DOI: 10.1289/EHP6729

Note to readers with disabilities: *EHP* strives to ensure that all journal content is accessible to all readers. However, some figures and Supplemental Material published in *EHP* articles may not conform to 508 standards due to the complexity of the information being presented. If you need assistance accessing journal content, please contact ehp508@niehs.nih.gov. Our staff will work with you to assess and meet your accessibility needs within 3 working days.

Supplemental Material

The Association between Residential Green Space in Childhood and Development of Attention Deficit Hyperactivity Disorder: A Population-Based Cohort Study

Malene Thygesen, Kristine Engemann, Gitte J. Holst, Birgitte Hansen, Camilla Geels, Jørgen Brandt, Carsten B. Pedersen, and Søren Dalsgaard

Table of Contents

Figure S1. Definition of study population.

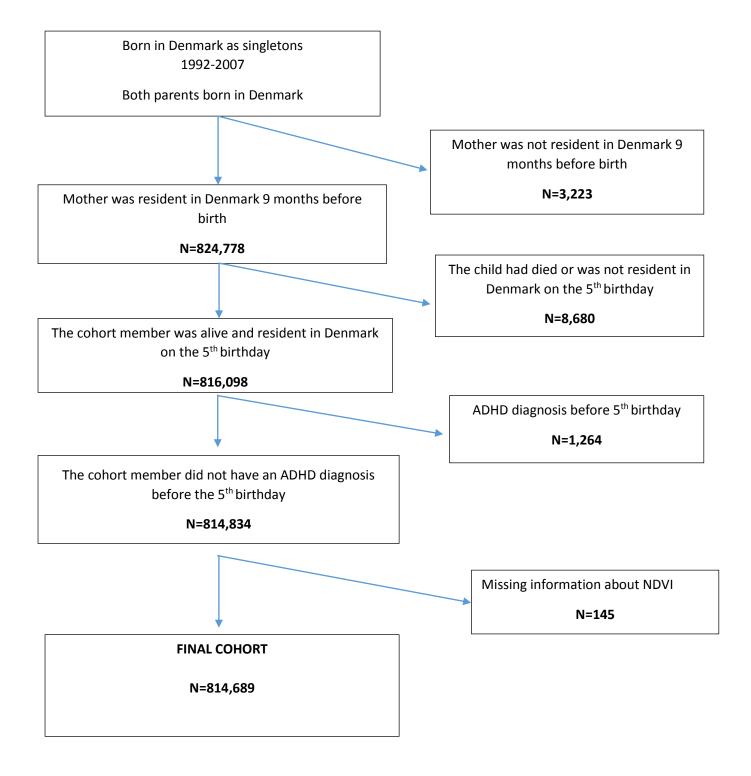
Table S1. IRRs for ADHD by NDVI within the first five years of life and stratified by year of birth, sex, region, urbanicity, parental SES and neighborhood level SES (with interaction term).

Table S2. IRRs for ADHD by NDVI within different proximities around residential address.

Table S3. Incidence rate ratios (IRRs) for ADHD by NDVI at different ages within an exposure zone of 210×210 m.

Table S4. IRRs for ADHD by NDVI among firstborn children.

Figure S1. Definition of study population



 $Table \ S1: IRRs \ for \ ADHD \ by \ NDVI \ within \ the \ first \ five \ years \ of \ life \ and \ stratified \ by \ year \ of \ birth, sex, region, urbanicity, parental \ SES \ and \ neighborhood \ level \ SES \ (with \ interaction \ term)$

