



Does the digitalisation of food retail increase neighbourhood out-of-home food environment exposure? Case study in Birmingham, UK

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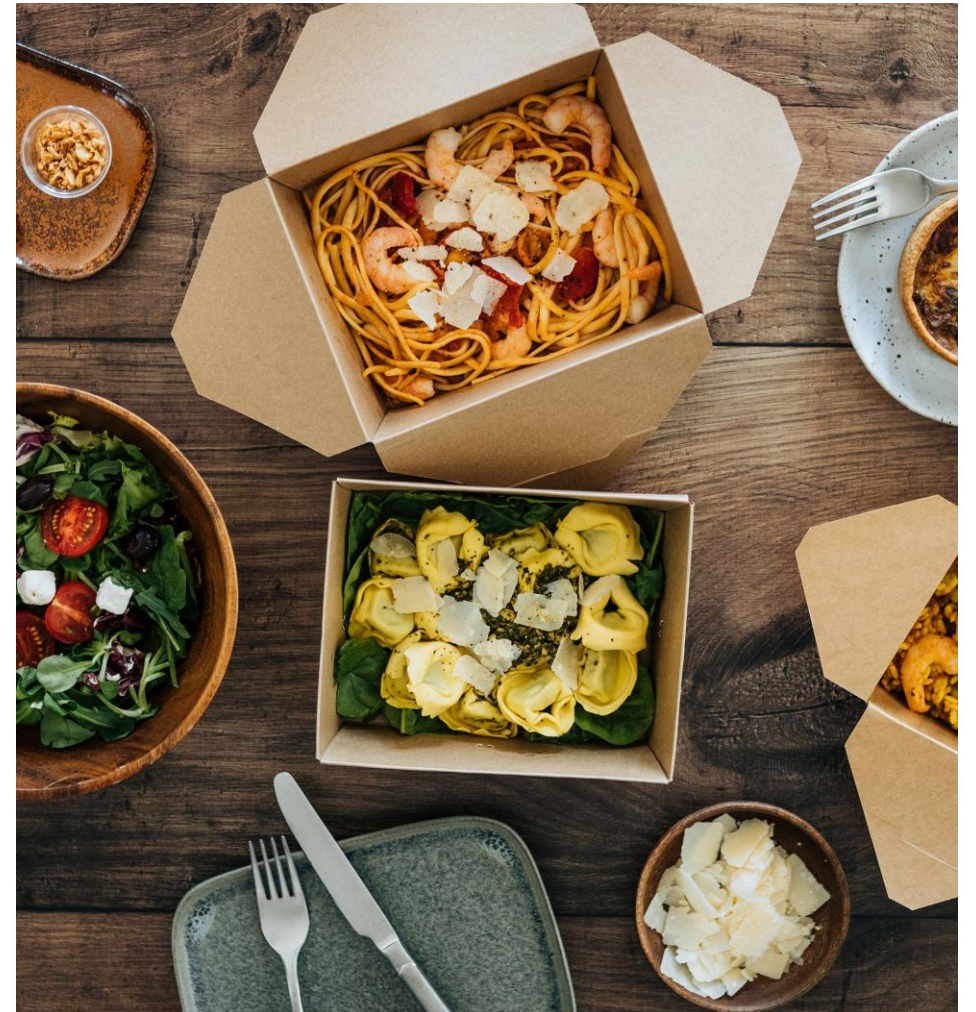
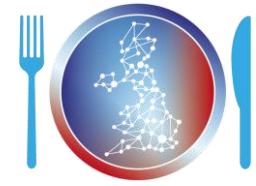
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Background

- Food retail is rapidly digitalising with the UK's online food delivery market estimated to be worth £3.4 billion in 2024¹
- This is transforming the food environment, a known risk factor for poor diet² & health
- Assessment of how digitalization is changing exposure to the local out-of-home food environment is underdeveloped
- Overlap between physical and online local food environments is poorly quantified
- Characterisation of socio-spatial inequalities in exposure to the online local food environment is also underexplored





Research Questions

- To what extent does the online food retail environment increase the **observable neighbourhood food retail environment** beyond what is captured in physical retail datasets?
- How does the online food retail environment compare to the physical out-of-home retail food environment across neighbourhoods (LSOAs) in Birmingham?
- What proportion of online outlet listings are **exclusively online** and are not represented in physical retail datasets?
- Does the **exclusivity** and **size** of the online food environment **vary by neighbourhood deprivation**?



