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Environmental Risk Factors for Railway Suicide: A Nationwide Analysis of England's Mainline Network (2019–2021)

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ABSTRACT

Objective: Suicide is the leading cause of death on the railway networks, yet little is known about the geography and socio-environmental determinants of such deaths in England.
Method: We analyzed official records of all suspected suicides recorded on England's mainline railway from April 2019 to March 2021 ($N = 436$), alongside area-level data (e.g., deprivation and urbanicity) and railway characteristics (e.g., station size). We used SaTScan's Poisson discrete scan statistic to detect spatial–temporal clusters and compared suicides at station and non-station locations, including stations with no recorded suicides over the study period.
Results: Most railway suicides—particularly those occurring at stations—took place in urban areas, typically at locations with a very low incidence of previous suicides. A large majority (84.5%) lived within 2 miles of a station and died close to home (median 2.1 miles) or their last known location (1.5 miles). Suicides occurred most often at stations (43.3%), followed by trackside locations (37.6%), foot/level crossing (15.1%) or other rail areas (3.9%). These were often not the nearest station to the deceased (59.6%), but were generally smaller and more likely to be served by fast/non-stopping trains. Across the network, stations without suicides were far less likely to be served by such trains (66% vs. 94.3%; $OR = 6.62$, 95% CI 3.33–13.18).
Conclusions: Urbanicity and the availability of non-stopping train services are key predictors of railway suicide. Restricting access to high-speed trains—especially at smaller urban stations and at non-station locations—could be an effective element of broader strategies and local partnership approaches to prevent suicide.

KEYWORDS
Cluster; environment; geography; location; railway; suicide

HIGHLIGHTS

- In England, most railway suicides (especially at stations) occur in urban areas
- Most people died near home, but often not at their nearest station
- Fast trains at nearby stations predicted death at station vs. non-station locations

INTRODUCTION

In many countries, suicide is the leading cause of death on the railway networks (European Union Agency for Railways, 2018). Such deaths constitute a substantial proportion of all suicide deaths, particularly in countries with dense railway networks (e.g., 7.3% of suicides in Germany and 10–12% in the Netherlands; Balt et al., 2024; Moritz et al., 2023). In Great Britain, where over 90% of fatalities on the railways are classified as suicides or suspected suicides, the yearly number of fatal and injurious attempts on the railways has ranged between 280 and 360 since 2011–2012 (Tyers & Stewart, 2024). This is equivalent to approximately one in 20 of all suicide deaths and one in 12 young suicides in England (Norman et al., 2024; Office for National Statistics, 2024a).

Research has shown that suicide prevention measures can be effective in reducing rail suicides (Barker et al., 2016; Belur et al., 2024). To date, the strongest evidence relates to interventions such as barriers and fencing which restrict access to the tracks (Barker et al., 2016; Havârneanu et al., 2015; Fredin-Knutzén et al., 2022). However, as these may not always be feasible or cost-effective in relation to rail networks, it is important to understand the environmental risk factors and geographical distribution of railway suicides so that preventative measures can be implemented and prioritized accordingly.

Previous studies suggest that, given the marked variation in rail density and infrastructure worldwide, local and national specificities must be taken into account when considering the geographic patterns of suicides on the railways (Mishara & Bardon, 2016; Too et al., 2014). For example, the proportion of suicides occurring at stations (as opposed to open tracks or level crossings) ranges from 2% in Canada to 53% in Sweden (Mishara & Bardon, 2016) and 43% in England (Norman et al., 2024). Urbanicity has been identified as a risk factor in several countries, but appears to be protective in the Netherlands (Balt et al., 2024). Similarly, track length correlates significantly with suicide frequency in England and Wales, but not in Germany or the Netherlands (Too et al., 2014). The extent to which deaths are concentrated in identifiable clusters or 'hotspots' also varies widely, from 0% in Canada to 17% in Austria, 30% in Chicago, and 35% in Belgium and Australia (Mishara & Bardon, 2016, 2017; Savage, 2016; Strauss et al., 2017; Too, Pirkis, et al., 2017).

Compared with other countries, there has been limited examination of spatial and environmental variables in relation to railway suicides in England (Department for Transport, 2025), despite evidence that findings from other settings may not be fully generalizable due to differences in rail density and infrastructure (Too et al., 2014). To address this gap, we conducted the first systematic analysis of the geography of railway suicides across England. Earlier comparable work has been confined to three routes within 75 miles of London (Ryan, 2017). Consistent with findings in Japan (Sueki, 2022) and Austria (Niederkrotenthaler et al., 2012), that study reported that most suicides occurred on 'fast lines', "where trains do not stop at most stations". However, the extent to which these findings represent the national picture remains unclear. For instance, the proportion of station suicides in that study (70%) was considerably higher than that observed across the rest of England (Norman et al., 2024).

The aim of this study was to examine a range of environmental factors that may be associated with railway suicides in England. Of key interest were questions around

(1) the geospatial distribution of suicides on the English rail network (e.g., were there any clusters of suicides occurring unusually close in space and time during the study period?); (2) the distance people traveled to their place of death (e.g., what proportion of people died at their nearest station?); (3) the role of urbanicity (e.g., was urbanicity a risk factors for rail suicides? How did deaths at urban locations differ from those in rural areas?); and (4) the characteristics of suicides at different location types (e.g., what factors predict deaths at station vs. non-station locations? How do stations with one or more suicides differ from stations on the wider network?).

METHODS

Database

The dataset for this project is derived from the fatality investigation files compiled by the British Transport Police (BTP) for suspected suicides on the railway in England (excluding London Underground) from April 2019 to the end of March 2021 ($N = 436$). We extracted information relating to personal demographic characteristics and circumstances of death including date, location, and time (see Norman et al. (2024) for full details, including exclusions, missing data and an overview of individual characteristics and circumstances of death). As the data include deaths occurring before and during the COVID-19 pandemic, we used the date of the first UK lockdown (March 23, 2020) to define these periods.

