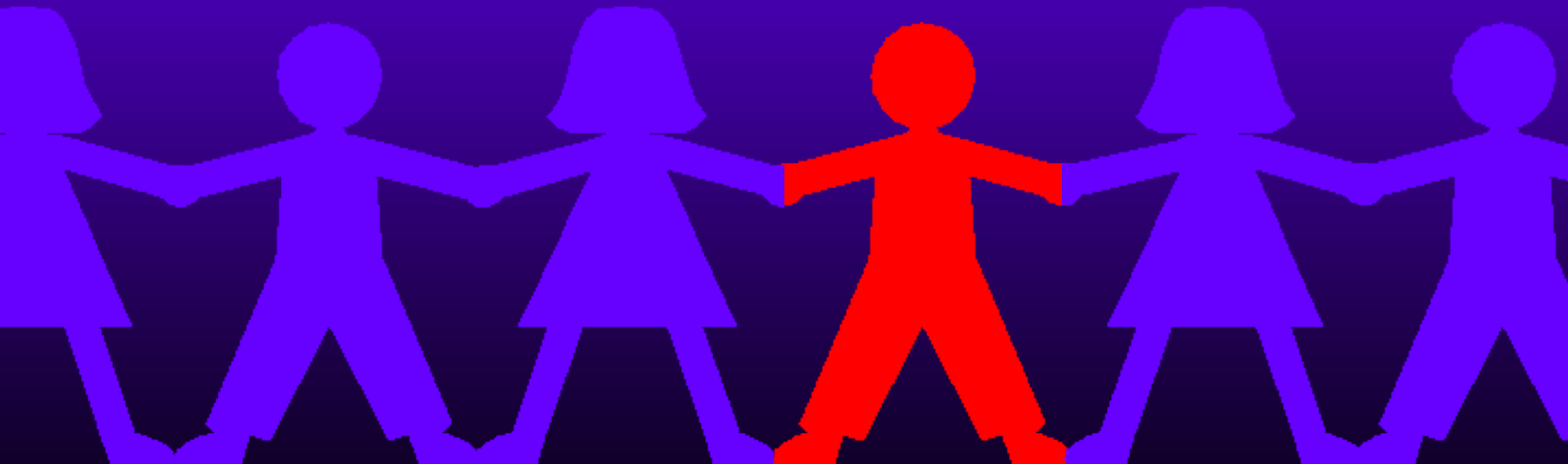


Epidemiologic Evidence for Air Pollution and Childhood Cancer

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Background/Rationale

- ❖ There is an interest in environmental factors and risk of childhood cancer.
- ❖ Some air pollutants are known or probable carcinogens (e.g. benzene and 1,3 – butadiene).
- ❖ Motor vehicle emissions are a major source of air pollution and levels of these chemicals are higher near busy roads.



Approaches

❖ Study designs:

- Case-Control
- Ecologic

❖ Exposure estimates:

- Interview data
- Residential proximity to emitters
- Traffic near residence
- Estimated/modeled air toxics:
 - By municipality
 - By neighborhood
 - By buffer around residence



Case-Control Studies: Traffic and Childhood Cancer

<i>Study</i>	<i>#</i>	<i>Exposure</i>	<i>Findings</i>
Wertheimer 1979 Denver	417 deaths 424 BC controls	Address w/in 40 meters of streets with 5000+ ADT	“mild excess” of case addresses (OR=1.6)
Savitz 1989 Denver	328 cases 262 RDD controls	Traffic on street of residence at diagnosis (10,000+ VPD)	OR=3.1, $p<.05$
Feychting 1998 Sweden	142 cases 550 BC controls	Estimated NO ₂ of outdoor air	OR=2.7 (n.s.) highest to lowest
Flood 1997 Arizona	210 cases 202 RDD controls (leukemia only)	Traffic volume near residences	No association
Pearson 2000 Denver	Savitz data (above)	Traffic density closest street within 750 feet of dx. residence (20,000+ VPD)	OR=5.9, $p<.05$