Data Sources - Physical

- **OS Points of Interest (POI) Data:** address-level location data of outlets
- **Date collected:** December 2024
- **Included outlets:**
 - Cafes, Snack Bars and Tea Rooms
 - Fast Food and Takeaway Outlets
 - Fast Food Delivery Services
 - Fish and Chip Shops
 - Pubs, Bars and Inns
 - Restaurants
 - Bakeries
- **Spatial filtering (based on time):** administrative boundary (e.g LSOA) + 400m radius¹
 - Boundary plus c. **5 min** walking distance

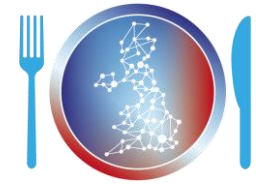




Data Sources – Digital

- **Web-scraped data from 3 leading delivery platforms**
 - Custom python codes to collect store information
 - Information includes outlet names, addresses, postcodes and coordinates (latitude/longitude)
- **Date collected:** January 2025
- **Excluded listings:** grocery, convenience, alcohol-only etc.
- **Spatial filtering (based on time):** administrative boundary (e.g. LSOA) + 1600m (1 mile) radius^{1,2}
 - Boundary plus c. **5 min** delivery distance





Measuring the local digital out-of-home food environment

1. Cumulative visible exposure:

- Each online retail “listing” can be counted once per platform up to a maximum of three times if visible across all three surveyed platforms.
- Represents cumulative visible exposure users have when entering the online environment to make food choices across multiple platforms.

2. Unique exposure:

- Number of unique food outlet listings, defined as the same outlet operating from the same physical location.
- Outlets can only be counted once even if they appear across multiple platforms.

Difference Between Deduplicated and Non-Deduplicated Food Environments



Non-Deduplicated Environment (Cumulative)

Each listing on each platform is treated as a separate outlet. No matching across platforms.



A = 5 total listings

Deduplicated Environment (Unique)

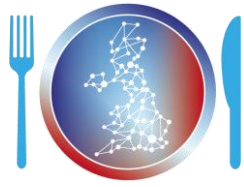
Listings that refer to same outlet are matched across platforms using name similarity & location.



B = 2 unique outlets

Total: Reflects exposure and visibility, i.e., how many listings users see.

Unique: Reflects true digital supply, i.e., unique outlets operating.



Neighbourhood exposure: two novel out-of-home metrics

Neighbourhood Online Exposure Ratio (uses cumulative exposure)

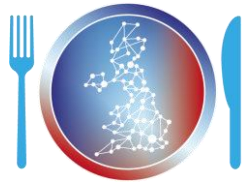
Relative size of the visible listed online out-of-home food environment compared to the visible physical food environment, based on the total number of listings accessible online divided by the total number of physical outlets.

$$OER = \frac{\text{All available OFD Listings}}{\text{All available POI Outlets}}$$

Neighbourhood Online exclusivity (uses unique exposure)

Proportion of unique online food outlets that operate exclusively online and have no identifiable physical counterpart in the physical retail dataset.

