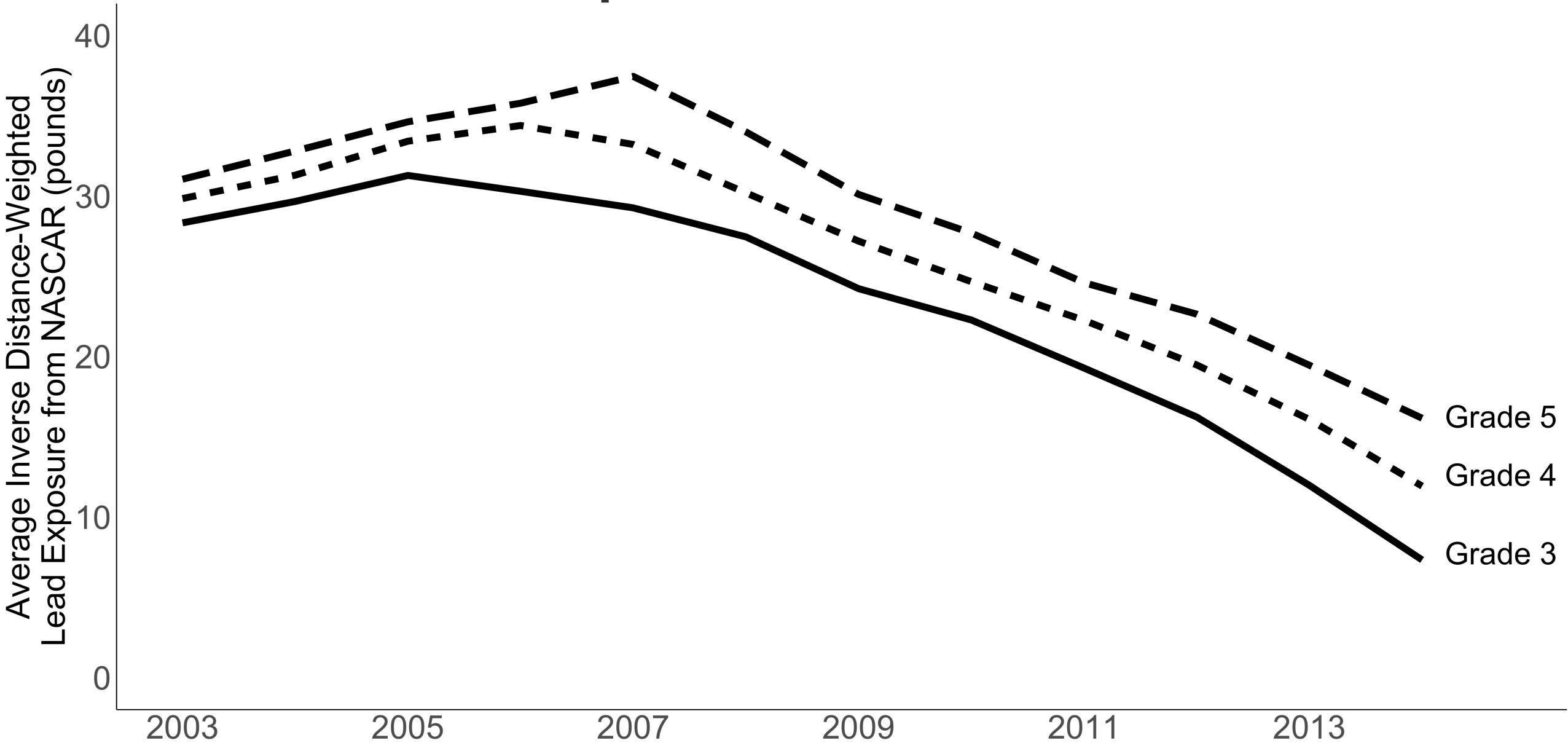
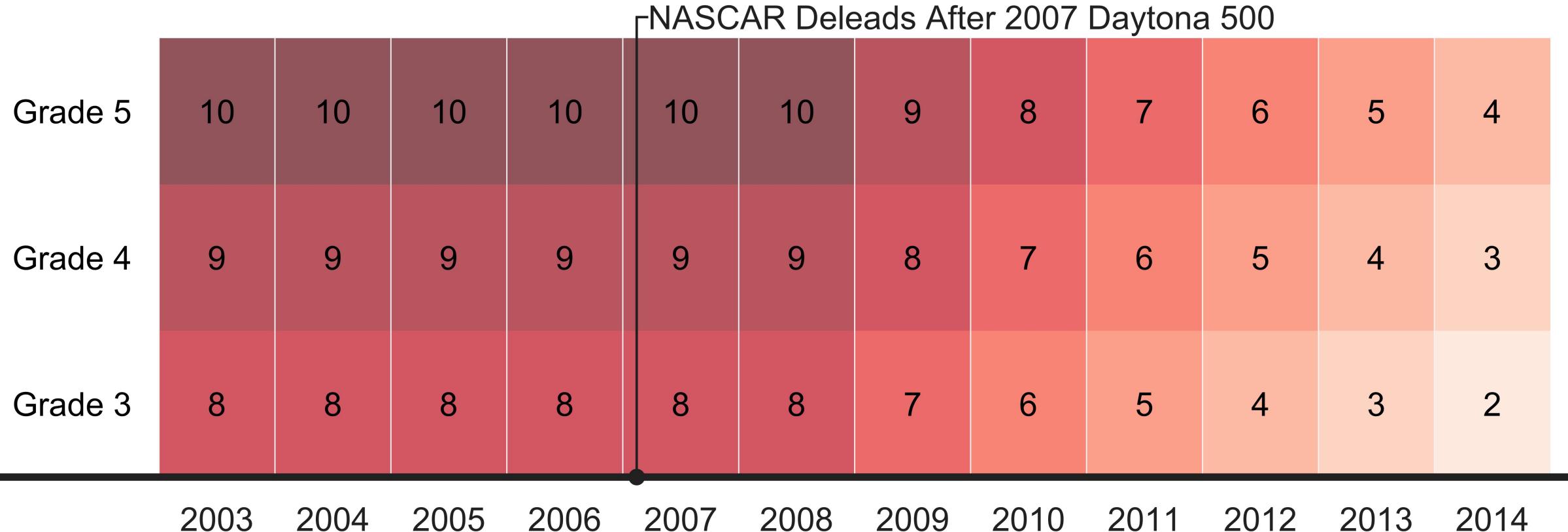