Case-Control Studies: Traffic and Childhood Cancer

<i>Study</i>	<i>#</i>	<i>Exposure</i>	<i>Findings</i>
Reynolds, 2001 San Diego, CA	90 cases (leuk) 349 BC controls	Traffic within 550 ft. of birth residence	No assoc.
Raachou-Nielsen, 2001 Denmark	1989 cases 5506 controls from popn rosters	Modeled NO ₂ and benzene for each address	Only assoc. for HD
Langholz, 2002 Los Angeles	212 cases (leuk) 202 controls (RDD and friend)	Traffic within 1500 feet of diagnosis residence	No assoc.
Crosignani, 2003 Italy	120 cases (leuk) 480 controls from popn rosters	Estimated benzene from traffic	<i>OR=3.9 (1.4-11.3) for highest exposure group (7 cases)</i>
Reynolds, 2004 California	4369 cases <age 5 8730 BC controls	Traffic within 500 ft. of birth residence	No assoc.
Steffen, 2004 France	280 cases 285 hosp. controls	Traffic, repair garage, and petrol station within 50 m of residence	No traffic assoc. OR=4.0 (1.5-10.3) for living near garage or gas station (17 cases)

Ecologic Studies: Traffic and Childhood Cancer

<i>Study</i>	<i>#</i>	<i>Exposure</i>	<i>Findings</i>
Knox 1996 Great Britain	22,448 childhood cancer deaths 1953-1980	Proximity to motorways	“Case excess” within 4.0 km of motorway
Norlinder 1997 Sweden	864 leukemias <age 25 (171 cases AML) 1975-1985	Car density (ownership) per municipality	Higher AML rates w. higher car density (p=0.05)
Harrison 1999 UK	130 leukemias <age 16 1990-1994	Proximity (100 m) to Main roads Petrol stations	Incidence Ratios: 1.2 (ns) 1.5 (ns)
Reynolds 2002 California	6,988 incident cases <age 15 1988-1994	Vehicle density Road density Traffic density	No association
Reynolds 2003 California	6,988 incident cases <age 15 1988-1994	HAPs: Mobile Sources Area Sources Point Sources	No association No association Trend for Leukemia

Factors Influencing Differences between Study Findings

- ❖ Study design (case–control vs. ecologic)
- ❖ Representativeness of cases (popn–based v. not)
- ❖ Control selection/comparison groups
- ❖ Sample size
- ❖ Outcomes:
 - Mortality vs. incidence
 - All sites vs. leukemia (and subtypes)
- ❖ Control for covariates
- ❖ Exposure assessment
 - Proxy measures for air quality
 - Geographic scale
 - Timing