Base adjustment model [†] IRR (95% CI)		Adjusted model ^β IRR (95% CI)	
Birth year group			
1992-1996	1.58 (1.47, 1.70)	1.26 (1.17, 1.36)	
1997-2001	1.35 (1.26, 1.43)	1.12 (1.05, 1.19)	
2002-2007	1.37 (1.25, 1.49)	1.10 (1.01, 1.20)	
P-value	(p = 0.00093)	(p=0.01820)	
Sex			
Female	1.62 (1.52, 1.74)	1.34 (1.25, 1.44)	
Male	1.28 (1.22, 1.34)	1.05 (1.00, 1.11)	
P-value	(p=<0.00001)	(p=<0.00001)	
Region			
North Denmark	1.68 (1.43, 1.98)	1.43 (1.21, 1.69)	
Central Denmark	1.54 (1.43, 1.66)	1.30 (1.20, 1.40)	
South Denmark	1.50 (1.37, 1.64)	1.26 (1.15, 1.38)	
Capital Region	1.35 (1.25, 1.47)	1.01 (0.93, 1.10)	
Zealand	1.14(1.03, 1.27)	0.93 (0.83, 1.04)	
P-value	(p = 0.00002)	(p=<0.00001)	
Mother's level of education [†]			
Primary school	1.29 (1.21, 1.38) 1.30 (1.21, 1.3		
Short education	1.27 (1.20, 1.35) 1.28 (1.20, 1.36)		
Medium long education	1.20 (1.09, 1.33)	.33) 1.20 (1.08, 1.33)	
Long education	0.97 (0.77, 1.22)	0.95 (0.76, 1.20)	
P-value	(p =0.08654)	(p =0.05562)	

Table S1 (Continued): IRRs for ADHD by NDVI within the first five years of life and stratified by year of birth, sex, region, urbanicity, parental SES and neighborhood level SES (with interaction term)