Time series of exposure



Life-years of exposure prior to test year

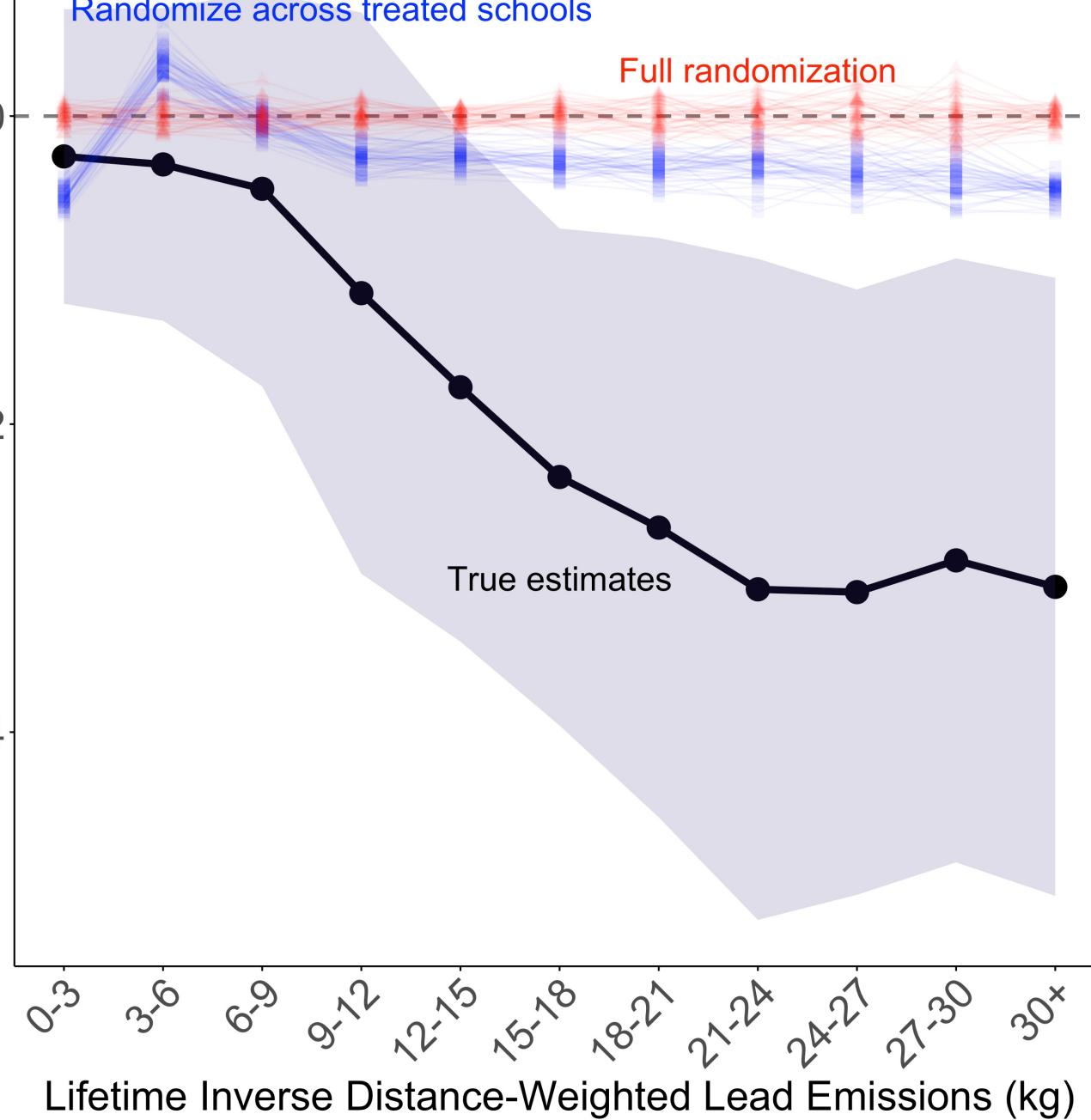


Dose-response

Test Score Response Function and Permutation Test

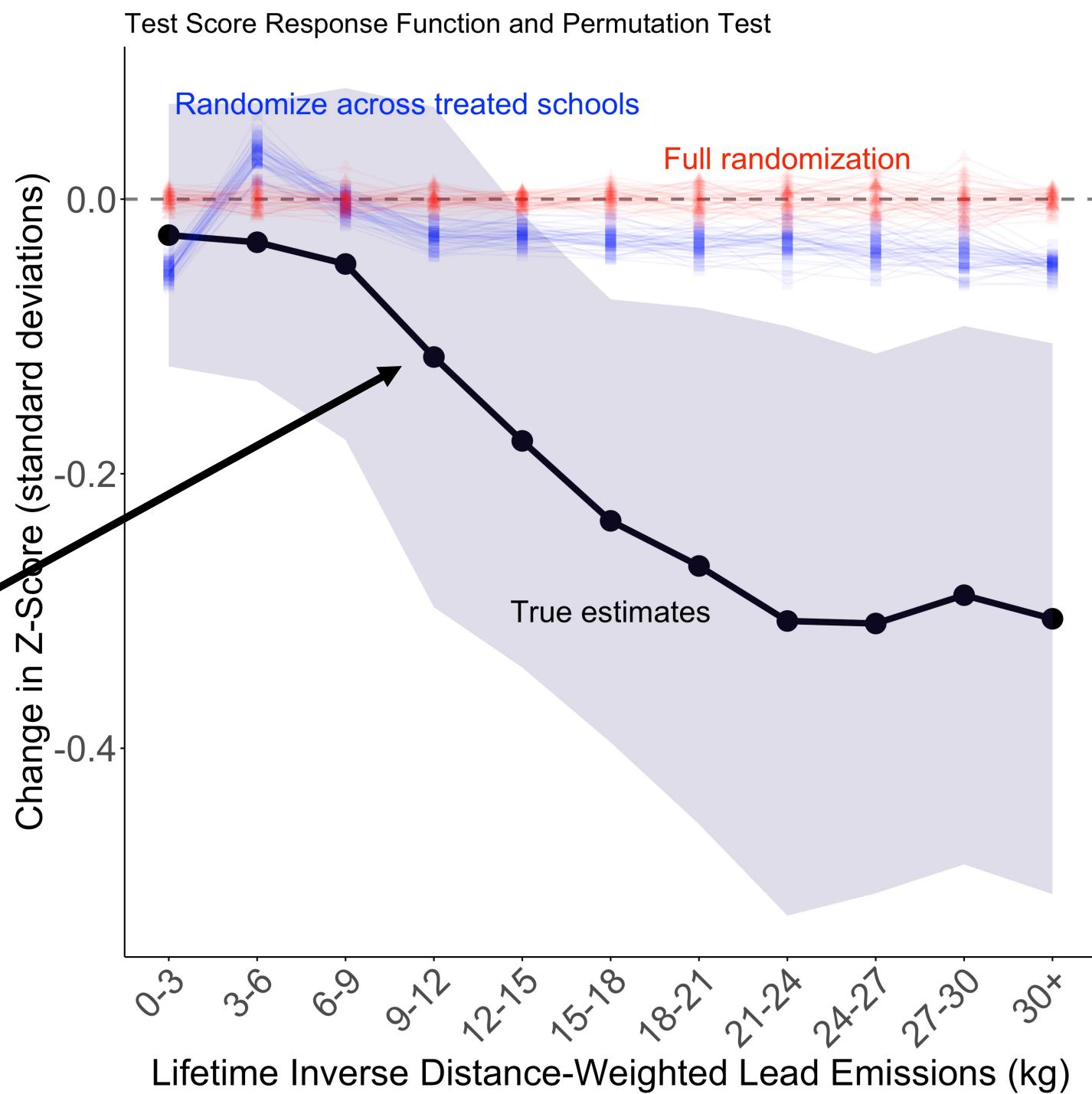
Change in Z-Score (standard deviations)

Lifetime Inverse Distance-Weighted Lead Emissions (kg)



Dose-response

Indicator variables for exposure in each bin, effect relative to 0 miles



Dose-response

Dose-responses from
permuted treatment time
series within treated
schools

Test Score Response Function and Permutation Test

Change in Z-Score (standard deviations)

Lifetime Inverse Distance-Weighted Lead Emissions (kg)

