

Interconnected Urban Systems and Road Safety: An In-depth Analysis of Fatal and Serious Cycling Collisions in the Liverpool City

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Background and Motivation

Recent trends have revealed an increase in Killed or Serious Injury (KSI) collisions, particularly among vulnerable road users like cyclists. Despite extensive research on road safety over the past three decades, much of the existing work focuses mainly on engineering solutions, often overlooking the broader urban context. This study aims to address this gap by adopting an integrated approach to examine KSI cycling collisions within Liverpool's urban system. It considers urban infrastructure, social and economic activities, and governance to develop comprehensive policy recommendations for improving road safety.

Data and Methods

The study combines qualitative and quantitative approaches, starting with a review of previous studies, policy documents, and interviews with local safety officers and councillor to identify factors within the urban system that contribute to KSI cycling collisions. The quantitative analysis as shown in the table below aims to examine correlations between these attributes and KSI cycling collisions at the neighbourhood level.

Analysis	Data
Vehicle types involved in the cycling KSI collisions	<ul style="list-style-type: none"> DfT STATS 19 Road Safety Datasets DfT Cycling Statistics Liverpool City Region Household Travel Surveys
Casualties, who were killed or seriously injured in the collisions.	
Demographic and socioeconomic characteristics of those involved in the collisions	
Spatial analysis of where the collisions occurred	<ul style="list-style-type: none"> DfT STATS 19 DfT Road Traffic Statistic LCRCA Vivacity Data
Regression analysis to investigate correlations between total number of KSIs in each local area and their urban systems	<ul style="list-style-type: none"> STATS 19 accident data Ordnance Survey National Geographic Database National Cycle Network Office for National Statistics

Key Findings

Increased Concerns in KSI Cycling Collisions: The study identifies an increase in KSI cycling collisions in the Liverpool City Region since 2020. While the rate of motor vehicle collisions per mile travelled continued to decline until 2020 (i.e. during the pandemic), the rate of KSI cycling collisions per mile cycled has remained relatively unchanged, with the exception of 2020, likely due to pandemic-related factors. This indicates that the risk of KSI cycling collisions is influenced by more than just the number of cycling trips or distance travelled.

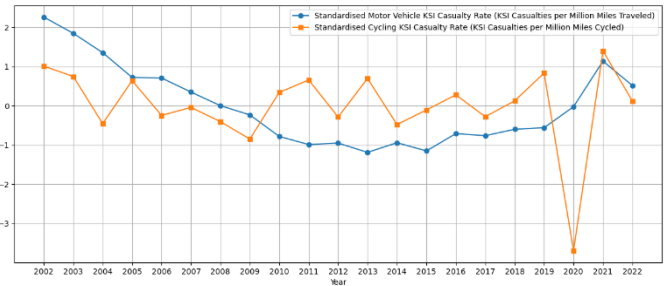


Figure 1 Standardised KSI Casualties per Million Miles Travelled

Ineffectiveness of Traditional Approaches: Traditional road safety measures, such as engineering solutions targeting collision hotspots, are ineffective for cycling KSI collisions due to their relative rarity and the complex role of urban and street forms.

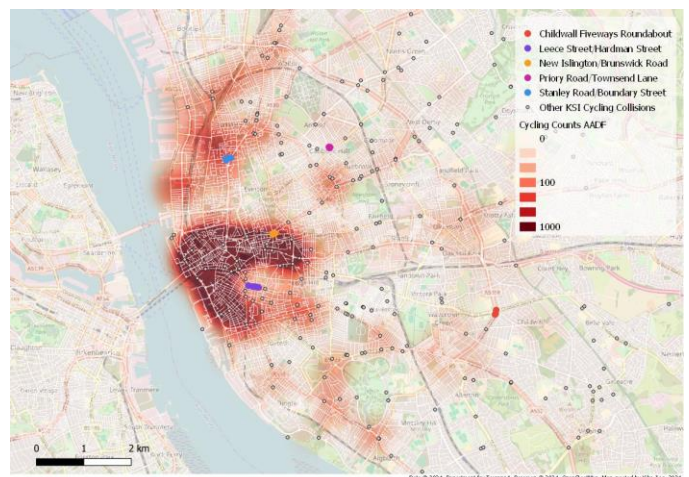


Figure 2 Cycling KSI Collisions Clusters & 2021 Annual Daily Average Cycling Flow Heatmap

Urban System Correlation: while factors like **network complexity** and **junction presence** are strongly correlated with KSI cycling collisions, cycling infrastructure, such as the length of cycle lanes, showed no significant correlation. **Traffic conditions** were statistically significant, with higher traffic density areas posing a greater risk. The inclusion of additional urban system attributes, specifically the **presence of colleges** is significantly correlated to the risk of KSI cycling collisions. Additionally, individuals from **economically deprived groups** are more likely to be involved in KSI cycling collisions. **Male** cyclists and **under-16** individuals display distinct patterns in collision involvement, though data for the under-16 group is limited.

Value of the Research

This study combines data analysis with a qualitative review and interviews, emphasising the importance of addressing cycling safety through a multifaceted approach. Unlike traditional planning practices, which have primarily focused on infrastructure investment, this study employs a methodology that considers the broader urban system in Liverpool while also identifying data limitations, particularly in relation to traffic counts, vulnerable populations, and emerging technologies.