We expanded the original database to include details of the nearest station to the deceased's home address (HA) and distance between each person's location of death (LoD) and their HA and last known location (LKL). A new variable was created to identify individuals who died at their nearest station, and for each 'nearest station' and LoD (where this was a station) we imported details of 'fast passes' at peak time (i.e., whether or not the station had any non-stopping trains passing a platform that is accessible to passengers between 7–10 am and/or 4–7 pm) (for 2024), passenger footfall (for 2018–2019) and 'station classification' (A—national hub; B—regional interchange; C—important feeder; D—medium staffed; E—small staffed; F—small unstaffed) (for 2020) from a database of all stations made available by Network Rail. Additional station characteristics and staffing information were sourced from a database complied by a disability and transport rights website (Doug Palley, 2021).

Using data provided by BTP on the 'risk level' of suicides on the railways by Police Force Area (as a proportion of all suspected suicides between February 1, 2022 and July 31, 2022, based on a national average of 4.5%), we assigned each HA and LoD to one of four categories: (i) Low risk: where suicides by rail accounted for less than 3.5% of all suicides; (ii) Average risk: 3.5% to 5.4%; (iii) High risk: 5.5% to 9.9%; (iv) Very high risk: 10% or more.

We also calculated indices of multiple deprivation for residential postcodes (Office for National Statistics, 2021) and levels of urbanicity for HAs, LoDs, and all stations in England, based on Local Authority Districts (Office for National Statistics, 2023) and Census Output Areas (the smallest unit of analysis for English census data) (Office for National Statistics, 2024b).

Finally, we created a separate database of all stations in England ($N = 1,994$) which listed whether each station had been the site of a suspected suicide during the study period and/or was one of the 'nearest stations' we identified.

Analysis

Descriptive statistics were produced using Excel and SPSS. t-Tests and Mann–Whitney U-tests were used to compare differences in relation to continuous variables. In other cases, chi-square was used as a test of statistical association.

We conducted binary logistic regression to examine which factors were independently predictive of suspected suicides at stations (vs. non-station locations and other stations in England). Variables that were significantly associated with the outcomes at univariate level ($p < .05$) were not included in regression models if highly correlated with each other (e.g., staffing levels and station category), to reduce the risk of over-adjustment.

To investigate the presence of spatial–temporal clusters we performed Poisson discrete scan statistic using SaTScan V.9.4.1 (Office for National Statistics, 2011) (see Appendix A for further detail).

Ethics

Ethical approval for this study was obtained from the Middlesex University Research Ethics Committee (reference 17711).

RESULTS

Geo-Spatial Distribution of Suspected Suicides on the Railways in England

We identified a significant geo-spatial cluster of eight white men in the North West of England (median age of 50, range 18 to 70) who had died at a station ($n = 4$) or other rail location (in no case the same) within 8.5 miles of their HA (median = 2 miles, range: 1.5 to 8.2 miles). There were no known links between these deaths.

No further significant clusters were identified based on HA or LoD. However, 16 deaths (3.67% of all suspected rail suicides in the study period) occurred within 4 months of one ($n = 15$) or two ($n = 1$) suspected suicides at the same rail location (in most cases (11/16, 68.8%) before the first UK lockdown in March 2020, particularly August and September 2019 ($n = 6$)). An additional 13 deaths (2.98% of the overall sample) occurred within 4 months of one or more suspected suicides within a mile radius.

Compared to other rail suicides in the study period, deaths occurring within 4 months and a 1-mile radius of another rail suicide were more likely to have occurred at a station (33/52, 63.5% vs. 156/384, 40.6%; $X^2 = 9.726$, $df = 1$, $p = .002$), and in an urban location (48/52, 92.3% vs. 289/384, 76.3%; $X^2 = 6.911$, $df = 1$, $p = .009$). The first deaths in such groupings included individuals who were on average younger than those who followed (i.e., those who died second or third) (median age = 33.5 vs. 49.5, Mann-Whitney $U = 460.0$, $p = 0.023$). They were also on average younger than the wider sample whose deaths were not geospatially linked to another rail suicide ($n = 384$, median age = 41), but not significantly so (p = 0.225). All three groups were otherwise comparable in terms of their socio-demographic profiles. In one case, the deceased knew each other. In all other cases (total n = 50), there were no known links between these deaths.

Distance Travelled

Most individuals traveled a short distance to their place of death (median distance from HA = 2.1 miles). Where known, the deceased's last known location (LKL) was often their HA (255/330, 77%) and most people traveled less than 2 miles to their LoD (median distance = 1.5 miles). For under 18s, this distance was significantly shorter than in older age groups (median = 0.6 miles vs. 1.6 miles). Distances from HA and LKL to LoD were slightly greater for people living in rural vs. urban locations, but not significantly so ($p = 0.529$).

There was little evidence that people had traveled to specific places that were meaningful to them, although 83 individuals (19%) had a known connection to the railways (e.g., living within 0.25 miles of their LoD (n = 23); a friend or relative who had died or worked on the railway (n = 10); being a regular train traveler (n = 11), a former or existing rail worker (n = 14) or a known railway enthusiast (n = 6); or familiarity with the location e.g., as a regular walking route (n = 17)). In 32 cases (7.3%), the person was known to have researched their LoD and 22 individuals (5.0%) had visited this prior to their death, although this could be an underestimate based on next of kin statements.

The profile of those who died at a significant distance (>5 miles) from their LKL (58/307, 18.89%) was comparable to that of people who had traveled a shorter distance in terms of gender, ethnicity, deprivation index of HA, presence of mental health problems, distance from nearest station, and circumstances of death (e.g., presence of a suicide note, location type, Covid-19 period, presence or interactions with other people at LoD, time of death). However, people who died in rural locations (N = 94 vs. 337 urban LoD) had traveled significantly further from their HA (which for 58.1% was in an urban area) and from their LKL (respectively, median 4.0 and 3.2 vs. 1.85 and 1.3 miles, $p < 0.05$).

