Bathing facilities and health phronesis

Bathing and Healthy Cities: Some Reflections on Urban Environments

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Overview

- The pandemic exposed regional health inequality and urban infrastructure neglect. UK is one of the unhealthiest developed nations (> 35% of obese by 2025)
- Local sports infrastructure is patchy

1. Backdrop UK health challenge
2. Literature review
   a) Historical context (Ancient Rome)
   b) Structured literature review of sports facilities & health
3. Quantitative
   a) Statistical analysis of English local area standardised mortality, pool density, deprivation, obesity & environmental factors
   b) Longitudinal time series modelling of English swimming pool construction data (120 years)
4. Qualitative: 3 X case studies
5. Synthesis

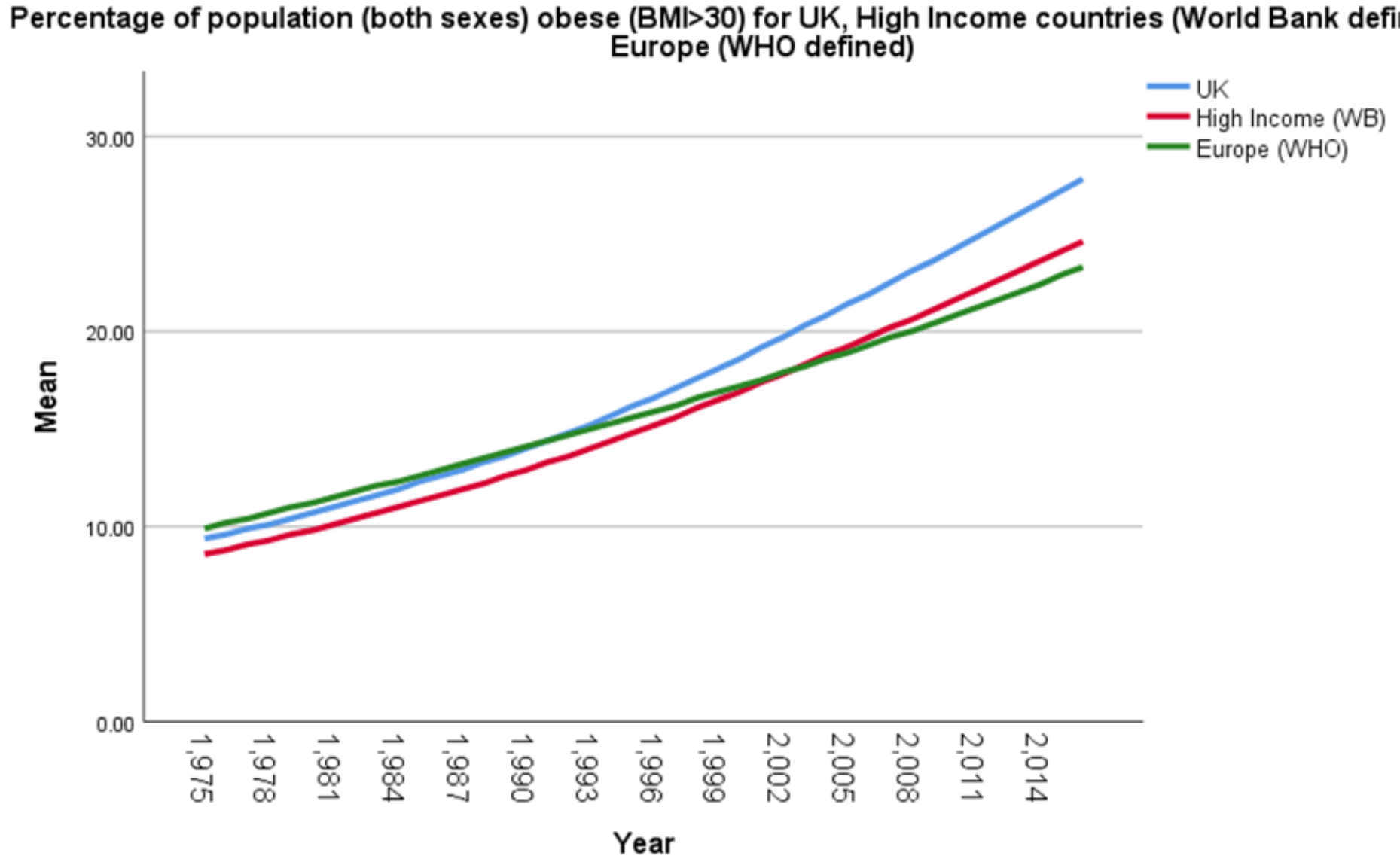
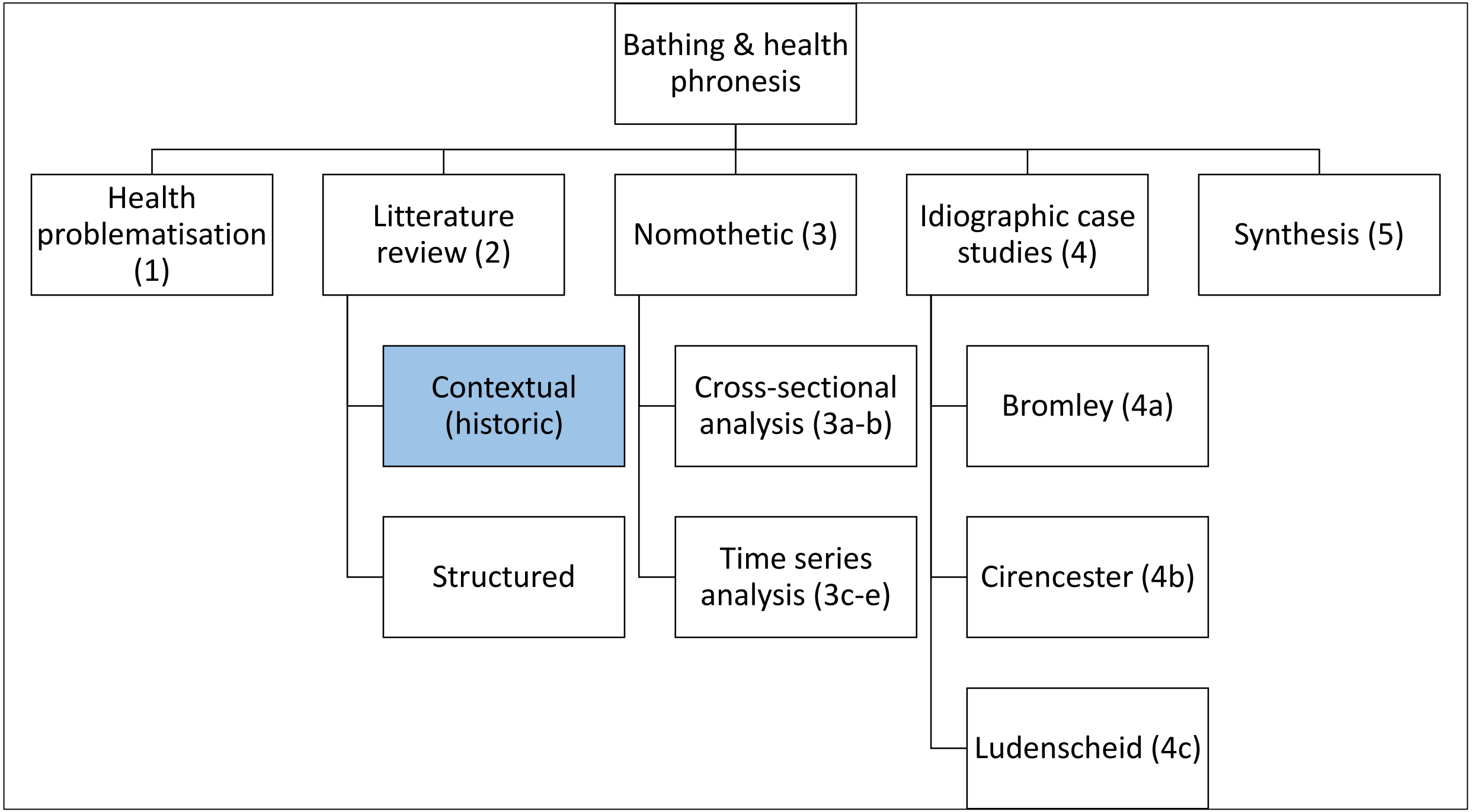


