active commuting was found to act as a moderator of this relationship. For example, commuting by cycling or walking was associated with the lowest risk of experiencing stress when compared with other modes.

Evidence on the relationship between active travel and quality of life, and life satisfaction was mixed and inconclusive. For example, walking to work was found to be associated with higher life satisfaction than driving to work, but not cycling. By contrast, another source determined that cycling to work was positively related to perception of good quality of life. Such variation could be due to differing measures and methodologies used, which makes it difficult to draw clear conclusions.

There was consistent evidence suggesting that active travel positively affected commute satisfaction. This is because active travel, was the least stressful mode of commuting, followed by public transport. The benefits of active commuting included physical exercise, being less affected by disruption/delay and greater control over commute, particularly when compared to drivers. However, there was an overall lack of evidence on how this relationship varies by mode of active commuting, particularly cycling and walking.

Impact on depression and anxiety. Evidence on the impact of active travel on the symptoms of anxiety were limited and/or inconsistent. Findings ranged from non-significant relationship or non-association to a negative association, i.e. some individuals who active travelled reported higher levels of anxiety, particularly if their journeys were longer than 15 minutes. Similarly, evidence on the relationship between active travel and depressive symptoms was mixed and inconclusive. Some sources found that switching to more active modes of travel and walking long distances were associated with the likelihood of developing new depressive symptoms, other data suggested the opposite. Whilst some sources found no significant association between active travel and depression. There is evidence within wider physical activity literature to suggest a positive association between activity levels and reduced depression. Such inconsistency is likely to be due to the differing methodologies of the reviewed studies, and the differing contexts in which the studies were conducted. The reviewed literature also highlighted several factors that could affect the extent to which active

travel impacted depressive symptoms. This included the characteristics of the neighbourhood and the built environment in which active travel takes place.

Determinants / barriers of participation

There was very limited conclusive evidence to explain the potential health and well-being impacts of active travel across the range of demographic characteristics. Several studies referenced the potential impact of participation age on key findings. It was reported that age may mediate or confound the impact of active travel on physical fitness. For example, active travel was found to improve cardiorespiratory fitness in adults but there was inconclusive evidence exploring the same effect in younger people. However, none of the studies measured long-term effects of active travel on physical fitness.

Research exploring the extent to which active travel can positively impact on general mental health and wellbeing also found that age was a factor. For example, evidence indicated a positive association between active commuting and better mental health among adults but less so among adolescents. This was attributed to the fact that adolescent engaging in active school travel were less likely to do so out of personal choice. Findings across the reviewed studies were inconsistent and the exact relationships between active travel and different dimensions of mental health and subjective wellbeing remain unclear.

7.1 Future research

Further research is required to test and expand on the findings of this evidence assessment. A future assessment of evidence may wish to consider a wider search of specific health conditions which represent a significant burden of disease in the UK and, as such, have a substantial impact on the healthcare system i.e. bone/musculoskeletal health, diabetes, cardiovascular disease, cancer, and dementia.

To ensure that future research can produce robust and conclusive findings, with greater comparability between studies, it is important that such research addresses the limitations of the existing evidence, specifically:

- **Apply consistent definitions and measurements of active travel.** There was considerable variation in the definitions and measurements applied to active travel across studies, e.g. modes, duration, intensity, and frequency of active travel. More standardisation, including shared definitions, are recommended to enable more rigorous comparability between studies.
- **Strengthened measurement – objective measures and common metrics.** The reviewed studies indicated a strong reliance on cross-sectional studies and self-reported/ subjective health outcome measures. Further randomised control trials are recommended to produce more definitive conclusions, particularly in relation to the causal effects of active travel on health, alongside the use of more robust assessments of an individual's physiological state.
- **Measure the long-term impacts of active travel.** The existing evidence predominantly addresses the short-to-medium term impacts of active travel. Additional longitudinal research is recommended to better explore whether and how such impacts are sustained over time (i.e. in the years and decades following behaviour change).

- **Examine how the health impacts of active travel vary by social group.** This was a clear and consistent gap in the literature. Future research could explore, for example, how the health impacts vary by socio-economic background and ethnicity.
- **Account for the range of mediating factors.** The available evidence indicates that the health impacts of active travel can vary considerably according to sociodemographic factors. Furthermore, different mediating factors can affect the impacts of active travel for different groups. Future research should seek to more consistently identifying and control for such factors.

