Pedalling for Health & Planet?

The Co-Benefits Model

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Moving Active Transportation to Higher Ground April 2015

Centre for Diet and Activity Research
A UKCRC Public Health Research Centre of Excellence

MRC Epidemiology Unit

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Provisional Results!

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UK Clinical Research Collaboration igniting our potential

University of Cambridge

University of East Anglia

MRC Medical Research Council

Our Issue

- Health consistently large
  - except if young with high injury risk
- Carbon mixed
  - Visions England & Wales
  - London hire bikes
- So more systematic approach

Structure of Talk

- Methods
  - Data sources
  - Marginal METs
  - Relation to ITHIM
  - Physical activity dose response curve
  - Probabilistic approach to switching to cycling
  - Distance Decay for Cycling
  - Trip Distance Reduction
- Results
- Future work

Methods

Data

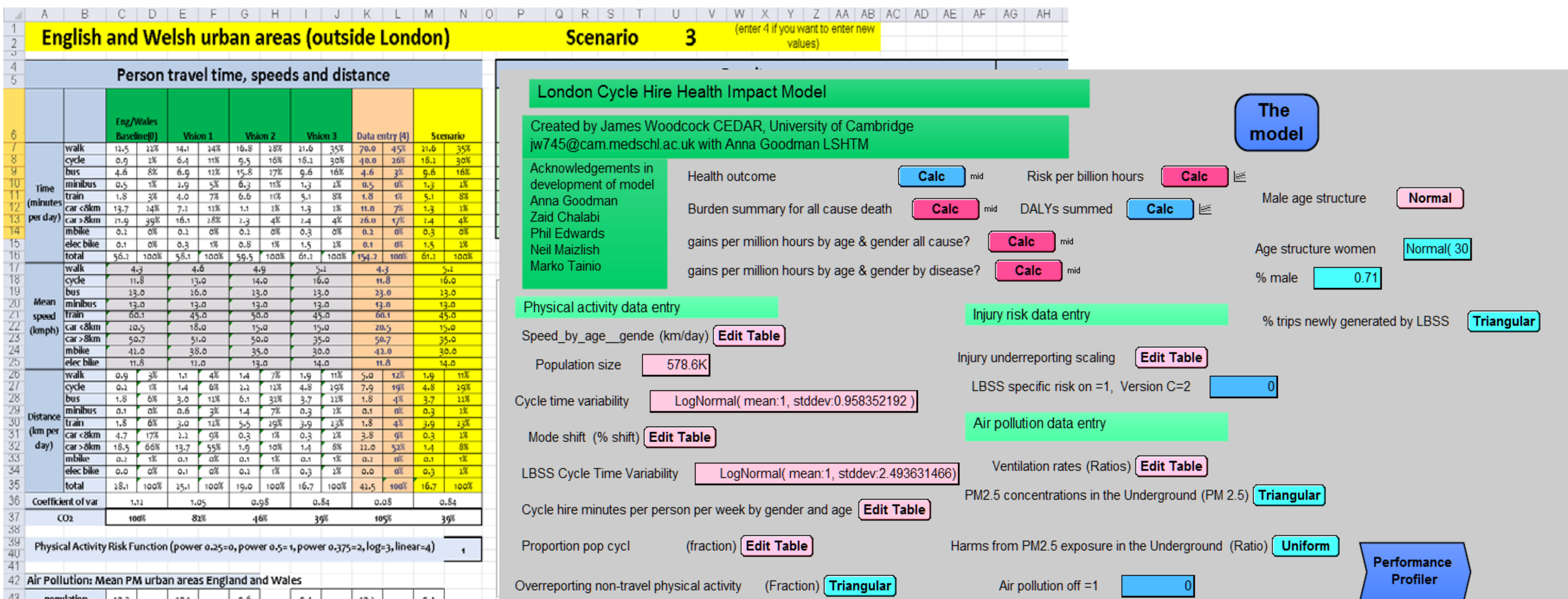
Data Source	Use of Data
National Travel Survey for England (NTS)	Trips & person level data
	Probability of Cycling 1 mile
	Relative probability of cycling longer trips
Health Survey for England (HSE)	Non-travel Physical Activity
Netherlands National Travel Survey	Relative probability of cycling longer trips for ebikes
Global Burden of Disease	Deaths, Years of Life Lost

Marginal METs - MMETs

- Metabolically Equivalent Tasks (METs)
- Marginal METs (MMETs): METs above resting
- Ebikes 3.5, Walking 3.6, Cycling 5.4

I know this is a session on ITHIM but…

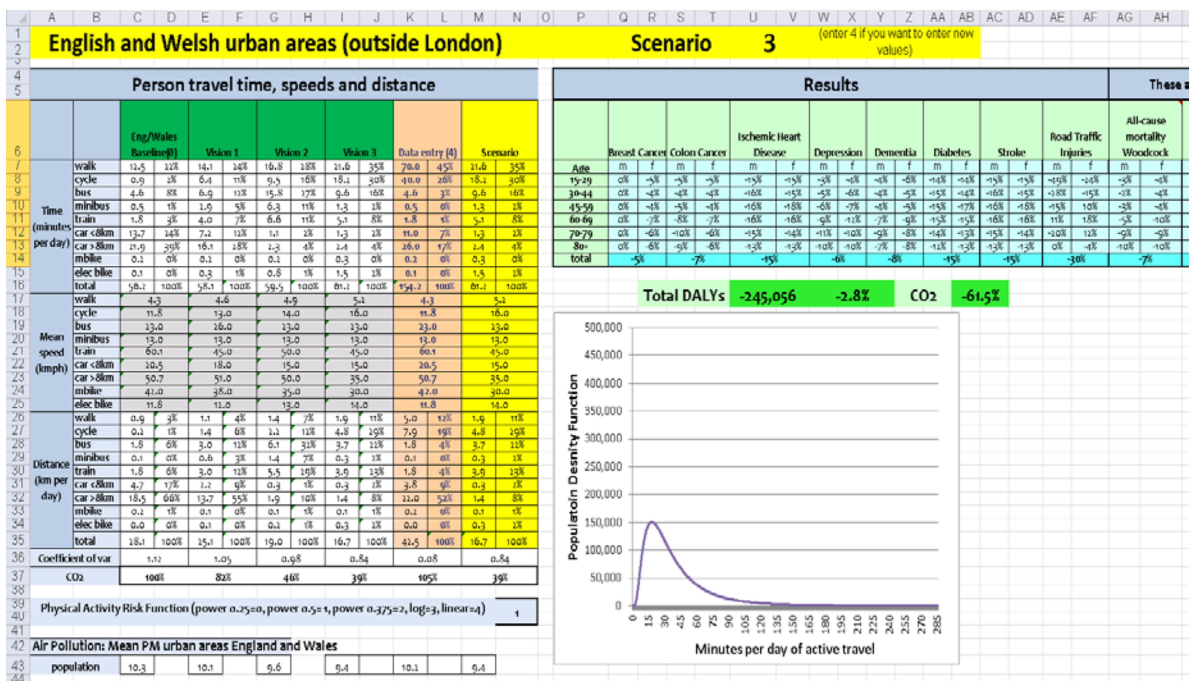
- Sorry not really using ITHIM
- Neither spreadsheet model nor Analytica model
- Analysis done in R