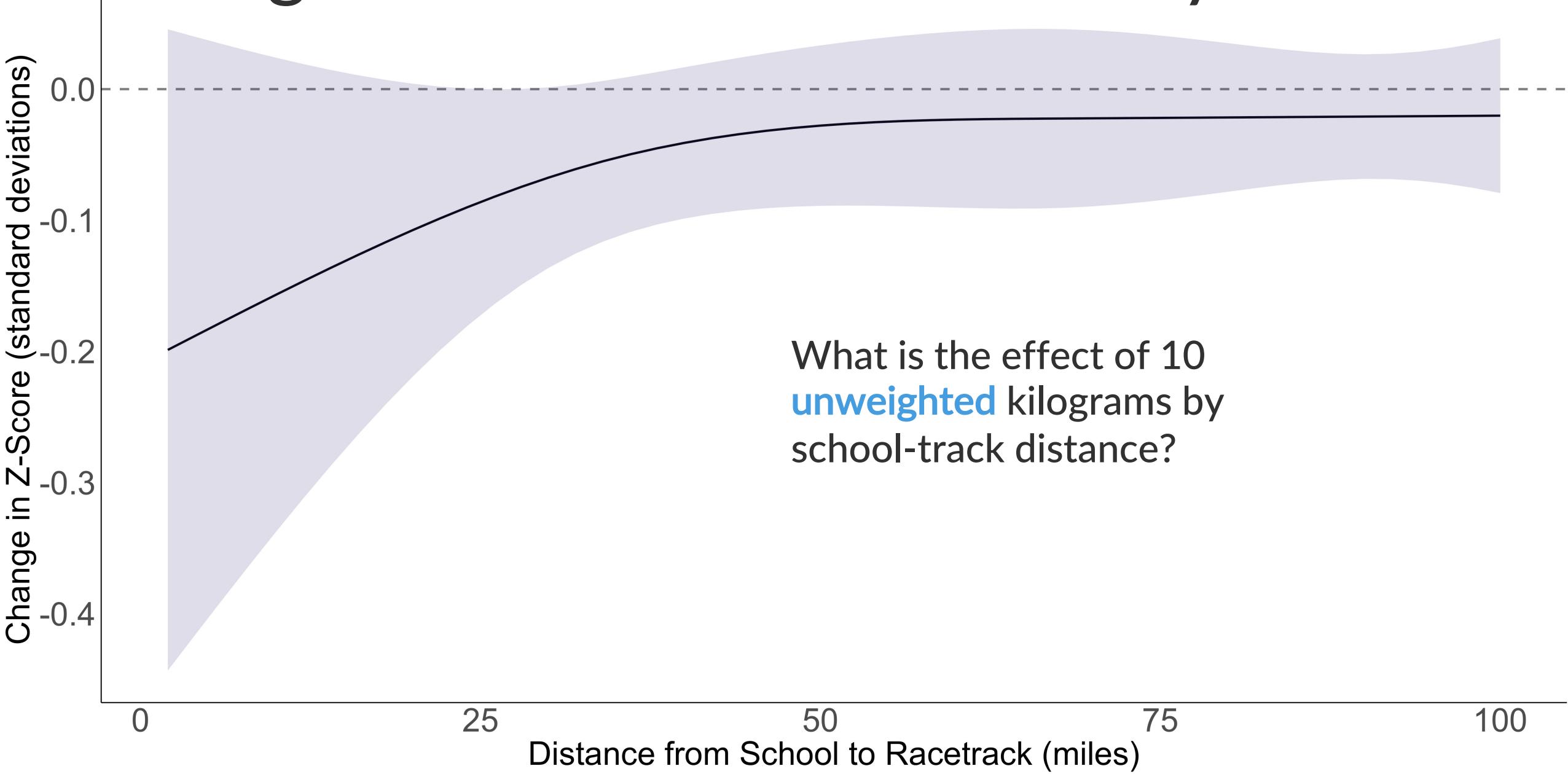
Randomize across treated schools

Full randomization

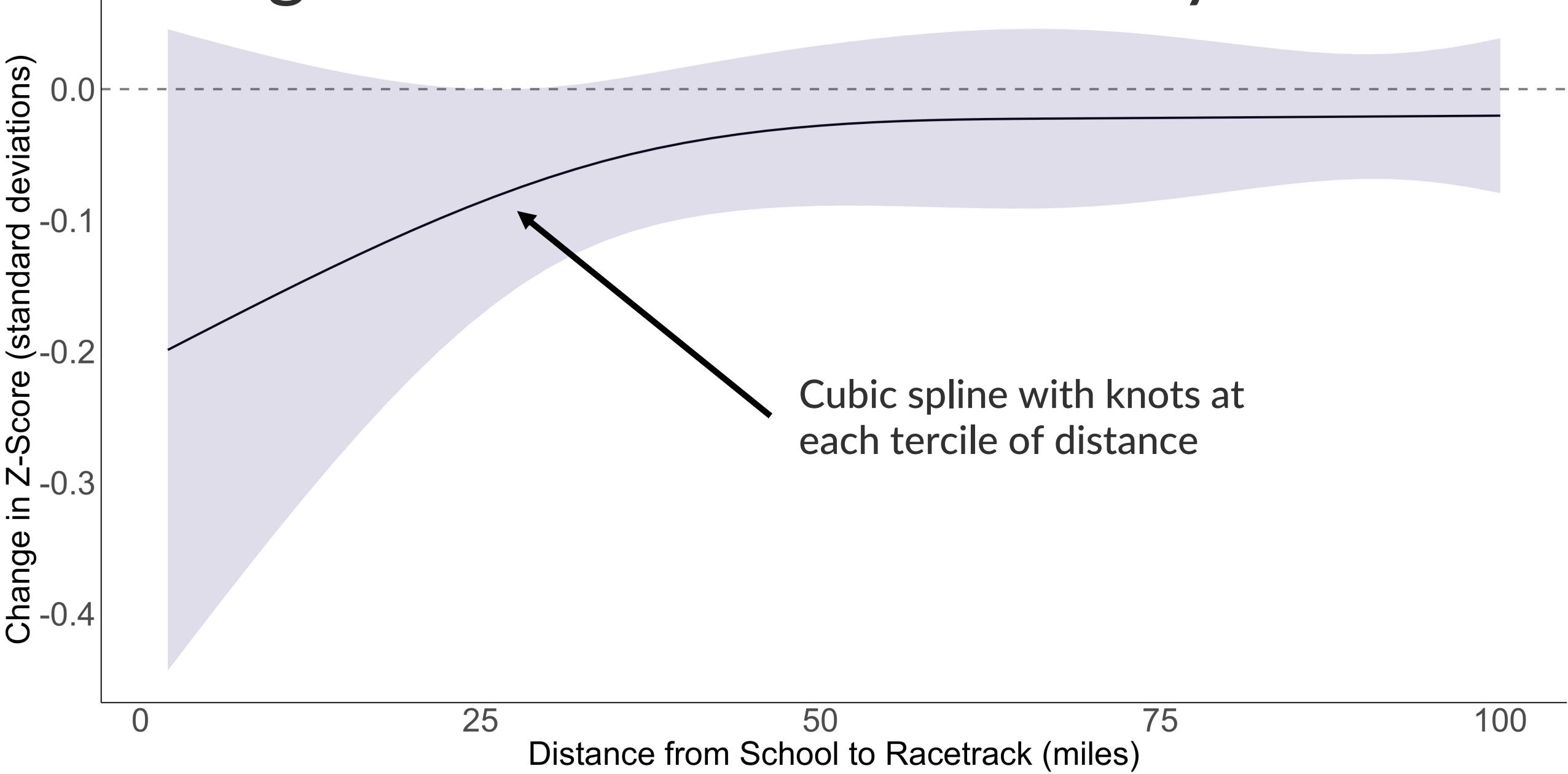
True estimates

0-3 3-6 6-9 9-12 12-15 15-18 18-21 21-24 24-27 27-30 30+