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Annex A – Database searches

Platform: Scopus

Date searched: 6 February 2024

Number of results: 1,465

Table 8: Health and wellbeing theme search strings

String no.	Search string	No. of results
1	TITLE-ABS((active) W/1 (travel* OR commut* OR journey*)) OR AUTHKEY((active) W/1 (travel* OR commut* OR journey*))	2760
2	TITLE-ABS(physical* OR fitness OR exercise OR mental* OR emotional* OR wellbeing OR ″well being″ OR weight OR health* OR obes* OR psychsocial* OR psychologic* OR psychiatric* OR bmi OR ″body mass″ OR ″quality of life″ OR depression OR anxiety OR stress OR energy OR energetic OR strength OR ″life satisfaction″) OR AUTHKEY(physical* OR fitness OR exercise OR mental* OR emotional* OR wellbeing OR ″well being″ OR weight OR health* OR obes* OR psychsocial* OR psychologic* OR psychiatric* OR bmi OR ″body mass″ OR ″quality of life″ OR depression OR anxiety OR stress OR energy OR energetic OR strength OR ″life satisfaction″)	20,972,293
3	#1 AND #2	2052
4	Limit Subject Area to Social Science, Medicine, Environmental Science, Engineering, Business/Management/Accounting, Decision Sciences, Psychology, Economics/Econometrics/Finance, Arts and Humanities	1965
5	Limit Language to English	1910
6	Limit Document Type: Article, Review	1760
7	Limit Publication Year to 2013-2024	1465
8	TITLE-ABS(″systematic review″ OR ″systematic literature review″ OR ″meta-analysis″ OR metanalysis OR ″scoping review″ OR ″systematic map″ OR ″evidence gap map″ OR ″evidence and gap map″ OR ″systematic mapping review″ OR ″umbrella review″ OR ″realist review″ OR ″integrative review″ OR ″metaregression″ OR ″meta-regression″ OR ″rapid review″ OR ″systematized literature review″))	
9	#3 AND #8	135
10	Limit Publication Year to 2003-2012	15

Grey literature searches

To supplement the academic database search, a search of ‘grey’ literature was conducted across a range of relevant websites using the Google search engine. This was undertaken on 28 February 2024 using a standardised set of search strings for all evidence assessments to identify further sources. This yielded 136 results, detailed below.

Table 9: Grey literature searches

Organisation	Search string	Valid results
Active Oxfordshire	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: activeoxfordshire.org/	6
Active Travel Academy (University of Westminster)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: westminster.ac.uk/ata/	5
Age UK	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: ageuk.org.uk/	6
Association of Cycle Traders (ACT)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: cycleassociation.uk/	1
British Heart Foundation (BHF)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: bhf.org.uk/	2
Campaign for Better Transport	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: bettertransport.org.uk	10
Campaign for National Parks	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: cnp.org.uk/	4
Centre for Transport & Society (University of the West of England)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: uwe.ac.uk/research/centres-and-groups/cts	0
Cycle BOOM	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: cycleboom.org/	1
Cycling UK	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: cyclinguk.org/	18
Disability Rights UK	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: disabilityrightsuk.org/	2
Living Streets	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: livingstreets.org.uk/	6
ModeShift	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: modeshift.org.uk	0
National Institute for Health and Care Excellence (NICE)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: nice.org.uk/	0
Partnership for Active Travel and Health	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: pathforwalkingcycling.com/	0
Paths for All	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: pathsforall.org.uk/	10

Organisation	Search string	Valid results
Royal National Institute of Blind People (RNIB)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: rnib.org.uk/	1
Sustrans	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: sustrans.org.uk/	15
The Ramblers	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: ramblers.org.uk/	1
Transport & Health Study Group (THSG)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: transportandhealth.org.uk/	4
Transport for London (TfL)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: tfl.gov.uk/	0
Transport Research Laboratory (TRL)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: trl.co.uk/	8
Transportation Research Group (University of Southampton)	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: southampton.ac.uk/research/groups/transportation-group	0
Sport England	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: sportengland.org/	9
Systra	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: systra.com/uk/	1
Transport Scotland	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: transport.gov.scot/	0
Bikeability	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: bikeability.org.uk/	0
Transport for New Homes	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: transportfornewhomes.org.uk/	4
ITS Leeds	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: leeds.ac.uk/transport	0
Centre for Cities	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: centreforcities.org/	7
Chartered Institute of Highways and Transport	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: ciht.org.uk/	14
Chartered Institute of Logistics and Transport	(INTITLE:research OR study OR analysis) AND (active AROUND(2) (travel OR commute OR journey OR transport)) AND AFTER:2012 AND site: ciltuk.org.uk/	1
Total		**136**