Urbanicity

Most suicides occurred in urban areas and involved individuals who had resided in urban areas (Table 1).

In addition to having a greater number of rail suicides (a likely reflection of population density), urban areas had a higher proportion of rail suicides as a percentage of all suicide deaths. Most rail suicides in police force areas with a high or very high proportion of rail suicides were in 'predominantly urban' local authority areas (138/183, 75.4%).

Urban LoDs also saw a greater concentration of suicides involving younger people (78/337, 23.1% were under 25 vs. 11/94, 11.7% in rural LoDs (output areas), $X^2 = 7.949$, df = 3, $p <= 0.047$), members of minority ethnic groups (60/330, 18.2% vs. 3/89, 3.4%, $X^2 = 12.036$, df = 1, $p < 0.001$), and people living in more deprived areas (120/362,

Table 1. Urbanicity of locations of deaths and residence (by census output areas).

	Location of death		Location of residence	
	N = 431	%	N = 422	%
Rural hamlets and isolated dwellings	33	7.7	7	1.7
Rural town and fringe	29	6.7	35	8.3
Rural village	32	7.4	18	4.3
Urban city and town	164	38.1	196	46.4
Urban city and town in a sparse setting	1	0.2	0	0
Urban major conurbation	159	36.9	150	35.5
Urban minor conurbation	13	3.0	16	3.8

33.1% lived in areas of high deprivation (index of multiple deprivation = 1–3) vs. 3/60, 5% of deceased from rural areas; $X^2 = 20.819$, df = 2, p< =0.001).

Of note is also the strong association between urbanicity and location type, with all but 15 station suicides recorded in locations classified as 'urban' (by census output area) and a substantial proportion of deaths at level/foot crossing (29/66, 43.9%) and track-side (47/160, 29.4%) taking place in rural areas (see Figure 1).

Location Type: Suicides at Non-Station Locations

Compared to individuals who died at station locations, those whose suicides took place away from stations were more likely to be male and white (Table 2). The latter finding may (also) reflect that a third of suspected suicides recorded at non-station locations (79/243, 32.5%) occurred in rural areas.

In many cases (158/241, 65.6%), deaths at non-station locations occurred further from the individual's HA than their nearest station (median: 1.5 miles)—but nonetheless in fairly close proximity. Individuals who died away from stations also lived further away from their nearest station than those who died at stations, although the latter were no more likely to die at their *nearest* station and traveled a comparable distance to their LoD.

At univariate level, the characteristics and circumstances of deaths at station vs. non-station locations varied across several dimensions. However, only ethnicity, urbanicity of LoD, and the presence of peak-time fast passes at the person's nearest station were significant predictors of station suicides in multivariate analyses (OR for white vs. minority ethnicity = 2.59, 95% CI [1.31, 5.13], p = .006; OR for urban (vs. rural) LoD = 4.13, 95% CI [2.08, 8.18], p < 0.001; for fast passes (any vs. none) OR = 2.07, 95% CI [1.00, 4.26], p = 0.049).

Suicides at Stations

Over the study period, suspected suicides were recorded at 158 stations across England (mostly 1 death per station (136, 86.1%); in fewer cases 2 (18, 11.4%), 3 (3, 1.9%) or 4 (1, 0.6%)).

Did People Die at Their Nearest Station?

There were no significant differences by age, gender, ethnicity, mental ill health, index of multiple deprivation of HA, urbanicity of HA or LoD, distance from nearest station or

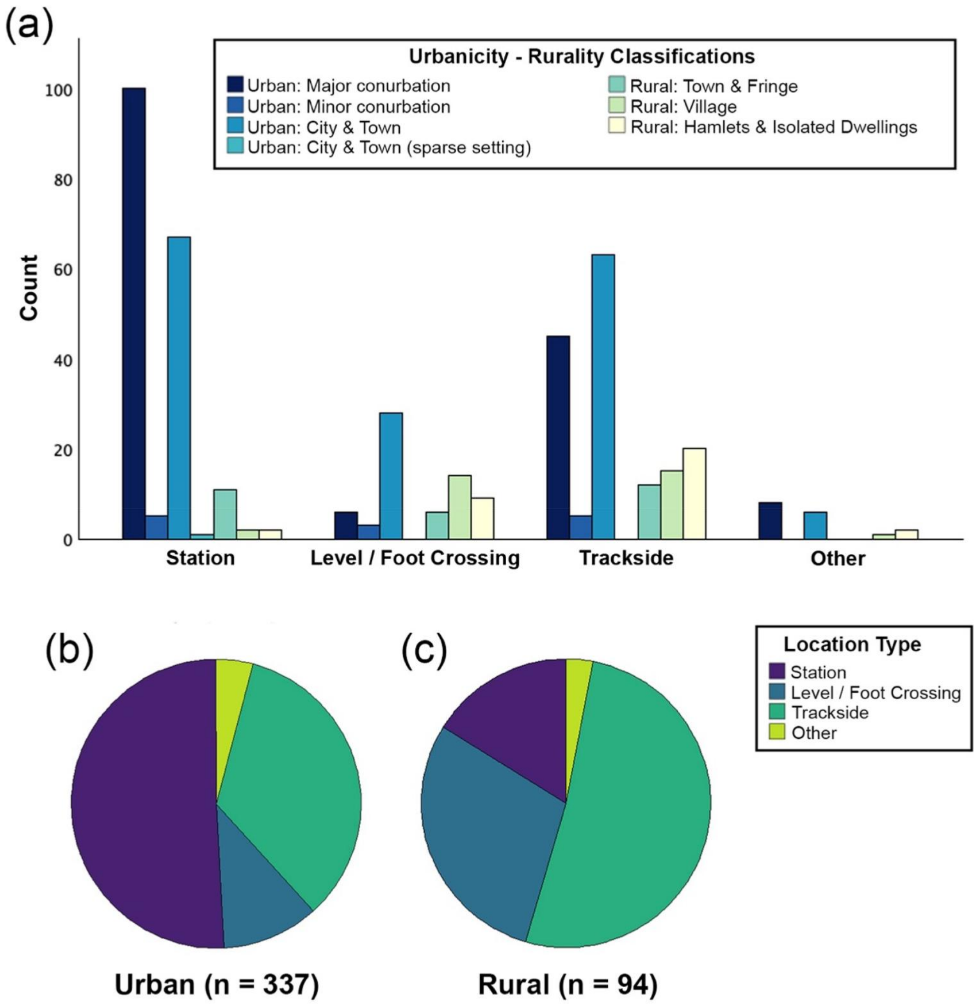

Figure 1. Associations between urbanicity of place of death and location type.