**Over 480 billion vehicle km
traveled each year in California**



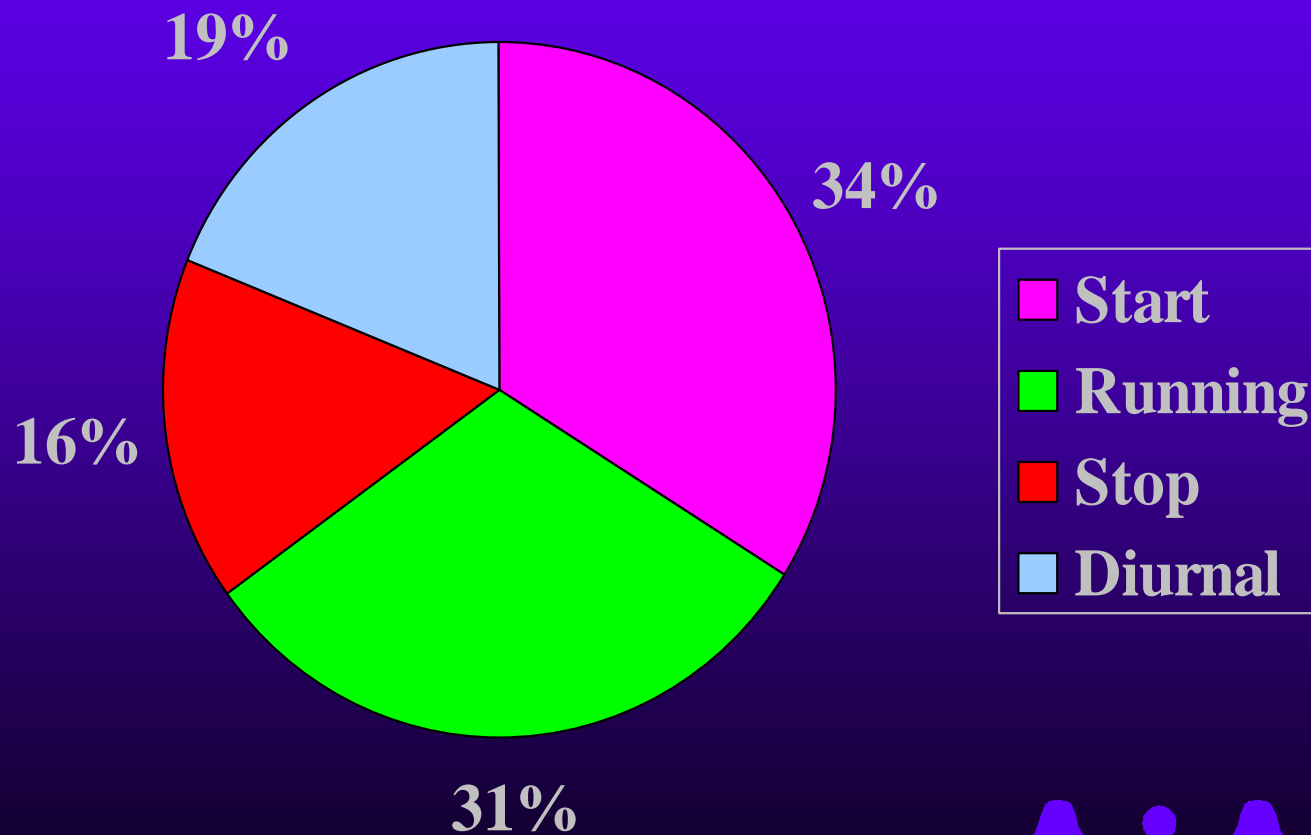
and 25 million cars and trucks!

In California, motor vehicles account for 66% of benzene emissions.



Automobile Hydrocarbon Emissions for a 20 Mile Roundtrip in 1990

Source: CALTRANS, 1992



Traffic Metrics Compared to Monitoring Data

- ❖ CARB air toxics data from 1990
- ❖ N=20 sites, all in urban areas of California
- ❖ Geocoded monitors to census block group
- ❖ Compared to annual median concentration of benzene and 1,3-butadiene



Pearson Correlation Coefficients

<i>Traffic Metric</i>	<i>CARB Benzene</i>	<i>CARB 1,3-Butadiene</i>
Vehicle Density	0.068	0.069
Road Density	0.030	0.040
Traffic Density	0.614 ($p=0.004$)	0.504 ($p=0.023$)