Figure 1: WHO time series data illustrating UK obesity issue (Global Health Observatory 2020)

Research questions

- RQ1: Does the geospatial distribution of swimming facilities impact health? (Nomothetic). ($H1_0$: *Pools* is insignificant vs. $H1_A$: *Pools* is significant)
- RQ2: Is the construction of swimming pools adequate for national health need? (Nomothetic). ($H2_0$: Forecast pool construction stable vs. $H2_A$: Forecast pool construction increases)
- RQ3: What policy learning emerges from idiosyncratic cases? (Idiographic & qualitative)


Bathing & health phronesis
Health problematisation (1)
Litterature review (2)
Nomothetic (3)
Idiographic case studies (4)
Synthesis (5)
Contextual (historic)
Structured
Cross-sectional analysis (3a-b)
Time series analysis (3c-e)
Bromley (4a)
Cirencester (4b)
Ludenscheid (4c)

In Ancient Rome

- 33BC – 170 registered private baths but within 400yrs # = 850 (Lane Fox, 2005, p.462)

Baths of Caracalla: Sir Lawrence Alma-Tadema Date: 1899 Style: Romanticism

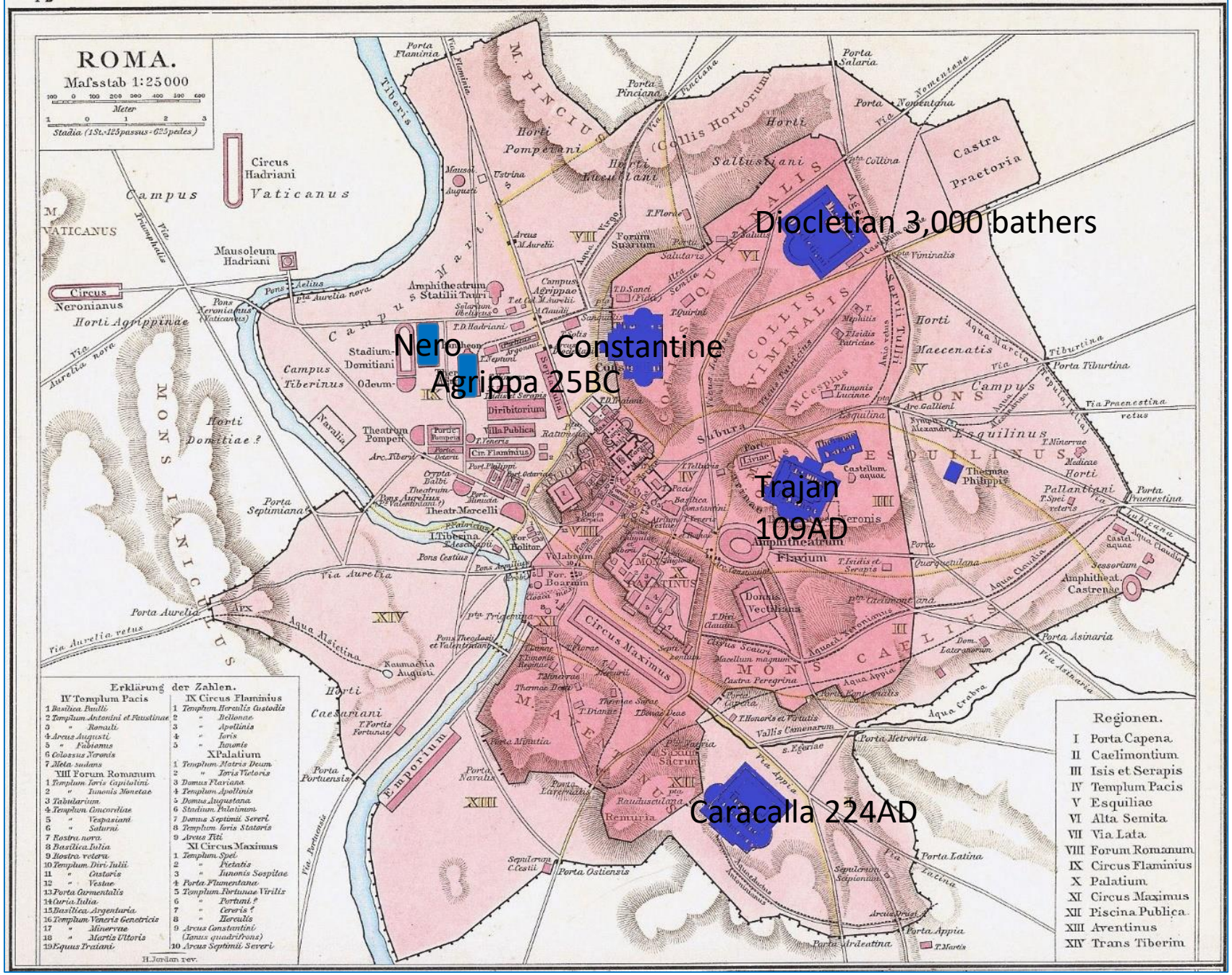
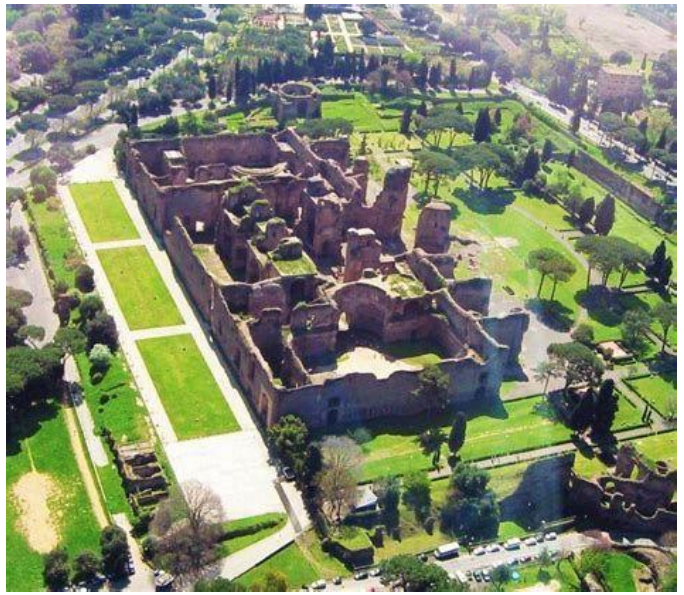
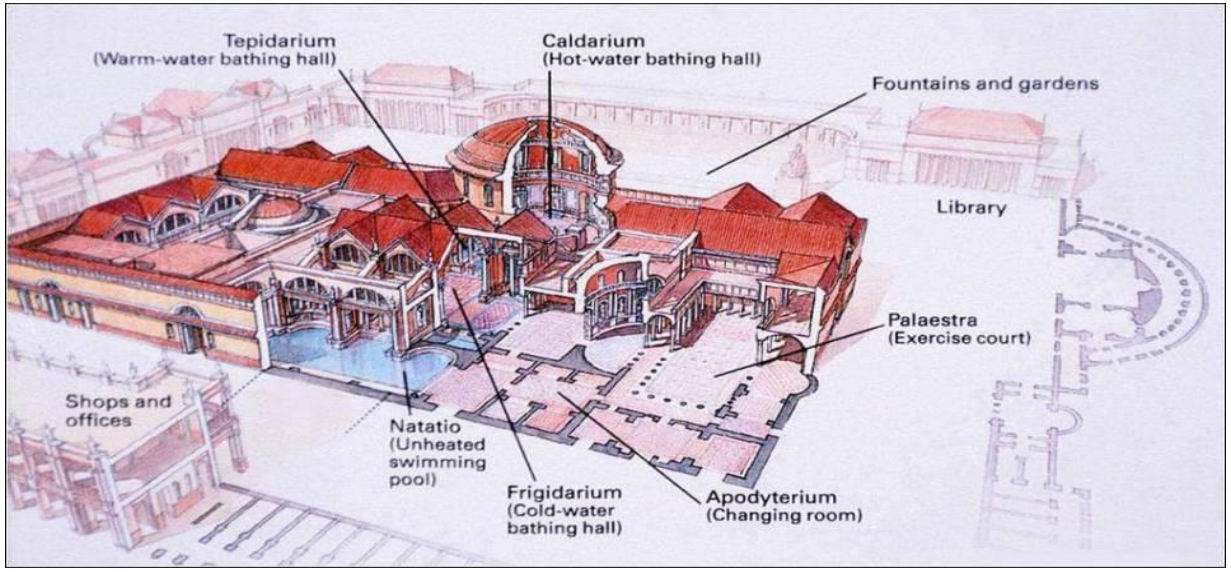
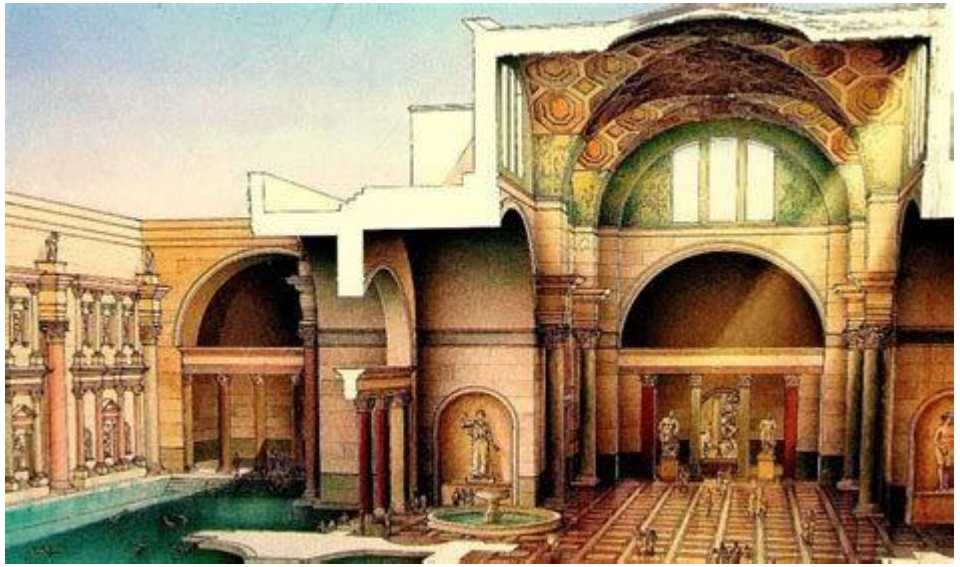