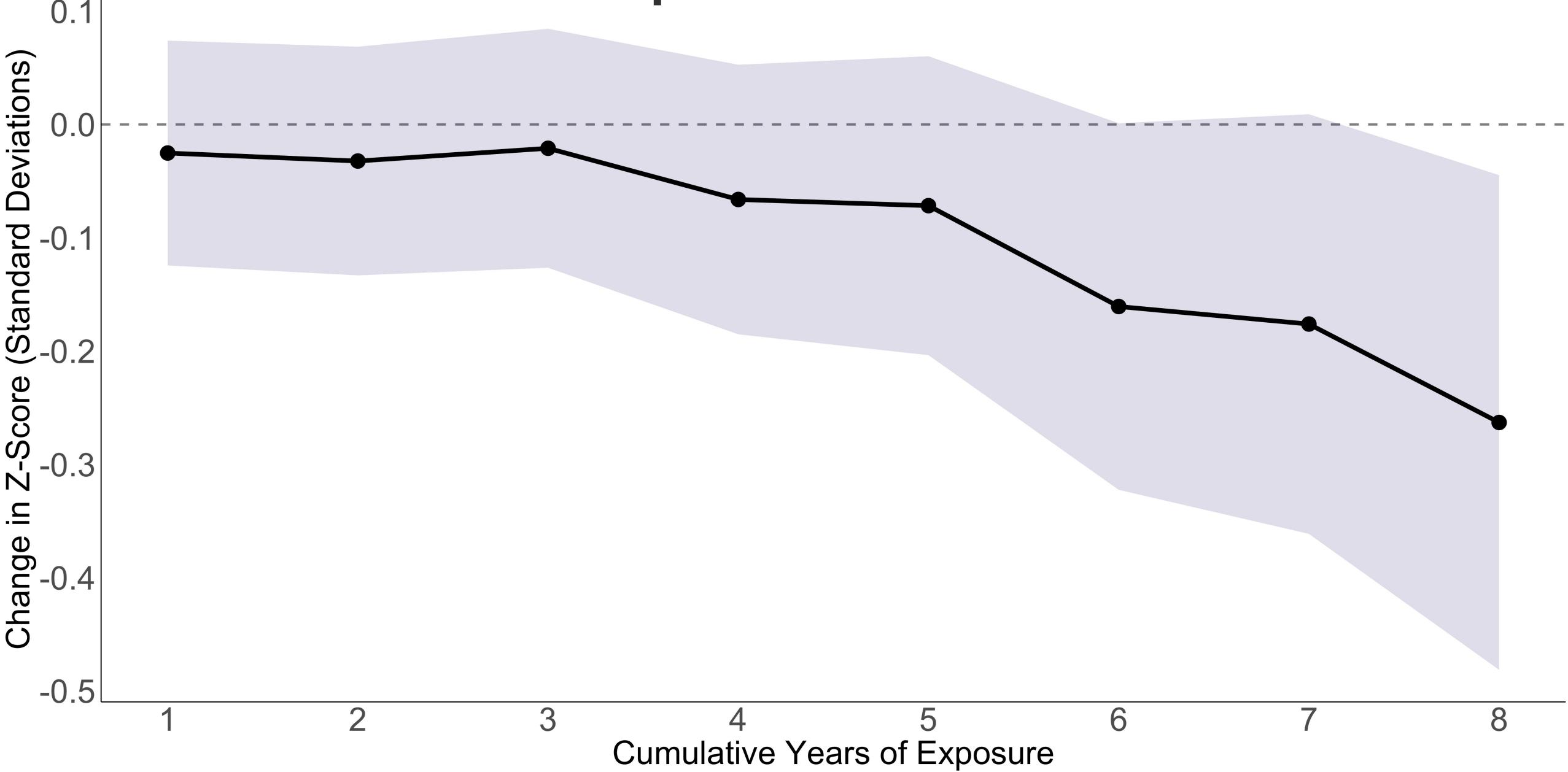
Effects go to zero at ~50 miles away



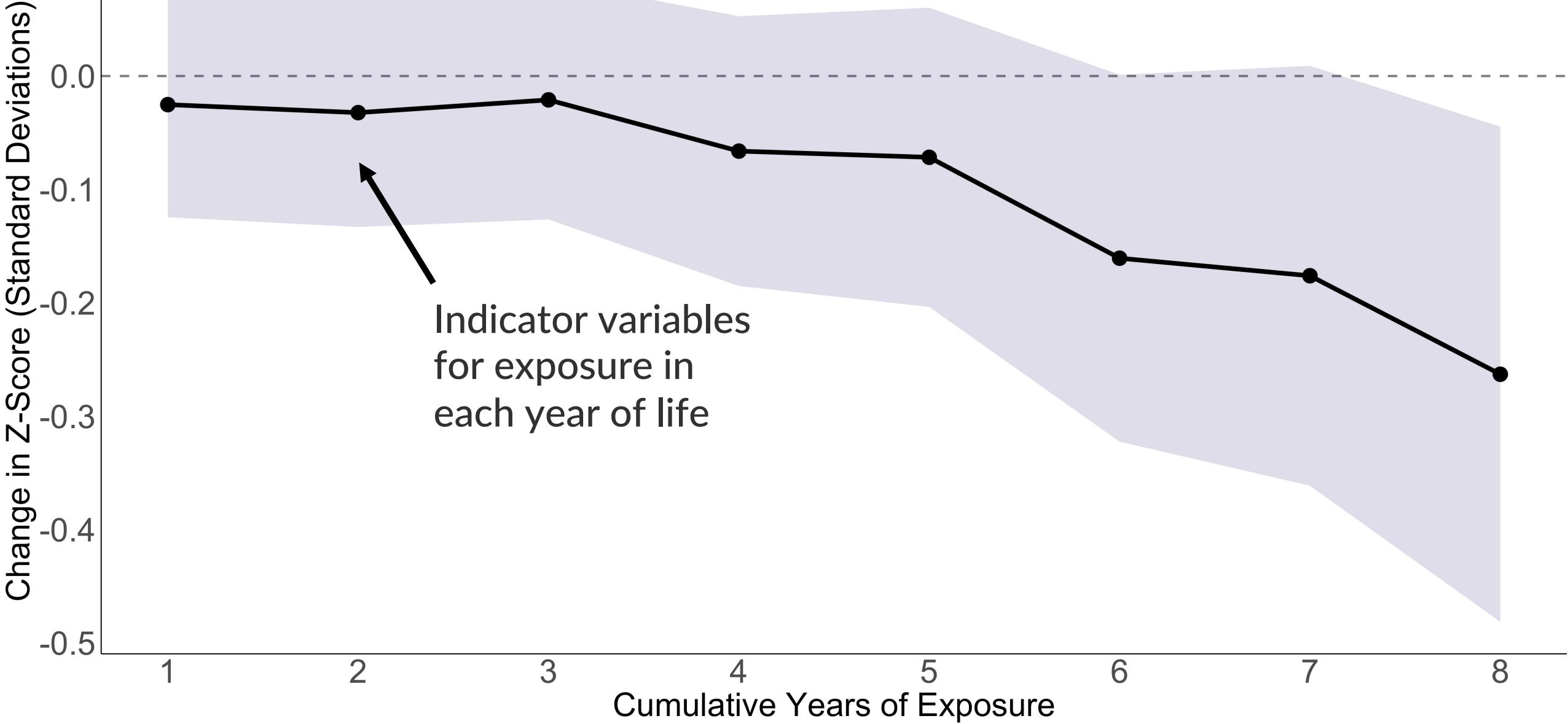
Effects go to zero at ~50 miles away



