

Factors influencing the safety of cycling in the UK

Evidence review

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/ Executive Summary

Lime Technology Ltd commissioned TRL to undertake an evidence review of the factors influencing cycling safety in the UK, with a focus on infrastructure, street design, traffic conditions, behaviour, training and education.



The review found the evidence base is substantial but uneven, with important gaps and known underreporting issues, particularly for non-fatal and single-cyclist incidents. The evidence identified suggests cycling safety is shaped by a complex interaction of infrastructure, environmental, behavioural and road-user interaction factors, rather than by any single cause.

The evidence supports a ‘Safety in Numbers’ effect, where higher cyclist volumes are generally associated with lower individual cyclist risk, but it also cautions that increases in cycling alone are unlikely to guarantee improved safety. The strongest practical findings point to the importance of high-quality cycling-specific infrastructure, particularly segregation from motor traffic, safer intersection design, management of traffic speeds and volumes, and road environments that reduce conflict and complexity. Driver and rider behaviour and cycle training also have a role.

Overall, the review finds that improving cycling safety requires a system-wide approach that combines infrastructure, behaviour, training, governance and policy, with interventions and investment targeted towards the areas and conditions of highest risk, in particular where cyclists and motor vehicles come into conflict. The recommendations from the review are:

- Any investment in cycling should focus on high-quality, continuous segregated infrastructure, particularly on roads with higher traffic volumes or speeds, and intersection improvements, recognising that intersections are among the highest-risk locations for cyclists.
- Cycling infrastructure investment should be prioritised using a risk-based approach, targeting locations where conflict between cyclists and motor traffic is greatest.
- Decision-makers should focus on creating coherent end-to-end cycling routes, rather than isolated sections of infrastructure.
- Decision-makers should ensure that infrastructure provision keeps pace with growth in cycling demand, particularly where cycling activity is increasing.
- Scheme design and prioritisation should be guided by established good-practice principles, particularly those set out in LTN 1/20.
- Government and local authorities should consider developing more comprehensive and standardised records of cycling infrastructure provision, to support planning, monitoring, evaluation and sharing of good practice.
- New cycling schemes should be accompanied by proportionate monitoring and evaluation, to improve understanding of which interventions deliver the greatest safety benefits and to build for best practice future schemes and infrastructure.

1. Introduction

Lime Technology Ltd commissioned TRL to undertake a review of evidence on the factors that influence cycling safety in the UK. Specifically, the review sought to address the following research question:

“What are the factors that influence the safety of cycling in the UK and how can we improve cycling safety?”

This report outlines the findings of a high-level evidence review designed to address this question. The review included, but was not limited to, the following factors: cycle-specific infrastructure, street design and environment, traffic volumes and traffic mix, training and education and driver and cyclist behaviour. A secondary aim was to understand any available insight into cycling safety in London, Bristol, Birmingham and Manchester specifically, to give a view of the UK picture across different cities.

Details of the method used for this review are provided in Appendix A.

2. Key findings

This review has taken a high-level approach to synthesising evidence on the factors influencing cycling safety in the UK. As such, it was not intended to be exhaustive, and the findings should therefore be interpreted with some caution. This section outlines the key findings from the evidence review; the detailed review findings are provided in Appendix B.

Within the evidence identified, the evidence base is substantial but uneven, with important gaps and known underreporting issues for cycling safety. Most of the studies were UK-based, or were international with insight relevant to the UK; several studies were specific to London and these were included in the review. None of the identified studies were specific to Bristol, Birmingham or Manchester, however the findings below are considered relevant to any UK city.

The evidence shows that:

- 1 **Higher cyclist volumes are generally associated with lower individual cyclist risk.** Evidence supports a ‘Safety in Numbers’ effect, where higher cyclist volumes are generally associated with lower individual cyclist risk. Some evidence suggests this may operate, at least in part, as a localised ‘Safety in Density’ effect at locations where motorists and cyclists interact, with cyclist density potentially affecting driver expectations and gap acceptance at intersections.
- 2 **But increases in cycling alone are unlikely to guarantee improved safety.** Several studies caution against assuming that increases in cyclist numbers automatically lead to improved safety. The safety benefits associated with increased cycling volumes may be overwhelmed where infrastructure provision is insufficient, for example, not providing sufficient physical protection to accommodate less experienced riders.

- 3 Cycling safety is influenced by a complex interaction of infrastructure, environmental, behavioural and road-user interaction factors.
 - a **Cycling-specific infrastructure is critical to safety, with the strongest evidence supporting full physical separation from motor traffic.** There is evidence that fully segregated infrastructure, such as kerb-separated and stepped cycle tracks, can significantly improve safety compared with provision that does not physically separate cyclists from motor vehicles, such as painted cycle lanes.
 - b **Intersections are a key risk to cyclists,** and design can improve safety by reducing vehicle speeds and increasing driver attention. Depending on context, this may be achieved through measures that encourage drivers to approach intersections more slowly, for example tighter roundabout geometry.
 - c **The interaction between speed limits, traffic speeds and traffic volumes is complex, with cyclist injury risk influenced by the combined effects of all three factors.** The benefits of lower traffic speeds may be reduced in congested environments where interactions between road users are more frequent.
 - d However, **measures to reduce motor vehicle speeds are an important component of improving cyclist safety.** While their effectiveness depends on the wider road environment and traffic conditions, lower vehicle speeds can reduce both collision likelihood and injury severity.
 - e **Increased complexity of the road environment may increase cyclist risk.** Evidence suggests that locations with a greater number of potential conflicts and interactions, such as high streets, areas with parked vehicles and busier urban environments, may be associated with higher cyclist injury risk.
 - f **Driver and rider behaviour is an important influence on cyclist safety.** However, even where incidents are attributed to driver or rider behaviour, evidence suggests that improved road environments, particularly those that reduce or remove conflicts between cyclists and motor vehicles, may help prevent such incidents from occurring.
- 4 **There are a number of practical ways to make cycling safer.** The strongest findings suggest attention should focus on high-quality cycling infrastructure, particularly physical separation from motor traffic where appropriate, safer intersection design, management of traffic speeds, and road environments that reduce conflict between cyclists and motor traffic.

Recent wider research from Active Travel England (ATE) (2026) aligns with the findings of this review. ATE's 2026 international review of safety, journey quality and urban realm impacts found that physically segregated cycle tracks are associated with lower cyclist injury risk than routes without cycling infrastructure, and that junction design, roundabouts, road type, vehicle speeds, lighting, surface quality and street clutter all influence cyclist safety. It also reports evidence for the Safety in Numbers hypothesis: higher cyclist and pedestrian

volumes may reduce individual risk by increasing visibility, but the effect depends on the local road environment and context.