ducation frimary school 1.32 (1.24, 1.41) 1.32 (1.24, 1.41) 1.35 (1.27, 1.42) 1.35 (1.27, 1.43) 1.09 (0.94, 1.25) 1.09 (0.95, 1.26) 1.11 (0.92, 1.35) 1.01 (0.92, 1.35) 1.01 (0.92, 1.35) 1.02 (1.24) 1.03 (1.25) 1.09 (0.95, 1.26) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.11 (0.92, 1.35) 1.12 (1.33, 1.24) 1.33 (0.93, 1.14) 1.34 (1.26, 1.27) 1.35 (1.21, 1.20) 1.36 (1.21, 1.20) 1.37 (1.21, 1.20) 1.38 (1.21, 1.20) 1.39 (1.21, 1.21) 1.30 (1.00, 1.70) 1.31 (1.21, 1.25) 1.32 (1.21, 1.45) 1.33 (1.21, 1.45) 1.34 (1.26, 1.43) 1.35 (1.24, 1.43) 1.35 (1.24, 1.43) 1.36 (1.24, 1.43) 1.37 (1.24, 1.43) 1.38 (1.24, 1.43) 1.39 (1.21, 1.45) 1.39 (1.21, 1.45) 1.39 (1.21, 1.45) 1.39 (1.21, 1.45) 1.39 (1.21, 1.45) 1.39 (1.21, 1.45)	_	Base adjustment model [†] IRR (95% CI)	Adjusted model IRR (95% CI)	
hort education 1.35 (1.27, 1.42) 1.35 (1.27, 1.43) fedium long education 1.09 (0.94, 1.25) 1.09 (0.95, 1.26) ong education 1.11 (0.91, 1.34) 1.11 (0.92, 1.35) ong education 1.11 (0.91, 1.34) 1.11 (0.92, 1.35) ong education (p =0.01203) (p =0.01640)	Father's level of education [‡]			
fedium long education $1.09 (0.94, 1.25)$ $1.09 (0.95, 1.26)$ ong education $1.11 (0.91, 1.34)$ $1.11 (0.92, 1.35)$ evalue $(p = 0.01203)$ $(p = 0.01640)$ Hother's level of recome [§] elow the 20^{th} percentile $2.12 (1.69, 2.66)$ $2.05 (1.63, 2.59)$ 0^{th} to the 40^{th} percentile $1.04 (0.95, 1.15)$ $1.03 (0.93, 1.14)$ 0^{th} to the 60^{th} percentile $1.44 (1.36, 1.53)$ $1.44 (1.36, 1.53)$ $1.30 (1.21, 1.40)$ above the 80^{th} percentile $1.09 (0.95, 1.27)$ $1.10 (0.95, 1.27)$ elow the 80^{th} percentile $1.30 (1.00, 1.70)$ $1.54 (1.16, 2.04)$ 0^{th} to the 40^{th} percentile $1.01 (0.89, 1.16)$ $1.21 (1.05, 1.39)$ $1.32 (1.21, 1.45)$ 0^{th} to the 40^{th} percentile $1.16 (1.07, 1.27)$ $1.32 (1.21, 1.45)$ $1.32 (1.21, 1.45)$ $1.34 (1.26, 1.43)$ above the 80^{th} percentile $1.39 (1.31, 1.48)$ $1.52 (1.43, 1.62)$ above the 80^{th} percentile $1.39 (1.31, 1.48)$ $1.52 (1.43, 1.62)$ above the 80^{th} percentile $1.39 (1.31, 1.48)$ $1.52 (1.43, 1.62)$ above the 80^{th} percentile $1.39 (1.31, 1.48)$ $1.52 (1.43, 1.62)$ above the 80^{th} percentile $1.30 (1.13, 1.28)$ $1.34 (1.26, 1.43)$	Primary school	1.32 (1.24, 1.41) 1.32 (1.3		
ong education 1.11 $(0.91, 1.34)$ 1.11 $(0.92, 1.35)$ -value $(p = 0.01203)$ $(p = 0.01640)$ Tother's level of acome selow the 20^{th} percentile 2.12 $(1.69, 2.66)$ 2.05 $(1.63, 2.59)$ 0^{th} to the 40^{th} percentile 1.04 $(0.95, 1.15)$ 1.03 $(0.93, 1.14)$ 0^{th} to the 60^{th} percentile 1.44 $(1.36, 1.53)$ 1.44 $(1.36, 1.53)$ 0^{th} to the 80^{th} percentile 1.29 $(1.20, 1.39)$ 1.30 $(1.21, 1.40)$ above the 80^{th} percentile 1.09 $(0.95, 1.27)$ 1.10 $(0.95, 1.27)$ -value $(p = < 0.00001)$ Tather's level of acome selow the 20^{th} percentile 1.30 $(1.00, 1.70)$ 1.54 $(1.16, 2.04)$ 0^{th} to the 40^{th} percentile 1.01 $(0.89, 1.16)$ 1.21 $(1.05, 1.39)$ 0^{th} to the 60^{th} percentile 1.16 $(1.07, 1.27)$ 1.32 $(1.21, 1.45)$ 0^{th} to the 80^{th} percentile 1.39 $(1.31, 1.48)$ 1.52 $(1.43, 1.62)$ above the 80^{th} percentile 1.39 $(1.31, 1.48)$ 1.52 $(1.43, 1.62)$	Short education	1.35 (1.27, 1.42)	1.35 (1.27, 1.43)	
-value (p =0.01203) (p =0.01640) **Tother's level of recome** elow the 20 th percentile 2.12 (1.69, 2.66) 2.05 (1.63, 2.59) **Oth to the 40 th percentile 1.04 (0.95, 1.15) 1.03 (0.93, 1.14) **Oth to the 60 th percentile 1.44 (1.36, 1.53) 1.44 (1.36, 1.53) Oth to the 80 th percentile 1.29 (1.20, 1.39) 1.30 (1.21, 1.40) **Oth to the 80 th percentile 1.09 (0.95, 1.27) 1.10 (0.95, 1.27) -value (p=<0.00001) (p=<0.00001) **ather's level of recome** elow the 20 th percentile 1.30 (1.00, 1.70) 1.54 (1.16, 2.04) Oth to the 40 th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) Oth to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) Oth to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) Above the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	Medium long education	1.09 (0.94, 1.25)	1.09 (0.95, 1.26)	
Continue	Long education	1.11 (0.91, 1.34)	1.11 (0.92, 1.35)	