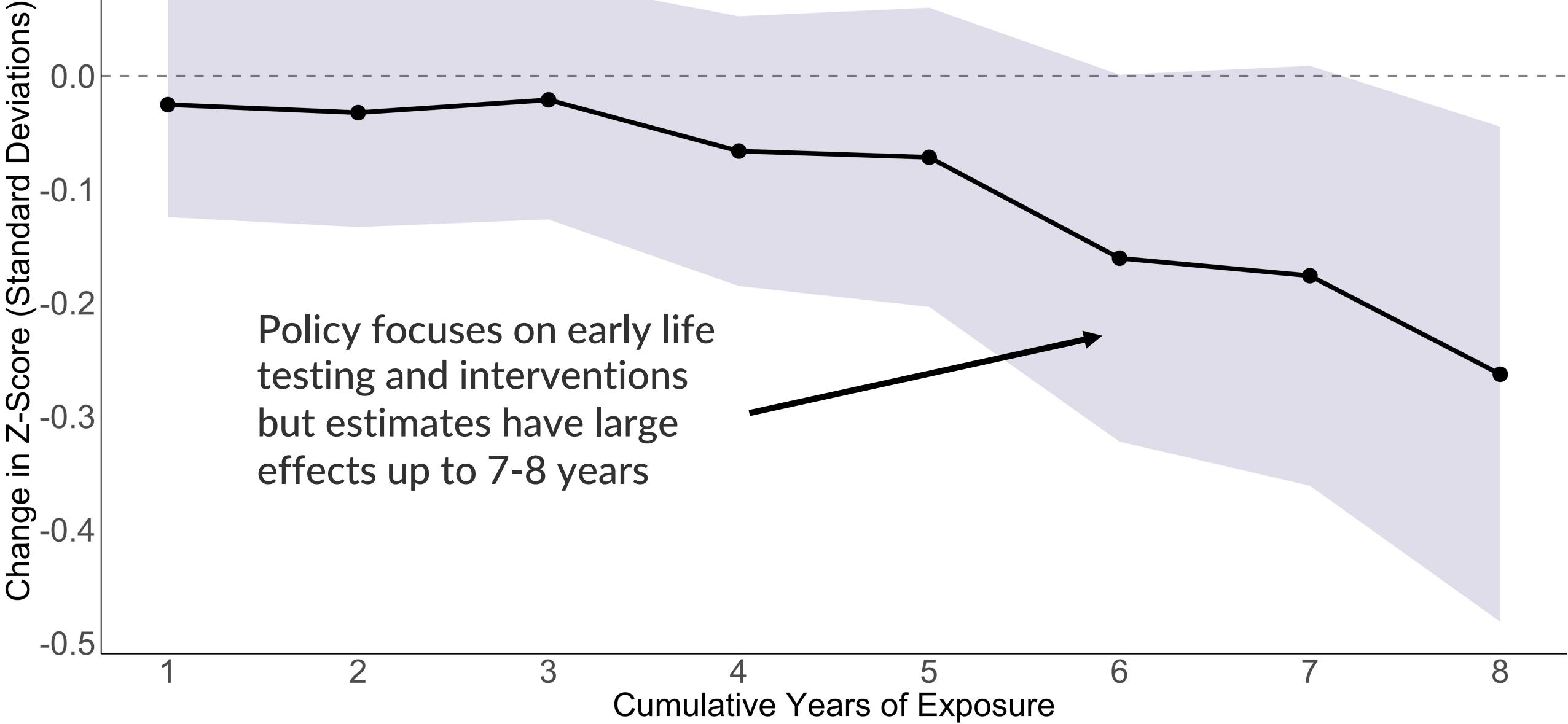
When does lead exposure matter?



When does lead exposure matter?

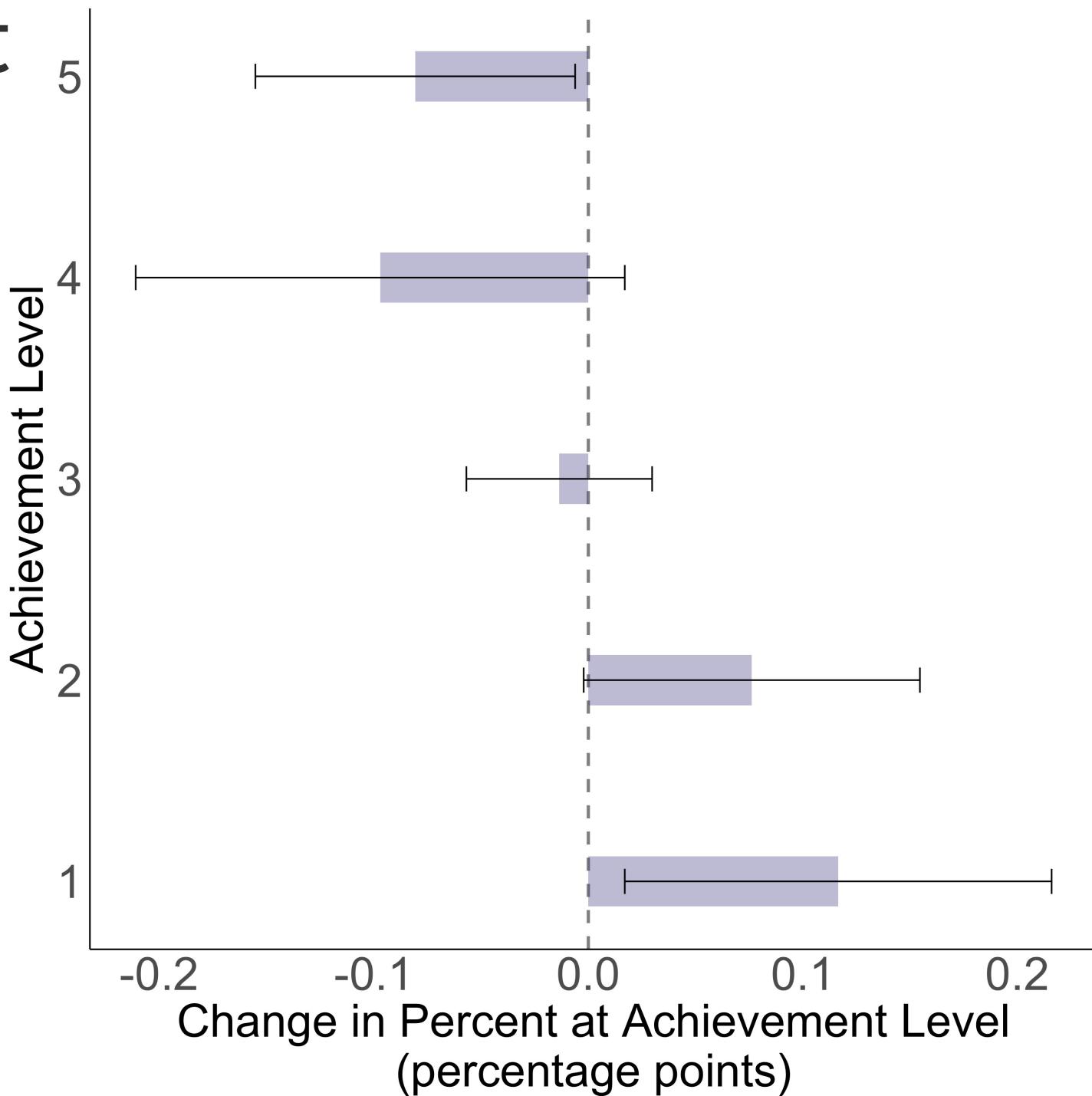


When does lead exposure matter?



