Personal Exposure To Environmental Tobacco Smoke (ETS) in a Demographically Representative Subject Population

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Covance, UK

Pat Amick

Amick Research

Study Objective and Design: Determination of **Personal** Exposure to ETS

- To determine the extent to which a demographically representative study population will be exposed to ETS differently than one selected primarily through random calling
- Target 60 non-smokers in each of four cells.
- Each subject wears a sampling pump at their workplace (8 hours) and "away from work" (16 hours).
  - Away-from-work includes commuting, shopping, dining, home, and sleeping.
- Particle and gas phase ETS components collected.
- Smoking status assessed using salivary cotinine.

Recruiting goals:

To approach 1990 Census information for Knox County, TN (Knoxville) with respect to:

- Age distribution
- Income distribution
- Gender
- Race
- Educational attainment
- Rural/urban mix
- Job title

Participant Inclusion Criteria

- Must live and work in Knox County, TN
- Older than 18 years of age
- No tobacco use within the last 6 months (includes prescription use of patch or gum)
- Work at least 35 hours per week outside the home.
- Avoid selected professions to exclude overly inquisitive participants or those with an interest in the outcome.
- No membership in smoking related public interest groups. (Either side of the issue.)

Subject Recruiting Methods

- Newspaper advertisements
- Businesses with target populations
- Announcement on public bulletin boards
- Announcement in public schools
- Personal contacts
- Stratified random calling

Task Responsibilities

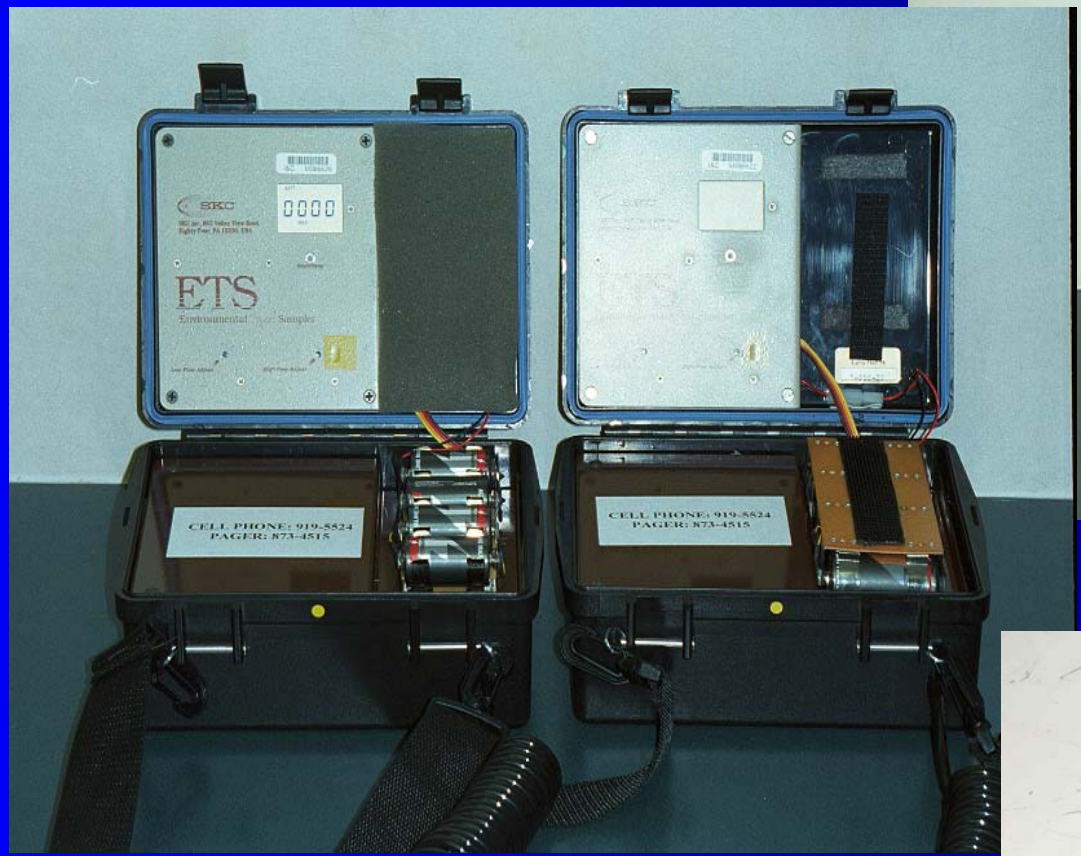
- **Oak Ridge National Laboratory**
  - Overall study design and oversight
  - Field sampling operations and logistics
  - Data integration, interpretation, and reporting
  - Air sample analysis
- **Tombras Group/Amick Research**
  - Questionnaire restructure from 16 Cities
  - Field recruitment of subjects
  - Assistance with field operations
  - Coding of subject demographic data
- **Covance Laboratories (UK).**
  - Salivary cotinine and 3-OH cotinine analyses