In conclusion, the evidence from this review suggests that cyclist safety is shaped by interactions between many factors, and rather than acting independently, these factors combine to influence the likelihood and severity of collisions and near misses. Improving cyclist safety therefore requires a system-wide approach that addresses infrastructure, behaviour, training, governance and policy together, recognising the interactions between them. To improve the safety of cycling in the UK, interventions and investment are best implemented in line with these findings, focusing on those areas of highest risk whilst acknowledging the interactions between the various factors.

Consistent with the findings of the review, infrastructure investment is likely to be most effective when following established good-practice principles, including prioritising continuous segregated cycling provision, improvements at higher-risk intersections, and applying a risk-based approach to locations where conflict between cyclists and motor traffic is greatest. More comprehensive and standardised records of cycling infrastructure, together with proportionate monitoring and evaluation of new schemes, would also support improved planning and a stronger evidence base for understanding which interventions deliver the greatest safety benefits.

3. Discussion and recommendations

The previous section sets out the key findings from this review. This section moves beyond the direct findings and offers a possible interpretation of what they may mean for policy, planning and investment.

The evidence reviewed supports a Safety-in-Numbers effect on a local level, but it also cautions against assuming that more cycling in general automatically makes cycling safer. Increased cyclist numbers and increased cyclist density may help reduce individual risk, but only where the road environment can safely accommodate growing demand. Where cycling grows faster than provision for cycling, more people may be exposed to routes and intersections that were not designed to manage that demand.

This is important because, although cycling fatalities in Great Britain have declined over the longer term, serious injuries have risen since 2021 and appear to be driving the recent increase in KSI casualty rates (see Appendix B.2 for further detail). A recent online news article on London cycling injuries highlights the importance of understanding where cycling growth is occurring and whether infrastructure is keeping pace with where, when and how cycling is changing (Swindells and Carlyon, 2026). Although London should not be treated as representative of all cities, the wider principle is relevant: cycling safety depends not only on cycling levels, but on whether sufficient provision exists in the places where demand is increasing. For decision-makers, the findings suggest that planning for cycling growth should extend beyond encouraging uptake alone.

The strongest implication from the review is that cycling safety is unlikely to be explained by any single factor and should be treated as a system issue. Infrastructure, traffic speed and volume, intersection design, road-user behaviour and training all interact. Measures are therefore likely to be most effective when planned as part of a system-wide approach, rather than as isolated interventions.

In practice, however, there are many competing demands and funding restrictions. A system-wide approach should not therefore be interpreted as meaning that improvements must be delivered everywhere at once. Rather, it suggests that individual schemes should be prioritised and implemented within a clear strategic vision for the wider network. Risk-based prioritisation can help deliver early safety benefits and may provide a practical step towards wider network development when resources are limited.

For decision-makers, the findings suggest that investment should be focused where improvements to infrastructure and road design have the greatest potential to reduce conflict between cyclists and motor traffic – in particular segregation on routes and improved intersection design, discussed in more detail below.

Firstly, the evidence points towards the value of high-quality segregated infrastructure on roads with higher traffic volumes or speeds. Where cyclists are provided with dedicated space that is continuous, direct and integrated into the wider network, they are less reliant on sharing road space with motor vehicles and can avoid many of the situations associated with increased risk.

The quality and continuity of provision is however important. Segregation is unlikely to achieve its full safety potential where routes are fragmented, inconsistent or end at locations where cyclists are required to re-enter mixed traffic. For local authorities and highway authorities, this suggests that investment may be most effective when it focuses on creating coherent routes that support complete journeys rather than isolated sections of infrastructure.

Existing official guidance, particularly LTN 1/20: Cycle Infrastructure Design (DfT, 2020), remains the most relevant basis for the planning, design and prioritisation of such infrastructure, with its emphasis on physical segregation and connectedness. It provides a framework for prioritising infrastructure that minimises conflict between cyclists and motor traffic, delivers continuity across journeys and addresses known risk locations such as intersections. LTN 1/20 also notes that most people will not feel comfortable cycling in mixed traffic on roads carrying more than 2,500 motor vehicles per day or where speeds exceed 20 mph and therefore recommends fully segregated cycling provision in many such environments. For local authorities and network planners, this provides a practical basis for prioritising schemes where funding and delivery capacity are constrained. Guidance published by Active Travel England (2025) also provides risk management advice on critical safety issues for cyclists.

Alongside route provision, the review indicates that improved intersection design should be a major priority for investment. The evidence suggests that intersection improvements

should focus on creating lower vehicle speeds and reducing the likelihood of conflicts between cyclists and motor vehicles, thus minimising high-speed interactions. Consistent with this, LTN 1/20 places particular emphasis on junction design that separates cyclists from conflicting motor vehicle movements wherever practicable. The review did not identify a single design solution that is appropriate in all circumstances; depending on the local context, this may be achieved through various approaches. As well as reducing speed limits, creating greater physical separation between users and managing turning movements, there are approaches aimed at influencing driver behaviour, such as narrowing roundabout geometry or reducing visibility distances where appropriate, such that drivers are encouraged to reduce their speed.

Speed management also appears to be most effective when considered alongside wider infrastructure measures. Lower speeds can reduce both collision likelihood and severity, but speed reduction alone may not address risks associated with traffic volumes and frequent conflict points. Measures that jointly reduce speeds and reduce interactions between cyclists and motor vehicles are therefore likely to offer the greatest potential safety benefits.

The findings also suggest that infrastructure investment should not necessarily be considered in isolation from programmes aimed at influencing road-user behaviour. While the evidence indicates that infrastructure is likely to provide the greatest safety benefits, training, education and behaviour-focused initiatives may help maximise the benefits of physical improvements, particularly where interactions between cyclists and motor vehicles remain unavoidable. Decision-makers may therefore wish to consider how infrastructure, training and behaviour-change programmes can be delivered as complementary parts of a wider safety strategy rather than as separate initiatives.

The review also highlights an opportunity to improve the information available to support decision-making, in particular, the absence of a comprehensive and consistent record of cycling infrastructure provision, including detailed information on the type, quality, location and delivery of infrastructure across different areas. Consideration could therefore be given to developing more comprehensive and standardised records of cycling infrastructure at a local or national level. This could provide a stronger basis for sharing good practice, identifying gaps in provision, and understanding how different infrastructure approaches relate to safety outcomes. Data on cycle lanes recently released by Ordnance Survey for the use of Government and local authorities may provide a useful step towards this (Ordnance Survey, 2026). Where new schemes are implemented, proportionate evaluation and monitoring could further support understanding of their effectiveness and help inform future investment decisions.