elow the 20 th percentile 2.12 (1.69, 2.66) 2.05 (1.63, 2.59) 0 th to the 40 th percentile 1.04 (0.95, 1.15) 1.03 (0.93, 1.14) 0 th to the 60 th percentile 1.44 (1.36, 1.53) 1.44 (1.36, 1.53) 0 th to the 80 th percentile 1.29 (1.20, 1.39) 1.30 (1.21, 1.40) 1.00 (0.95, 1.27) 1.10 (0.95, 1.27)	-value	(p = 0.01203)	(p =0.01640)	
0^{th} to the 40^{th} percentile $1.04 (0.95, 1.15)$ $1.03 (0.93, 1.14)$ 0^{th} to the 60^{th} percentile $1.44 (1.36, 1.53)$ $1.44 (1.36, 1.53)$ 0^{th} to the 80^{th} percentile $1.29 (1.20, 1.39)$ $1.30 (1.21, 1.40)$ above the 80^{th} percentile $1.09 (0.95, 1.27)$ $1.10 (0.95, 1.27)$ -value $(p=<0.00001)$ $(p=<0.00001)$ ather's level of recome [§] $(p=<0.00001)$ $(p=<0.00001)$ ather's level of recome [§] $(p=<0.00001)$	Mother's level of ncome [§]			
0th to the 60th percentile 1.44 (1.36, 1.53) 1.44 (1.36, 1.53) 0th to the 80th percentile 1.29 (1.20, 1.39) 1.30 (1.21, 1.40) 1.50 the 80th percentile 1.09 (0.95, 1.27) 1.10 (0.95, 1.27) 1.10 (0.95, 1.27) 1.10 (0.95, 1.27) 1.10 the 40th percentile 1.30 (1.00, 1.70) 1.54 (1.16, 2.04) 1.10 the 40th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) 1.10 the 60th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 1.50 the 80th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) 1.50 the 80th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	selow the 20 th percentile	2.12 (1.69, 2.66)	2.05 (1.63, 2.59)	
0^{th} to the 80^{th} percentile $1.29 (1.20, 1.39)$ $1.30 (1.21, 1.40)$ above the 80^{th} percentile $1.09 (0.95, 1.27)$ $1.10 (0.95, 1.27)$ -value $(p=<0.00001)$ $(p=<0.00001)$ ather's level of neome§ $(p=<0.00001)$ $(p=<0.00001)$ elow the 20^{th} percentile $(p=<0.00001)$ <td>0th to the 40th percentile</td> <td>1.04 (0.95, 1.15)</td> <td colspan="2">1.03 (0.93, 1.14)</td>	0 th to the 40 th percentile	1.04 (0.95, 1.15)	1.03 (0.93, 1.14)	
The labove the 80^{th} percentile $1.09 (0.95, 1.27)$ $1.10 (0.$	0 th to the 60 th percentile	1.44 (1.36, 1.53)	1.44 (1.36, 1.53)	
-value (p=<0.00001) (p=<0.00001) ather's level of neome [§] elow the 20 th percentile 1.30 (1.00, 1.70) 1.54 (1.16, 2.04) 0 th to the 40 th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) 0 th to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) above the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	10^{th} to the 80^{th} percentile	1.29 (1.20, 1.39)	1.30 (1.21, 1.40)	
ather's level of neome [§] elow the 20 th percentile 1.30 (1.00, 1.70) 1.54 (1.16, 2.04) 0 th to the 40 th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) 0 th to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) above the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	Above the 80 th percentile	1.09 (0.95, 1.27)	1.10 (0.95, 1.27)	
recome [§] elow the 20 th percentile 1.30 (1.00, 1.70) 1.54 (1.16, 2.04) 0 th to the 40 th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) 0 th to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) 0.bove the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	P-value	(p=<0.00001) (p=<0.00		
0 th to the 40 th percentile 1.01 (0.89, 1.16) 1.21 (1.05, 1.39) 0 th to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) above the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	ather's level of			
0 th to the 60 th percentile 1.16 (1.07, 1.27) 1.32 (1.21, 1.45) 0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) bove the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	Below the 20 th percentile	1.30 (1.00, 1.70)	1.54 (1.16, 2.04)	
0 th to the 80 th percentile 1.39 (1.31, 1.48) 1.52 (1.43, 1.62) bove the 80 th percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	0 th to the 40 th percentile	1.01 (0.89, 1.16)	1.21 (1.05, 1.39)	
above the 80^{th} percentile 1.20 (1.13, 1.28) 1.34 (1.26, 1.43)	0 th to the 60 th percentile	1.16 (1.07, 1.27)	1.32 (1.21, 1.45)	
	0 th to the 80 th percentile	1.39 (1.31, 1.48)	1.52 (1.43, 1.62)	
-value $(p = 0.00002)$ $(p = 0.00233)$	Above the 80 th percentile	1.20 (1.13, 1.28)	1.34 (1.26, 1.43)	
	-value	(p =0.00002)	(p = 0.00233)	