ETS Components Measured

ORNL Demographically Representative Exposure Study

- ETS Particle Phase
  - *Respirable suspended particulate matter (RSP)*
  - *UV-absorbing particulate matter (UVPM)*
  - *Fluorescing particulate matter (FPM)*
  - *Solanesol (Sol-PM or ETS-RSP)*
- ETS Vapor Phase
  - *3-ethenyl pyridine*
  - *Nicotine*
  - *Myosmine*
- Saliva
  - *Cotinine*
  - *3-OH Cotinine*

Sampling Equipment



Sample Collection in the Workplace

Sampling Head

Sampling Pump

Study Design: 2 x 2 Cell Structure

	Smoking Workplace	*Non-Smoking Workplace*
Smoking Home	Cell 1	Cell 2
Non-Smoking Home	Cell 3	Cell 4

Estimated Misclassification Rates of Subjects Claiming to be Never-Smokers

All Subjects Recruited on Basis of Non-Smoking Status

Salivary Cotinine Level, ng/mL	*Females Above Cut-off Point*	*Female Misclassification Rate, %*	*Males Above Cut-off Point*	*Male Misclassification Rate, %*	*Overall Misclassification Rate, %*
Mean >106	6	14.3	2	4.4	9.1
Mean >35	8	19.0	2	4.4	11.4
Mean > 15	10	23.8	3	6.6	14.8

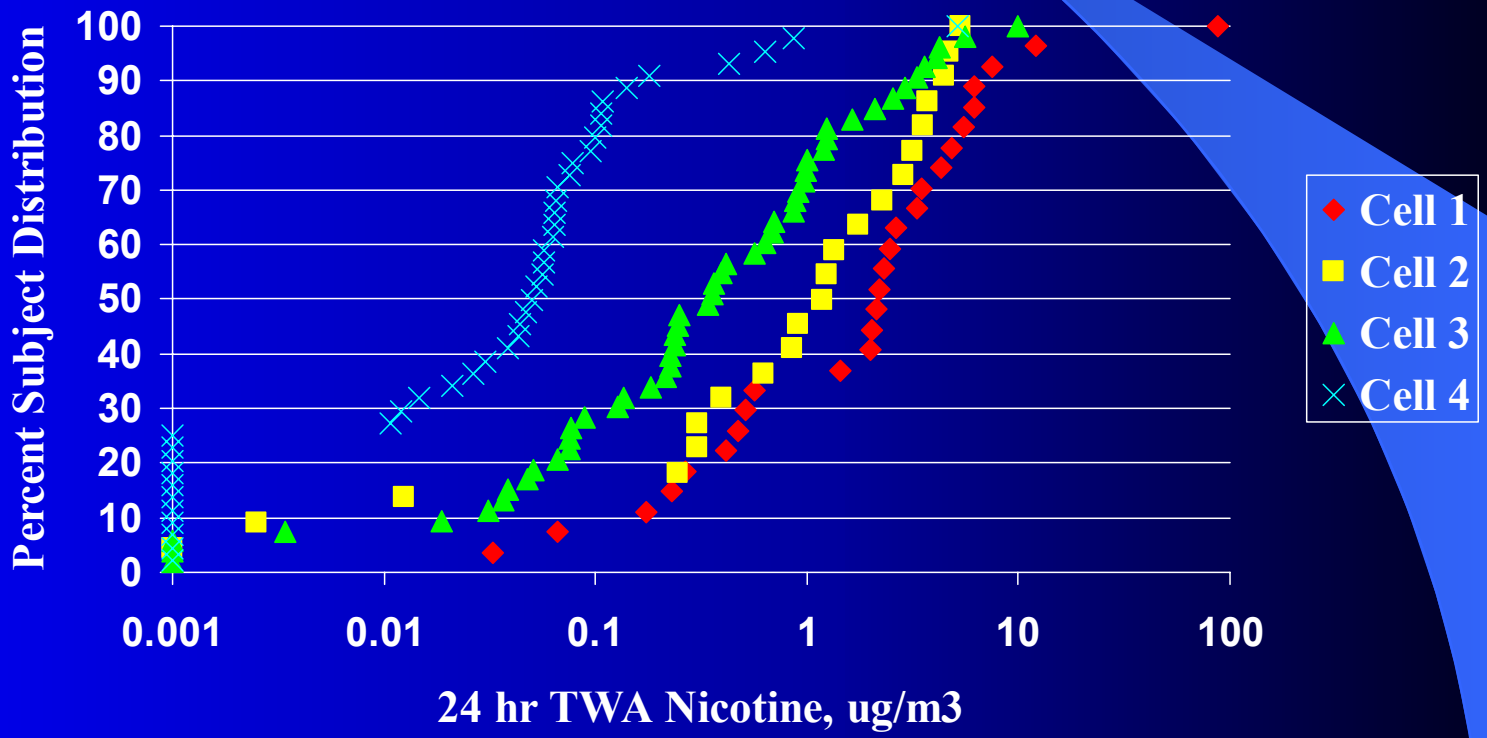
Overall Simple Misclassification Rate: 13/277, or 4.7%