Reduction in highest achieving students

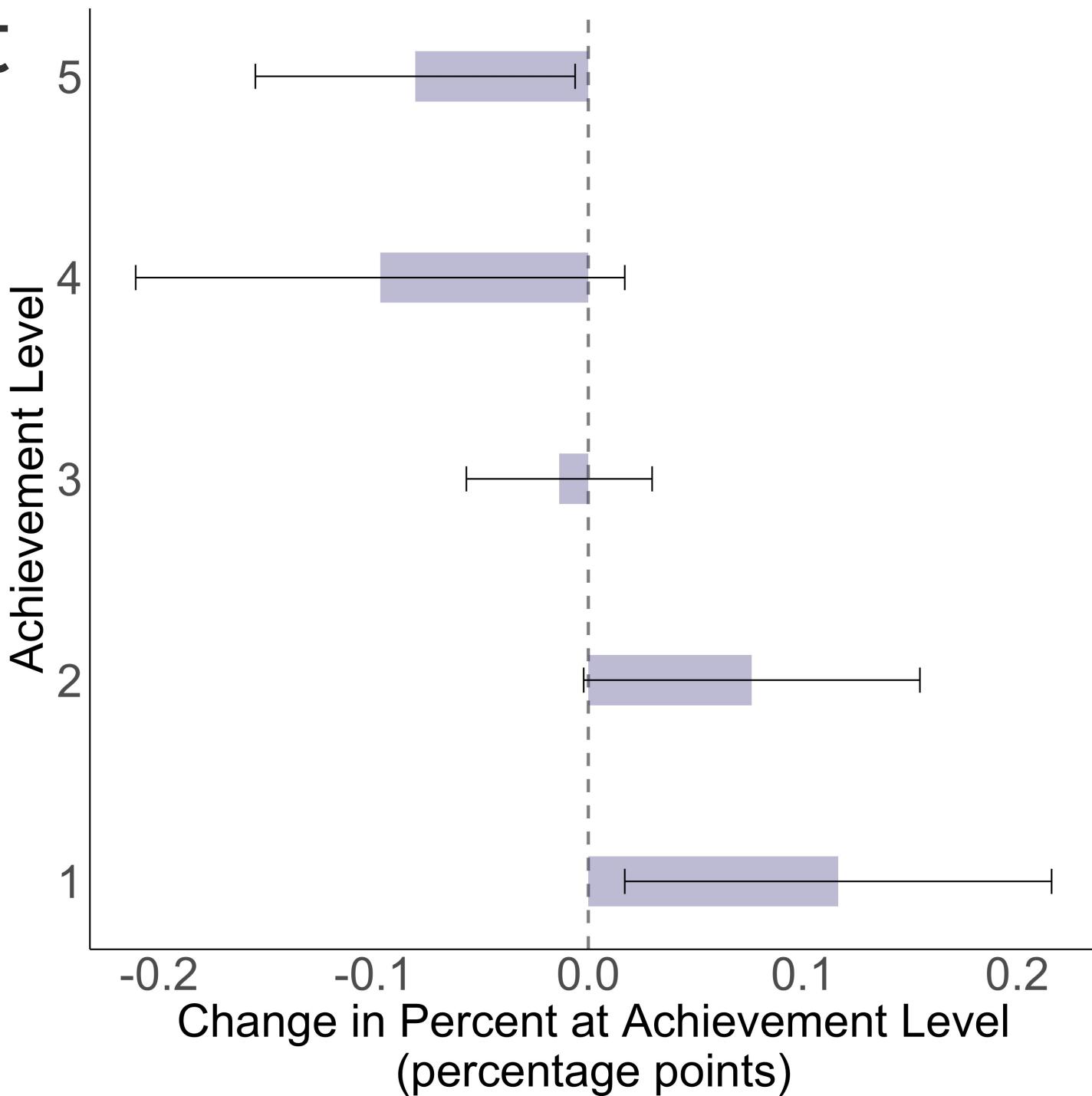
Students shift into lower achievement levels