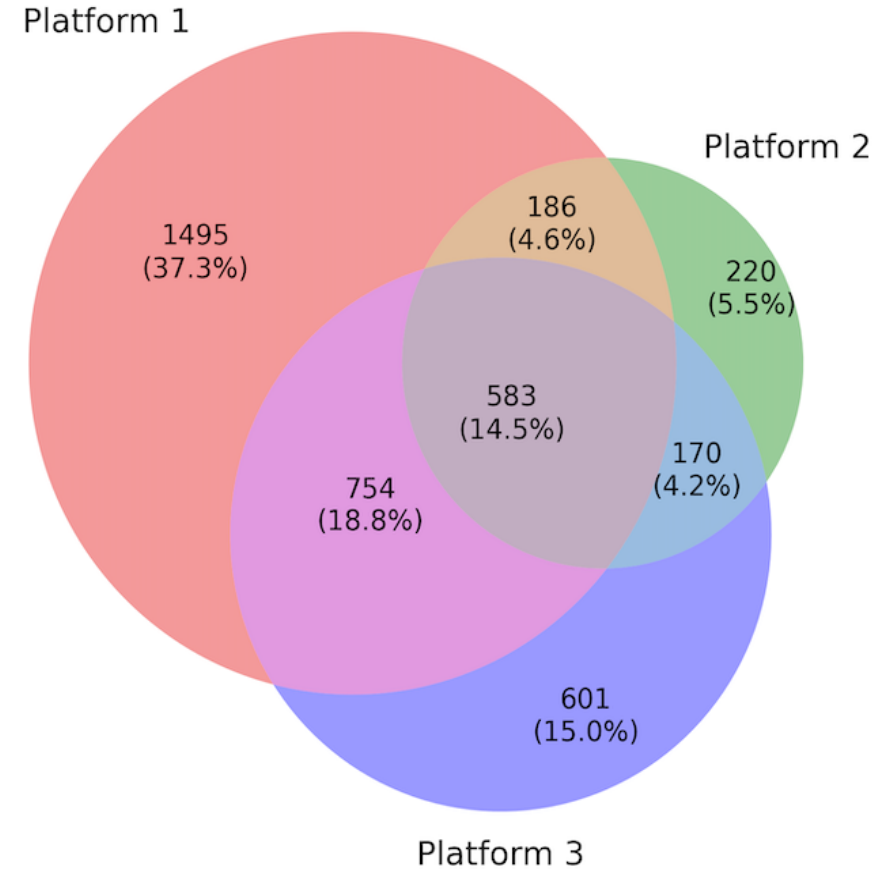
$$OE = \frac{\text{OFD only Outlets}}{\text{All available OFD Outlets}}$$



Results: the Birmingham food environment

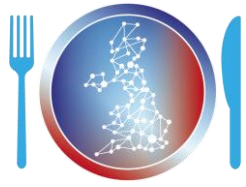
- **Physical out-of-home food environment**
 - **N=3,223** unique physical out-of-home food outlets
- **Digital out-of-home food environment**
 - **N=6,822** online food delivery (OFD) listings were identified across the three major platforms
 - After deduplication **n=4,009** unique online food outlets.
 - Substantial but incomplete overlap between platform listings (Fig 1).
 - Platform 1: n= 3,018 listings (75.3%),
 - Platform 2: n= 1,159 listings (28.9%)
 - Platform 3: n= 2,108 listings (52.6%)
- **Total food environment (physical and digital)**
 - After all data integrated and deduplicated:
n=5,384 unique out-of-home food outlets identified

Platform Overlap — Unique OFD Listings (Jan 2025)