whether a suicide note was left, between people who died at their nearest station (74/183, 30.4%) and those who traveled to a station which was further away—albeit sometimes marginally—from their home address (n = 109, 59.6%). The latter traveled significantly further from home (5.0 miles vs. 0.95 miles) and from their LKL (4.0 miles vs. 0.8 miles) and were less likely to have walked to their location of death (where known: 23/84, 27.4% vs. 32/48, 66.7%; $X^2 = 34.231$, df = 5, $p < .001$), although both groups lived at a similarly short distance from their closest station (median = 0.7 miles and 0.6 miles).

The proportion of people who died at their nearest station in the year before the Covid-19 pandemic was only slightly lower than after the start of the pandemic (39.8% vs. 41.2% respectively, $p = 0.849$).

As the individuals' choice of station was not clearly associated with demographic or proximity factors, we analyzed differences in station characteristics between locations with one or more suspected suicides during the study period and (i) those across the wider rail network, (ii) stations that were closest to the deceased's HA than their LoD.

Table 2. Characteristics and circumstances of suspected suicides (by rail location type).

	Location type (n/N[a], %) Station	Level/foot crossing[b]	Trackside	Other[c]	All
Number of deceased	**189**	**66**	**164**	**17**	**436**
% of all deaths	43.3%	15.1%	37.6%	3.9%	100%
Sex*					
Male	139/189 (73.5)	45/66 (68.2)	140/164 (85.4)	16/17 (94.1)	340/436 (78.0)
Female	50/189 (26.5)	21/66 (31.8)	24/164 (14.6)	1/17 (5.9)	96/436 (22.0)
Age					
Under 25	34/189 (18.0)	11/66 (16.7)	40/164 (24.4)	4/17 (20.4)	89/436 (20.4)
25 to 44	67/189 (35.4)	22/66 (33.3)	58/164 (35.4)	7/17 (41.2)	154/436 (35.3)
45 to 65	62/189 (32.8)	22/66 (33.3)	47/164 (28.7)	2/17 (11.8)	133/436 (30.5)
65+	26/189 (13.8)	11/66 (13.7)	18/164 (11.6)	4/17 (20.4)	60/436 (13.8)
Ethnicity					
Asian or Asian British	21/185 (11.4)	2/66 (3.0)	7/157 (4.5)	3/16 (18.8)	33/424 (7.8)
Black or Black British	15/185 (8.1)	—	5/157 (3.2)	—	20/424 (9.4)
Mixed/Multiple Ethnic Groups	4/185 (2.2)	—	1/157 (0.6)	—	5/424 (1.2)
White**	143/185 (77.3)	64/66 (97.0)	141/157 (89.8	13/16 (81.3)	361/424 (85.1)
Other	2/185 (1.1)	—	3/157 (1.9)	—	5/424 (1.2)
Mental ill health*					
Yes (diagnosed or suspected)	149/158 (94.3)	53/59 (89.8)	119/137 (86.9)	15/16 (93.8)	336/370 (90.8)
No	9/158 (5.7)	6/59 (10.2)	18/137 (13.1)	1/16 (6.3)	34/370 (9.2)
Index of Multiple Deprivation[d], home address (HA)					
1 to 3 (most deprived)	57/182 (31.3)	8/64 (12.5)	53/159 (33.3)	5/17 (29.4)	123/422 (29.1)
4 to 7	77/182 (42.3)	33/64 (51.6)	61/159 (38.4)	7/17 (41.2)	178/422 (42.2)
8 to 10 (least deprived)	48/182 (26.4)	23/64 (35.9)	45/159 (28.3)	5/17 (29.4)	121/422 (28.7)
Urbanicity[e] of HA**					
Urban	170/182 (93.4)	48/64 (75.0)	129/159 (81.1)	15/17 (88.2)	362/422 (85.8)
Rural	12/182 (6.6)	16/64(25.0)	30/159 (18.9)	2/17 (11.8)	60/422 (14.2)
Urbanicity[e] of location of death (LoD)**					
Urban	173/188 (92.0)	37/66 (56.1)	113/160 (70.6)	14/17 (82.4)	337/431 (78.2)
Rural	15/188 (8.2)	29/66 (43.9)	47/160 (29.4)	3/17 (17.6)	94/431 (21.8)
Transport to LoD**					
Walked	55/134 (41.0)	21/48 (43.8)	72/116 (62.1)	11/15 (73.3)	159/313 (50.8)
Biked	5/134 (3.7)	1/48 (2.1)	7/116 (6.0)	—	13/313 (4.2)
Bus	4/134 (3.0)	—	0/116 (0.0)	—	4/313 (1.3)
Car	27/134 (20.1)	24/48 (50.0)	32/116 (27.6)	3/15 (20.0)	86/313 (27.5)
Train	30/134 (22.4)	—	2/116 (1.7)	—	32/313 (10.2)
Multiple	13/134 (9.7)	2/48 (4.2)	3/116 (2.6)	1/15 (6.7)	19/313 (6.1)

(*continued*)

Table 2. Continued.