Based on this review and discussion, the recommendations are as follows:

- Investment should focus on high-quality, continuous segregated cycling infrastructure, particularly on roads with higher traffic volumes or speeds, and intersection improvements, recognising that intersections are among the highest-risk locations for cyclists.

- Infrastructure investment should be prioritised using a risk-based approach, targeting locations where conflict between cyclists and motor traffic is greatest.
- Decision-makers should focus on creating coherent end-to-end cycling routes, rather than isolated sections of infrastructure.
- Decision-makers should ensure that infrastructure provision keeps pace with growth in cycling demand, particularly where cycling activity is increasing.
- Scheme design and prioritisation should be guided by established good-practice principles, particularly those set out in LTN 1/20.
- Government and local authorities should consider developing more comprehensive and standardised records of cycling infrastructure provision, to support planning, monitoring, evaluation and sharing of good practice.
- New cycling schemes should be accompanied by proportionate monitoring and evaluation, to improve understanding of which interventions deliver the greatest safety benefits.

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Appendix A. Method

A.1 Overview

This review has taken a high-level narrative approach to synthesising evidence on the factors influencing cycling safety in the UK. Figure 1 shows an adapted PRISMA 2020 flow diagram (PRISMA, n.d) outlining the process taken to identify relevant evidence for the review. Each stage of the method is described in more detail in the following sections.

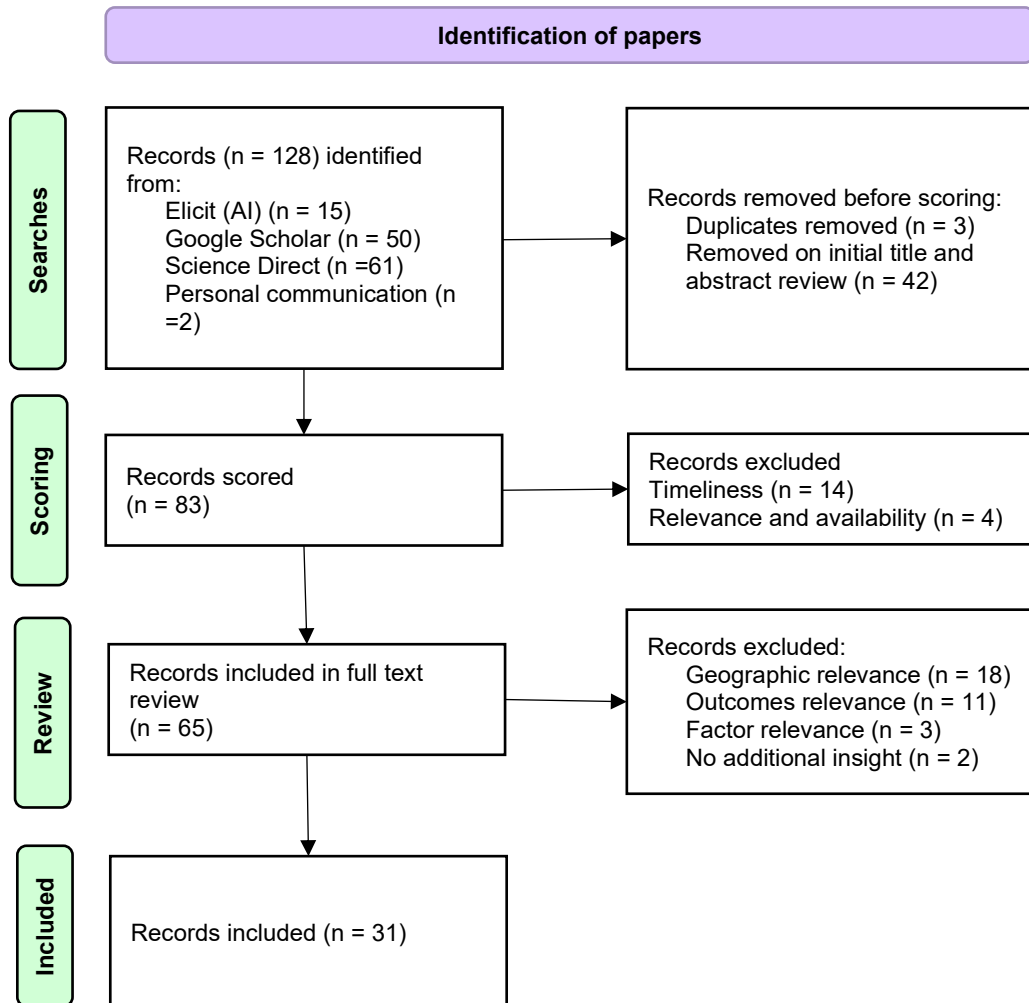


Figure 1: Flow diagram for evidence identification.

A.2 Searches

Search terms were developed using three levels of terms as shown in Table 1. The academic AI evidence searching tool Elicit (www.elicit.com) was used to confirm there were no significant omissions in the search terms.

Table 1: Search terms

1st Level	2nd Level	3rd Level
Cyclist	Safety	Impact
Cycling	Collision	Evaluation
Bicycle	Injury	Factors
Bike	Accident	Effect
	Crash	Outcome
	Risk	Predictors
	Fatality	Determinants
	Near miss	

Although the review was focused on the factors of interest discussed in Section 1, these were not explicitly included in basic search terms; this approach was used to ensure that the choice of factors had not overlooked any significant topics. Since the review methodology was non-exhaustive and high-level, the increased scope of the search terms was manageable.

Note that the search terms shown in Table 1 are illustrative; in practice all forms of each term were included, e.g. injuries as well as injury.

The searches were limited to literature available in the English language. This is a common limitation and justifiable in this instance as the focus is on UK-relevant studies.

Three database searches were carried out.

Elicit: Elicit was used with the full research question (rather than the search terms) to identify 15 relevant records.

Google Scholar: All three levels of search terms were used for a manual search in Google Scholar using Boolean search expressions. Google Scholar accesses various professional and academic databases including TRID, ScienceDirect, Taylor & Francis, PubMed, ResearchGate). The first 50 results were included.

Science Direct: A separate manual search was carried out in ScienceDirect including with a fourth level of search terms based on the factors of interest and requiring inclusion of 'UK'. This additional filtering was added due to the large number of results (over 1 million) following the initial search. The subsequent (filtered) search resulted in 168 records, reduced to 61 based on a relevance assessment (for example, removing records associated with cycles of business activity).