Figure 3: Indicative map, illustrating just a few of Classical Rome's 23 imperial *thermae*. (Sources: Author, Zanker, 2010 p. 62; Andree, R. 1886 in *Allgemeiner Historischer Handatlas*, Droysen. G. (Ed)).



Baths of Caracalla
(constructed 211-224 by the emperors Caracalla, Heliogabalus, and Severus Alexander. Olympic size pool – the Natatio, two libraries and gardens. Accommodated ~ 1,600 bathers until 6th century (537AD).

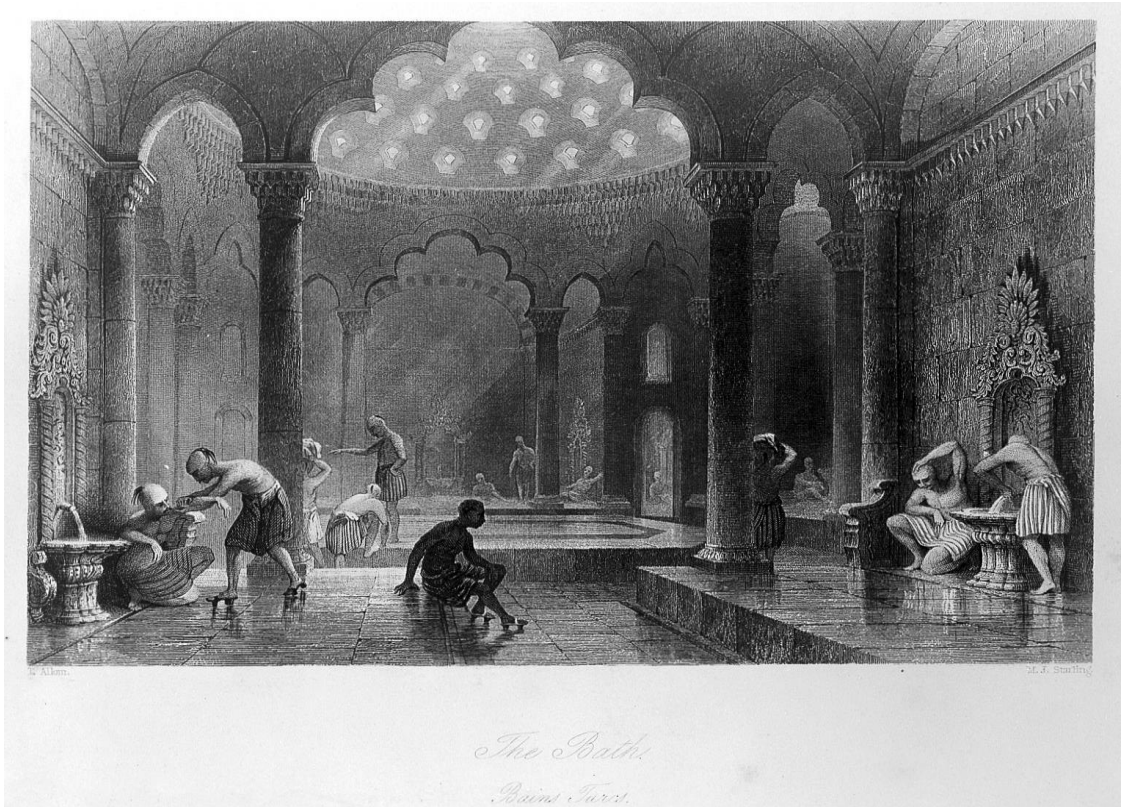




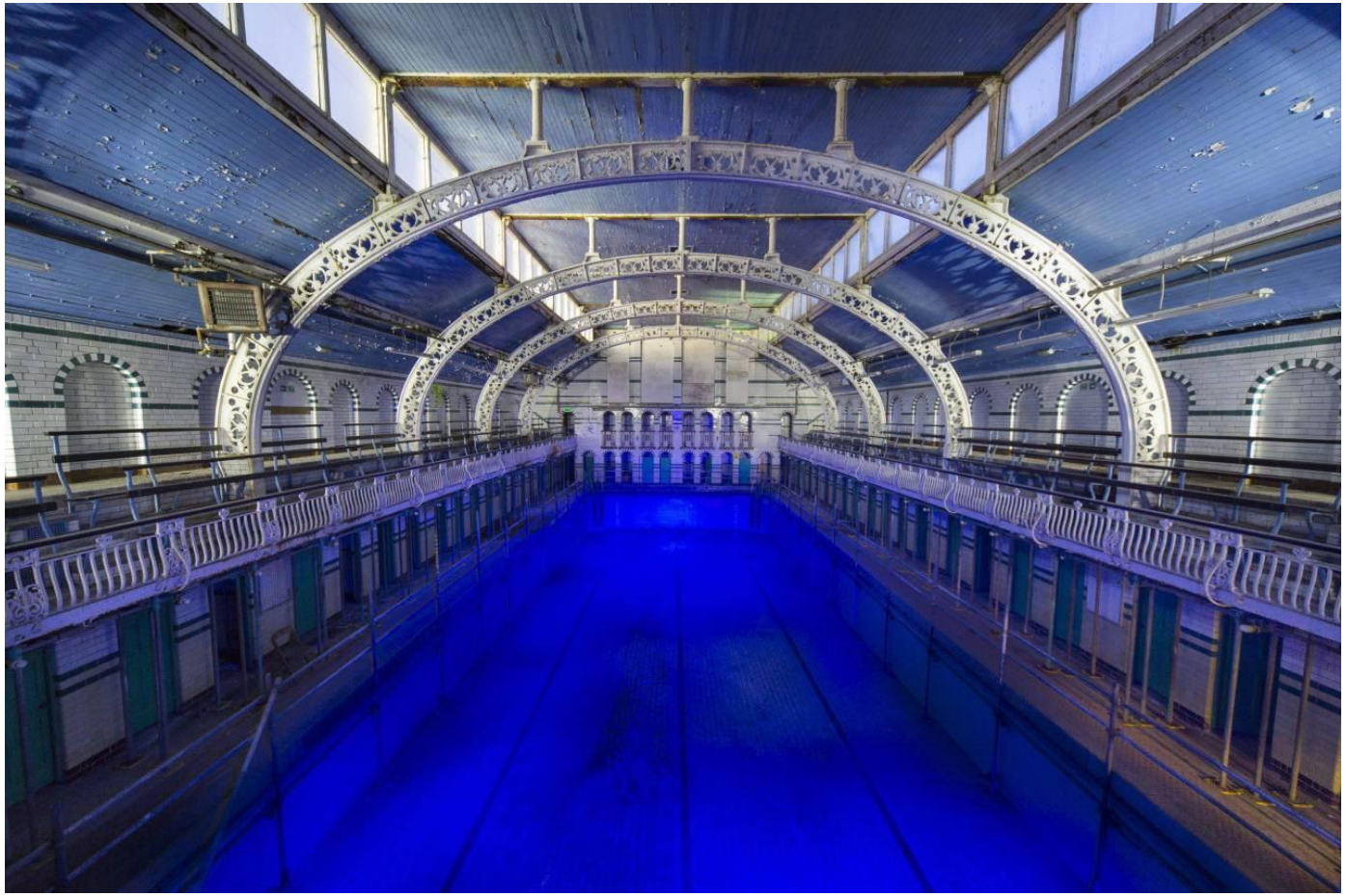
Ottomans: Istanbul

In Ottoman Empire, *hamams* were multi-faceted urban amenities with socio-cultural (networks), health and religious dimensions. 177 *hamams* mapped.

Nina Ergin, 'Bathing Business in Istanbul: A Case Study of the Çemberlitaş Hamamı in the Seventeenth and Eighteenth Centuries', *Bathing Culture of Anatolian Civilizations*: *Architecture, History and Imagination* (Louvain: Peeters, 2011), 142-167.



Contrast with abandoned UK facilities



Phase 2: Literature review

Structured rather than systematic review of health, physical activity and facilities (swimming pools).

Several formal stages:

- Databases
- Academic journals
- Industry / grey literature
- E.g. library database search looked for the term, ‘swimming pools health’ in peer-reviewed journals. 11,646 results were returned so the search was restricted to the field of public health which reduced the output to 1,941 articles. When the filter ‘swimming pools’ was applied, only 399 results were returned.

Often articles were incidental to the main purpose of this investigation. Irrelevant subjects included: chlorination (33), disinfection (37), epidemiology (36), trihalomethanes, water quality (31) and environmental sciences (31).

The literature review supports common sense that swimming or other sport participation brings physical and psychological benefits, notwithstanding some chemical, bacteriological or injury risks. The literature repeatedly links excess morbidity with spatially fragmented deprivation. Affluence and sports facility accessibility influence physical activity. The literature motivates an investigation into the influence of swimming pools on mortality, the influences on bathing facilities investment and fruitful policy directions.

Phase 3: Nomothetic (quantitative)

- The third phase of the sequential mixed methods research involved 5 statistical investigations,
- Stage I (Cross-sectional)
  - Exploratory (factor analysis) (3a)
  - Regression of English mortality and its covariates (3b).
- Stage II (nomothetic) phase of the research, the study analysed 120 years of English pool construction data using autoregressive distributed lag models - ARIMA (3c), ADL (3d) and ECM (3e)

Cross sectional data

- Deaths (DV, Yd): cross-sectional analysis (3a & 3b) dependent variable (DV,). Sourced from ONS standardised mortality ratio (2013-2017). Observed total deaths from all causes (by five year age and gender band) as a percentage of expected deaths. Mortality in Richmond upon Thames is below age-adjusted expectation (77.3%) compared to Middlesbrough where actual deaths exceeded standard expectations by over 40% (143%).