	Location type (n/N[a], %)				
	Station	Level/foot crossing[b]	Trackside	Other[c]	All
Number of deceased	**189**	**66**	**164**	**17**	**436**
% of all deaths	43.3%	15.1%	37.6%	3.9%	100%
Known to have traveled from HA	112/143 (78.3)	42/49 (85.7)	88/121 (72.7)	13/17 (76.5)	255/330 (77.3)
Travel to LoD*					
Direct	19/57 (33.3)	2/8 (25.0)	11/26 (42.3)	2/3 (66.7)	34/94 (35.1)
Indirect/including stopping point	38/57 (66.7)	6/8 (75.0)	15/26 (57.7)	1/3 (33.3)	60/94 (64.9)
Median Distance Traveled (miles)					
Distance from home (miles)	2.1/183	2.4/64	2.2/160	0.9/17	2.1/424
Distance fr. last known location	1.6/134	2.1/46	1.3/111	0.8/16	1.5/307
Distance from home to nearest station*					
Median (miles)	0.6/179	1.1/64	1.1/160	0.5/17	0.8/420
Under 1 mile	126/179 (70.4)	29/64 (45.3)	74/160 (46.3)	13/17 (76.5)	242/420 (57.6)
1 to 5 miles	53/179 (29.6)	31/64 (48.4)	78/160 (48.8)	4/14 (23.5)	166/420 (39.5)
Over 5 miles	—	4/64 (6.3)	8/160 (5.0)	—	12/420 (2.9)
LoD further from HA than nearest station	109/183 (59.6)	41/64 (64.1)	109/160 (68.1)	8/17 (47.1)	267/424 (63.0)
Did the station closest to HA have 'fast passes?[f]*	163/182 (89.6)	54/64 (84.4)	121/159 (76.1)	14/17 (82.4)	352/422 (83.4)
Time Period					
Early morning (12 am to 6 am)	17/186 (9.1)	5/66 (7.6)	16/157 (10.2)	2/17 (11.8)	40/426 (9.4)
Morning (6 am to 12 pm)	54/186 (29.0)	17/66 (25.8)	48/157 (30.8)	6/17 (35.3)	125/426 (29.3)
Afternoon (12 pm to 6 pm)	67/186 (36.0)	18/66 (27.3)	51/157 (32.3)	7/17 (41.2)	143/426 (33.6)
Evening (6 pm to 12 am)	48/186 (25.8)	26/66 (39.4)	42/157 (26.8)	2/17 (11.8)	118/426 (27.7)
Light Conditions*					
Day	115/189 (60.8)	33/66 (50.0)	72/161 (44.7)	10/16 (62.5)	230/432 (53.2)
Dusk/Dawn	28/189 (14.8)	8/66 (12.1)	19/161 (11.8)	5/16 (31.3)	60/432 (20.0)
Night	61/189 (32.3)	29/66 (43.9)	81/161 (50.3)	5/16 (31.3)	142/432 (32.9)
Other people present at time*	114/181 (63.0)	12/56 (21.4)	6/132 (4.5)	6/11 (54.5)	138/380 (36.3)
Interaction with other people**	27/160 (16.9)	4/56 (7.1)	8/133 (6.0)	5/16 (31.3)	44/365 (12.1)
Left suicide note	68/189 (36.0)	24/66 (36.4)	67/164 (40.9)	2/17 (11.8)	161/436 (36.9)
Covid-19 period					
Before (April 1, 2019 to March 24, 2020)	103/189 (54.5)	34/66 (51.5)	87/164 (53.0)	7/17 (41.2)	231/436 (53.0)
During (March 25–31, 2021)	86/189 (45.5)	32/66 (48.5)	77/164 (47.0)	10/17 (58.8)	205/436 (47.0)
Speed of Train*					
Under 40 mph	25/173 (14.5)	3/59 (5.1)	9/135 (6.7)	0/8 (0.0)	37/391 (9.5)
40 mph to 69 mph	62/173 (35.8)	31/59 (52.5)	64/135 (47.4)	3/8 (37.5)	160/391 (40.9)
70 mph to 99 mph	61/173 (35.3)	18/59 (30.5)	38/135 (28.1)	2/8 (25.0)	119/391 (30.4)
Over 100 mph	25/173 (14.5)	7/59 (11.9)	24/135 (17.8)	3/8 (37.5)	59/391 (15.1)

[a]Denominators vary because of missing information.
[b]Level crossings (n = 30), foot crossings (n = 36).
[c]Other locations include road bridge (n = 8) and footbridge (n = 9) over track.
[d]Decile of multiple deprivation of home postcode (2019).
[e]Based on Rural Urban Classification (2011) of Output Areas in England and Wales data.
[f]Station with non-stopping trains passing a platform that is accessible to passengers at peak times (7–10 am and/or 4–7 pm).
*Significant association with station vs. non-station location (df = 1; $p \leq 0.05$).
**Significant association with station vs. non-station location (df = 1; $p \leq 0.001$).