Reduction in highest achieving students

Students shift into lower achievement levels

Even those in the top achievement levels

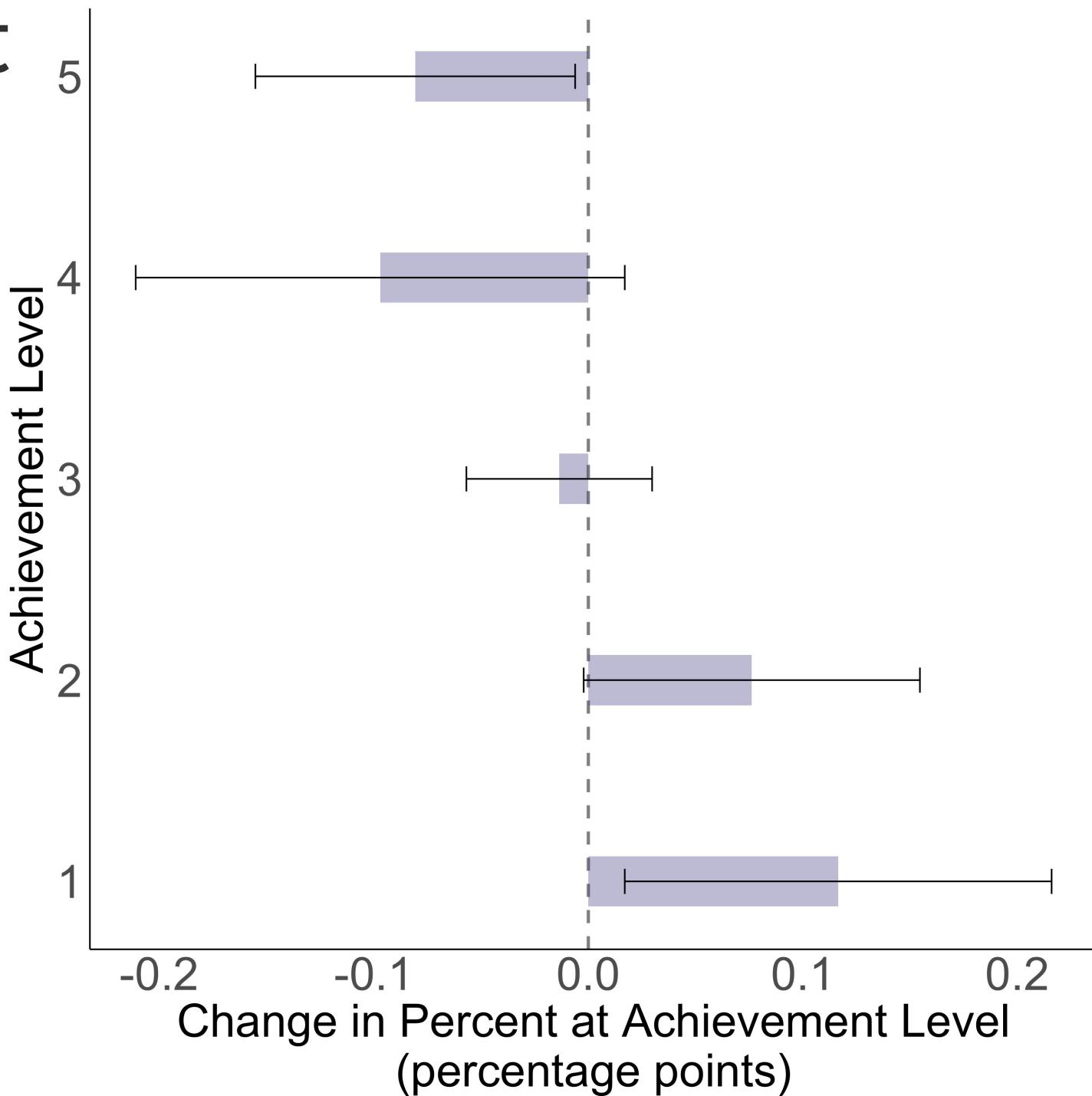


Reduction in highest achieving students

Students shift into lower achievement levels

Even those in the top achievement levels

Can't tell whether low level students do worse



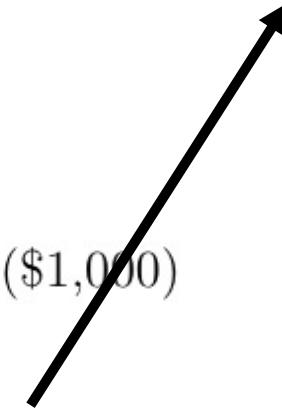
Nutrition can mitigate lead's effects

	(1)	(2)	(3)
Lifetime Inverse Distance-Weighted Lead Emissions (10 kg)	-0.527*** (0.137)	-0.515*** (0.135)	-0.512*** (0.147)
Lifetime Lead Emissions \times Dairy Sales (\$1,000)	0.147*** (0.046)	0.146*** (0.047)	
Lifetime Lead Emissions \times Vitamin Supplement Sales (\$1,000)		-0.127 (0.161)	
Lifetime Lead Emissions \times Vitamin Supplement + Dairy Sales (\$1,000)			0.139*** (0.049)
Base Controls	Yes	Yes	Yes
School-Subject-Grade FE	Yes	Yes	Yes
Subject-Grade-Year FE	Yes	Yes	Yes
Observations	125,359	125,359	125,359

Nutrition can mitigate lead's effects

	(1)	(2)	(3)
Lifetime Inverse Distance-Weighted Lead Emissions (10 kg)	-0.527*** (0.137)	-0.515*** (0.135)	-0.512*** (0.147)
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Lifetime Lead Emissions \times Vitamin Supplement Sales (\$1,000)		-0.127 (0.161)	
Lifetime Lead Emissions \times Vitamin Supplement + Dairy Sales (\$1,000)			0.139*** (0.049)
Base Controls	Areas with greater dairy consumption have smaller negative effects of lead	Yes	Yes
School-Subject-Grade FE		Yes	Yes
Subject-Grade-Year FE		Yes	Yes
Observations		125,359	125,359

Areas with greater dairy consumption have smaller negative effects of lead



Why dairy?

Pb displaces metal ions (Ca^+ , Zn^+)
that are required for bodily function

Interferes with Ca^+ in the brain

More calcium → less interference

Well-known in public health



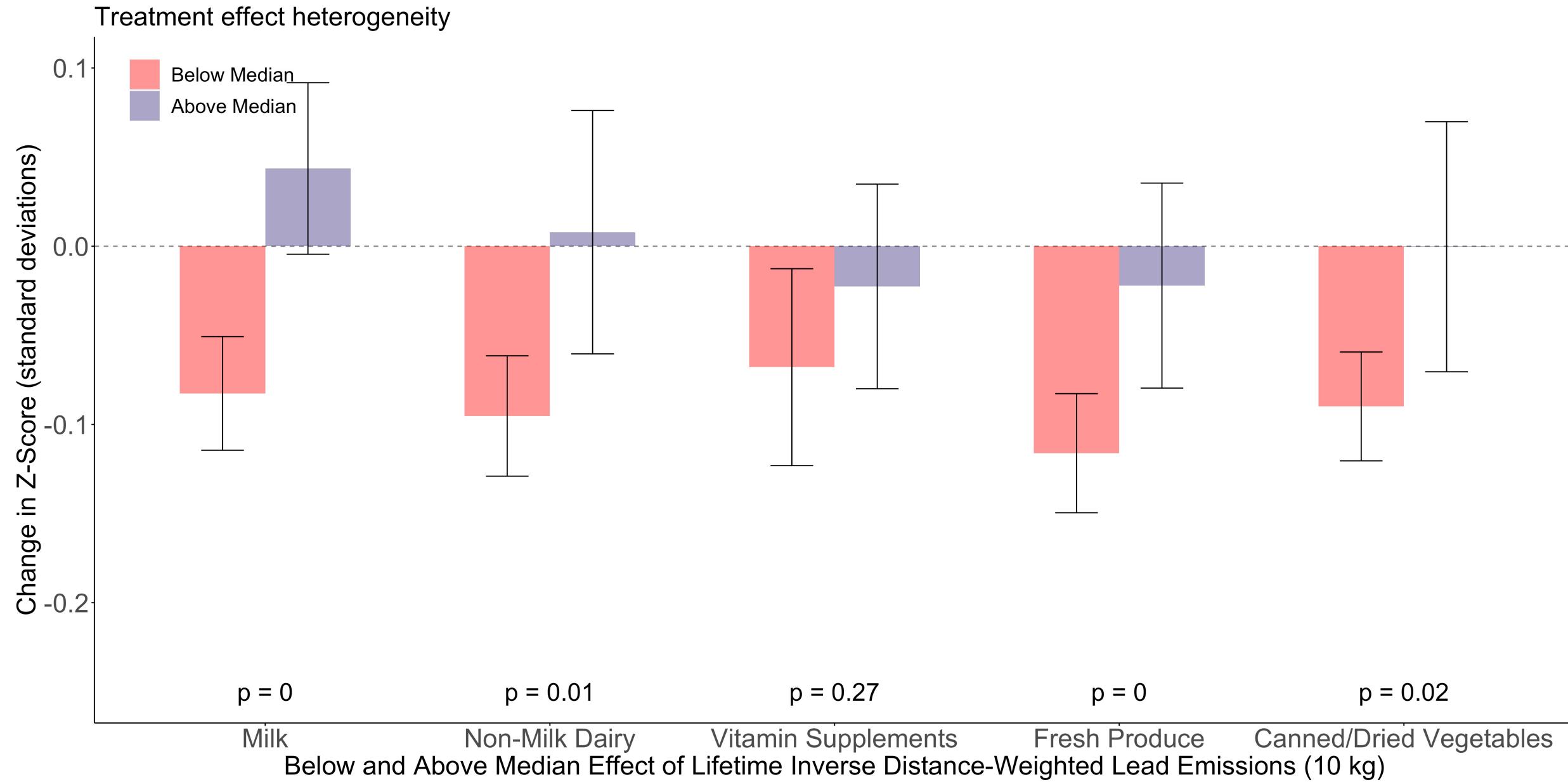
Sources of calcium include:

- milk, cheese and other **dairy** foods.
- green leafy vegetables – such as curly kale, okra and spinach.
- soya drinks with added calcium.
- bread and anything made with fortified flour.
- fish where you eat the bones – such as **sardines** and pilchards.