Traffic Density by Population Characteristics

❖ Race/ethnicity

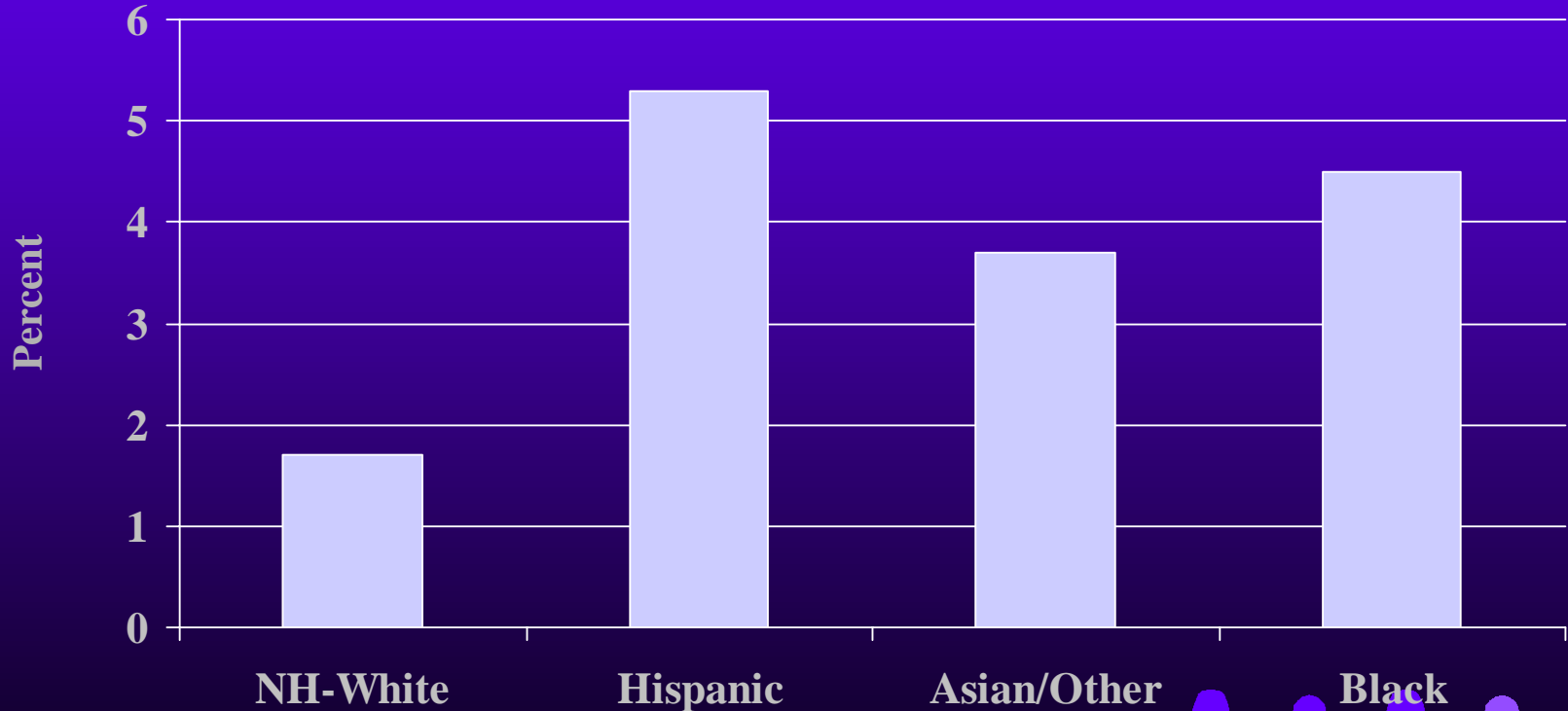
- NH–white, black, Hispanic, Asian/other