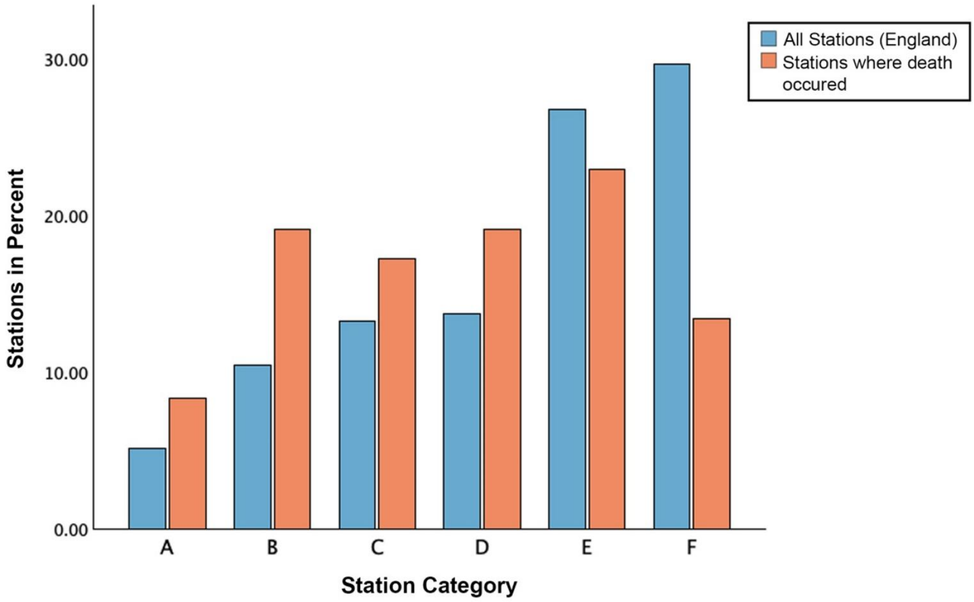

Figure 2. Category of stations with one or more suspected suicide (vs. all stations in England). A—national hub; B—regional interchange; C—important feeder; D—medium staffed; E—small staffed; F—small unstaffed.

Comparison with All Stations in England

Reflecting the greater concentration of rail suicides in urban areas and especially London (27.4% of stations with a suicide were in London, despite the Capital accounting for 16.8% of all English stations), stations with one or more suicides were on average larger than stations across England (see Figure 2).

Compared to stations with no suspected suicides over the study period, those with one or more suicides were also more likely to be staffed at least some of the time during opening hours, and to have CCTV, toilets and a greater passenger flow. Almost all had fast passes in peak hours (Table 3).

When these variables were entered in a regression model (dropping staffing levels for reasons of multicollinearity), only the presence of fast passes and urbanicity of location remained statistically significant (respectively OR = 6.62, 95% CI 3.33–13.18, $p < 0.001$; OR = 2.33, 95% CI 1.31–4.13, $p = 0.004$).

Comparison with Closer Stations

Individuals who died at stations were less likely to have traveled to a location further from their HA when their nearest station had fast passes (71/74, 95.9% vs. 92/108, 85.2%, $X^2 = 5.438$, df = 1, $p = 0.020$), and appeared to avoid larger stations. When nearest station was LoD, the median passenger flow at nearest station was 598.368 (vs. 1.532.950 when people did not die at their nearest station, Mann-Whitney U test = 2817, $p < 0.001$). The former were also less likely to be category A-C stations than when individuals traveled to a different station location (32/74, 43.2% vs. 72/107, 67.3%, $X^2 = 14.611$, df = 5, $p = 0.012$) and, perhaps linked to this, to have defined seating areas within the station (54/74, 73.0% vs. 91/106, 85.8%, $X^2 = 4.613$, $df = 1$, $p = 0.032$). Staffing levels, the presence of CCTV, and other station characteristics were not correlated with the likelihood of station deaths being at the deceased's nearest station.

DISCUSSION

Differences in spatial patterns in suicides—both geographically and by location type—can usefully inform where and how prevention measures should be implemented (Mishara & Bardon, 2016). We found limited evidence that people had traveled to specific places that were in some way meaningful to them. Young people under the age of 18 died closer to home than older age groups (perhaps reflecting more limited means or reason to travel further afield); and males were more likely than females to have died at a trackside location, and to have traveled further from home (but not further from their last known location). Other socio-demographic factors (e.g., deprivation of home address or the presence of mental health issues) were poor correlates of where or how far from home a person died, as were factors which may be associated with suicidal intent (e.g., the presence of a suicide note).

In contrast, environmental factors were significantly associated with where people died. Two thirds of rail suicides occurred in predominantly urban areas, and over 80% of the deceased resided in urban areas. Whilst these proportions broadly align with national population density levels (Department for Environment, Food & Rural Affairs, 2025), it is worth noting that areas of greater urbanicity appear to be disproportionately affected by *rail* suicides (as a proportion of all suicide deaths), and especially suicides at stations (almost 80% of station suicides were in predominantly urban areas). Except for the Netherlands (Balt et al., 2024), research in other countries has also found that railway suicides occur more frequently in urban areas (Strale et al., 2017; Too et al., 2015), despite geographical isolation being a strong predictor of suicide by other methods (Barry et al., 2020; Casant & Helbich, 2022). This has in turn been linked to increased railway density, rail traffic intensity and/or familiarity with trains, and thus possible increased cognitive availability of trains as a method of suicide (Too, Bugeja, et al., 2017; van Houwelingen et al., 2013).

It was not possible to fully explore these factors, as national data on train traffic intensity (i.e., the number of trains passing at each station) are not readily available in the UK. However, we found that most people who died on their railways lived in close proximity of a station (particularly in urban areas), often a fairly large and busy station (for half the deceased, their nearest station was a category A-C station, despite only 29.1% of English stations falling in such categories). This is likely to be linked to levels of urbanicity, and may then increase people's exposure to trains as a method of suicide, as well as their access to trains as a means of suicide.

As previously reported in relation to rail suicides and other suicide deaths (Department for Transport, 2025), most individuals traveled short distances to their location of death, often on foot. Interestingly, this was often not their nearest station, but another nearby station which was on average smaller and more likely to have fast passing trains. The presence or absence of fast passes at the deceased's closest station

Table 3. Station characteristics (England)[a].