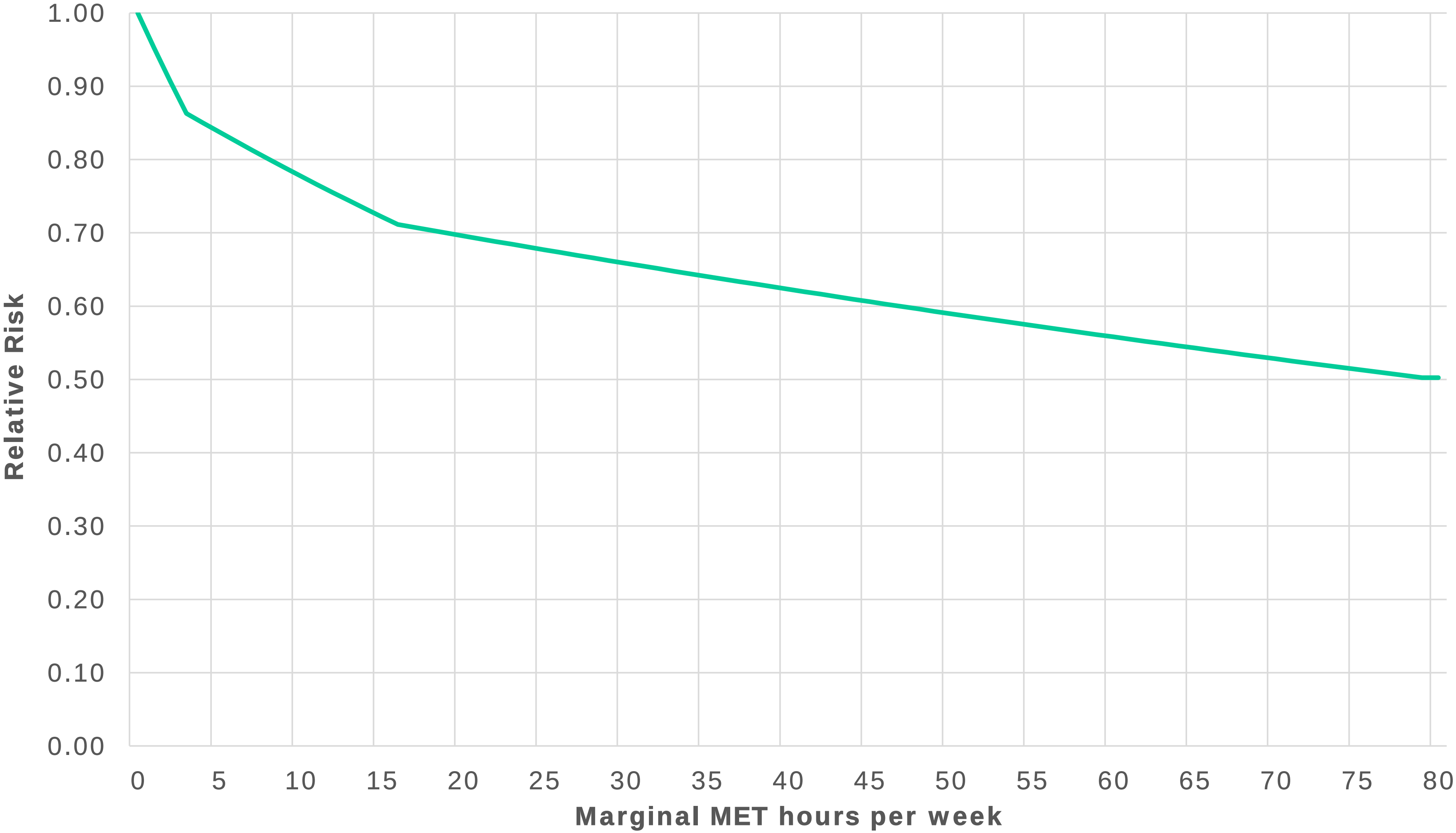
Compared with ITHIM & HEAT

- Uses Comparative Risk Assessment
- No air pollution or injuries!
- Only mortality- but includes YLLs from GBD
- Like ITHIM age & gender specific
- Like ITHIM 2 ½ individual level travel survey data

HEAT
Health economic assessment tool



Relative Risks All-Cause Mortality from Leisure Activity



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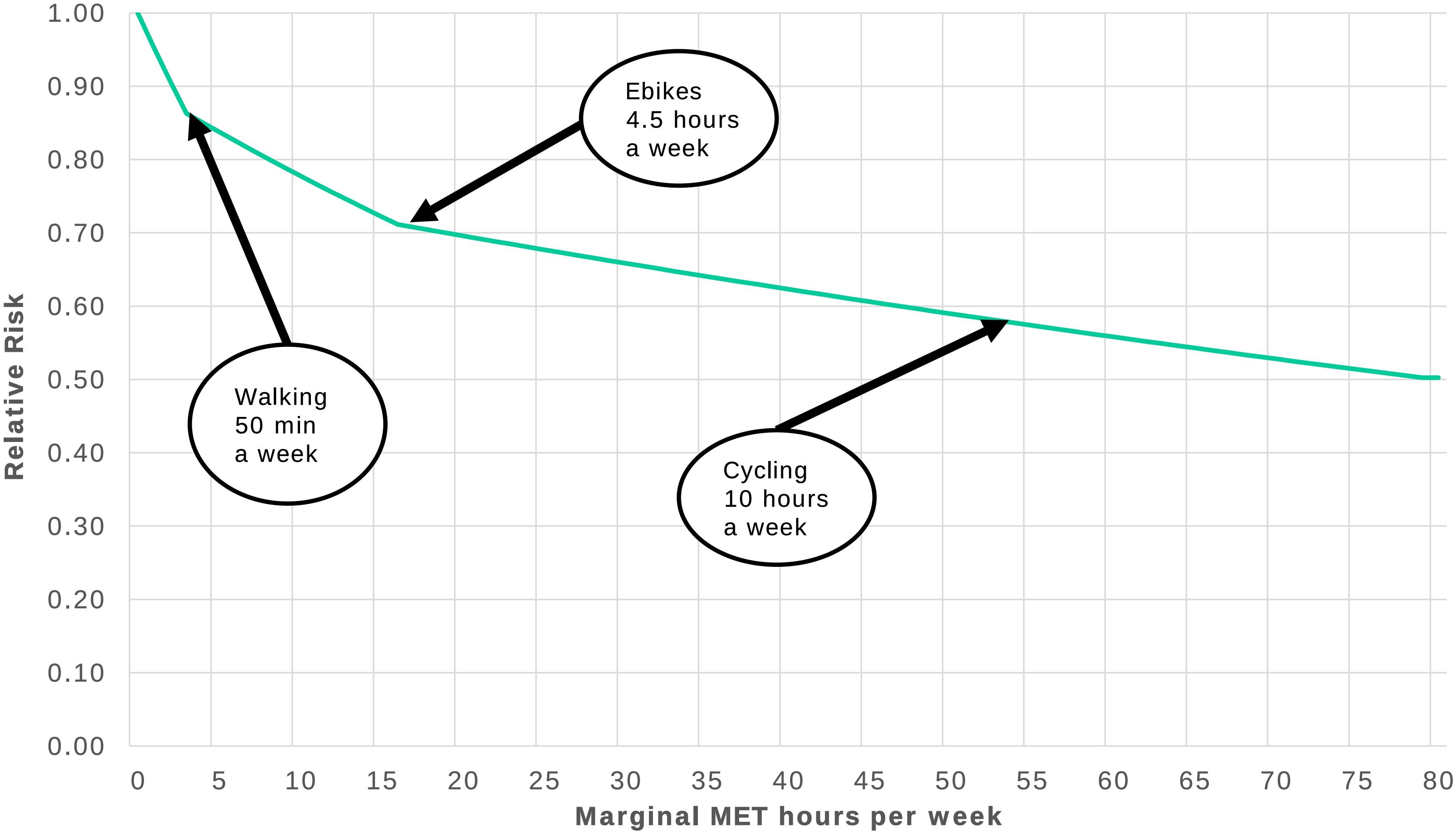
Wen et al. *Lancet* 2011; 378: 1244–53