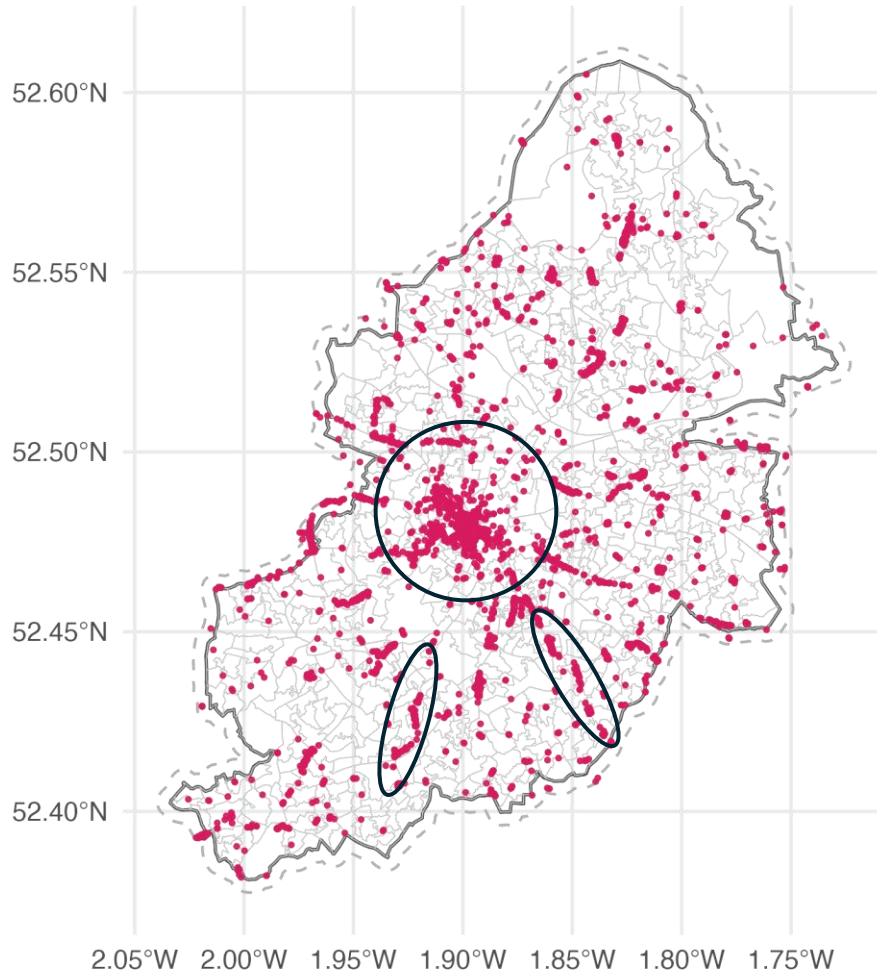




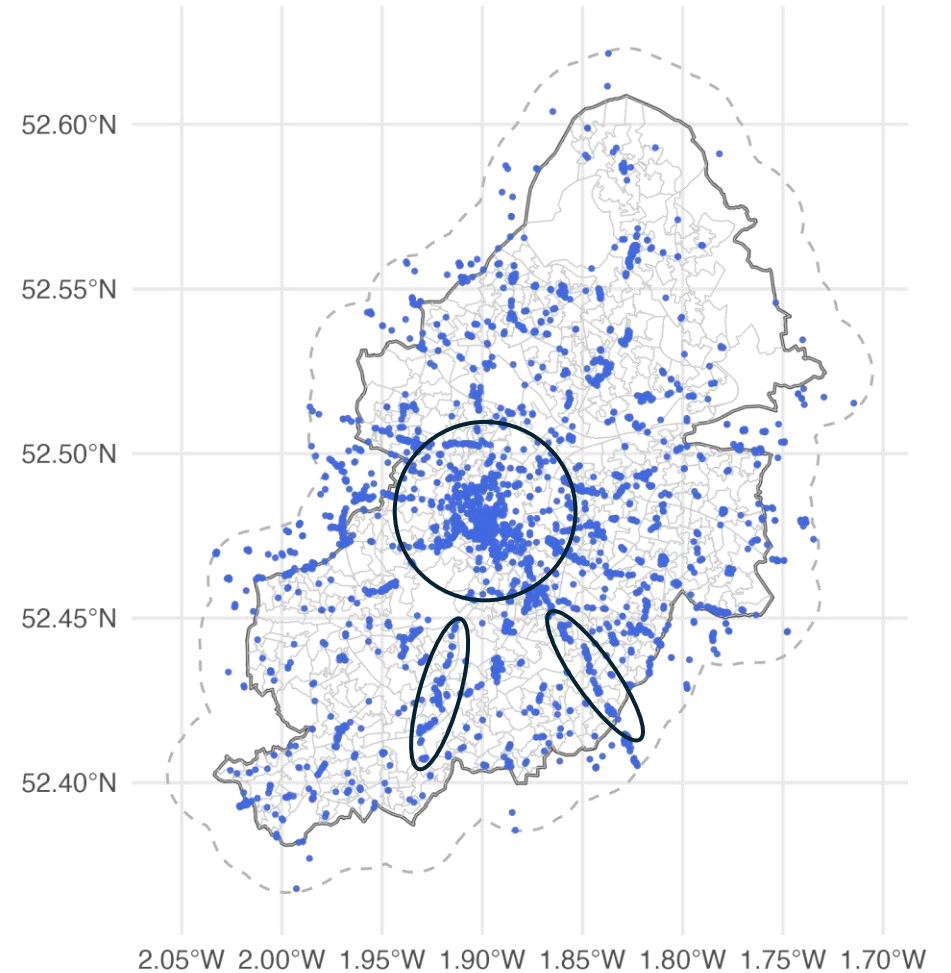
Results: spatial representation across Birmingham