Two additional papers were received through personal communications.

In total, this process resulted in 128 records being identified from the searches; these were reviewed for duplicates and initial relevance based solely on title and abstract. This resulted in 83 records taken forward to scoring.

A.3 Scoring

Each of the 83 records was scored for relevance, quality, and timeliness using the criteria show in Table 2.

Table 2: Scoring criteria

	Score = 1	Score = 2	Score = 3
Relevance	Not relevant to the objectives of the project - little direct evidence on cycling safety factors or safety improvements	Indirect relevance - some discussion of safety-related factors but safety is not the primary outcome	Directly - directly investigates cycling safety risks, collisions, injuries, fatalities, near misses, or evaluates safety interventions
Quality	Non-scientific article (e.g. online source, newspaper, or magazine article)	Scientific article not peer-reviewed	Peer-reviewed
Timeliness	Published over 10 years ago	Published between 5-10 years ago	Published within the past 5 years

Papers receiving a score of 1 for timeliness were checked manually for relevance and quality. If it was felt that they were still sufficiently relevant (for example, a systematic review) they were retained. Fourteen papers were removed for timeliness.

Eight papers that were not freely available were manually assessed for relevance based on title and abstract. Four of these were then purchased / obtained directly from the authors; four were excluded.

NotebookLM was used to assist with the assessment of relevance for the remaining papers; the following three questions were asked for each paper:

- Does the paper examine cycling safety directly?
- Does it identify factors influencing cycling safety or evaluate improvements?
- Are the findings applicable to everyday cycling and transport policy (particularly in the UK or comparable settings)?

Each paper was then given a rating between 1 and 3 on the relevance scale. No papers were excluded for relevance at this stage; the combined score was used for prioritisation in the full-text review. Each paper was also categorised geographically to provide an additional input into prioritisation.

A.4 Full-text review

A full-text review was conducted on 65 papers. All papers which scored a combined score of 8 or 9 and were UK-based or global were prioritised (n=38). The research methodology and key findings of each paper were summarised using NotebookLM and then each paper was manually reviewed by a human researcher to update or modify the summaries as needed.

The lower scoring and non-UK based papers were firstly summarised for methodology and key findings by NotebookLM based on the full text. Based on these summaries, 15 papers were proposed for exclusion; these summaries were checked for accuracy by a human researcher before these were excluded. All remaining papers were then manually reviewed by a human researcher.

The full-text review resulted in a total of 34 papers being excluded. The reasons for exclusion were as follows:

- Geographic relevance, i.e. not related to the UK (n = 18)
- Outcomes relevance, i.e. not related to safety as the main outcome of interest (n = 11) – including perceived safety, uptake, scheme usage, propensity to cycle, inclusivity
- Factor relevance, i.e. not related to the factors of interest (n = 3) – including helmets, enforcement
- No additional insight provided (n = 2)

This resulted in 31 papers included in the review.

A.5 City-specific search

Separate searches were carried out for additional papers specifically relevant to the four cities discussed in Section 1: Birmingham, Bristol, Manchester and London. These searches were carried out using Elicit and Google using the search questions “what is known about the safety of cyclists in X, UK?”, “What factors are the most important in reducing cycling collisions in X UK?” and “cycling safety in X UK”.

No relevant studies were identified specific to Bristol, Birmingham or Manchester. No relevant studies specific to London were identified in addition to those already obtained through the main review process.

Appendix B. Detailed findings

B.1 Factors influencing the safety of cycling in the UK

B.1.1 The evidence base is substantial but uneven, with key gaps and underreporting issues.

The evidence base on factors influencing cyclist safety is substantial but of variable quality. A Cochrane review by Mulvaney et al. (2015) found that robust evidence on the effectiveness of cycling infrastructure in reducing injuries was limited, partly because infrastructure effects are difficult to isolate from wider site-specific factors. It should be noted however that the inclusion criteria for Cochrane reviews are very strict and that a large amount of research has been carried out since its publication, including the studies discussed in this review. A critical review by DiGioia et al. (2017) also highlighted that, while there is evidence for the safety benefits of some infrastructure interventions such as bike lanes, there remains a lack of rigorous research overall (DiGioia et al., 2017).

This is supported by more recent reviews. Salmon et al., 2022 suggests a strong body of evidence around the road environment, infrastructure and cyclist/driver behaviour, but also identifies significant gaps in relation to broader systemic factors, such as training and education, road regulations and design standards.

A further limitation is that the recorded collision data in most studies is likely to underestimate the scale of cycling incidents. Official UK collision statistics highlight an underreporting challenge: “Non-fatal casualties for pedal cyclists are amongst the most likely to be under-reported in road casualty data since cyclists have no obligation to inform the police of collisions” (DfT, 2025). Several papers note this underreporting, particularly for single-cycle crashes, which may be recorded by hospitals but not reported to the police. Myhrmann et al. (2021) suggest that single-cycle crashes make up more than half of cycle crashes in Sweden; Shinar et al. (2018) report that, in the UK, only slightly over 30% of crashes involving severely injured cyclists and only 21% of slight injuries, are documented by the police. Several studies suggest that using near miss data can provide useful additional insight as they can capture unsafe interactions and risks that are not reflected in collision data, however such datasets are usually self-reported and limited in size.

B.1.2 Cycling safety is influenced by a complex interaction of infrastructure, environmental, behavioural and road-user interaction factors.

Systematic reviews by Ibrahim et al. (2021) and Yang and Yang (2023) identify broadly similar groups of factors affecting cyclist safety despite focusing on different outcomes: near misses in the former and collisions in the latter. Both papers identify a group of factors concerning infrastructure and the physical road environment, including the presence, quality and type of cycling-specific infrastructure, intersections, surrounding street design and context such as bus stops. A second group of factors relate to visibility and

environmental factors, including darkness, lighting, weather and time of day. The two remaining groups of factors relate to interactions between road users, and behaviour. Both collisions and near misses tend to be influenced by combinations of infrastructure, environmental road user interaction and behavioural factors.

Overall, the evidence supports the importance of focusing on the factors described in Section 1, that is; cycle-specific infrastructure, street design and environment, traffic volumes and traffic mix, training and education and driver and cyclist behaviour. It is worth noting that factors such as traffic speed and speed limits, although not explicitly included in the search, are fundamentally integral to discussions of traffic volume, infrastructure and street design and so have been addressed by association. One aspect that is not covered within this review is the literature around use and benefits of cyclist personal protection, such as helmets. Although there is a substantial literature on cyclist personal protection, including helmet wearing, this was not a primary focus of this review.