Relative Risks for All-Cause Mortality from Leisure Activity

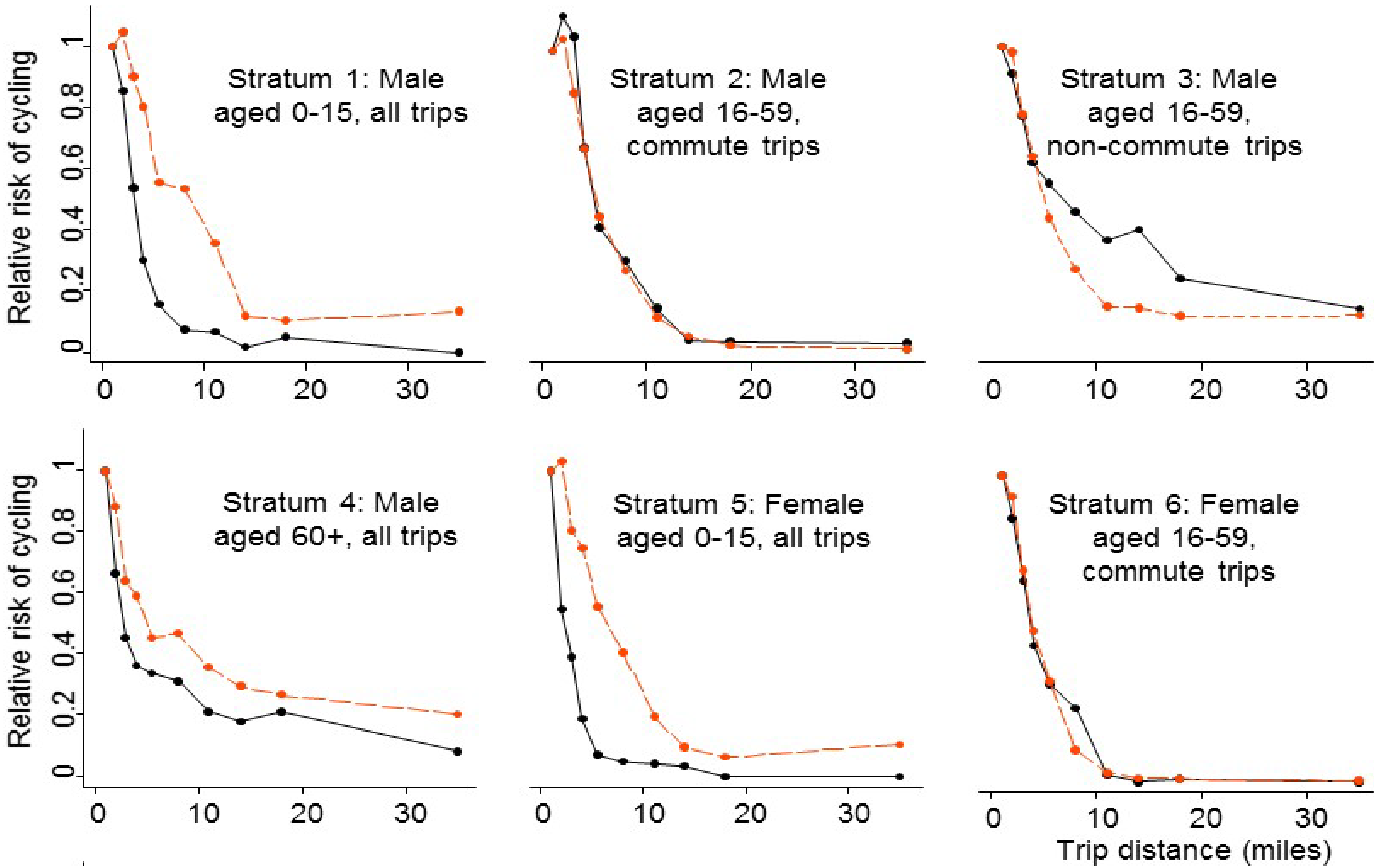


Wen et al. *Lancet* 2011; 378: 1244–53

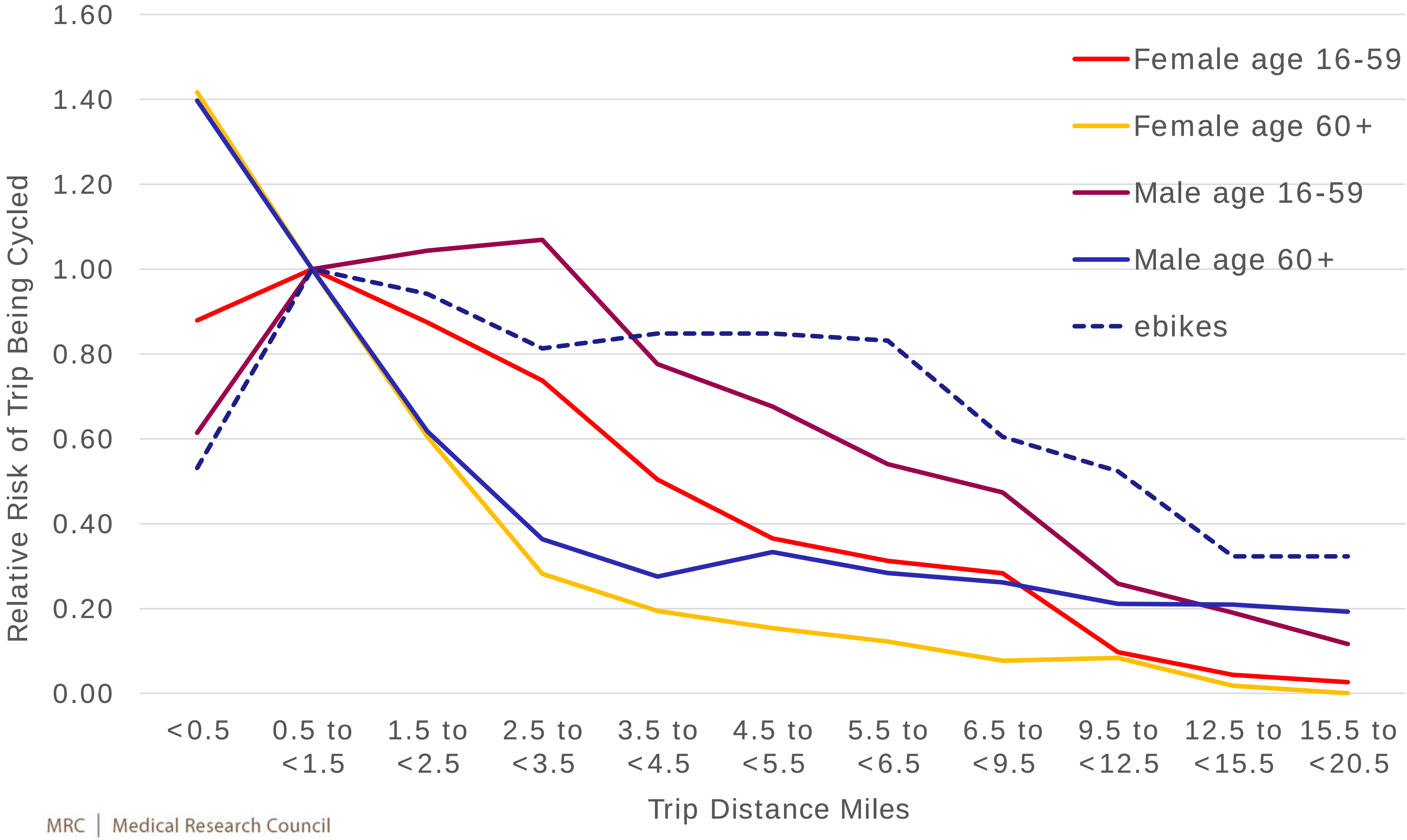
Probability of Cycling a Trip

- Probabilistic rules better than fixed distance cut-off
- Probabilistic rules better than excluding groups e.g. age/gender/ ethnicity
- Models should offer scenarios about change

Distance decay England and the Netherlands



Relative Risk of Trip Being Cycled



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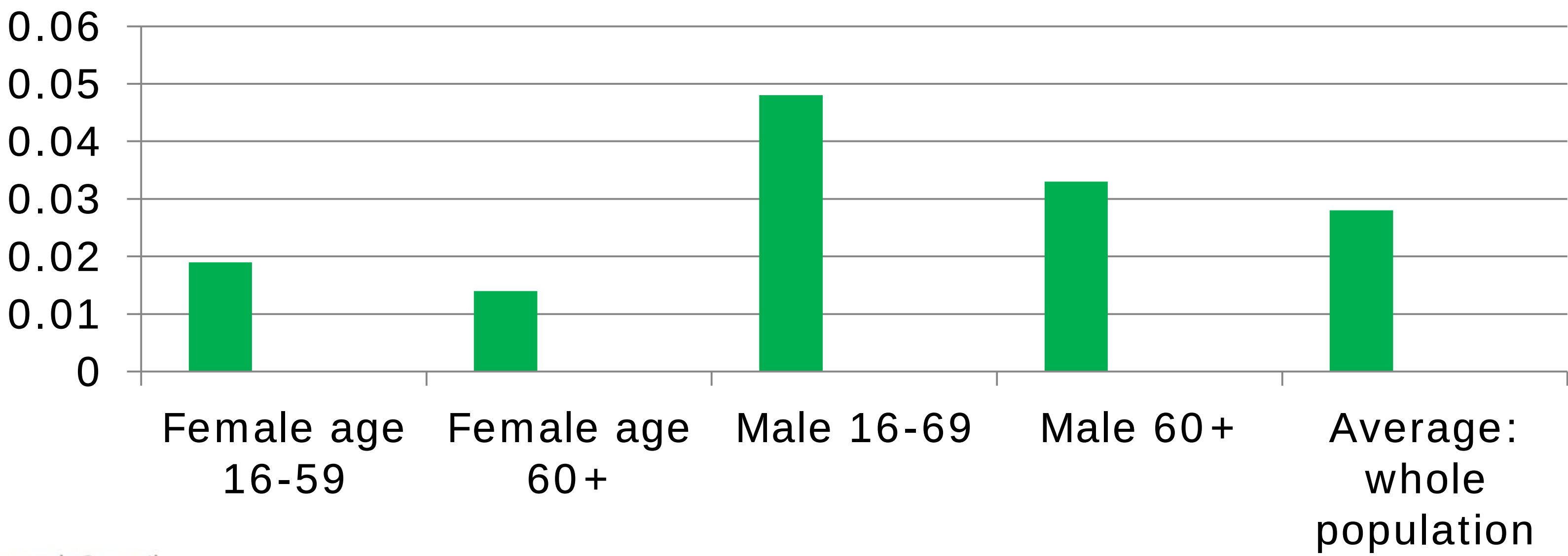
Relative Risks of Cycling Trips By Distance