- Access Leisure (IV, X1): reflects accessibility to 727 leisure centres, swimming baths or 2,738 health clubs in kilometres. Sourced via SE (2020) from Liverpool University's Consumer Data Research Centre (CDRC), Access to Healthy Assets and Hazards (AHAH) index (CDRC, 2020). AHAH integrates retail environment, health services, physical environment and air quality to generate an overall summary of locales environmental health (Green et al., 2016). The Isles of Scilly (74.3) or Melton Mowbray (19.9) have relatively poor access compared to City (0.3), Kensington and Chelsea (0.4) or Islington (0.5). Ceteris paribus, easier access should improve health so the coefficient expectation for X1 is positive (lower km or easier access, then lower mortality or if X1 ↓, → Yd ↓
- Obesity (IV, X2): percentage of adult population with a body mass index (BMI) of 30 kg/m2 or higher, age-standardized sourced from WHO 2389 NCD_BMI_30 (2020). In Kensington and Chelsea it was 14% compared to, for example Gateshead at 30.7%. Coefficient expectation for independent variables (IV), X2 = Obesity, is positive as more excess obesity is expected to increase excess deaths. If X2 ↑, → Yd↑

Cross-sectional data II

- Deprivation (IV, X3): deprivation score for English small areas, sourced from Index of Multiple Deprivation (2019). To generate the index, deprivation indicators across seven domains (income, employment, education/training/skills, health and disability, crime, housing, and environment) are, adjusted, combined, ranked, transformed and weighted. A lower rank indicates higher deprivation (e.g. Birmingham and Solihull = 4,191 vs. Windsor 26,634 (mean 17,460). Expectation is that if X3 ↑, → Yd ↓
- Environment (IV, X4) measures accessible blue and green space, sourced via SE (2020), the data constitutes an element of AHAH (2017) (see above). Hackney had the worst environmental score (0.2) compared to Mid Suffolk (60.4). The expectation is that environment coefficient will be negative as more green or blue space access should reduce mortality ceteris paribus so if X4 ↑, → Yd ↓
- Pools (IV, X5): reflects pools per 10,000 in 2018 (latest available data). Data extracted from Active Places Power (APP) SE's analytical interactive web mapping and reporting tool. APP references England's most authoritative sport facility and club database. The study then used ONS population data to compute the number of pools per 10,000 residents in each locales. Locales comprised 343 English local authorities (county councils, district councils, unitary authorities, metropolitan districts and London boroughs) but also SE Active Partnerships (45) and Local Delivery Pilots (11). The study acknowledges the need to audit the geospatial integrity of pool data (see study limitations). Expectations is that if X5 ↑, → Yd ↓

Time series data

- Pools constructed (PC & ΔPC): English swimming pools constructed each year during a 120 year period since 1900, sourced form Sports England: Active Places Power (2020) database.
- English output (GDP & ΔGDP): Bank of England millennium of macroeconomic data UK (2017) provides historical macroeconomic and financial statistics. Based on the Blue Book 2016, it includes historical data from Broadberry et al. (2015), cross checked against Mitchell (1988).
- English population (Pop & ΔPop): English population and population growth 1900-2020, sourced from Office for National Statistics (ONS): Total population (2018). ONS England population mid-year estimate (2019) shows mid-year estimates of total population of area (all ages and genders). English population estimates 2000-2018 were cross checked against ONS Population growth in the United Kingdom (2018).