Table S1 (Continued): IRRs for ADHD by NDVI within the first five years of life and stratified by year of birth, sex, region, urbanicity, parental SES and neighborhood level SES (with interaction term)

	Base adjustment model [†] IRR (95% CI)	Adjusted model ^β IRR (95% CI)	
Neighborhood level of income in municipality			
Low income municipality	1.43 (1.33, 1.53)	1.18 (1.10, 1.27)	
Medium income municipality	1.54 (1.43, 1.65)	1.27 (1.18, 1.36)	
High income municipality	1.33 (1.24, 1.43)	1.05 (0.98, 1.13)	
P-value (p=0.01060)		(p=0.00062)	
Neighborhood level of education			
Low education municipality	1.51 (1.42, 1.62)	1.28 (1.20, 1.38)	
Medium education municipality	1.45 (1.34, 1.56)	1.15 (1.06, 1.24)	
High education municipality	1.29 (1.19, 1.39)	1.02 (0.95, 1.11)	
P-value	(p=0.00462)	(p=0.00006)	
Neigborhood level of unemployment			
High uemployment municipality	1.54 (1.43, 1.65)	1.20 (1.12, 1.29)	
Medium unemployment municipality	1.43 (1.34, 1.53)	1.18 (1.10, 1.26)	
Low unemployment municipality	1.32 (1.23, 1.42)	1.10 (1.03, 1.19)	
P-value	(p=0.00986)	(p =0.22444)	

Table S1 (Continued): IRRs for ADHD by NDVI within the first five years of life and stratified by year of birth, sex, region, urbanicity, parental SES and neighborhood level SES (with interaction term)

	Base adjustment model [₹] IRR (95% CI)	Adjusted model ^β IRR (95% CI)
Urbanicity		
Capital	1.51 (1.32, 1.73)	1.07 (0.93, 1.23)
Capital suburb	1.31 (1.17, 1.47)	1.00 (0.89, 1.12)
Municipalities with a town with > 100,000 inhabitants	1.37 (1.20, 1.57)	1.19 (1.04, 1.36)
Municipalities with a town with 10,000 – 100,000 inhabitants	1.43 (1.32, 1.54)	1.14 (1.06, 1.24)
Other municipalities (largest town < 10,000 inhabitants)	1.46 (1.37, 1.57)	1.25 (1.17, 1.34)
P-value	(p =0.38813)	(p=0.01371)

Abbreviations: NDVI; Normalized Difference Vegetation Index. IRR; Incidence rate ratio.

 $^{^{\}mathsf{T}}$ Multilevel modeling was used to estimate the association between NDVI in numeric deciles measured at 210×210 m around an individual's residential address between age 0 to 5 years and the outcome of ADHD in a cohort of 814 689 individuals born in Denmark 1992 to 2007 and who were followed from 1997 until 2017 and adjusted for age, calendar year, sex

 $^{^{\}beta}$ Multilevel modeling was used to estimate the association between NDVI in numeric deciles measured at 210×210 m around an individual's residential address between age 0 to 5 years and the outcome of ADHD in a cohort of 814 689 individuals born in Denmark 1992 to 2007 and who were followed from 1997 until 2017 and adjusted for age, calendar year, sex, mother's and father's level of education and income, urbanicity and proportion of low income, low education and unemployment at municipal level

Table S2: IRRs for ADHD by NDVI within different proximities around residential address

NDVI within quadrat size IRR (95%	
210 X 210 m (7 X 7 cells)	1.16 (1.11, 1.22)
330 X 330 m (11 X 11 cells)	1.16 (1.11, 1.22)
570 X 570 m (19 X 19 cells)	1.15 (1.10, 1.21)
930 X 930 m (31 X 31 cells)	1.13 (1.08, 1.19)

Abbreviations: NDVI; Normalized Difference Vegetation Index. IRR; Incidence rate ratio.