❖ Socioeconomic status

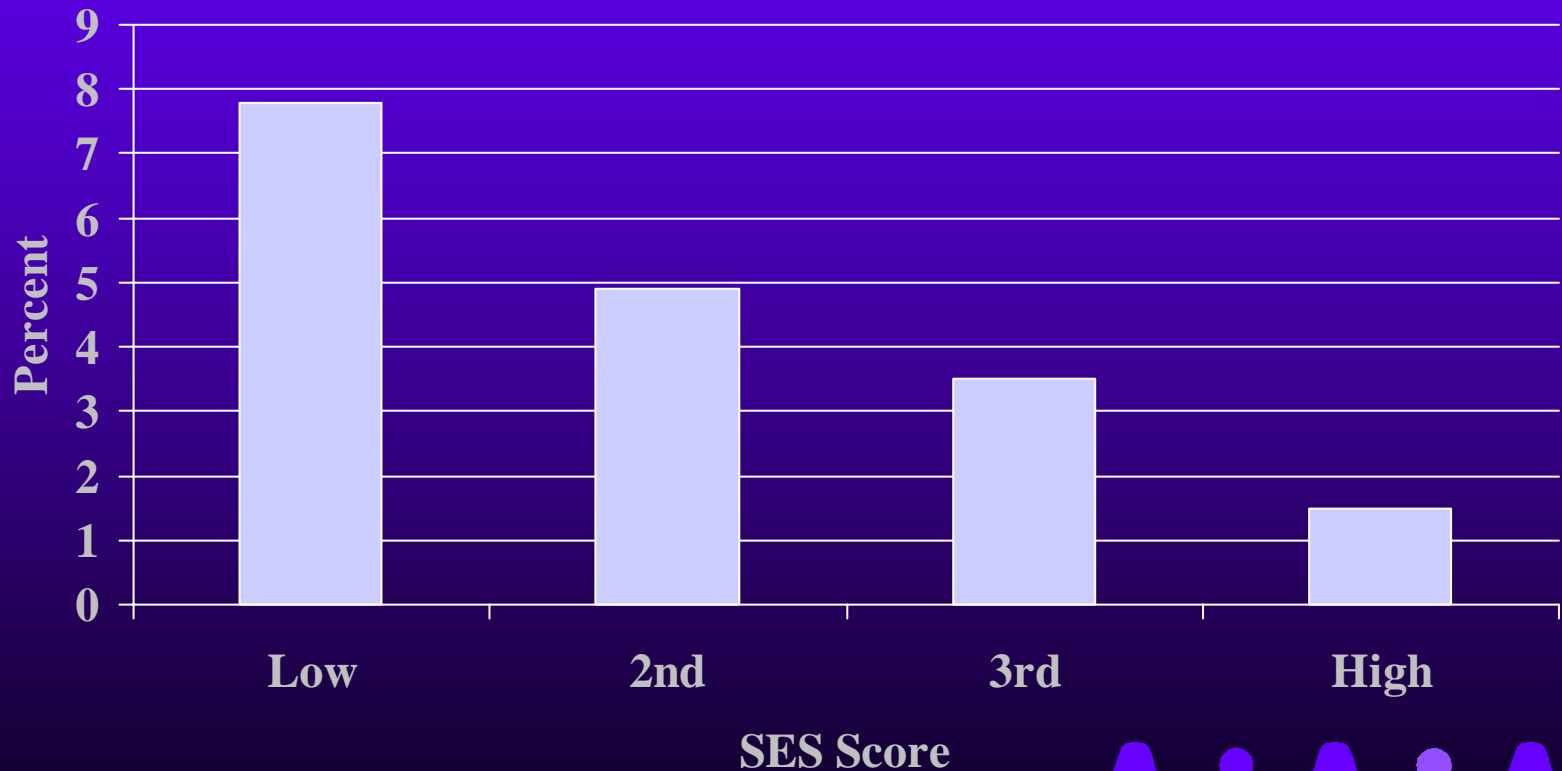
- median family income
- percent with income below poverty level
- percent with college degree
- percent in managerial/professional occupations