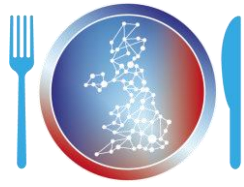


Food Retail Outlets in Birmingham
POI • December 2024



Online Food Delivery Clusters
OFD • January 2025



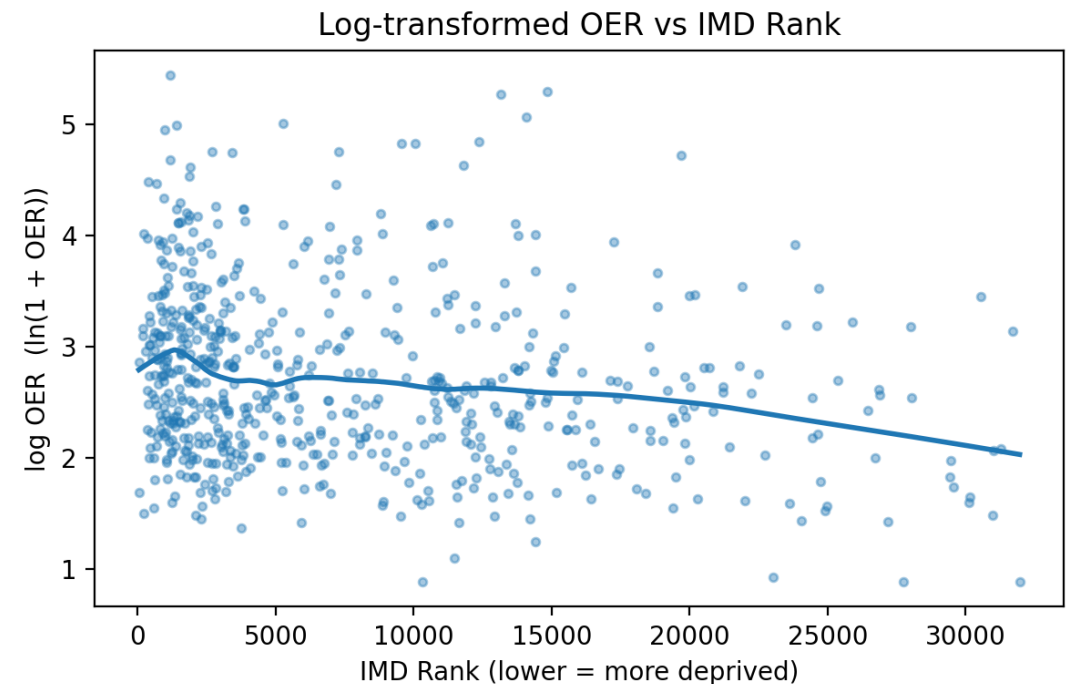


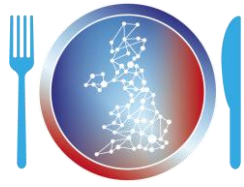
Results: neighbourhood online exposure ratio

- The overall **online exposure ratio** for Birmingham is **2.12**, meaning that number of ‘listings’ in the online food environment are double that of available physical outlets
- At the **area level** there is variation in median OER across space and by scale with OERs getting larger as areas get smaller
- **Example: LSOAs** (n=639), median OER is 12.29 with a huge range (as shown by the IQR) - in some neighbourhoods visible physical outlets are dwarfed by ‘listings’ visible online

- As LSOAs **become more deprived, the online exposure ratio increases** ($r_s = 0.217, p < 0.001$)
- This indicates that ‘listings’ in the online food environment get increasingly larger compared to physical outlets as neighbourhoods get poorer