Quadrat size is the different exposure zones of green space around the residential address. Multilevel modeling was used to estimate the association between NDVI in numeric deciles and ADHD

All estimates were adjusted for age, calendar year, sex, mother's and father's level of education and income, urbanicity and proportion of low income, low education and unemployment at municipal level

Table S3: Incidence rate ratios (IRRs) for ADHD by NDVI at different ages within an exposure zone of 210×210 m

NDVI deciles	Age 1 IRR (95% CI)	Age 2 IRR (95% CI)	Age 3 IRR (95% CI)	Age 4 IRR (95% CI)	Age 5 IRR (95% CI)
1	1.10 (1.04, 1.17)	1.08 (1.02, 1.15)	1.08 (1.02, 1.14)	1.10 (1.05, 1.17)	1.16 (1.09, 1.22)
2	1.09 (1.04, 1.16)	1.07 (1.01, 1.13)	1.09 (1.03, 1.15)	1.10 (1.05, 1.17)	1.14 (1.08, 1.20)
3	1.09 (1.04, 1.15)	1.09 (1.03, 1.15)	1.08 (1.02, 1.14)	1.08 (1.02, 1.14)	1.08 (1.03, 1.14)
4	1.05 (1.00, 1.11)	1.08 (1.02, 1.14)	1.07 (1.01, 1.13)	1.10 (1.05, 1.16)	1.12 (1.06, 1.18)
5	1.07 (1.01, 1.13)	1.09 (1.03, 1.15)	1.04 (0.98, 1.09)	1.03 (0.98, 1.09)	1.08 (1.02, 1.14)
6	1.03 (0.98, 1.09)	1.05 (1.00, 1.11)	1.02 (0.96, 1.07)	1.02 (0.97, 1.08)	1.05 (0.99, 1.11)
7	1.08 (1.02, 1.14)	0.98 (0.93, 1.04)	1.02 (0.97, 1.08)	1.02 (0.96, 1.07)	1.06 (1.01, 1.12)
8	1.06 (1.00, 1.12)	1.03 (0.98, 1.09)	1.01 (0.96, 1.07)	1.03 (0.98, 1.08)	1.12 (1.06, 1.18)
9	1.06 (1.01, 1.12)	1.05 (0.99, 1.10)	0.98 (0.93, 1.03)	1.04 (0.98, 1.09)	1.08 (1.03, 1.14)
10	1.00 (ref)				

Abbreviations: IRR; Incidence rate ratio. NDVI; Normalized Difference Vegetation Index.

Multilevel modeling was used to estimate the association between NDVI in deciles measured at 210×210 m around an individual's residential address between age 0 to 5 years and the outcome of ADHD in a cohort of 814 689 individuals born in Denmark 1992 to 2007 and who were followed from 1997 until 2017.

All models were adjusted for age, calendar year, sex and mother's and father's level of education and income, urbanicity and proportion of low income, low education and unemployment at municipal level

Table S4: IRRs for ADHD by NDVI among firstborn children

NDVI	IRR (95% CI)
High vs Low	1.10 (1.03, 1.17)

Abbreviations: NDVI; Normalized Difference Vegetation Index. IRR; Incidence rate ratio.

Multilevel modeling was used to estimate the association between NDVI in deciles measured at 210×210 m around an individual's residential address between age 0 to 5 years and the outcome of ADHD in a cohort of 814 689 individuals born in Denmark 1992 to 2007 and who were followed from 1997 until 2017.