Principal components

Results	Component	
	1	2
Access Leisure	.382	.627
Obesity	-.551	.672
Deprivation	.885	-.048
Environment	.508	.631
Deaths	-.909	.164
Pools	-.006	-.406

- 2 main components explained > 62% of variable fluctuations.
- Component 1 privileged locales, loaded strongly and negatively on obesity and deaths but positively on environmental variables and deprivation index
- Component 2 semi-rural/rural locales with access to green and blue space, a dearth of sports infrastructure
- Reinforces the literature geographically and socially fragmented English landscapes

Regressions

- $Y_t = \propto + \beta X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$ (3b)
- Where:
- Y_t = English LGA standardised mortality ratio (2007-13)
- X_1 = Access to leisure (coefficient expectation >1, as easier access/shorter distance, lowers excess mortality)
- X_2 = Obesity (coefficient expectation >1, as higher excess obesity increases excess mortality)
- X_3 = Deprivation (coefficient expectation <1, as low score indicates worse deprivation and expected increase in excess deaths)
- X_4 = Environment (coefficient expectation <1 as better environment should reduce mortality).
- $X_{5\ =}$ LGA Pools per 10,000 (coefficient expectation <1, as higher pool density should cut excess mortality. Null hypothesis for RQ1: $H1_0$: $\beta_5 = 0$

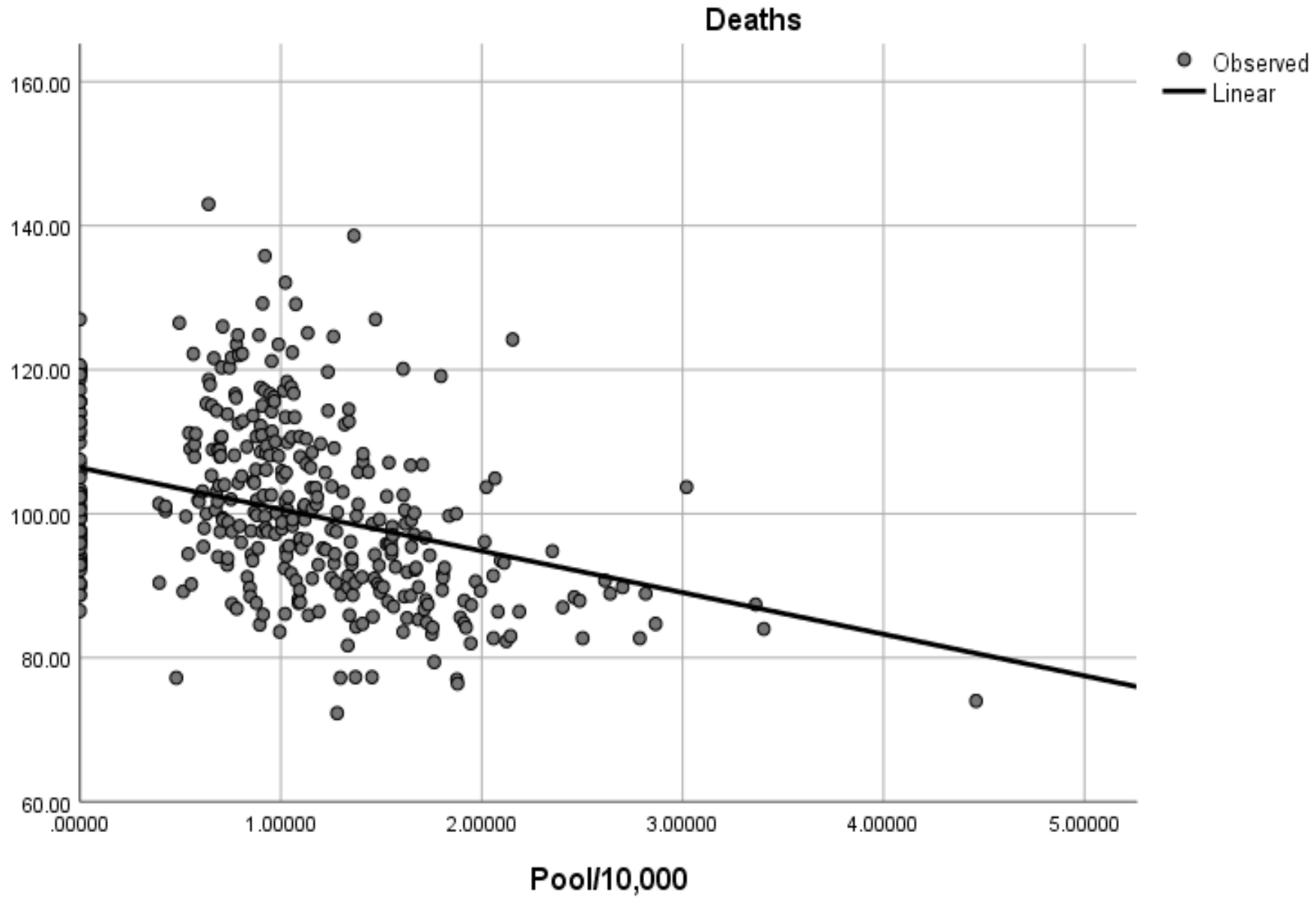


Figure 8: Scatterplot of deaths and pool density with City of London outlier removed

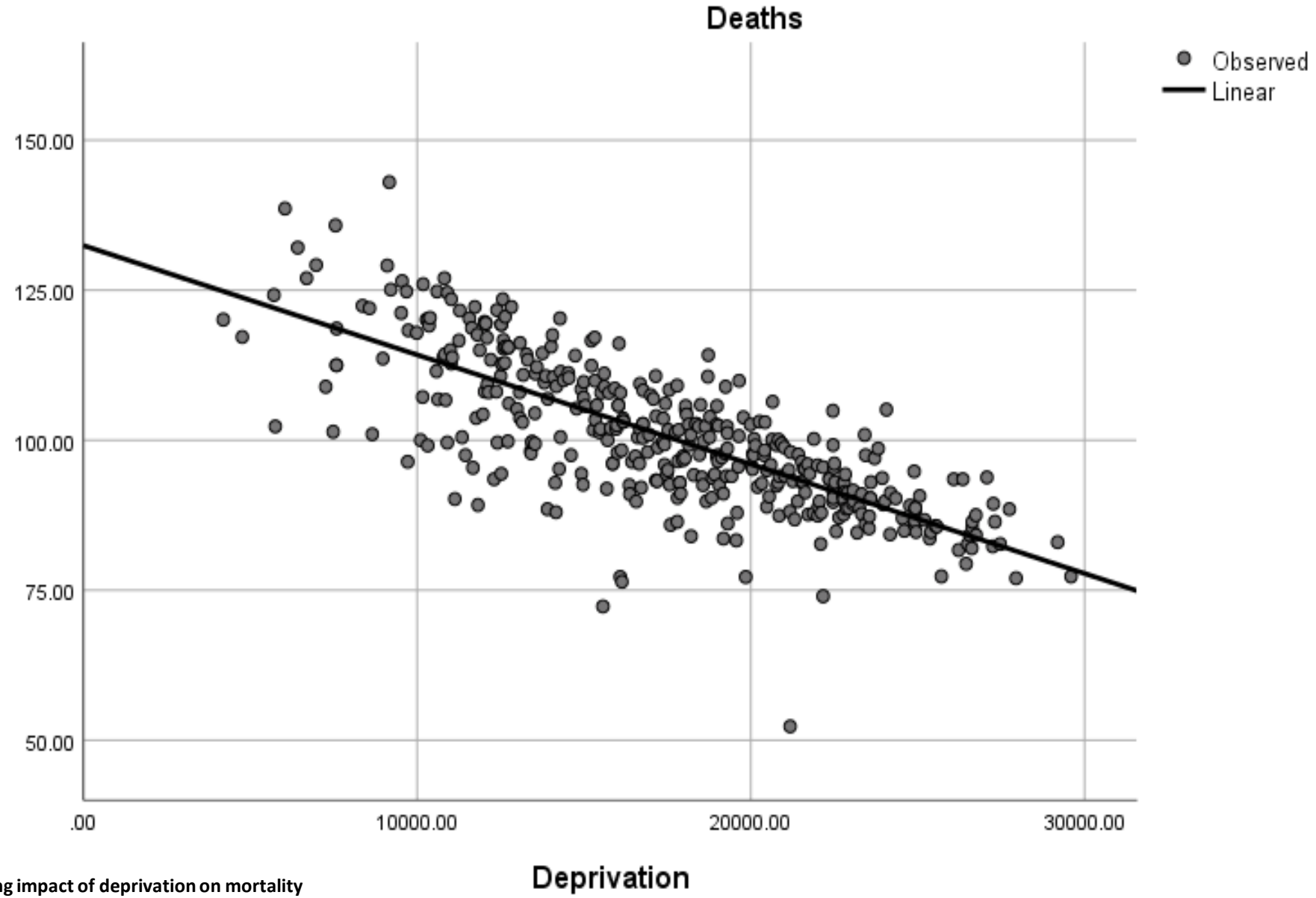


Figure 9: Strong impact of deprivation on mortality

DV Deaths with Predictors: (Constant), Pool/10,000, Environment, Obesity, Access Leisure, Deprivation