This omission is supported by Walker and Robinson (2019), who used cycles equipped with recording devices in the UK to examine lateral passing distances and highlighted that cyclists are often forced to share space with larger and faster motor vehicles while bearing almost all the physical risk. They argue that focus should be shifted to eliminating risk, for example through infrastructure, rather than relying on harm mitigation measures or placing responsibility on cyclists themselves. This is consistent with a wider road safety concept reflected in the recent changes to the UK Highway Code, which emphasise that drivers have a responsibility to make sure they're not putting cyclists at risk.

B.1.3 Cycling-specific infrastructure is critical to safety.

The evidence consistently identifies cycling-specific infrastructure as one of the most important factors in cycling safety. Ayad et al. (2024) developed a cyclist risk index using literature reviews, collision reports from multiple countries and video analysis. The resulting risk index assigned the greatest weight to 'facility features', notably the type of infrastructure (for example, cycle lane, cycle path, shared use path, off-road/unpaved) and points of conflict (for example, junctions, intersections, parking), highlighting that these factors were considered the most important for driving improvements in cyclist safety.

Modelling using helmet-mounted video footage in London (Christie et al., 2026) also showed the importance of infrastructure when considering near misses; their analysis revealed that the vast majority of near misses (69 out of 94 recorded events) occurred on roads lacking any cycling infrastructure and ten occurred on an on-road cycle lane (non-segregated).

B.1.4 Segregating cyclists from motor traffic significantly improves safety

The evidence on segregation consistently indicates that physical separation from motor traffic is one of the strongest infrastructure-related safety measures for cyclists, although its effectiveness depends on design quality and local context.

Anupriya et al. (2025) evaluated the impact of London's Cycle Superhighways on cycling volume and safety from 2000 to 2019, comparing segregated and non-segregated segments. They found that segregation encouraged greater uptake but also played a protective role in managing the risks associated with higher cycling volumes, with the upgrading of non-segregated routes to full segregation significantly reducing collision risk. (Note that this finding was independent of the so-called 'Safety in Numbers' effect, discussed further below).

Adams and Aldred (2020) carried out a study comparing injury locations in London (between 2016-2018) with control locations; here the authors found that protected infrastructure significantly improved safety in London, with kerb-separated and stepped cycle tracks reducing injury risk, whereas advisory painted cycle lanes increased risk and mandatory painted lanes showed no safety benefit. The authors do not explicitly investigate the reasons for this, although advisory lanes allow motor vehicle encroachment and neither provides physical separation from traffic. Evidence from Kapousizis et al. (2021), which used a matched case study design across Britain, also supports this distinction, suggesting that poor-quality cycling infrastructure, particularly painted cycle lanes, does not appear to protect cyclists and pointing instead to the need for high-quality segregated facilities and better road design. Tait et al. (2022), while focused on compliance with infrastructure standards rather than safety outcomes, highlight that physically segregated on-road cycle lane provision in London remains limited (with only 6% of on-road cycle length being physically segregated). Cycling infrastructure is unevenly distributed across London and variable in quality across boroughs.

Yang & Yang 2023 identify a lack of specialised cycling infrastructure as a key contributory factor to cycling safety. The study highlights that separated cycle paths are significantly safer than shared paths, as they remove cyclists from motorised traffic. This is reflected in the Department for Transport's guidance for local authorities on cycle infrastructure design (LTN 1/20) which identifies separation from motor traffic as critical for cycling safety on busy or fast roads. It specifies that most people will not feel comfortable cycling in mixed traffic on roads with more than 2,500 vehicles per day or speeds exceeding 20 mph. To improve safety in these scenarios, the DfT recommends fully physically segregated cycle tracks, and redesigning junctions to separate cyclists from conflicting motor vehicle movements.

At the same time, the evidence suggests that segregation should not be treated as automatically sufficient in all circumstances. The DfT guidance also highlights the importance of reducing motor traffic volumes and speeds. In a systematic review of cycle infrastructure design for safety, Chen et al. (2026) identify a strong consensus that physically separating cyclists from motor traffic through separate cycle tracks is the most effective way to reduce injury risk. They emphasise, however, that safety outcomes remain highly context-dependent, highlighting the impact of traffic volumes, the surrounding environment and intersections. This is particularly important where cyclists and motor vehicles are brought back into conflict after being separated, reinforcing the need for segregated infrastructure to be continuous, well-designed and integrated with junction and wider street design.

B.1.5 Intersections are a key risk to cyclists.

Intersections are consistently identified as among the highest-risk locations for cyclists. While segregation can reduce conflicts between cyclists and motor vehicles along links, many of the remaining risks are concentrated where routes cross or where different road users are brought into conflict with each other. The evidence suggests that both the presence of an intersection and its specific characteristics, such as road type, visibility and layout, influence cyclist safety.

Kapousizis et al. (2021) examined infrastructure risk factors across Britain using a matched case study design and found that cycling injury risk was higher on main roads, wider roads and at intersections. The increased risk for main roads and wider roads is likely related to associated higher motor vehicle speeds; this interaction is discussed later in this section.

Ye et al. (2024) created a machine learning model using Google Street View imagery alongside collision and casualty data from London (2017–2021). The study supports the finding that intersections are the primary high-risk locations for cyclists but goes beyond this by suggesting that risk increases with the class of the intersecting road (for example, ‘A’ class or ‘B’ class roads). This may indicate a safety benefit to targeting intervention where higher-class roads intersect with cycling routes.

Talbot et al. (2017) investigated the factors involved in 53 fatal and serious-injury cyclist collisions in London between 2007 and 2011, with a particular focus on 27 involving heavy goods vehicles (at least 3.5 tonnes). The study identified visibility issues and road users being ‘forced’ into conflict at intersections due to road narrowing and shared lanes as key contributing factors.

B.1.6 Intersection design can improve cyclist safety by reducing vehicle speeds and increasing driver attention.

While intersections are generally associated with elevated cyclist risk, the evidence suggests that the specific geometric design of these locations can have a substantial influence on both collision likelihood and injury severity. Features that affect vehicle speed, visibility and the nature of interactions between road users appear to be particularly important.

Akgun et al. (2018) investigated geometric design factors influencing cyclist casualty severity at non-signalised roundabouts. The study found that higher speed limits, a greater number of lanes on the approach, and a wider entry path significantly increased the probability of a cyclist sustaining a serious injury. The authors suggest that the entry path radius can be considered a proxy for vehicle speed, with wider, more open designs encouraging higher vehicle speeds and increasing cyclist risk.