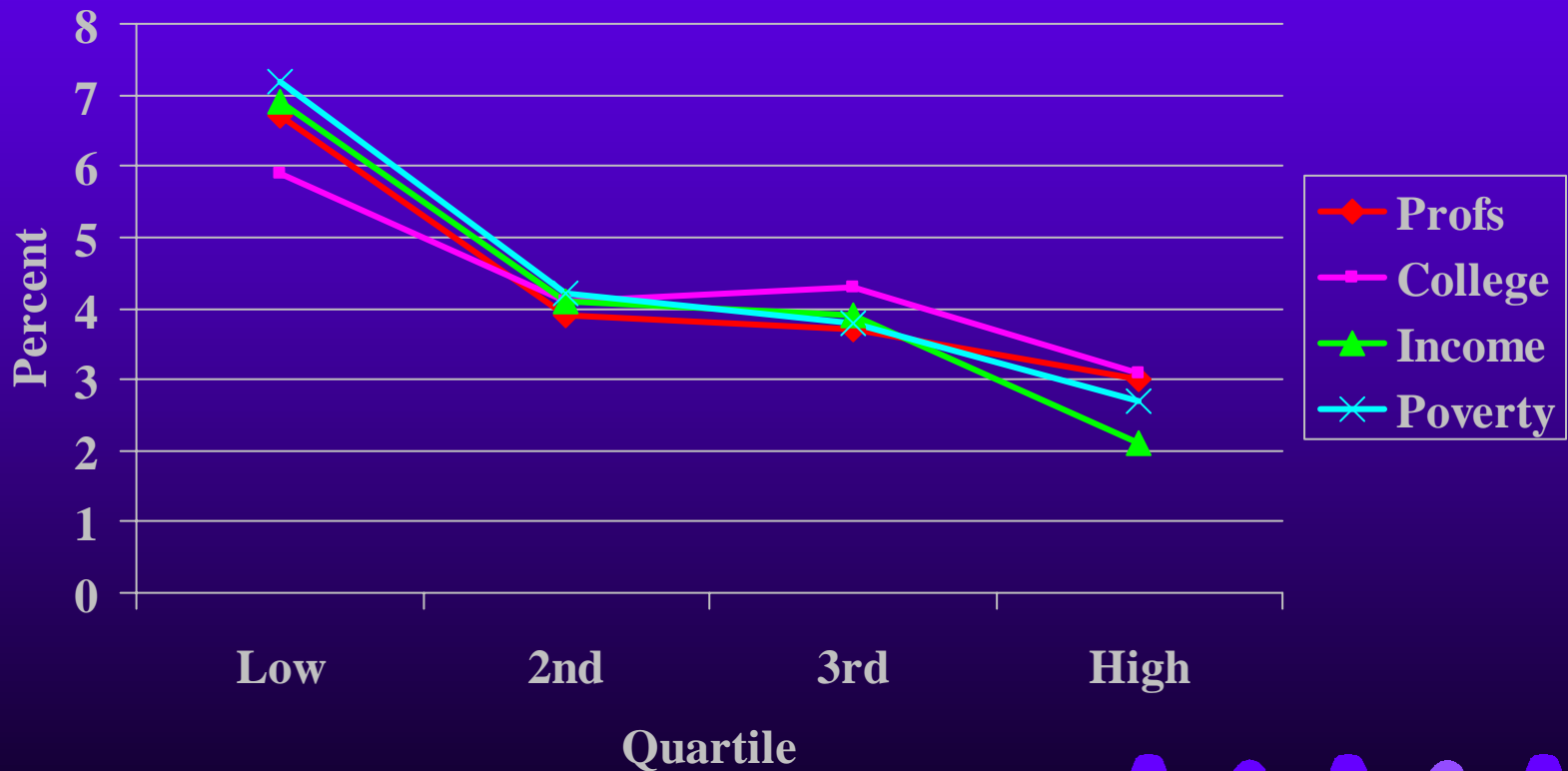
Percent of Population Under Fifteen Years of Age Living in Block Groups with Traffic Density Greater than 500,000 vmt/mi²