	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	.823[a]	.677	.673	7.02895	
	Sum of Squares	df	Mean Square	F	Sig.
Regression 3a	41340.840	5	8268.168	167.351	.000
Residual	19713.043	399	49.406		
Total	61053.883	404			

	Expected sign	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)		100.397	4.150		24.190	.000		
Access Leisure (X_1)	>1	-.245	.087	-.088	-2.803	.005	.826	1.211
Obesity (X_2)	>1	1.184	.144	.279	8.225	.000	.701	1.426
Deprivation (X_3)	<1	-.001	.000	-.569	-15.763	.000	.621	1.611
Environment (X_4)	<1	-.092	.041	-.080	-2.279	.023	.659	1.517
Pool/10,000 (X_5)	<1	-1.434	.317	-.136	-4.517	.000	.895	1.117

Summary cross-sectional regression results

- Model coefficients are all significant at the 5% confidence level. There is strong evidence that leisure access, obesity, deprivation and pool density are significantly associated with mortality ($p < 0.01$) but only some evidence ($p = 0.023$) that the environment is significant. All have the expected signs except for leisure access, already flagged as a variable with confounding issues. Variance inflation factors (VIFs), that quantifies multicollinearity severity, are under the generally accepted 2.5 threshold. Due to IV measurement variability, the standardised coefficients provides most useful insights into the relative impact of the variables and suggests, unsurprisingly, a strong association between deprivation and excess deaths.

Time series analysis

- The time series analysis sought to answer RQ2: Is the construction of swimming pools adequate for national health need? (Nomothetic). The study ran three time series models where pools constructed (PC) or changes in this dependent variable (ΔPC) were fitted to lag values of itself and other predictors, covariates or independent variables (IVs):
- Autoregressive Integrated Moving Average - ARIMA (3c)
- Autoregressive Distributed Lag - ADL (3d)

ΔPC = PCt-1, ΔPCt-1, GDP, ΔGDP, ΔGDPt-1, Pop +ΔP + ΔPt-1 (3d)

- Error Correction Model - ECM (3e) where departures from fitted estimates influence pool construction. Found strong evidence (p=0.003) of error correction (reversion to mean) but lagged changes in GDP only have a borderline influence on construction (p = 0.075)

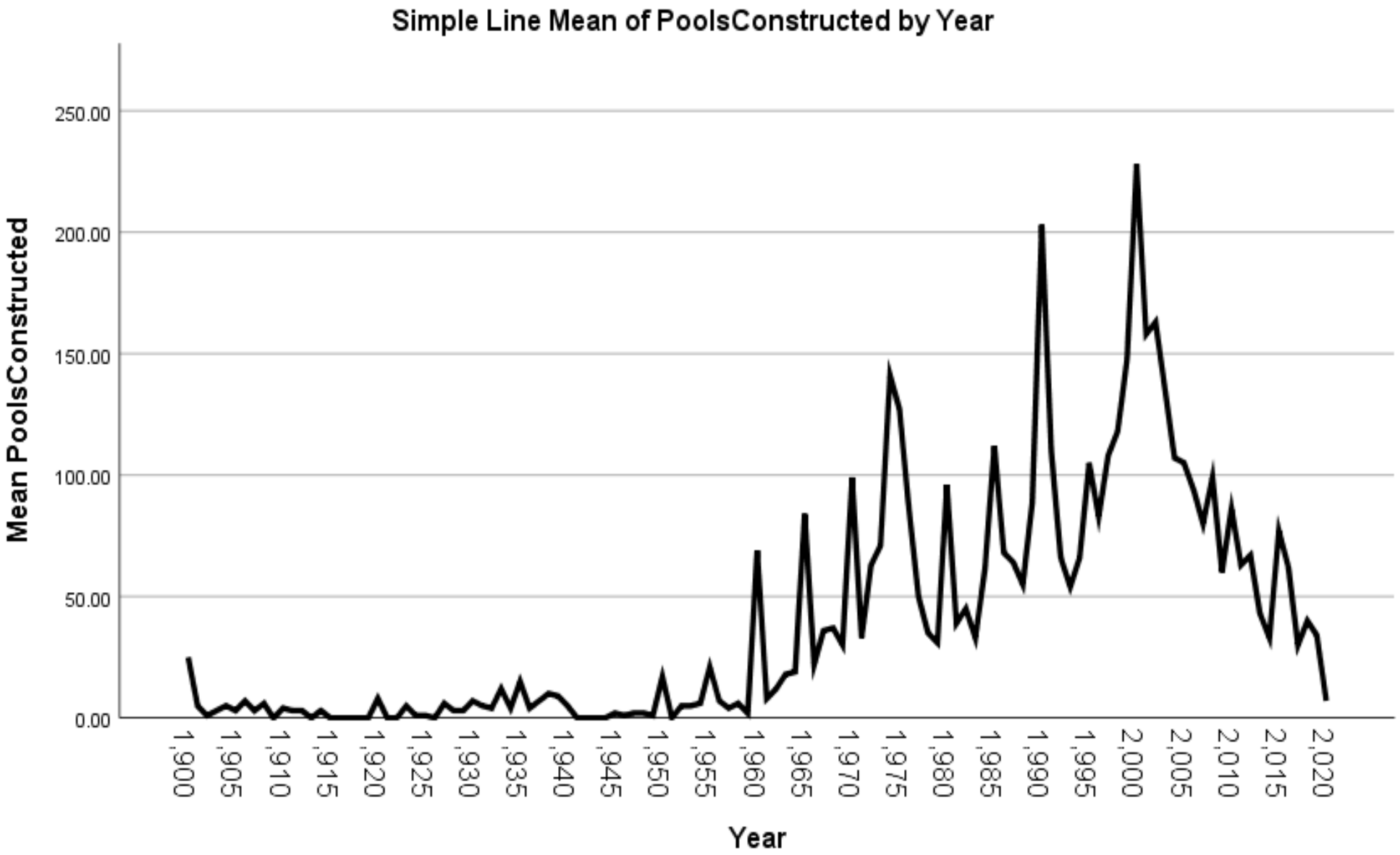


Figure 10: Pool construction in England and Wales (Sports England, 2020)