Akgun et al. (2021) compared cycling safety between the UK and Belgium to identify factors associated with cyclist injury severity and explore national differences. In the UK, higher speed limits were associated with a greater probability of cyclists being killed or seriously injured, whereas speed limit was not a significant factor in Belgium. The research suggested

that tighter roundabout geometry, such as a radial design (more commonly used in Belgium) rather than tangential designs (more commonly used in the UK), can improve cyclist safety by forcing drivers to reduce their speed when approaching the roundabout.

Evidence from Ekmekci et al. (2024) further highlights the relationship between geometry, visibility and speed at intersections. The study evaluated priority intersections in Portsmouth and found that geometric visibility plays an important role in collision risk, particularly for right-turn collisions. Consistent with the principles set out in the UK's 'Manual for Streets' (DfT and DCLG, 2007), the findings suggest that shorter visibility distances in lower-speed residential environments may sometimes improve safety by encouraging more cautious driving behaviour. The study found that good visibility from 9 m back from the junction was associated with higher collision rates, potentially because drivers were less likely to reduce speed when approaching the junction.

The evidence also suggests that vehicle speed on approaches from minor roads is associated with increased collision risk. Ekmekci et al. (2024) suggest that 20 mph speed limits and road width are significant moderators of vehicle speed on minor roads.

These studies indicate that intersection design can improve safety through design features that reduce speeds, encourage greater driver attention and minimise the severity of conflicts between cyclists and motor vehicles.

B.1.7 The interaction between speed limits, traffic speeds and traffic volumes is complex, with cyclist injury risk influenced by the combined effects of all three factors.

The evidence suggests that speed limits, actual traffic speeds and traffic volumes interact in shaping cycling injury risk, rather than operating independently.

A study comparing cycling injuries in London between 2013 and 2014 with randomly selected control sites (Aldred et al., 2018) investigated traffic volume, speed limits and road type and found that 20mph speed limits were safer than 30mph speed limits, residential streets were safer than other road types and, again, junctions were less safe, and that increased motor traffic volume is associated with higher odds of cycling injury.

Adams and Aldred (2020) repeated a similar study using data from London between 2016 and 2018 to provide more detail. This showed that intersections were the strongest injury risk factor, tripling injury odds compared with a non-intersection location. The use of actual traffic speed in this study (as opposed to just speed limits) highlighted an important distinction; where low speed environments were created by congestion, they were associated with a higher frequency of collisions, probably because high traffic density increases interactions between road users. Therefore, while faster roads remain riskier in terms of injury severity, the apparent protection of low-speed limits may be reduced in congested or high-traffic environments. In low traffic volumes, residential roads and minor roads were shown as safer than major roads.

Near-miss evidence supports these findings; Christie et al. (2026) showed that designated cycle routes through low-traffic, low-speed residential streets in London were associated with a reduction in reported near misses, but at the same time, they suggest that cyclists choosing to avoid heavy traffic on major roads may move onto 30mph residential roads that are not designated cycle routes, and this may in fact result in them being exposed to higher risk.

B.1.8 The complexity of the road environment may increase cyclist risk.

The evidence suggests that cyclist risk may also be influenced by the overall complexity of the road environment. Environments containing a greater number of potential conflicts, interactions and visual stimuli may be associated with increased risk.

Kapousizis et al. (2021) found that cycling injury risk was higher on high streets, in the presence of guard rails, and around parked vehicles and other sources of traffic conflict. Ye et al. (2024) also identified characteristics associated with more complex environments. Their model suggested that darkness and high levels of greenery coverage were associated with increased cyclist risk; the latter is identified as counter-intuitive and requiring further research. The study also found that 20 mph speed limits were associated with higher risk, contrary to findings from other studies. The authors suggest that this may reflect characteristics of the surrounding environment rather than the speed limit itself.

Similarly, Adams and Aldred (2020) found that higher pedestrian density was associated with increased injury risk; this may reflect the greater number of interactions and movements that cyclists encounter in busier urban environments.

B.1.9 Evidence supports a ‘Safety in Numbers’ effect, where higher cyclist volumes are generally associated with lower individual cyclist risk.

The ‘Safety in Numbers’ (SiN) hypothesis proposes that as the number of cyclists in a given environment increases, the risk faced by individual cyclists decreases. A commonly suggested explanation is that motorists become more aware of cyclists, or have a higher expectation of seeing them, and adapt their behaviour accordingly.

Support for the Safety in Numbers effect is provided by Aldred et al. (2018), who found that higher cycling flows were associated with lower odds of cycling injury in London. Similar findings were reported by Adams and Aldred (2020) and Kapousizis et al. (2021), suggesting that increased cyclist flow is generally associated with lower risk to individual cyclists at a local level.

Aldred et al. (2019) examined the Safety in Numbers effect across 202 local authorities in Britain using census data between 1991 and 2011 and STATS19 KSI records. The study found that areas with higher levels of cycling tended to have lower risk per cyclist than areas with fewer cyclists. It also found longitudinal evidence for the effect, with areas experiencing increases in cycling tending to become safer per cyclist compared with areas where cycling levels declined. However, the authors note that this effect co-existed with worsening cyclist

safety at the national level, suggesting that increases in cycling alone are not sufficient to guarantee improved safety.

B.1.10 Several studies caution against assuming that increases in cyclist numbers automatically lead to improved safety however.

A multi-disciplinary study in Oslo, Norway (Fyhri et al., 2017) found strong support for the Safety in Numbers hypothesis but also argued that increased cyclist volume may mean that different types of cyclists become involved, including less experienced and less skilful riders; this may offset some of the safety benefits associated with higher cycling volumes.

Similarly, Anupriya et al. (2025) found that the safety benefits associated with increased cycling volumes can be overwhelmed if infrastructure does not provide sufficient physical protection to accommodate less experienced cyclists. The authors argue against the assumption that increased cycling volumes alone can compensate for poor infrastructure provision.

Research into the potential mechanisms behind the SiN effect suggests that cyclist *density* may be more important than overall cyclist numbers. Thompson et al. (2019) analysed video observations at an intersection from Melbourne, Australia and found that improved safety appeared to be driven by local cyclist spatial density rather than just an overall increase in cyclist numbers. They propose a ‘safety in density’ effect in places where motorists and cyclists interact where the causal mechanism is smaller time gaps between cyclists that motorists are less likely to accept, independent of any ‘familiarity’ mechanism.