Distribution of 24-hour TWA Nicotine Levels

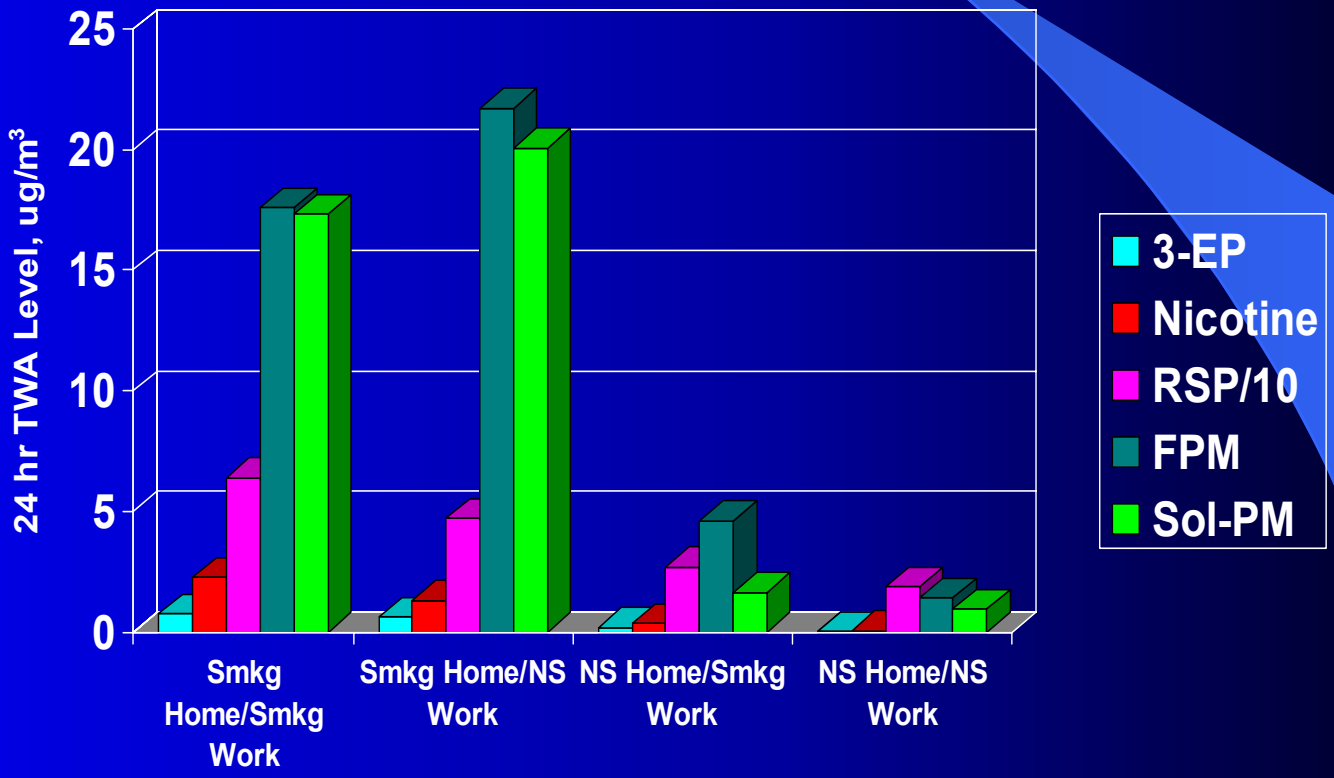
Subject Segregation by Self-Reported Home and Workplace Smoking