	LoD and closest to HA (n = 63)		LoD but not closest to HA (n = 104)		Not LoD but closest to HA (n = 277)		Not LoD and not closest to HA (n = 1590)	
	n/N	%	n/N	%	n/N	%	n/N	%
Category (2020)**								
A	3/63	4.8	11/104	10.6	28/276	10.1	67/1585	4.2
B	13/63	20.6	20/104	19.2	48/276	17.4	141/1585	8.9
C	12/63	19.0	17/104	16.3	57/276	20.7	186/1585	11.7
D	12/63	19.0	20/104	19.2	42/276	15.2	211/1585	13.3
E	14/63	22.2	24/104	23.1	65/276	23.6	442/1585	27.8
F	9/63	14.3	12/104	11.5	36/276	13.0	542/1585	34.1
Fast trains at peak times?**								
Yes	60/63	95.2	97/104	93.3	217/277	78.3	1028/1588	64.7
No	3/63	4.8	7/104	6.7	60/277	21.7	560/1588	35.3
Passenger Flow**								
Median	674,132		836,274		881,000		247,152	
Under 100,00	8/63	12.7	9/104	8.7	35/276	12.7	508/1580	32.2
100,000 to 500,000	17/63	27.0	28/104	26.9	73/276	26.4	510/1580	32.3
500,000 to 1.5 million	19/63	30.2	33/104	31.7	69/276	25.0	309/1580	19.6
Over 1.5 million	19/63	30.2	34/104	32.7	99/276	35.9	253/1580	16.0
Staffing Levels**								
Fulltime	16/63	25.4	27/104	26.0	88/277	31.8	287/1598	17.4
Parttime	35/63	55.6	59/104	56.7	116/277	41.9	598/1598	37.4
Unstaffed	12/63	19.0	18/104	17.3	73/277	26.4	713/1598	44.6
CCTV**								
Yes	58/63	92.1	93/104	89.4	248/277	89.9	1251/1587	78.8
No	5/63	7.9	11/104	10.6	29/277	10.1	336/1587	21.2
Departure Screens								
Yes	41/63	65.1	66/104	63.5	202/277	72.9	1040/1587	65.5
No	22/63	34.9	38/104	36.5	76/277	27.1	547/1587	34.5
Announcements								
Yes	45/63	71.4	63/104	60.0	191/277	69.0	974/1587	61.4
No	18/63	28.6	41/104	39.4	87/277	31.0	613/1587	38.6
Toilets*								
Yes	34/63	54.0	50/104	48.1	143/277	51.6	536/1585	33.8
No	29/63	46.0	54/104	51.9	134/277	48.4	1049/1585	66.2
Seated Areas								
Yes	46/63	73.0	79/104	76.0	205/274	74.8	1111/1580	70.3
No	17/63	27.0	25/104	24.0	69/274	25.2	469/1580	29.2
Customer Help Points								

(*continued*)

Table 3. Continued.

	LoD and closest to HA (n = 63)		LoD but not closest to HA (n = 104)		Not LoD but closest to HA (n = 277)		Not LoD and not closest to HA (n = 1590)	
	n/N	%	n/N	%	n/N	%	n/N	%
Yes	54/63	85.7	88/104	84.6	227/276	82.2	1338/1583	84.5
No	9/63	14.3	16/104	15.4	49/276	17.8	245/1583	15.5
Telephones								
Yes	21/63	33.3	35/104	33.7	133/278	48.0	655/1587	41.3
No	42/63	66.7	69/104	66.3	144/178	52.0	932/1587	58.7
Rurality (2 category)**								
Rural	5/63	7.9	11/104	10.6	36/277	13.0	537/1583	33.9
Urban	58/63	92.1	93/104	89.4	241/277	87.0	1046/1583	66.1
Rurality (10 category)**								
Rural hamlets and isolated dwellings in a sparse setting	—	—	—	—	—	—	21/1583	1.3
Rural hamlets and isolated dwellings	1/63	1.6	2/104	1.9	11/277	4.0	122/1583	7.7
Rural villagein a sparse setting	—	—	—	—	—	—	10/1583	0.6
Rural village	—	—	3/104	2.9	7/277	2.5	164/1583	10.4
Rural town and fringein a sparse setting	—	—	—	—	—	—	9/1583	0.6
Rural town and fringe	4/63	6.3	6/104	5.8	18/277	6.5	211/1583	13.3
Urban city and town in a sparse setting	—	—	1/104	1.0	—	—	4/1583	0.3
Urban city and town	29/63	46.0	32/104	30.8	137/277	49.5	513/1583	32.4
Urban minor conurbation	2/63	3.2	3/104	2.9	7/277	2.5	21/1583	1.3
Urban major conurbation	27/63	42.9	57/104	54.8	97/277	35.0	508/1583	32.1

[a]LoD = Location of Death; HA = Home address of deceased; Individual stations may fall in more than one category (based on proximity to deceased HA).
*Significantly associated with LoD stations (vs. stations with no suspected suicides during the study period), regardless of proximity to deceased HA ($p \leq 0.05$).
**Significantly associated with LoD stations (vs. stations with no suspected suicides during the study period), regardless of proximity to deceased HA ($p \leq 0.001$).

was also a key predictor of whether people died at a station or non-station location, with the latter being more common in rural areas. Indeed, along with urbanicity, the passing of fast trains was the only factor independently associated with the risk of one or more suicides occurring at a given station.

Whether or not these locations were deliberately 'chosen' because of these characteristics is difficult to determine, nor does the available data enable conclusions as to whether suicidal behavior at different locations (e.g., larger stations with no fast trains) is more likely to be interrupted and/or to have non-fatal outcomes (e.g., a study in Vienna found that suicide deaths but not suicide attempts significantly increased when stations were served by fast trains (Niederkrotenthaler et al., Niederkrotenthaler et al. 2012), but our analysis did not extend to non-lethal attempts and crisis interventions). Either way, these findings underscore the importance of environmental measures to prevent railway suicides by restricting access to lethal means– both at stations (especially in urban areas) and elsewhere on the network. In both contexts, this would ideally involve restricting access to fast trains, where possible using barriers or similar (e.g., midtrack fencing (Fredin-Knutzén et al., 2022)). Other strategies have also been suggested to mitigate the risks associated with fast trains (e.g., decreasing train speed, modifying the front design of trains), but to date the installation of full or partial barriers is the only measure to have been associated with reductions in suicide in this context (though with some evidence of displacement to other locations) (Department for Transport, 2025; Too et al., 2014). Further research is warranted to better understand and maximize the effectiveness and cost-effectiveness of measures to restrict access to high-speed trains/tracks, and to increase the likelihood of safe and effective interventions (e.g., via surveillance technologies and staff training) when such measures are unlikely to be feasible or sufficient (Katsampa et al., 2022). As argued elsewhere, these important questions (also) call for meaningful consultation with people with lived experiences of suicidality related to the railways (Mackenzie et al., 2025).