Evidence also suggests that similar effects can be observed more widely in micromobility. A natural experiment by Edwards et al (2025) tested the SiN hypothesis following the introduction of e-scooter rental schemes in England. They found that the rate of cycle collisions reduced following the introduction of the e-scooter rental schemes, compared with control districts which had no rental schemes. The introduction of e-scooter schemes was associated with, on average, around a 20% relative reduction in cycle collisions; this effect was specific to cycle collisions (the effect was not seen for non-cycle collisions) and strongest for KSI collisions.

It is important to note that the evidence discussed here should not be interpreted as meaning that simply increasing the total number of cyclists will automatically improve cycling safety, particularly when considering safety at a national level. The Safety in Numbers hypothesis is usually framed as operating ‘in a given environment’, implying that the effect depends on the local road context. This is consistent with the effect being observed at local authority level but does not necessarily imply the same is true nationally. At national level, changes in cyclist casualty risk may be influenced by other factors, as discussed above. The suggested ‘safety in density’ mechanism also supports this, as it depends on local concentrations of cyclists affecting driver behaviour, rather than on overall cyclist numbers across a wider area.

B.1.11 Driver and rider behaviour is an important influence on cyclist safety.

The behaviour of drivers and cyclists is consistently identified as an important factor in cyclist safety and is widely discussed in the evidence base as part of the complex interaction with environmental and infrastructure factors, however little direct evidence investigating behaviour in isolation was found in this review.

Official collision statistics indicate that many incidents may be due to behaviour. Table 1 shows the factors recorded by the police as contributing to fatal and serious collisions involving pedal cycles in Great Britain between 2019 and 2023.

Table 1: Contributory factors allocated to vehicles involved in fatal or serious collisions with pedal cycles, GB: 2019 to 2023 (DfT, 2024a)

Contributory Factor	Pedal cyclists	Non-pedal cyclists	Any vehicle involved
Driver or rider failed to look properly	2,557	5,240	7,797
Driver or rider failed to judge other person's path or speed	1,154	1,679	2,833
Driver or rider careless, reckless or in a hurry	961	1,580	2,541
Cyclist entering road from pavement	835	101	935
Poor turn or manoeuvre	467	999	1,467
Rider wearing dark clothing	417	37	454
Loss of control	375	111	486
Travelling too fast for conditions	260	162	422
Not displaying lights at night or in poor visibility	253	16	269
Driver or rider impaired by alcohol	241	128	370

The most frequently recorded factors are the driver or cyclist 'failing to look properly', 'failing to judge other person's path or speed' and being 'careless, reckless or in a hurry'. In all cases, these errors are assigned to users other than cyclists more often than to cyclists.

These figures are consistent with evidence from self-reported incidents and near misses. Aldred (2016), using an online diary survey of UK cyclists, explored the impact of road user behaviour and infrastructure and found that the most common near misses reported were: a cyclist's way being blocked (often resulting in the cyclist needing to swerve), close or problematic overtaking, and vehicles pulling across a cyclist's path. Most respondents believed that these incidents could be prevented by improved road environments to remove conflicts, particularly separated infrastructure, or changes in others' behaviour. The authors suggest that infrastructure improvements could be complemented by appropriately designed enforcement and educational campaigns aimed at reducing unsafe driving behaviours. Similarly, Useche et al. (2018), in a survey of 1,064 cyclists across 20 countries, found that 83.6% of respondents reported frequent problematic interactions with other road users.

Cycling experience may also influence safety outcomes; using data from the UK Near Miss Project, Aldred and Goodman (2018) found that cyclists with less than two years' experience reported substantially higher near-miss rates than more experienced riders. Given that the

incidents are self-reported, the authors caution that newer cyclists may be more sensitive to such incidents than the more experienced. The relationship between experience and safety is also impacted by differences in exposure and cycling behaviour, for example experienced riders may become more skilled but they may also feel more confident and choose to ride in higher-risk environments more often, such as on non-segregated infrastructure.

B.1.12 Cycle training has been shown to contribute to improved cyclist safety, but only limited evidence was identified.

Compared with other factors, particularly infrastructure and street design, the evidence base on training and education identified in this review is relatively limited.

Based on a TRL study, Bishop et al. (2026) analysed the relationship between Bikeability training and cyclist KSIs across 112 English local authorities between 2013 and 2022. The study found that higher levels of Bikeability Level 2 training were associated with lower cyclist-involved KSI rates. No equivalent relationship was identified for Bikeability Level 3 training, though this may be explained by the relatively low amount of Level 3 training delivered compared with Level 2. These findings suggest that cycle training for children may contribute to safer cycling, though the study acknowledges that cause-and-effect cannot be established.

Evidence also suggests that training can improve skills associated with safe riding. Bishop et al. (2022) carried out a small pilot study of an immersive video-based training intervention for children designed to improve hazard perception and situation awareness. The trained group performed significantly better than the control group during real-world on-road assessments, specifically in observation, communication, positioning and understanding road priorities. The study was based on a small sample and did not measure safety outcomes directly however it may suggest the potential value of such training.

B.1.13 In summary, cyclist safety is shaped by the interaction of multiple factors, requiring a system-wide approach to improving safety.

Useche et al. (2018) argue that cyclist safety should be understood as a complex, multi-faceted problem rather than the product of any single factor. Their international survey of 1,064 cyclists across 20 countries identified significant associations between human factors, infrastructural conditions and self-reported road crashes, highlighting the interdependence of these influences. This perspective is consistent with the overall findings of this review.

B.2 Collision data

The Department for Transport (DfT) publishes annual statistics on pedal cyclists involved in road collisions in Great Britain. These are based on STATS19 data on all collisions reported by or to the police and on National Road Traffic Census estimates which produce the total vehicle miles cycled.

Table 3 summarises the number of reported cyclist casualties by severity, the total vehicle miles cycled and the resulting cyclist casualty rates by severity in Great Britain between 2010 and 2025.