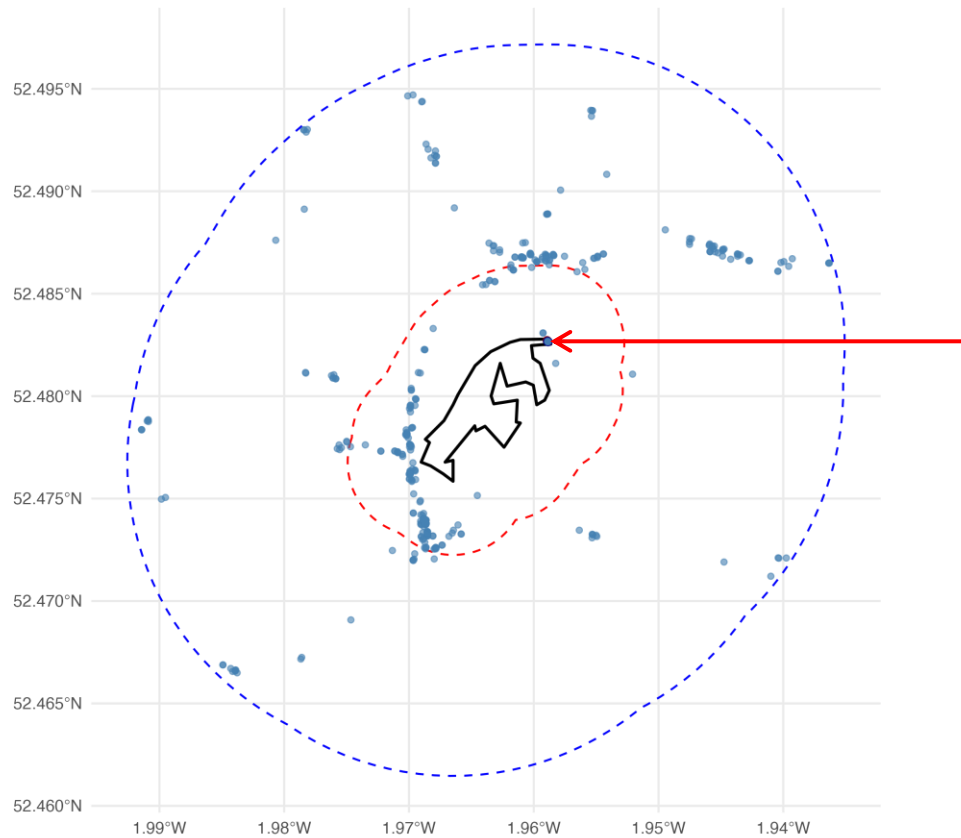
Area	Median OER	IQR
Constituency	4.10	3.33-4.97
Ward	6.36	4.81-9.45
MSOA	7.68	5.34-0.97
LSOA	12.29	7.57-22.69