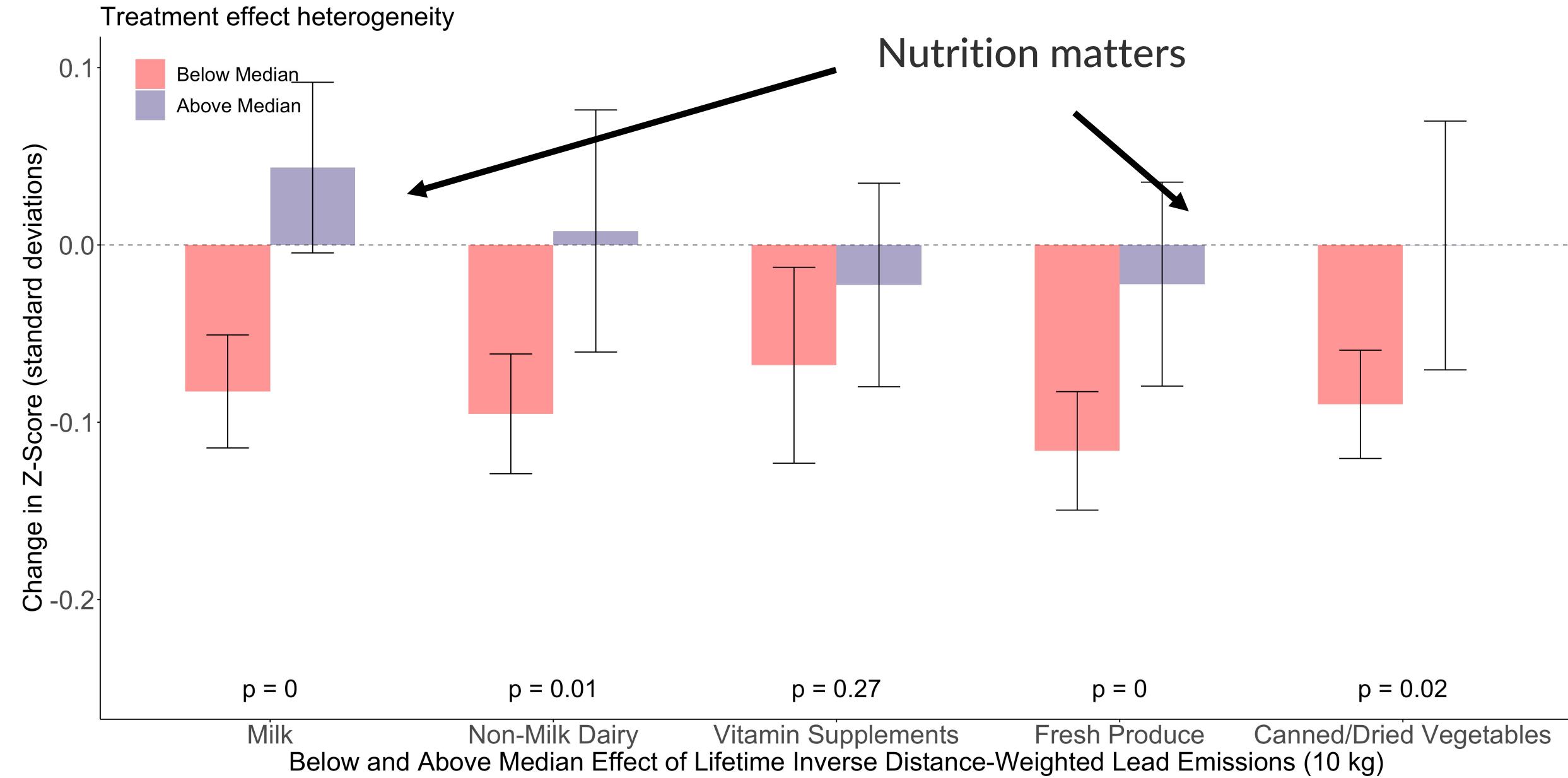
[www.nhs.uk › Health A to Z › Vitamins and minerals](https://www.nhs.uk/conditions/vitamins-and-minerals/calcium/)

[Vitamins and minerals - Calcium - NHS](https://www.nhs.uk/conditions/vitamins-and-minerals/calcium/)

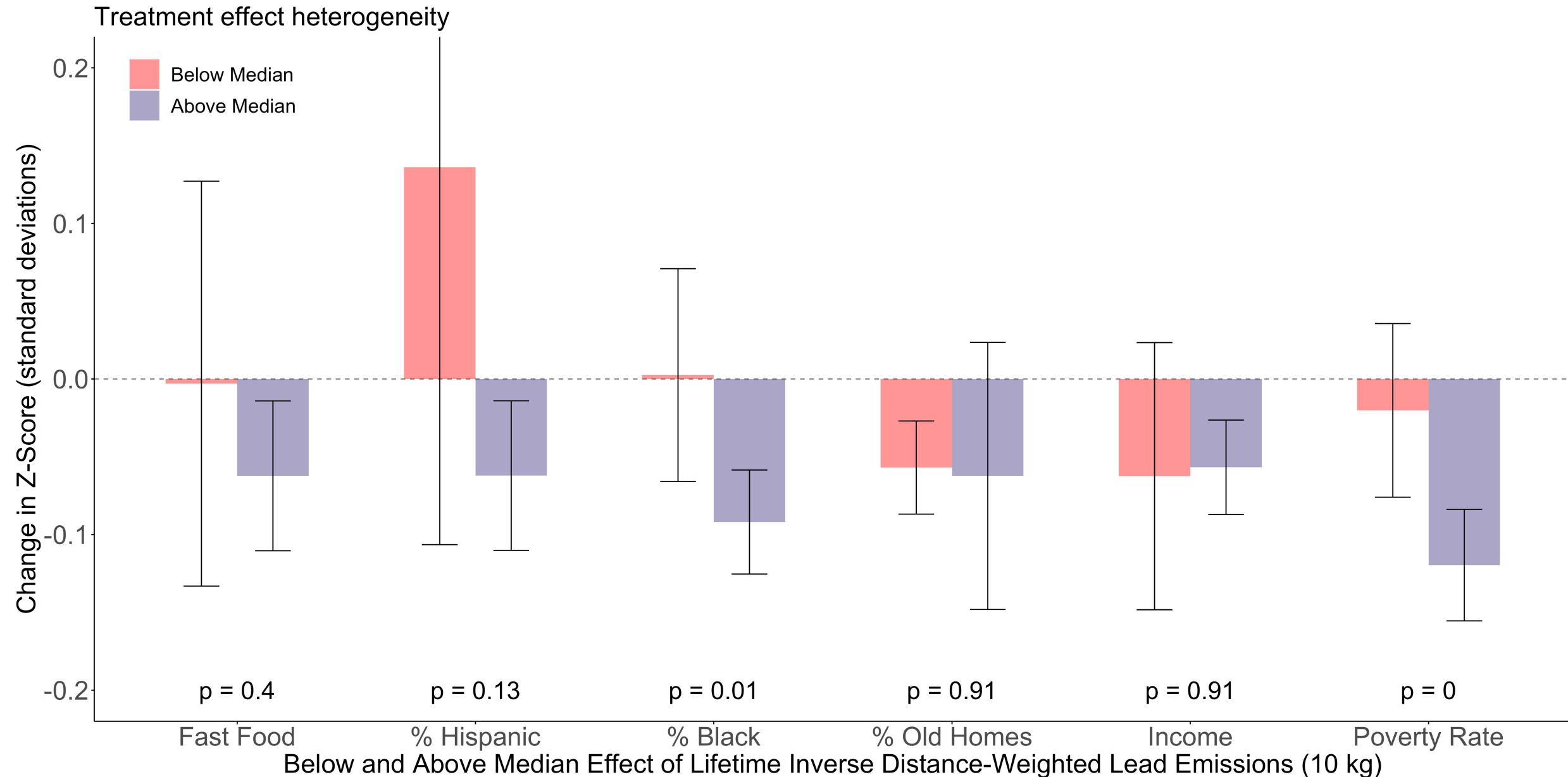
Nutrition matters



Nutrition matters



Negative effects vary by socioeconomic status



Negative effects vary by socioeconomic status