Our findings suggest that this may prove to be a more useful focus for intervention than measures targeting specific 'high-risk' locations, which appear not to be clearly defined in geospatial terms. Notwithstanding the identification of a cluster of 8 deaths during the study period, we found that the majority of suicides were spread over locations of very low frequency. This is in line with evidence from the Netherlands, a country with similar rail density to the UK (United Nations Economic Commission for Europe, 2023). Whilst system-wide preparedness for clusters of rail suicides is clearly important (Read et al., 2025), less that 12% of suicides in the current study occurred within a 1 mile and 4-month window of another suspected suicide, a smaller proportion than in other countries (Strale et al., 2017; Too, Pirkis, et al., 2017). Further research is needed to replicate these findings over a longer period, ideally expanding the focus to key variables such as proximity of mental health services and media coverage of suicide (Marzano et al., 2025; Mishara & Bardon, 2017).

Limitations

We had access to a rich dataset, supplemented with official infrastructure data. However, not all data were available for all cases or stations, and we were not able to analyze data on train frequency, number of platforms, and the presence or absence of specific mitigations (e.g., mid-track fencing) as these are not gathered at national level. Data on fast passes at non-peak hours were also not available for analysis; however, it is worth noting that in England, fast line routes remain operationally distinct from 'slow lines' throughout the day. In other words, non-stopping services are likely to pass through stations served by fast peak-hour trains even during off-peak periods, if with reduced frequency (see e.g. Department for Transport, 2013; Network Rail, 2015).

Some of the variables used were proxy measures (e.g., geographical proximity based on straight-line distances is a helpful indicator, but we cannot exclude the possibility of quicker/easier/preferred routes). Additionally, some of the data we analyzed (e.g., population census data, station infrastructure characteristics and police force data) were not from the same period (though relatively close in time). Police force risk categories were based on a relatively short period, and arguably less useful than more granular data (e.g., at the level of local authority or output areas). Further research could replicate these analyses using such data (for all suicide deaths), taking into account rail and population density.

In addition, our analyses were based on suspected suicides. Although data from established real-time surveillance systems have been shown to closely reflect suicide rates confirmed by official statistics (Turnbull et al., 2024), any inferences or conclusions about suicides should be made cautiously. Also, findings may not be generalizable to other countries or to other methods or locations of suicides, and further research would be required to establish whether the patterns and associations we identified are also relevant to non-fatal suicidal behavior at railway locations. Finally, London Underground data were not included, as the network operates under a separate system from mainline railway in Great Britain, with distinct infrastructure and environmental characteristics that warrant separate investigation.

CONCLUSION

This study is the first systematic analysis of the association between key geographical and environmental factors and railway suicides in England. Notwithstanding the importance of individual and situational circumstances (Norman et al., 2024), and the potential role of wider environment factors (e.g., our analysis did not extend to train traffic intensity), our results suggest that urbanicity and the availability of non-stopping train services are key predictors of railway suicides, particularly at stations (vs. lineside or other locations). Whilst our examination of geospatial patterns confirms that attempts to predict when or exactly where a death is likely to occur have limited utility, findings underscore the importance of targeted interventions to restrict access to high-speed trains and tracks. In-depth analysis of the characteristics of stations affected by one or more suicides during the study period suggests that smaller than average urban stations served by fast trains may especially benefit from such measures. These, and other suicide mitigations at station and non-station locations, are likely to be most effective as part of broader multi-layered strategies to prevent suicidal ideation as well as behavior. As most people died in close proximity to their home address, local partnership approaches for upstream suicide prevention are likely to be crucial in this context.

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DISCLOSURE STATEMENT

The authors have no relevant financial or non-financial interests to declare.

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DATA AVAILABILITY STATEMENT

Due to the sensitive nature of this research, supporting data are not available.

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APPENDIX A. Geospatial Analyses

To investigate the presence of spatial–temporal clusters we performed Poisson discrete scan statistic using SaTScan V.9.4.1 (Office for National Statistics, 2011). As SaTScan requires information on individual cases, population estimates and area coordinates, we aggregated the number of railway suicides by day of death and residential postcode, and obtained population estimates for each postcode from the Office for National Statistics (ONS) 2011 census data (Office for National Statistics, 2011). The longitude and latitude of each residential postcode were calculated using the UK Grid Reference Finder. After importing the required data into SaTScan, we pre-specified the size of the spatial and temporal scan windows. To set the spatial window, we first calculated the incidence rates of railway suicides for each postcode: there was an outlier of 0.2294 due to a small population associated with one particular postcode, with the next maximum rate was 0.0724 per 100 persons. For this reason, we set the size of any railway suicide cluster to be no larger than an area with 7.2% of the total population at risk. We chose a circular shape for the spatial scan window because this shape has been commonly used to detect clusters (Kulldorff, 1997). Our temporal window was set from a minimum of 1 month to a maximum of 4 months, replicating previous research (Savage, 2016). The likelihood of each potential cluster was assessed using Monte Carlo simulation (Kulldorff, 1997). Clusters were considered to be statistically significant if their p value was <0.05. This procedure was then repeated using location of death postcodes, and truncated/outer home and location of death postcodes (which cover a larger area than full postcodes). Location of death coordinates were also used to derive, at a more descriptive level, groupings of deaths occurring at the same location and within a mile of each other, in a 4-month window.