Distance (miles)	Female age 16-59	Female age 60+	Male age 16-59	Male age 60+	Ebikes
<0.5	0.88	1.42	0.61	1.40	0.53
0.5 to <1.5	1.00	1.00	1.00	1.00	1.00
1.5 to <2.5	0.87	0.60	1.04	0.62	0.94
2.5 to <3.5	0.74	0.28	1.07	0.36	0.81
3.5 to <4.5	0.50	0.19	0.78	0.28	0.85
4.5 to <5.5	0.37	0.15	0.68	0.33	0.85
5.5 to <6.5	0.31	0.12	0.54	0.28	0.83
6.5 to <9.5	0.28	0.08	0.47	0.26	0.60
9.5 to <12.5	0.10	0.08	0.26	0.21	0.52
12.5 to <15.5	0.04	0.02	0.19	0.21	0.32
15.5 to <20.5	0.03	0.00	0.12	0.19	0.32

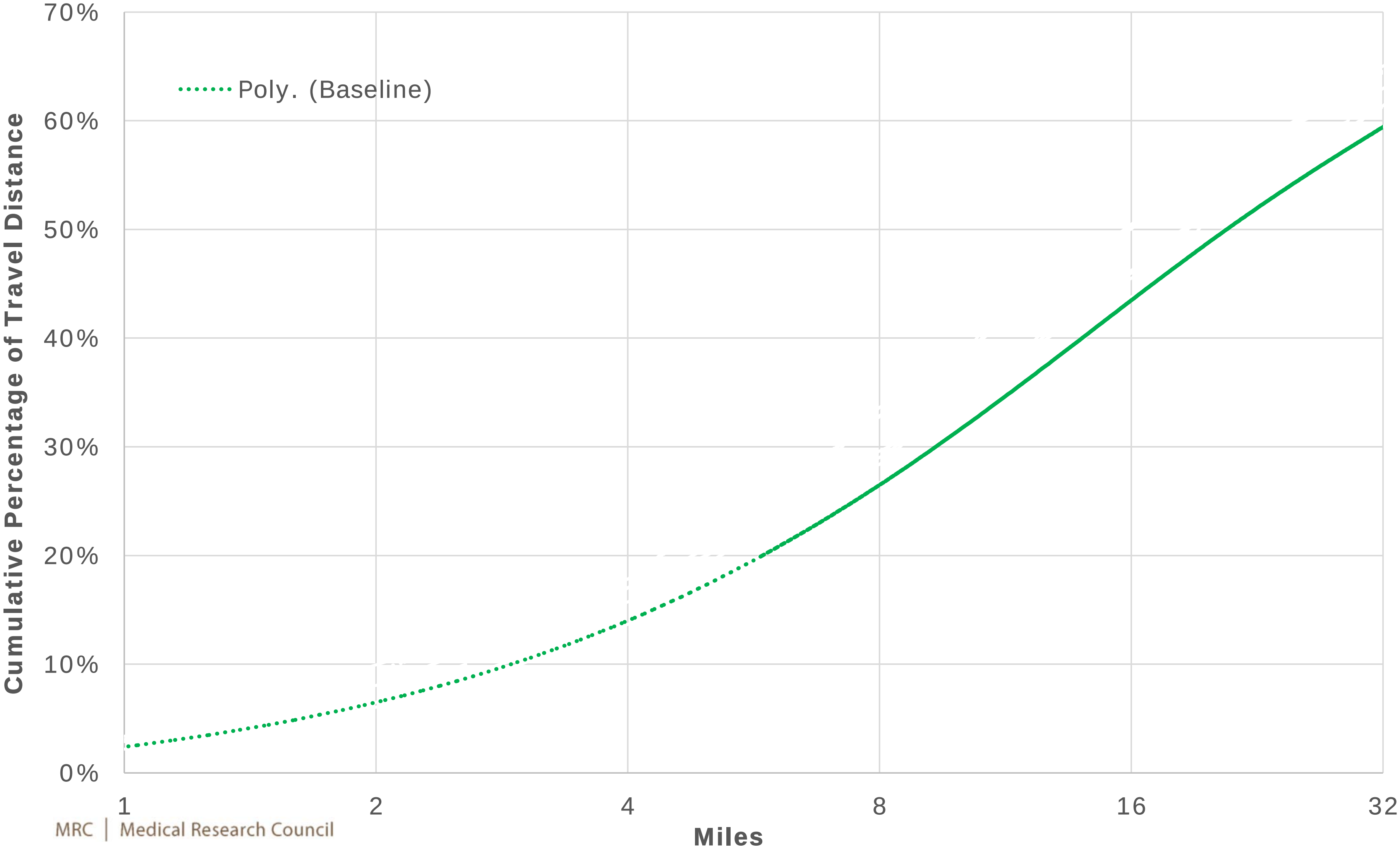
Probability of Cycling Trip of 1 mile

	Female age 16-59	Female age 60+	Male age 16-59	Male age 60+	whole population
BASELINE RISK (for trip 0.5 to <1.5 miles)	0.019	0.014	0.048	0.033	0.028



Sprawl versus Density & Trip Distances

Cumulative % of Travel Distance: England



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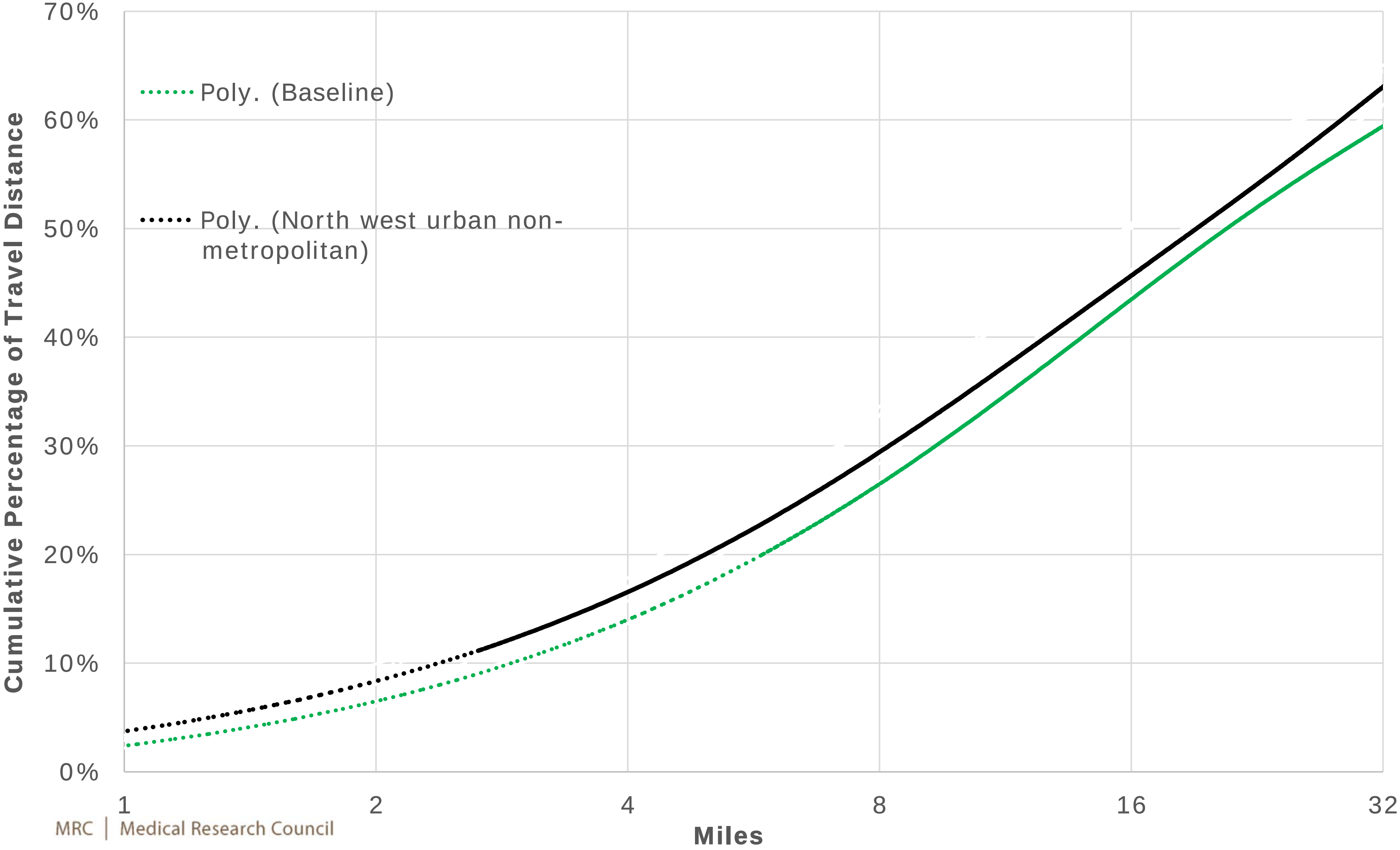
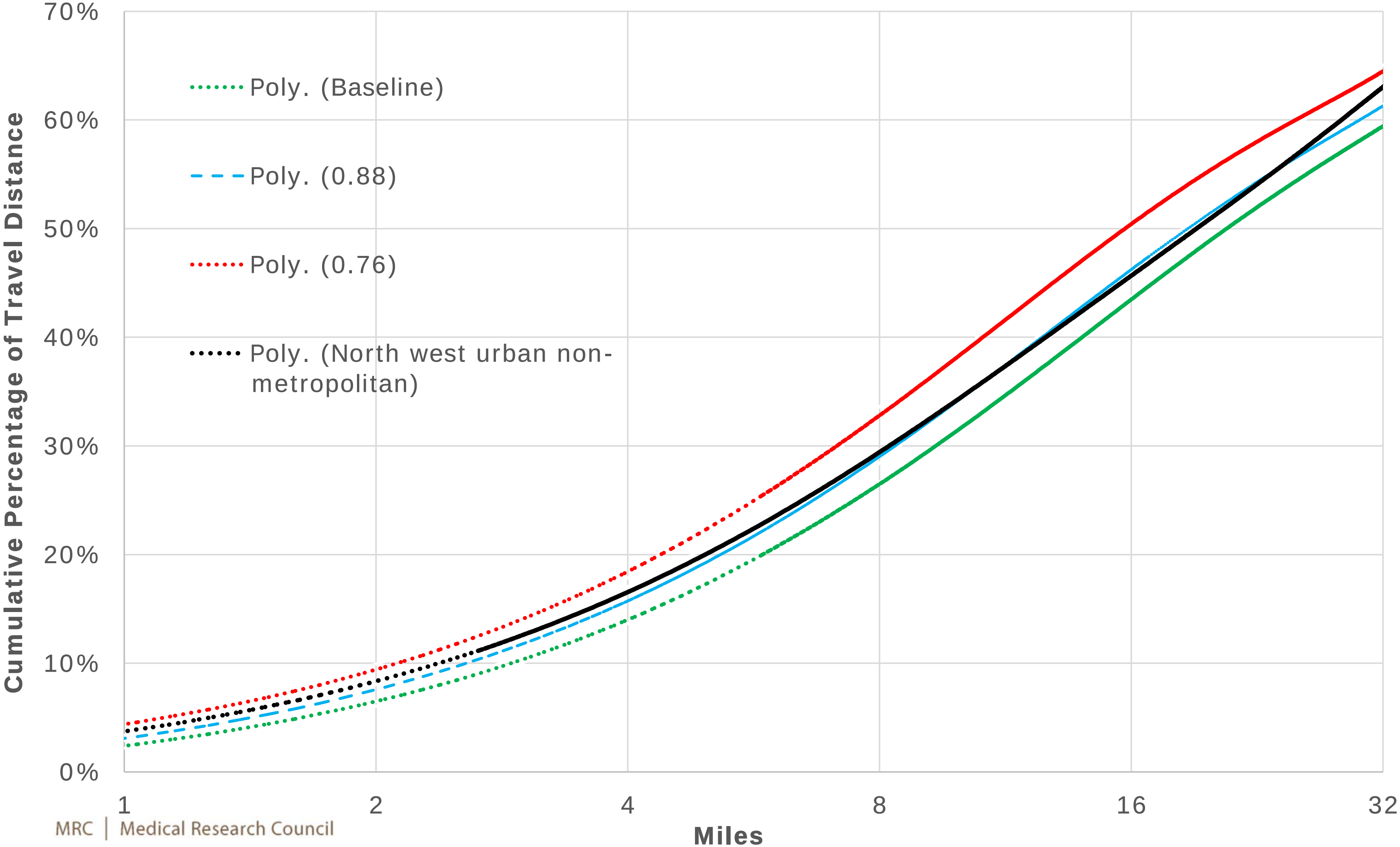
England Urban North West non-metropolitan