Table 3: Number and casualty rates of reported pedal cycle casualties by severity GB: 2010 to 2025 (Source: Department for Transport, 2026)

	Number of reported pedal cycle casualties by severity and traffic (pedal cycle billion vehicle miles travelled)					Casualty rates by severity per billion vehicle miles			
Year	Killed	Serious	Slight	All	Traffic	Killed	Serious	Slight	All
2010	111	3,719	13,355	17,185	3.10	36	1,201	4,313	5,549
2011	107	4,252	14,856	19,215	3.17	34	1,343	4,693	6,070
2012	118	4,406	14,567	19,091	3.35	35	1,313	4,342	5,690
2013	109	4,369	14,960	19,438	3.24	34	1,347	4,611	5,991
2014	113	4,782	16,392	21,287	3.59	32	1,333	4,571	5,936
2015	100	4,402	14,342	18,844	3.37	30	1,307	4,258	5,594
2016	102	4,200	14,175	18,477	3.36	30	1,249	4,216	5,495
2017	101	4,203	14,017	18,321	3.46	29	1,213	4,046	5,289
2018	99	4,202	13,249	17,550	3.52	28	1,194	3,764	4,986
2019	100	4,062	12,721	16,883	3.63	28	1,120	3,506	4,653
2020	141	4,152	12,001	16,294	5.30	27	784	2,265	3,075
2021	111	4,176	12,171	16,458	4.20	26	995	2,899	3,920
2022	91	3,940	11,662	15,693	3.90	23	1,011	2,992	4,026
2023	87	3,843	11,069	14,999	3.61	24	1,064	3,064	4,152
2024	82	3,753	10,714	14,549	3.52	23	1,065	3,040	4,128
2025	79	4,311	11,652	16,042	3.67	22	1,174	3,172	4,367

Figure 2 shows the estimated 'killed and seriously injured' (KSI) casualty rate for cyclists in Great Britain between 2010 and 2025.

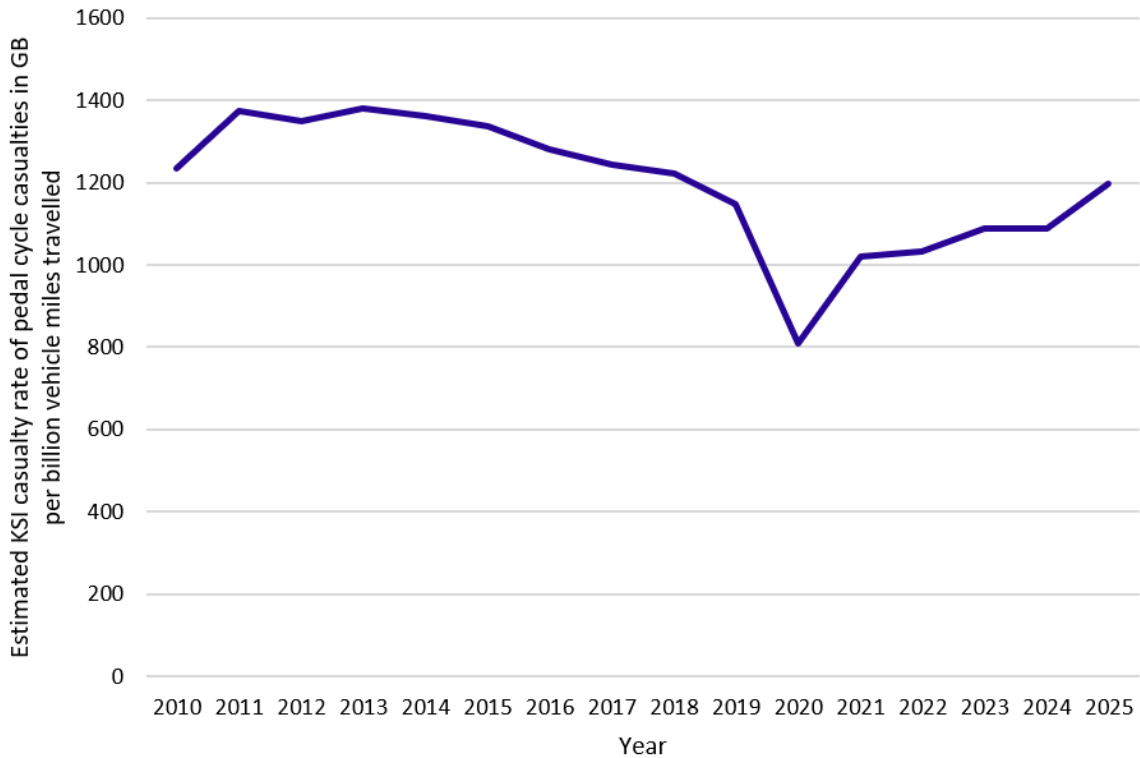


Figure 2: Estimated KSI casualty rate of pedal cycle casualties in Great Britain per billion vehicle miles travelled, 2010 to 2025 (Source: Department for Transport, 2026)

There is a clear drop in the casualty rate in 2020, presumably due to the COVID-19 pandemic, however since 2021 there appears to be an upwards trend which is largely driven by the 'serious injury' category.

B.3 City-specific findings

The city-specific element of the review aimed to identify whether there was evidence of particular cities providing transferable 'best practice' examples, for example where a specific intervention had been implemented and robustly evaluated in a way that could inform recommendations for other cities in terms of improving safety. However, the review did not identify evidence that would support this type of city-to-city comparison.

This reflects two apparent evidence gaps. Firstly, there appears to be no comprehensive, consistent and up-to-date record of what cycling infrastructure has been delivered in each city, including the type, location, quality, continuity and delivery date of schemes. Without this information, it is difficult to compare cities meaningfully or to understand which interventions may be associated with changes in cycling safety outcomes. Secondly, the review found limited local-level evaluation evidence assessing the safety impacts of specific cycling infrastructure schemes or interventions, outside a small number of London-focused studies, which were included in the main review. As a result, it is not currently possible to identify robust examples where a particular city-level intervention can confidently be

described as having improved cycling safety and recommended for direct replication elsewhere.

In the absence of this evidence, the most appropriate source of ‘best practice’ remains existing design guidance, for example Local Transport Note 1/20 (DfT, 2020) as previously discussed. This sets out DfT guidance on cycle infrastructure design for local authorities and provides principles for delivering coherent, direct, safe, comfortable and attractive cycling networks. It emphasises the importance of high-quality, continuous infrastructure, including appropriate separation from motor traffic on busier or faster roads and careful treatment of junctions where conflict risk is highest. The findings of this review are broadly consistent with these principles, particularly in relation to segregation, junction design, and the need to consider traffic speed and volume.

Future work would benefit from better data on both infrastructure provision and intervention impact. A central, standardised database of cycling infrastructure schemes would provide a stronger basis for monitoring, comparison and evaluation. This could be complemented by more consistent local-level evaluations of cycling interventions, using before-and-after collision, exposure and near-miss data where possible.

Recommendations for cities should be framed around applying established design principles and improving local monitoring and evaluation, rather than replicating specific city examples that have not been robustly evaluated.

Factors influencing the safety of cycling in the UK

Evidence review

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