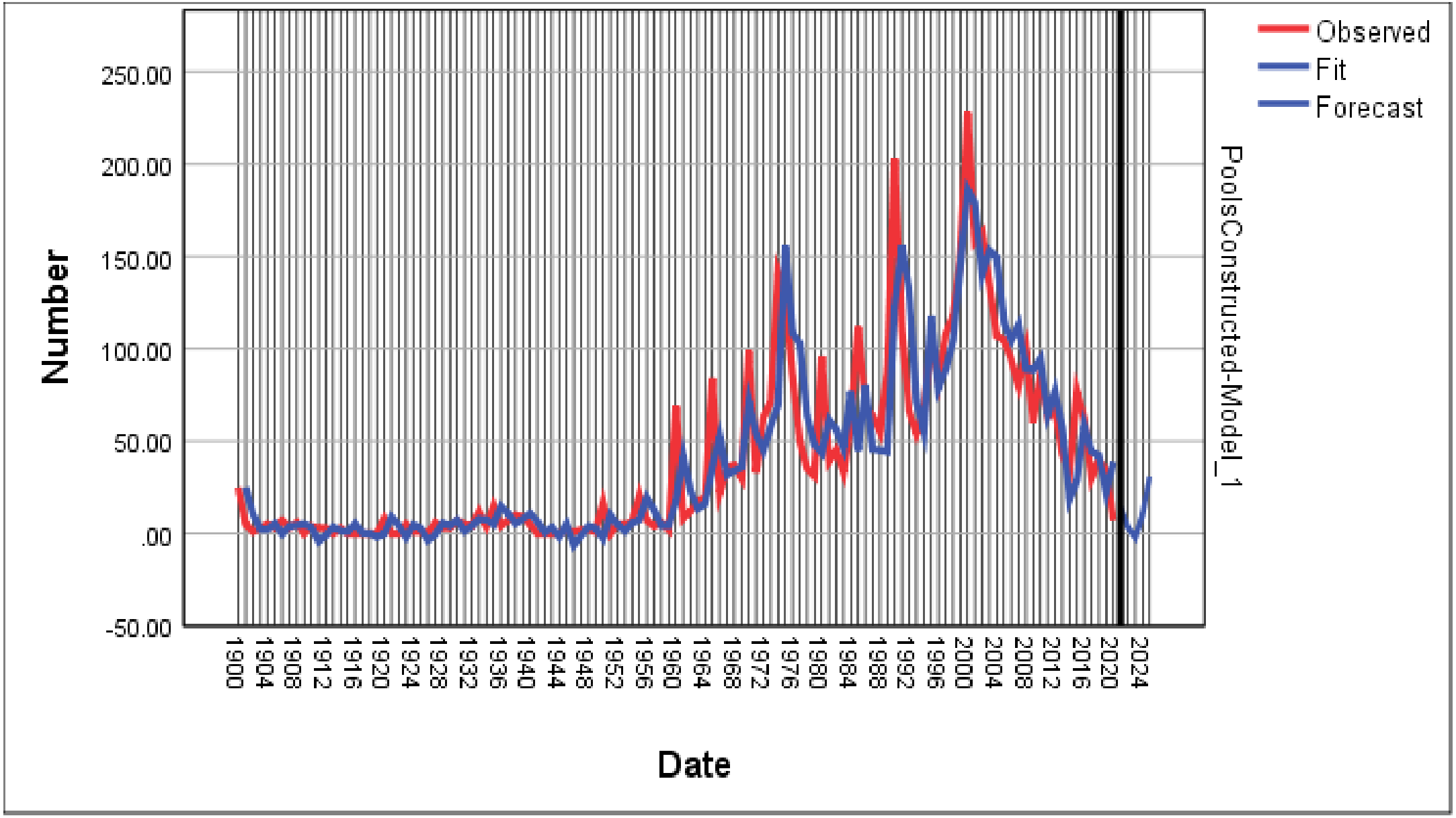


Figure 11: Time series model (3c) on untransformed pool construction data, forecast to 2025

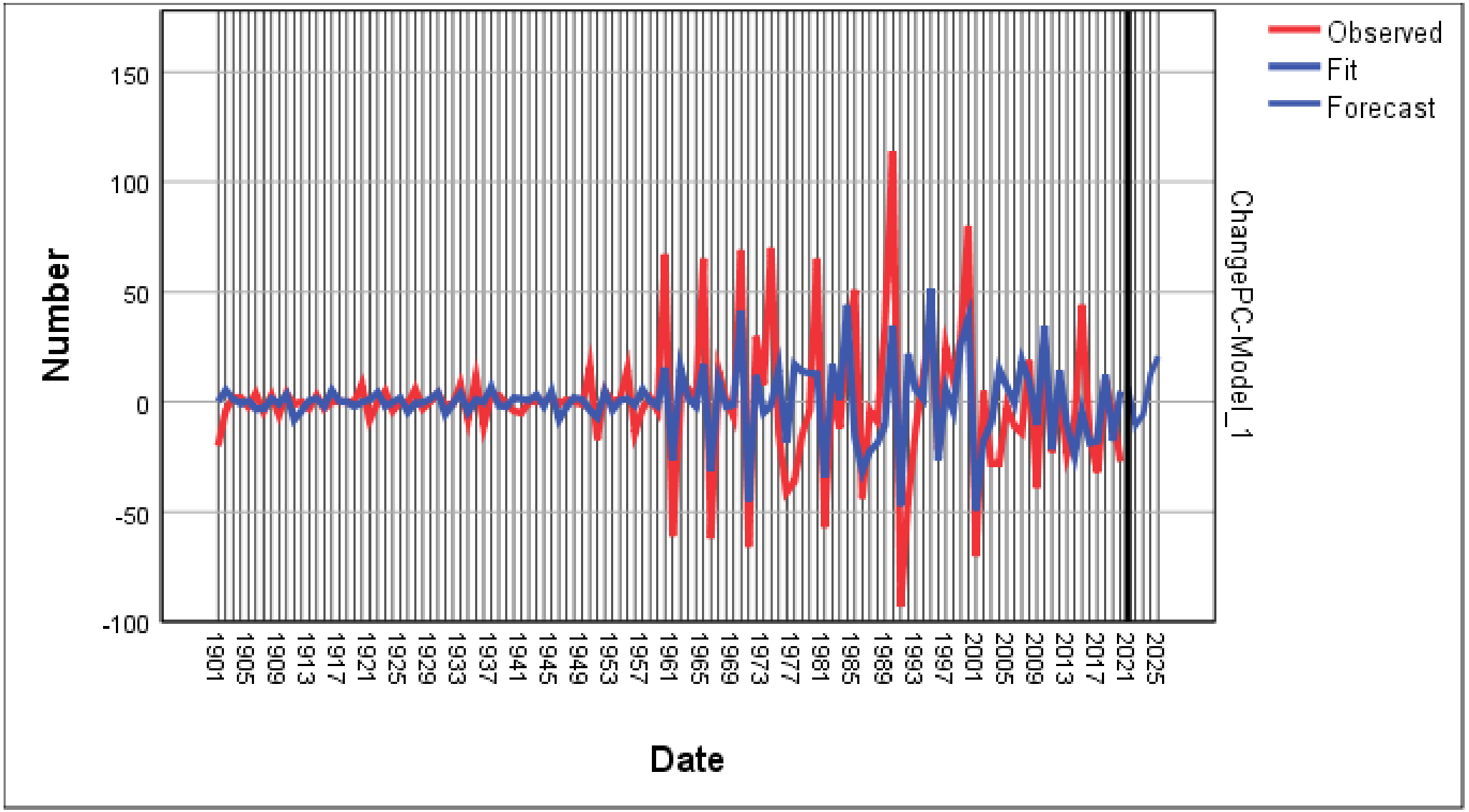


Figure 12: Forecasting result generated by transformed pool construction ADL modelling of time series (3d)