Annex B – Details of sources included in the full assessment

Reference and DOI	Method / data	Sample	Geography	Weight of Evidence score	Reason for inclusion where WoE is not high	Wellbeing	Mental health	Physical health
Berrie, L. et al., 2024. Does cycle commuting reduce the risk of mental ill-health? An instrumental variable analysis using distance to nearest cycle path. *International Journal of Epidemiology*, 53(1).	Census data and Scottish National Prescription Information System	378,253 people aged 16–74	Scotland	N/A – not screened	Relevance to sub-theme; Total Weight of Evidence score; Paper type (high quality longitudinal study)	✓		
Boniface, S., Scantlebury, R., Watkins, S. J. & Mindell, J. S., 2015. Health implications of transport: Evidence of effects of transport on social interactions. *Journal of Transport & Health*, Volume 2, pp. 441-446.	Literature review	Not specified	N/A	8 (medium)	Paper type (evidence review); Relevance to sub-theme	✓	✓	✓
Bourne, J. E. et al., 2018. Health benefits of electrically-assisted cycling: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 15(116).	Systematic review	17 studies	Global	N/A – not screened	Paper type (systematic review); Relevance to sub-theme	✓		✓
Cepeda, M. et al., 2017. Levels of ambient air pollution according to mode of transport: a systematic review. *Lancet Public Health*, Volume 2, pp. 23-34.	Systematic review	39 studies	European, West Pacific, American and southeast Asian countries	13 (high)	N/A			✓
de Nazelle, A., Bode, O., Orjuela & P., J., 2017. Comparison of air pollution exposures in active vs. passive travel modes in European cities: A quantitative review. *Environment International*, Volume 99, pp. 151-160.	Quantitative review/literature review	10 studies	Europe	12 (high)	N/A			✓

Reference and DOI	Method / data	Sample	Geography	Weight of Evidence score	Reason for inclusion where WoE is not high	Wellbeing	Mental health	Physical health
Dinu, M., Pagliai, G., Macchi, C. & Sofi, F., 2019. Active Commuting and Multiple Health Outcomes: A Systematic Review and Meta-Analysis. *Sports Medicine,* Volume 49, pp. 437-452.	Systematic review and meta-analysis	23 studies	Global	14 (high)	N/A			✓
Dutheil, F. et al., 2020. Protective Effect on Mortality of Active Commuting to Work: A Systematic Review and Meta-analysis. *Sports Medicine,* Volume 50, p. 2237–2250.	Systematic review and meta-analysis	17 studies	Global	N/A - not screened	Relevance to sub-theme; Paper type (systematic review & meta analysis)			✓
Figueiredo, N., Rodrigues, F., Morouço, P. & Monteiro, D., 2021. Active commuting: An opportunity to fight both climate change and physical inactivity. *Sustainability,* 13(8).	Literature overview	Not specified	Global	4 (low)	Paper type (literature review); Relevance across the theme		✓	✓
Frömel, K. et al., 2020. Active travel of Czech and Polish adolescents in relation to their well-being: Support for physical activity and health. *International Journal of Environmental Research and Public Health,* 17(6).	Questionnaire	36 Czech and 39 Polish schools, 1,110 boys and 1,695 girls aged 15–19	Czechia and Poland	12 (high)	N/A	✓		
Hamer, M. & Chida, Y., 2008. Active commuting and cardiovascular risk: A meta-analytic review. *Preventative Medicine,* Volume 46, pp. 9-13.	Meta analysis	8 articles	Global	14 (high)	N/A			✓

Reference and DOI	Method / data	Sample	Geography	Weight of Evidence score	Reason for inclusion where WoE is not high	Wellbeing	Mental health	Physical health
Hansmann, K. J., Grabow, M. & McAndrews, C., 2022. Health equity and active transportation: A scoping review of active transportation interventions and their impacts on health equity. *Journal of Transport & Health*, Volume 25.	Scoping review	10 studies	Not specified	N/A – not screened	Total Weight of Evidence score; Paper type (scoping review); Relevance to sub-theme		✓	✓
Henriques-Neto, D. et al., 2020. Active commuting and physical fitness: A systematic review. *International Journal of Environmental Research and Public Health*, 17(8).	Systematic review	16 studies	Global	14 (high)	N/A			✓
Jacob, N., Munford, L., Rice, N. & Roberts, J., 2020. Does commuting mode choice impact health? *Health Economics*, 30(2), pp. 207-230.	Regression-based analysis of UK Household Longitudinal Study data	Approx 100,000 individuals in 40,000 households	UK	9 (medium)	Total Weight of Evidence score; Paper type (high quality longitudinal study); Relevance across theme		✓	✓
Liu, J., Ettema, D. & Helbich, M., 2022. Systematic review of the association between commuting, subjective welbeing and mental health. *Travel Behaviour and Society*, Volume 28, pp. 59-74.	Systematic review	45 studies	Not specified	N/A – not screened	Relevance to sub-theme; Paper type (systematic review)	✓	✓	
Lorenzo, E. et al., 2020. Relationship between walking for active transportation and cardiometabolic health among adults: A systematic review. *Journal of Transport & Health*, Volume 19.	Systematic review	13 studies	Japan, China, USA, Colombia, Canada, India, Finland, Norway	14 (high)	N/A			✓