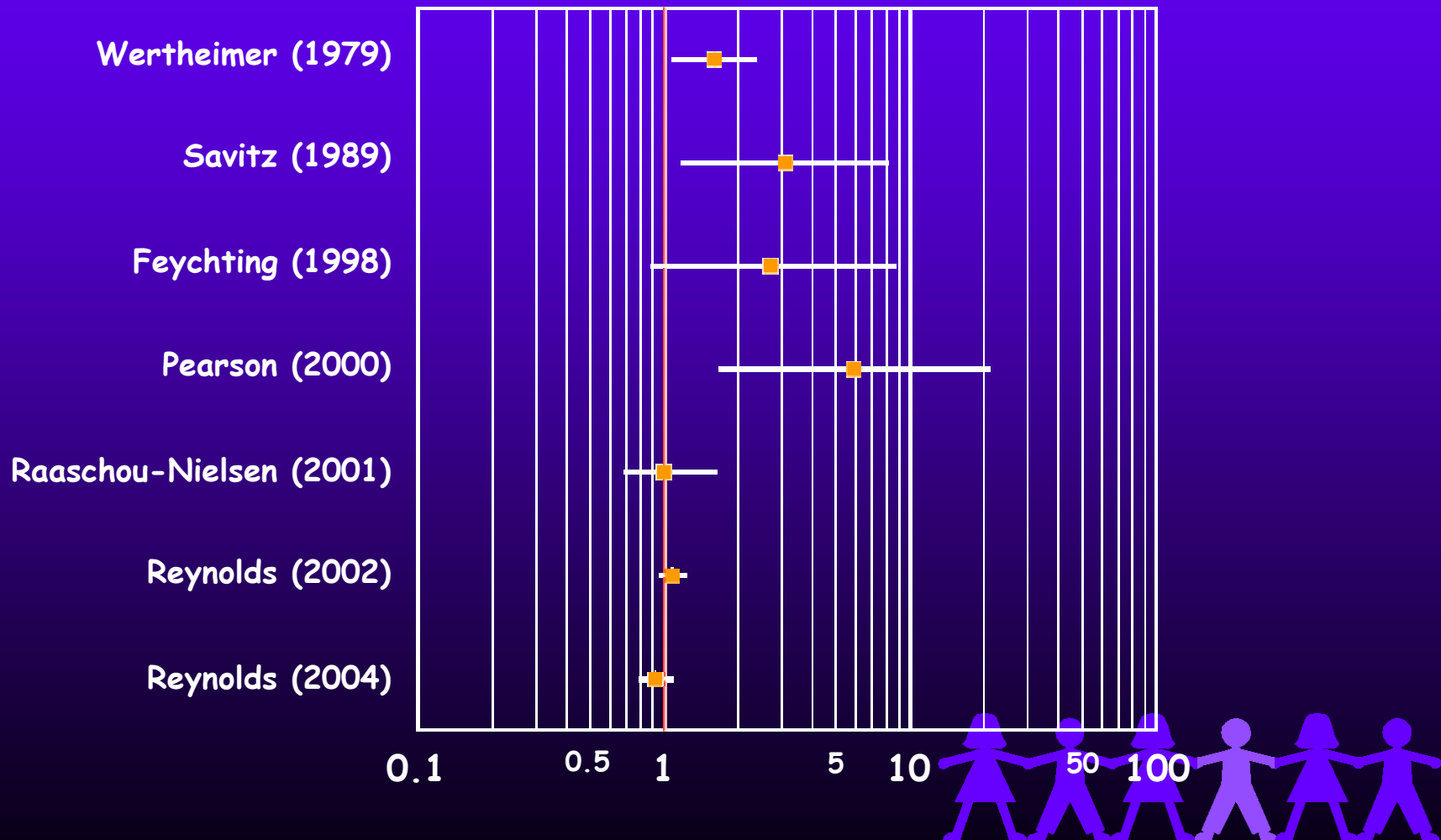
Percent of Block Groups by Combined SES Score with Greater than 500,000 vmt/mi²