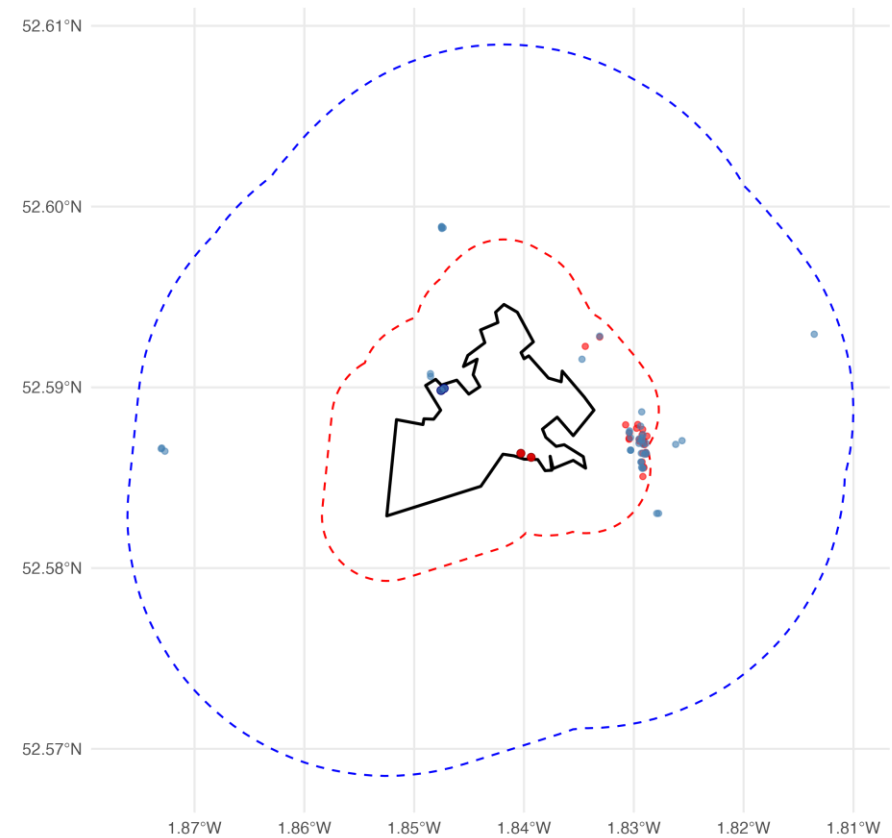
Example of different LSOAs

Food Environment Exposure — E01009139
POI (400 m) and OFD (1600 m) buffers

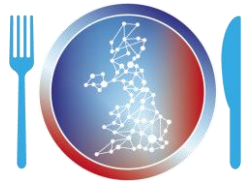


OER: 367 IMD Score: 11,582 IMD Rank: 4

Food Environment Exposure — E01009422
POI (400 m) and OFD (1600 m) buffers



OER: 1.5 IMD Score: 27,741 IMD Rank: 9



Results: out-of-home food outlets exclusively online

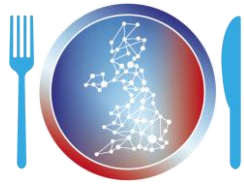
- Of the n=5,384 unique outlets identified, **27.2% (n=1,467)** were only recorded in the POI dataset
- **44.7% (n=2,409)** of outlets were available exclusively through delivery platforms and were absent from POI records.
- Remaining **28.1% (n=1,508 outlets)** were identified in **both** physical and online datasets.
- Of the identified unique online outlets **only 38.5% had a matched physical counterpart – 61.5% operated exclusively online.**

- Online exclusivity varies by neighbourhood (LSOA) deprivation in a broadly dose-response pattern ($F_{9, 629} = 16.08, p < 0.001$)

IMD Decile (National)	Exclusivity (%)	LSOA Count
1 (deprived)	55.0	264
2	50.7	96
3	49.7	68
4	47.9	72
5	49.3	56
6	47.3	25
7	47.0	23
8	45.0	15
9	40.3	12
10 (affluent)	39.2	8



Results Summary



- Overall, listings in the **online out-of-home food environment are 2.12 times the size** of their physical counterparts across Birmingham
- At the neighbourhood-level (LSOA) **median OER is 12.29 (IQR 7.57 – 22.69)** meaning that online outlet “listings” dwarf physical outlets
- When compared to physical outlets, the OER shows that relative neighbourhood exposure to online out-of-home food outlet **listings increases as deprivation increases.**
- Local availability of **exclusively** online out-of-home outlets is **greater in more deprived areas.**

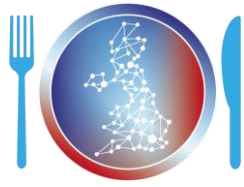


Implications



- Reliance on physical out-of-home food outlet **data significantly underestimates the true size of the observable neighbourhood** out-of-home food environment
- **Digital proliferation** may be becoming more important than physical proliferation in the neighbourhood out-of-home food environment in Birmingham
- Digital proliferation is due to a combination of: dark kitchens, sub-brands, **difference between the size of walkable and deliverable areas**, retail format blurring (e.g. convenience store concessions etc) and market growth.

- A **combined approach** is necessary when making decisions, taking both the physical and digital environments into account
- There is an ongoing need for digital data to be more **freely available to policy makers & researchers** to prevent over exposure and potential increased risks of poor health
- Across food data there needs to be a **consensus on environmental and exposure metrics** for comparability across studies

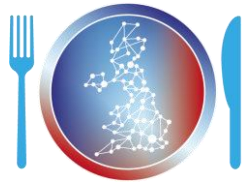


What is next for this data?

- The digital food environment & consumer purchasing
 - How does the digital food environment (i.e., OER & exclusivity) relate to people's purchasing habits?
 - Is there a link between neighbourhood deprivation and online food choices?
- Longitudinal changes in the digital food environment
 - How does the online food environment change and how rapid is listing turn over?
 - How does this compare to the rate of change in the physical landscape?
 - Is there a difference over time in the types of online listings available to users?



FEED Network



- Food Environment Evidence & Data methods (FEED)
 - Bring together stakeholders in food data science
 - Harmonise exposure metrics (e.g., spatial units)
 - Produce a consensus paper
- First meeting: **29th April 2026, LSHTM, London**
- If interested, email me: sophiehedges2@lshtm.ac.uk

Concept Note



Thank you

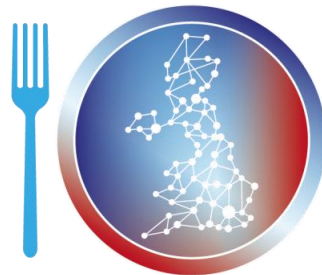
Any questions?

Contact: Sophie.hedges2@lshtm.ac.uk

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