Reference and DOI	Method / data	Sample	Geography	Weight of Evidence score	Reason for inclusion where WoE is not high	Wellbeing	Mental health	Physical health
Marques, A. et al., 2020. Active commuting and depression symptoms in adults: A systematic review. *International Journal of Environmental Research and Public Health*, 17(3).	Systematic review	7 studies	Global	13 (high)	N/A		✓	
Martin, A., Goryakin, Y. & Suhrcke, M., 2014. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventive Medicine*, Volume 69, pp. 296-303.	British Household Panel Survey data from 1991 to 2009, fixed regression models	17,985 adult commuters	UK	11 (medium)	Paper type (high quality longitudinal study); Relevance to sub-theme	✓		
Raza, W., Forsberg, B., Johansson, C. & Sommar, J. N., 2018. Air pollution as a risk factor in health impact assessments of a travel mode shift towards cycling. *Global Health Action*, 11(1).	Systematic review	18 studies	'Developed countries'	12 (high)	N/A			✓
Schäfer, C. et al., 2020. Health effects of active commuting to work: The available evidence before GISMO. *Scandinavian Journal of Medicine & Science in Sports*, 30(1), pp. 8-14.	Systematic review	6 studies (8 articles)	Finland, Netherlands, Sweden. Belgium, Denmark	11 (medium)	Paper type (systematic review); Relevance to sub-theme			✓
Scrivano, L., Tessari, A., Marcora, S. & Manners, D., 2024. Active mobility and mental health: A scoping review towards a healthier world. *Cambridge Prisms: Global Mental Health*, Volume 11, pp. 1-23.	Scoping review	55 studies	Global	N/A – not screened	Relevance to sub-theme; Paper type (scoping review)	✓	✓	

Reference and DOI	Method / data	Sample	Geography	Weight of Evidence score	Reason for inclusion where WoE is not high	Wellbeing	Mental health	Physical health
Sustrans, 2017. The Role of Active Travel in Improving Health: Toolkit Part 3: The role of active travel in improving mental health. Bristol: Sustrans.	Grey literature review	Not specified - 20 referenced papers throughout (not all AT)	N/A	4 (low)	ATE/DfT recommended; Relevance to sub-theme	✓	✓	
Tittlbach, S., Brockfeld, A., Kindig, S. & Herfet, M., 2024. Maintaining health in daily life—is active travel the solution?: A scoping review. *German Journal of Exercise and Sport Research,* Volume 54, pp. 121-134.	Scoping review	35 studies	UK, US, Sweden, Finland, China, Netherlands, Denmark, Norway, Switzerland, Ireland	10 (medium)	Total Weight of Evidence score; Paper type (scoping review); Relevance to sub-theme		✓	✓
White, R. L. et al., 2017. Domain-specific physical activity and mental health: A meta-analysis. *American Journal of Preventative Medicine,* 52(5), pp. 653-666.	Systematic review and meta-analysis	98 studies	Global	N/A – not screened	Relevance to sub-theme; Paper type (meta analysis)	✓	✓	
Wu, J. et al., 2021. Active commuting and the risk of obesity, hypertension and diabetes: A systematic review and meta-analysis of observational studies. *BMJ Global Health,* 6(6).	Systematic review and meta-analysis	28 articles	Global	13 (high)				✓
Zijlema, W. L. et al., 2018. Active commuting through natural environments is associated with better mental health: Results from the PHENOTYPE project. *Environment International,* Volume 121, pp. 721-727.	Cross-sectional study, questionnaires	3,599 adults	Spain, Netherlands, Lithuania, and UK	10 (medium)	Total Weight of Evidence score; Relevance to sub-theme		✓	