Trip Distance Reduction



Logic of model

- Generate multiple scenarios by
  - Reducing trip distances
  - Increasing probability of cycling each trip

Logic of model: For All Trips

1. Calculate MMETs based on walking or cycling time
2. Apply Trip Distance Reduction
   - Range 0% to 24%
3. Apply Increase in Odds of Cycling* Baseline Odds of Cycling
   - Non-cycled trips <20.5 miles
   - Range 1 to 64
4. Probabilistically decide if trip is now cycled
5. If trip is now cycled then calculate MMETs from cycling
6. If trip previously had walking element lose walking MMETs
7. Sum MMETs for each person
8. Compare scenario vs baseline
9. Calculate outcomes

Scenario Trip Distance Reduction 0.88 Mode Shift * 8 No Equity, No Ebikes

Trip Distance (miles)	Mode	Old MMET Hours	New Trip Distance	Probability of Cycling	New mode	New MMET Hours
2	Walk	1.7	1.76	12%	Cycle	0.95
4	Bus	1	3.53	8.3%	Bus	1
10	Car	0	8.8	4.5%	Cycle	4.8
		Total: 2.7				Total: 6.7

Female 40 year

Baseline risk 0.019

For the Walking Trip:

Trip Distance 1.76 so relative risk 0.87

Mode Shift *8

So Odds of Cycling= (0.019 * 0.87) /(1- (0.019 * 0.87))*8= 0.13

Probability of Cycling= 0.12

Changing the Assumptions: Equity and Ebikes

Scenario Type	Risk of Cycling 1 Mile	Relative Odds of Cycling Longer Trip
Basic	Age & gender odds of cycling 1 miles	Age & gender relative odds of cycling a longer trip
Equity	Population average odds of cycling 1 mile	Age & gender relative odds of cycling a longer trip
Ebikes	Age & gender odds of cycling 1 mile	Ebike specific relative odds of cycling a longer trip
Ebikes plus equity	Population average odds of cycling 1 mile	Ebike specific relative odds of cycling a longer trip

Caveats

- Only applied to people aged 18 to 79 years
- Not included injuries
  - Likely higher for electric bikes
- Run on sample of data- 30,000 trips
- Only reporting car miles not carbon emissions

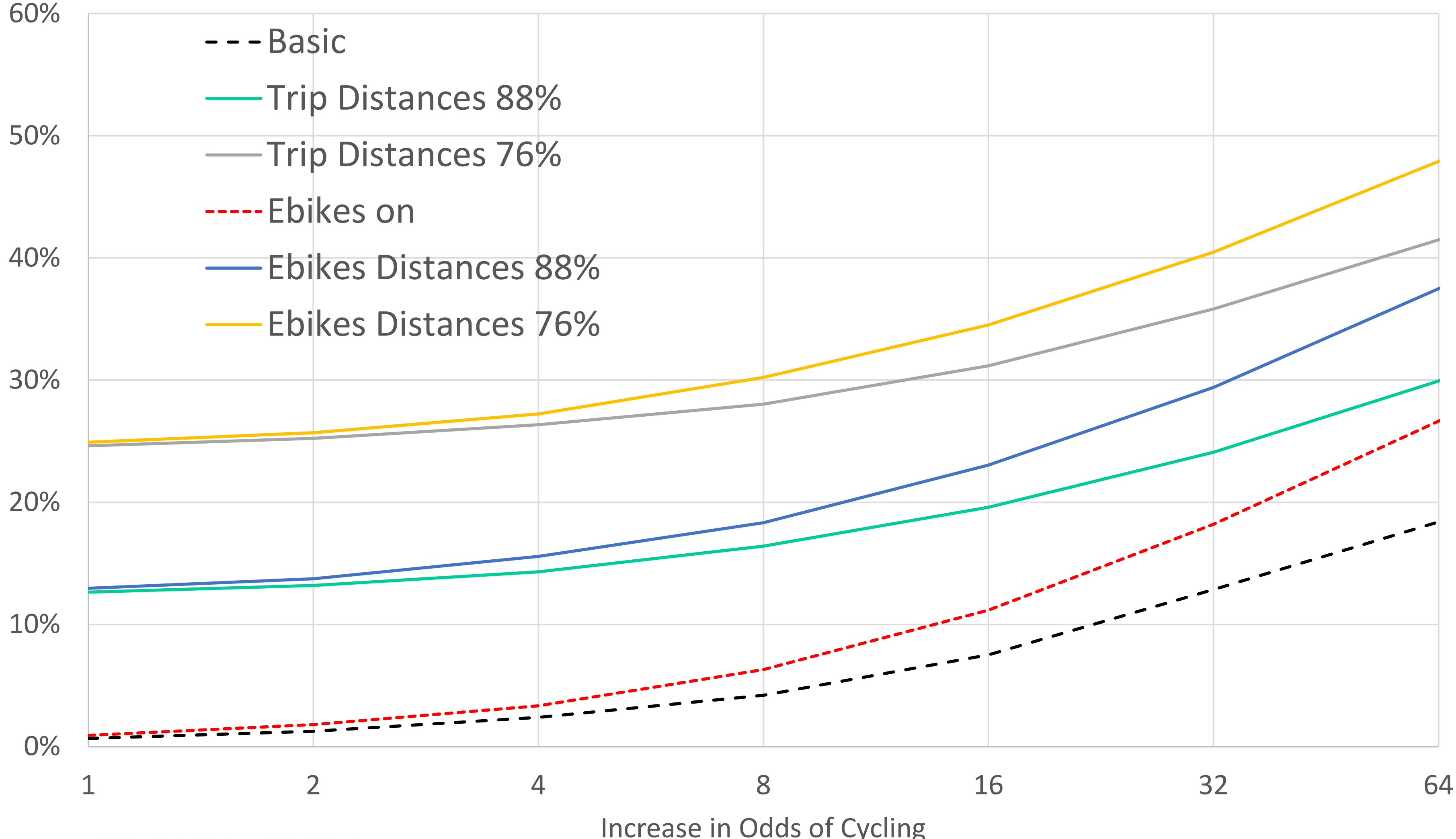
Provisional Results

Provisional Results:

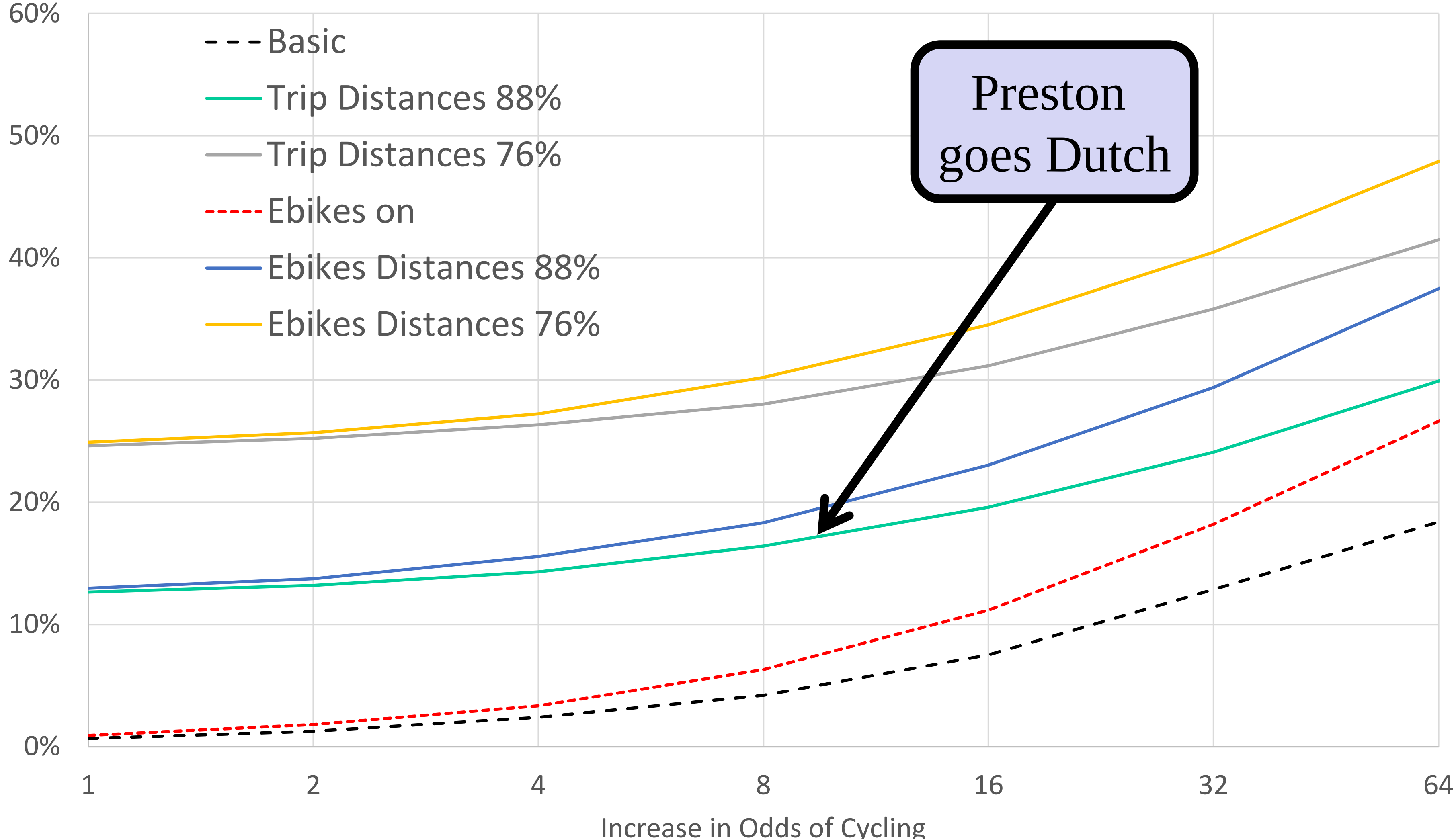
Putting Results in Context

- Dutch mode share 27% vs England 1.9%
  - Hilliness of England reduce Dutch value to c.19%
  - So c.10* greater cycling propensity in the Netherlands
- Trip distance reduction 12% ≈ urban area with shorter trips