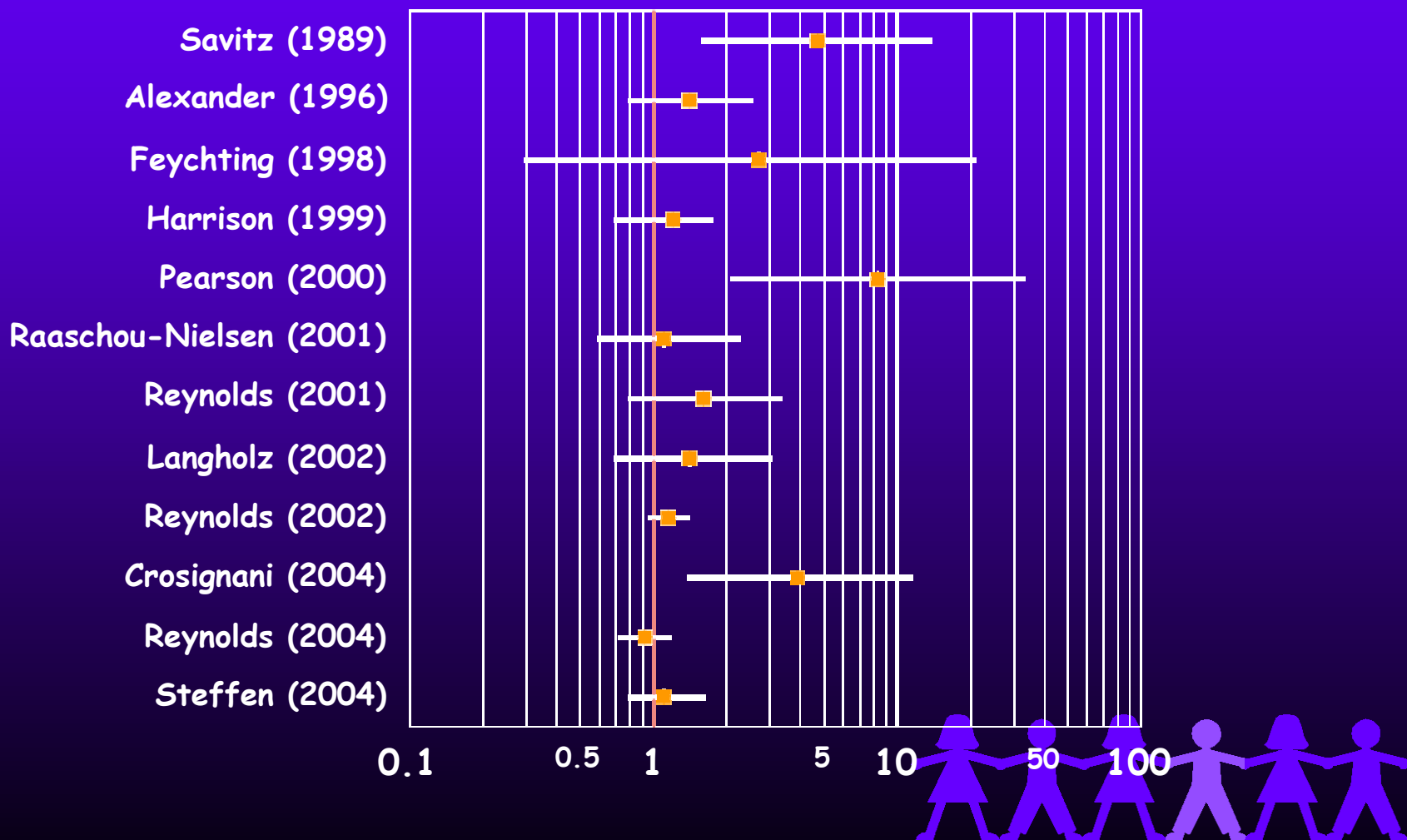
Percent of Block Groups in Each Quartile with Traffic Density Greater than 500,000 vmt/mi²



Odds ratios and 95% confidence intervals for **childhood cancer** in proximity to highest vs. lowest levels of traffic-associated exposures for seven published studies



Odds ratios and 95% confidence intervals for childhood leukaemia in proximity to highest vs. lowest levels of traffic-associated exposures for twelve published studies



Summary

❖ Traffic:

- Suggested associations come primarily from earlier and smaller studies
- More recent and larger studies suggest null associations

❖ General air quality:

- Limited mixed evidence, but some suggestions of risk associations



Limitations of Current Studies

- ❖ Most studies compromised by:
 - Small sample sizes, and/or
 - Crude exposure indicators
- ❖ Few studies account for exposure estimates for more than one point in time
- ❖ Few studies evaluate histologic subtypes
- ❖ No studies account for host susceptibility



Conclusions

- ❖ Evidence for air pollution associated risks is weak, BUT
- ❖ Future work may be warranted that:
 - Uses large sample sizes
 - Better characterizes exposures:
 - measurement
 - timing (cumulative, critical time periods)
 - Accounts for individual susceptibilities