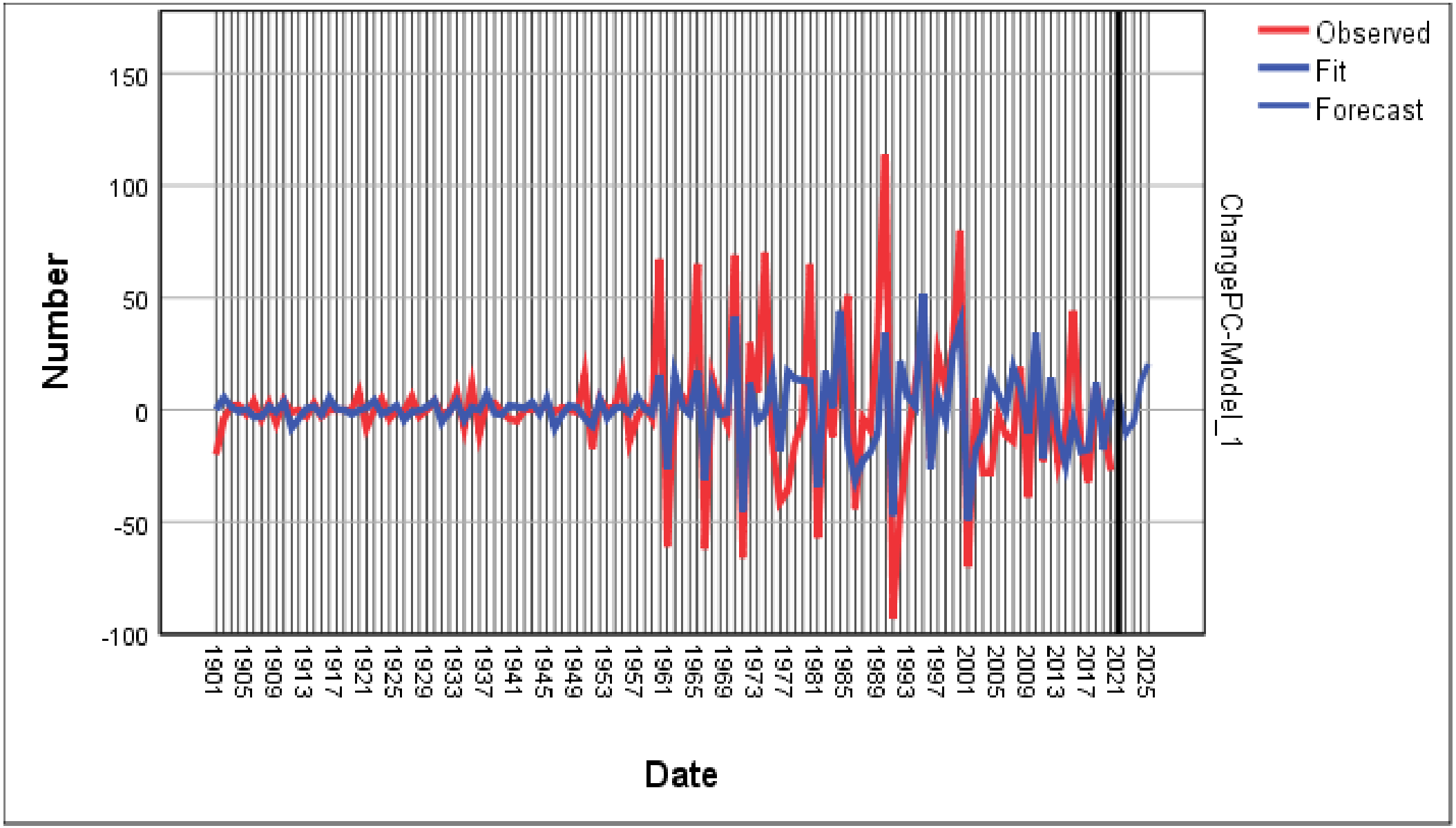


Figure 14: ECM modelling (3e), illustrating indicative need to ramp up bathing facilities construction to return to equilibrium

Nomothetic conclusion

- The cross-sectional statistical analysis (3a) refuted the null hypothesis that pool density has no influence on deaths ($H1_0$: $\beta 5 = 0$).
- For the times series modelling, recent construction fluctuations and the time series forecasts (3c-e) are indicative of policy flux and lend qualified support to a moderate and targeted increase in pool construction, subject to appropriate evaluation and planning approval.
- To mitigate the risk of statistical myopia and enrich its policy insights for RQ3, the study also considered some idiosyncratic swimming pool case studies.

Idiographic case studies

- Study identified three idiosyncratic bathing facilities to triangulate evidence and generate some useful preliminary insights.
- The three cases included:
  - English metropolitan (Bromley)
  - English regional (Cirencester)
  - European regional (Ludenscheid, Germany).
- The comparative case study research integrated visits, recollections, online information or requested documentation to sketch geographical context and pool facilities development or management issues.

Intensification & transformation from public to private domain

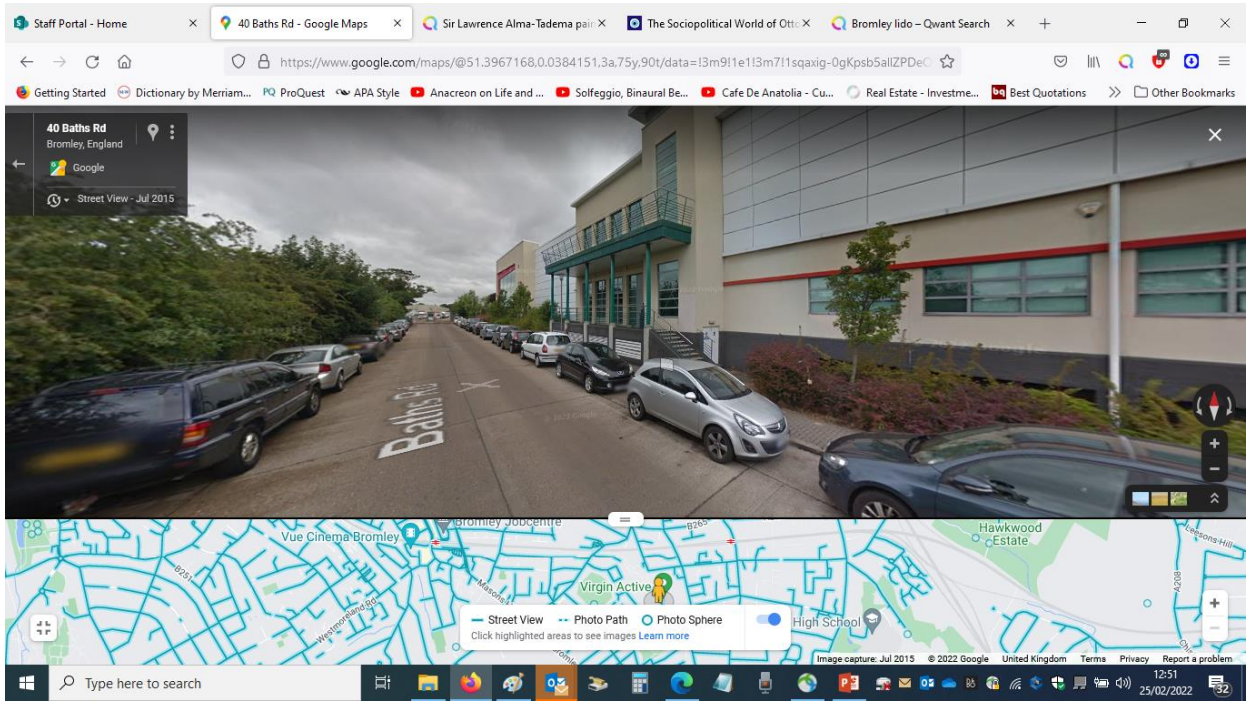


Figure 15: Familienbad Nattenberg Lüdenscheid illustrating quality local bathing facilities (Source: Franz van Stephoudt GmbH & Co. KG Bauunternehmung).

Case study conclusion

- The idiographic case studies illustrate bathing facility idiosyncratic complexity in diverse geographies
- The exemplary German facility contrasted with mismatch between English health rhetoric and facilities liquidation (Bromley) or outsourcing and semi-privatisation (Cotswolds).
- The contrast with ancient Rome seems marked.
- Case studies bring interpretivist insights that seem to reinforce statistical concerns about English health *phronesis*.

Study conclusion

- The study investigated the impact of pools on health and their construction history in England.
- It used mixed methods in 5 phases
- Identified the health and bathing infrastructure issue and outlined the English chronic obesity epidemic, underlying the current COVID-19 epidemiological one (1)
- A contextual and structured literature review (2) expounded Rome's aquatic achievements (notwithstanding its slave economy) (2a)
- Cross-sectional analysis found that deprivation, obesity but also swimming facilities density significantly influenced mortality in English locales (3a & b)
- Time series statistical analysis of 120 years of English swimming pool construction activity from 1900 found infrastructure provision increasingly erratic and inadequate for health needs (3c-e)
- Finally, for insight and policy learning, the study conducted idiosyncratic, interpretive research involving three swimming pool case studies (4). The case studies illustrated complexity and contrasted unsatisfactory English public asset management with, seemingly, more enlightened overseas provision.

Limitations

- For the literature review (2), the search terms and article screening could be tightened (e.g. by incorporating modified Downs & Black (1998) criteria to restrict diversity and perhaps enable a meta-analysis.
- The cross-sectional excess mortality and pool density analysis (3b), was limited by heterogeneous pool data with diverse facilities in disparate states of repair and varied access or ownership structures.
- Future research should involve individual-level personal panel data analysis.
- For time series (3c-e), an independent expert audit of modelling would be useful.
- The three idiographic case studies (4a-c) tightening thematic analysis to improve trustworthiness (Nowell et al., 2017)

General community implications

- More local spending on sports/social facilities to promote community health
- More local consultation to identify culturally appropriate facilities that promote health and community networking – not necessarily bathing facilities.

Selected bibliography

- Lane Fox, R. (2005) The classical world: an epic history of Greece and Rome, Penguin.
- Nina Ergin, ‘Bathing Business in Istanbul: A Case Study of the Çemberlitaş Hamamı in the Seventeenth and Eighteenth Centuries’, Bathing Culture of Anatolian Civilizations: Architecture, History and Imagination (Louvain: Peeters, 2011), 142-167.
- Sports England for online access to their *Active Places Power* database https://www.sportengland.org/
- Franz van Stephoudt GmbH & Co. KG Bauunternehmung for Figure 15 photo of Familienbad Nattenberg Lüdenscheid http://www.stephoudt.de/
- Further reading: pre-print with literature & data available at:

https://doi.org/10.31219/osf.io/4atsk