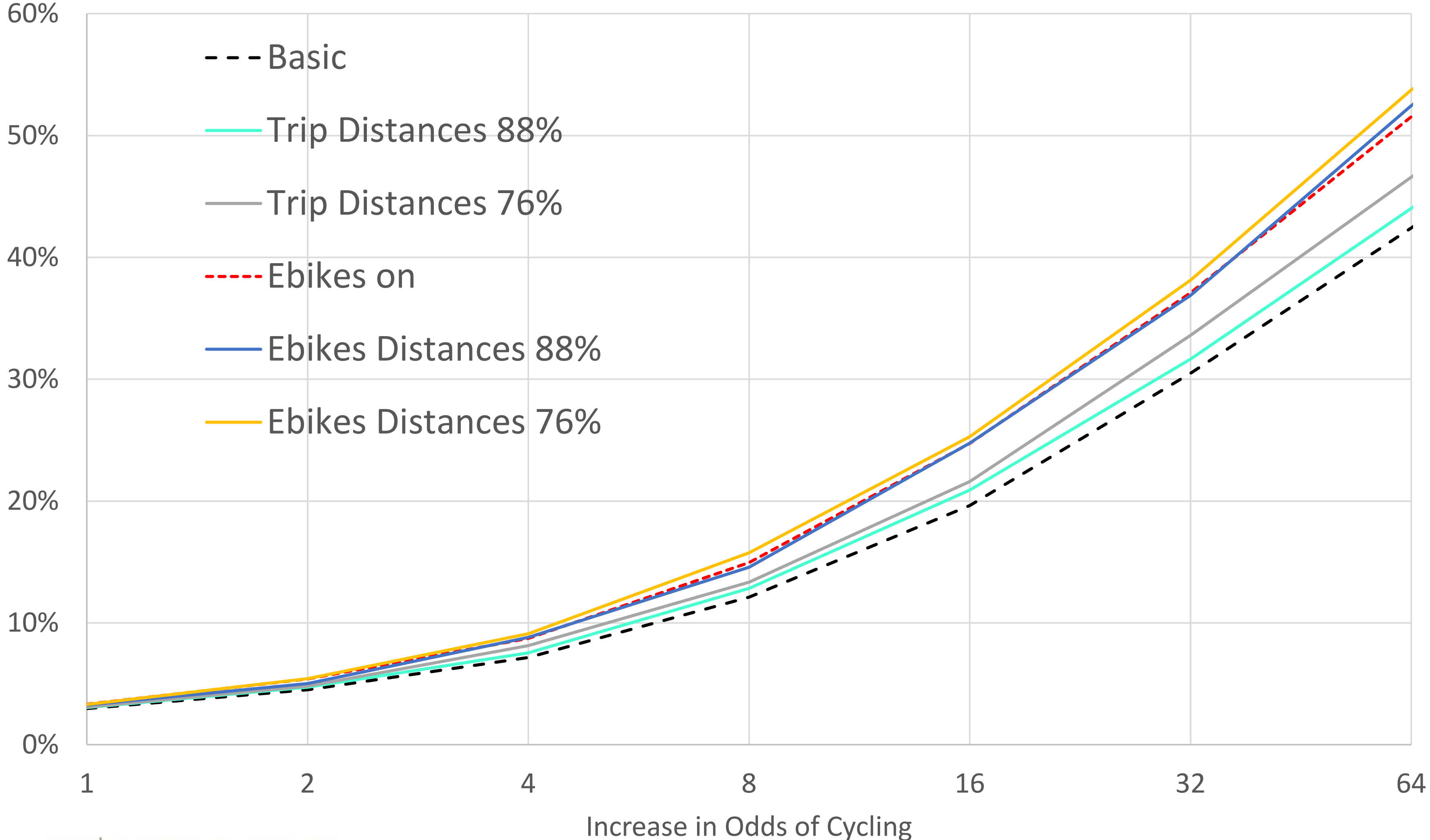
Reduction in Car Miles: Equity Off



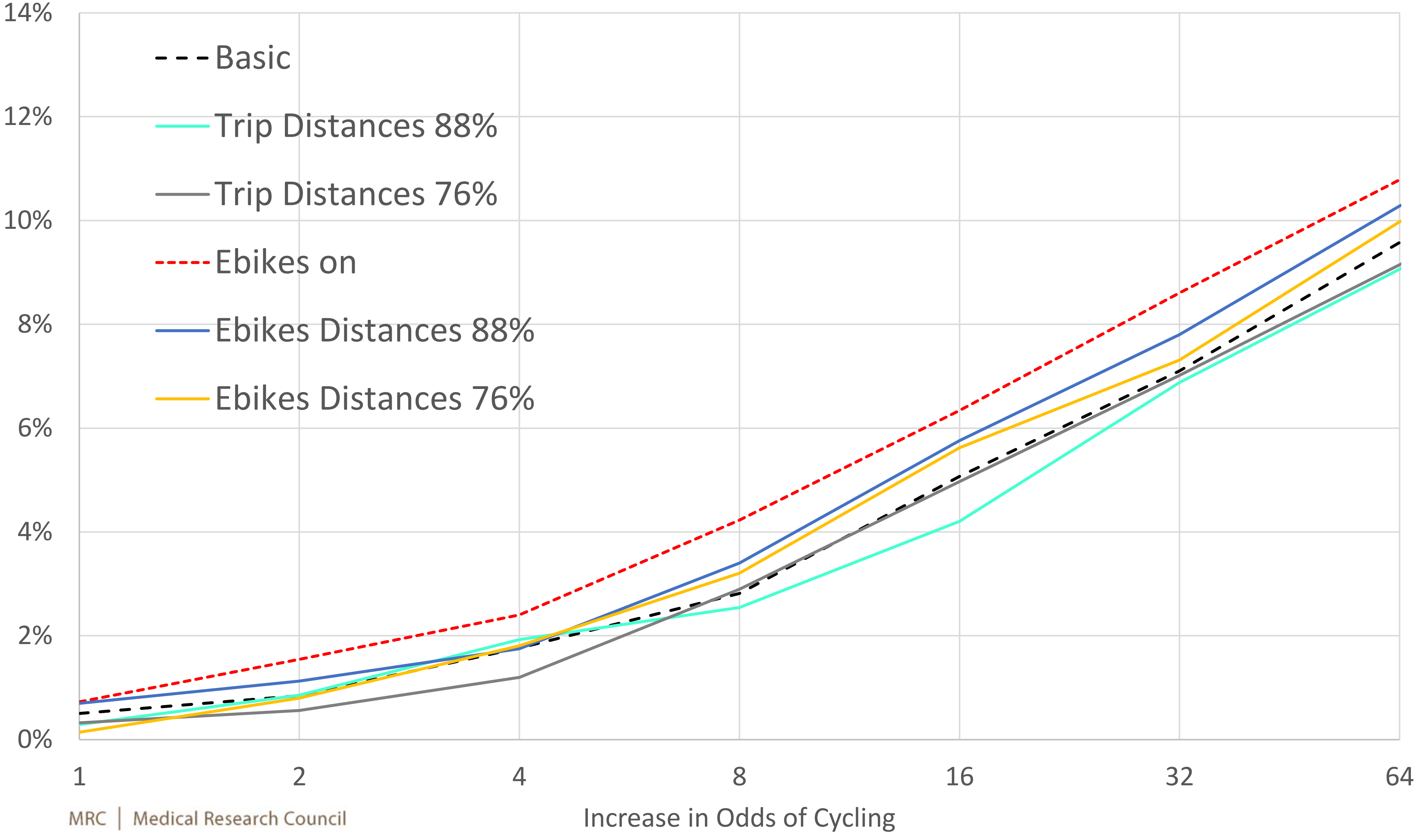
Reduction in Car Miles: Equity Off



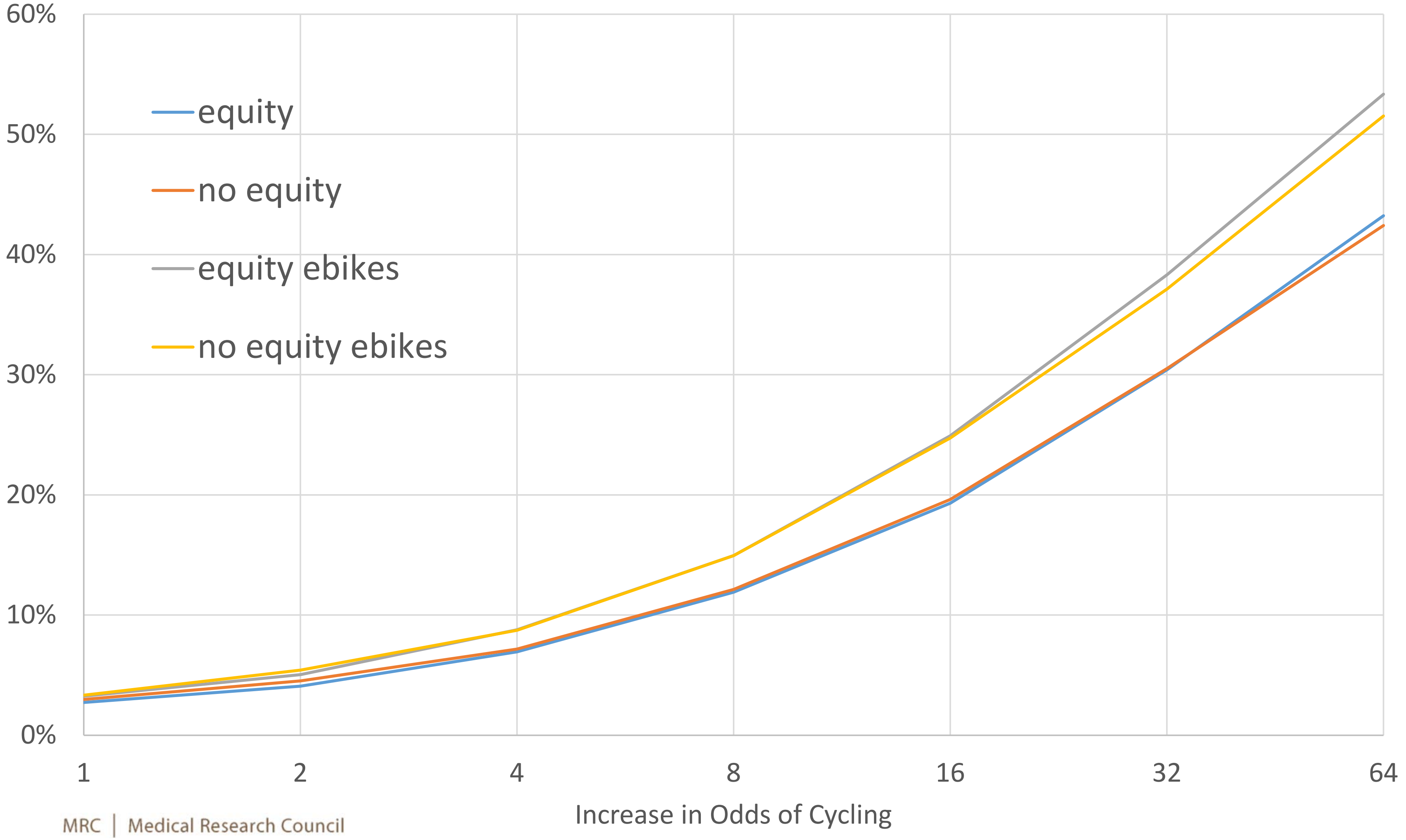
Mode Share no equity



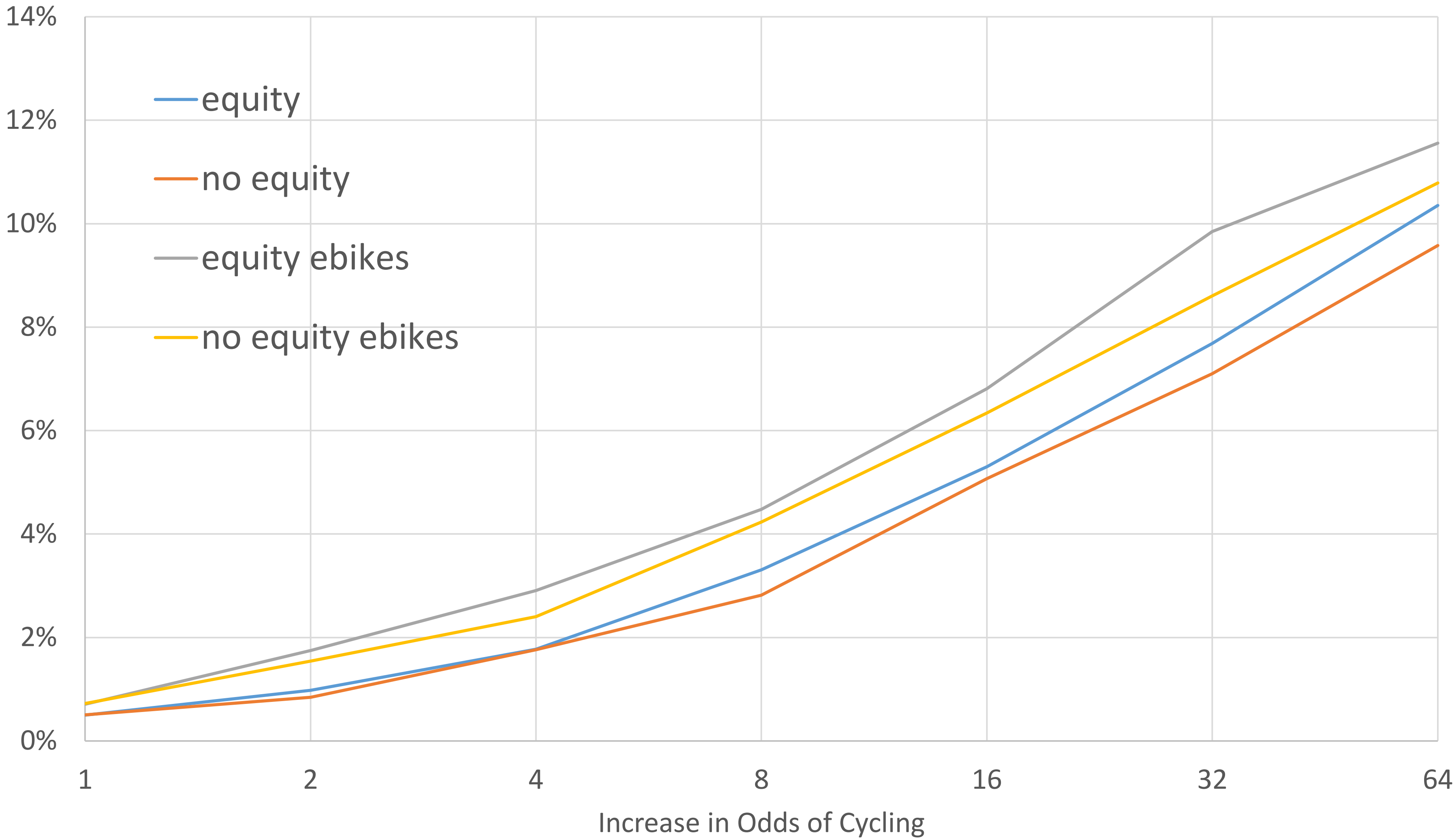
% Reduction Years of Life Lost



Mode share: equity vs no equity



Health Gain: equity vs no equity



What is happening with results?

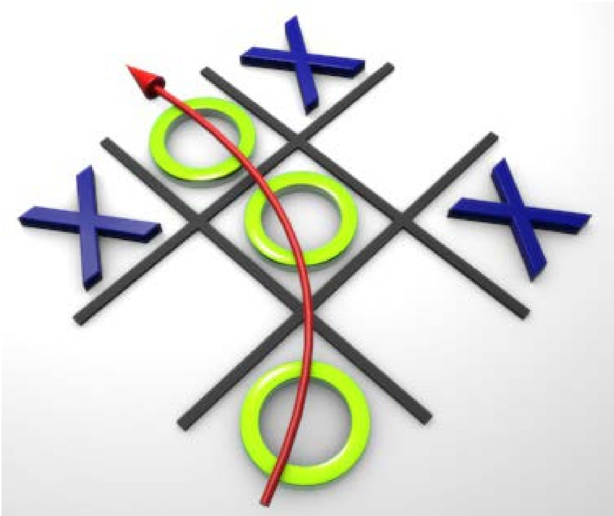
- Provisional – could change substantially
- Walking & Health
  - As distances fall walking trips become shorter so fewer MET hours
  - Not assuming shift between other modes

Future Steps

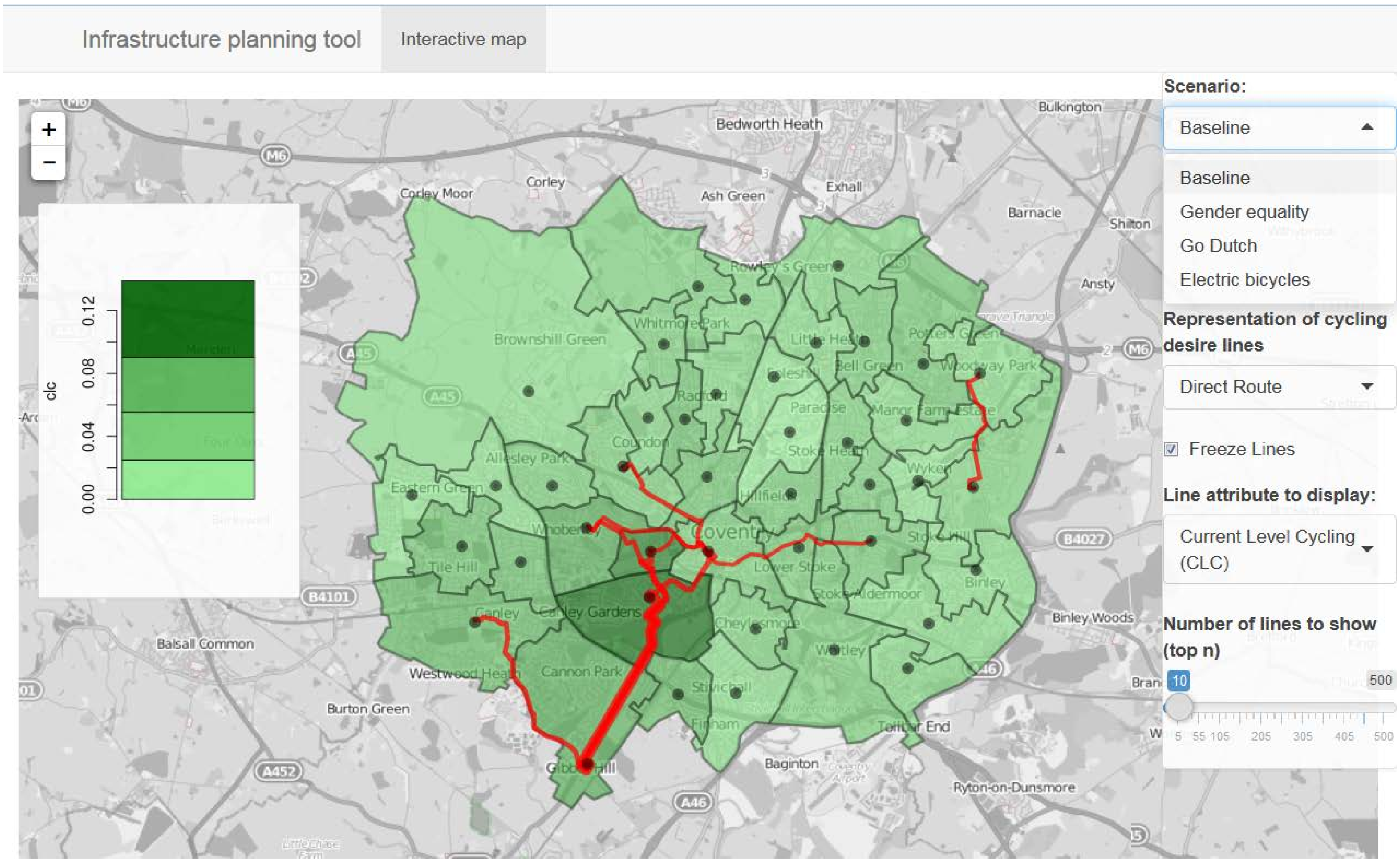
- **Redoing & checking the analysis!**
- **Simulation**
  - Uncertainty & variability
  - Optimising speed
- **Health outcomes**
  - Morbidity
  - Injuries: higher risks for ebikes
  - Air pollution (less important)
- **Adding other outcomes**
  - By age, gender, socio-economic status
  - Time savings/costs
  - Who stops needing to own a car?

Future Steps: Modifying the rules

- Walking mode shift assumptions
- Trips longer than 20 miles
- Oldest ages & behaviour change?
- Limits on individual cycling
- Varying Trip Distance Reduction by trip purpose
- Ebike assumptions



Future Steps: Propensity to Cycle Tool



igniting our potential

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Thanks for listening!

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