Status Confirmed by Diary Observations

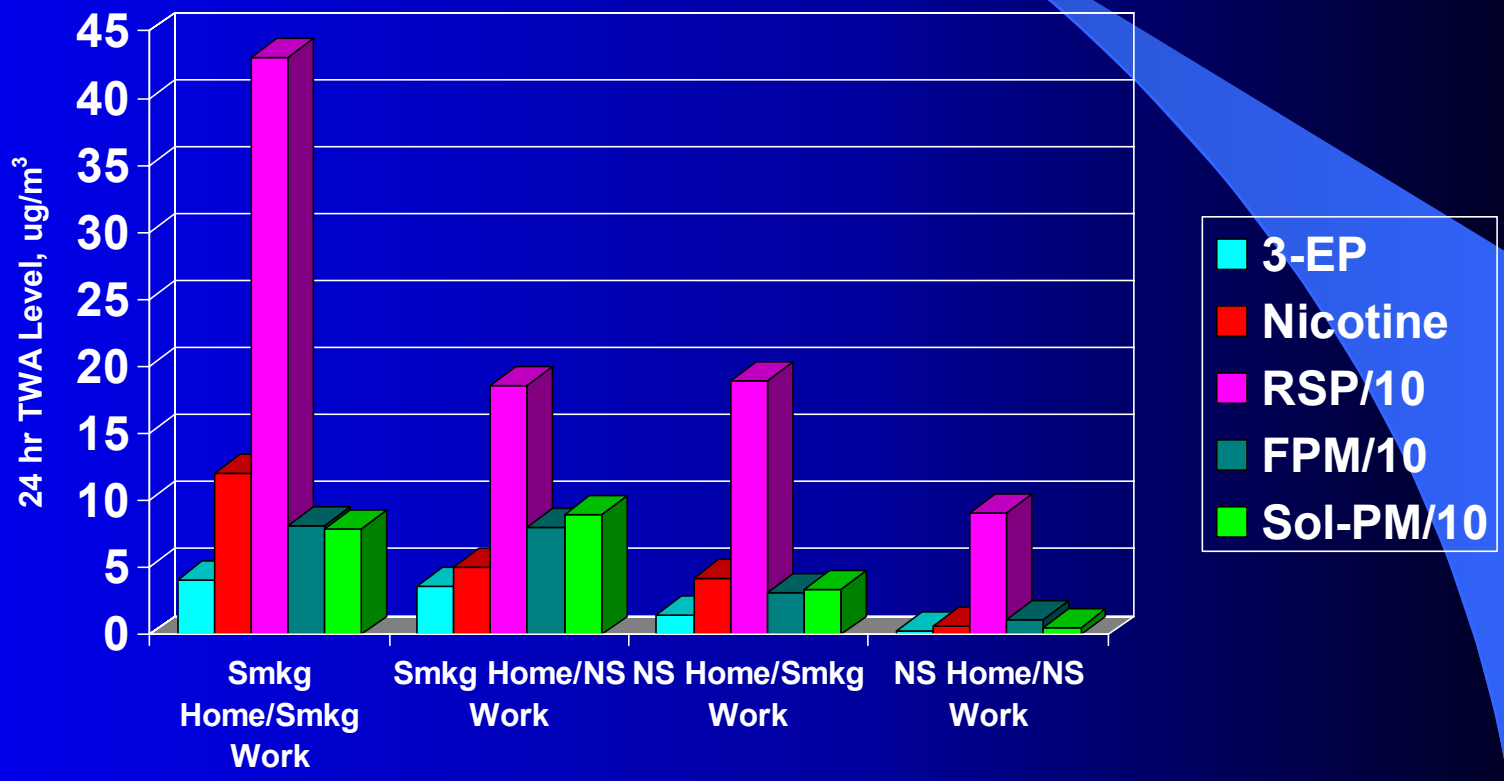
(All Subjects with Avg. Cotinine <15 ng/mL)



Concentrations of Selected ETS Markers: Confirmed Smoking/Non-Smoking Locations Median 24-hr TWA Levels, ug/m^3

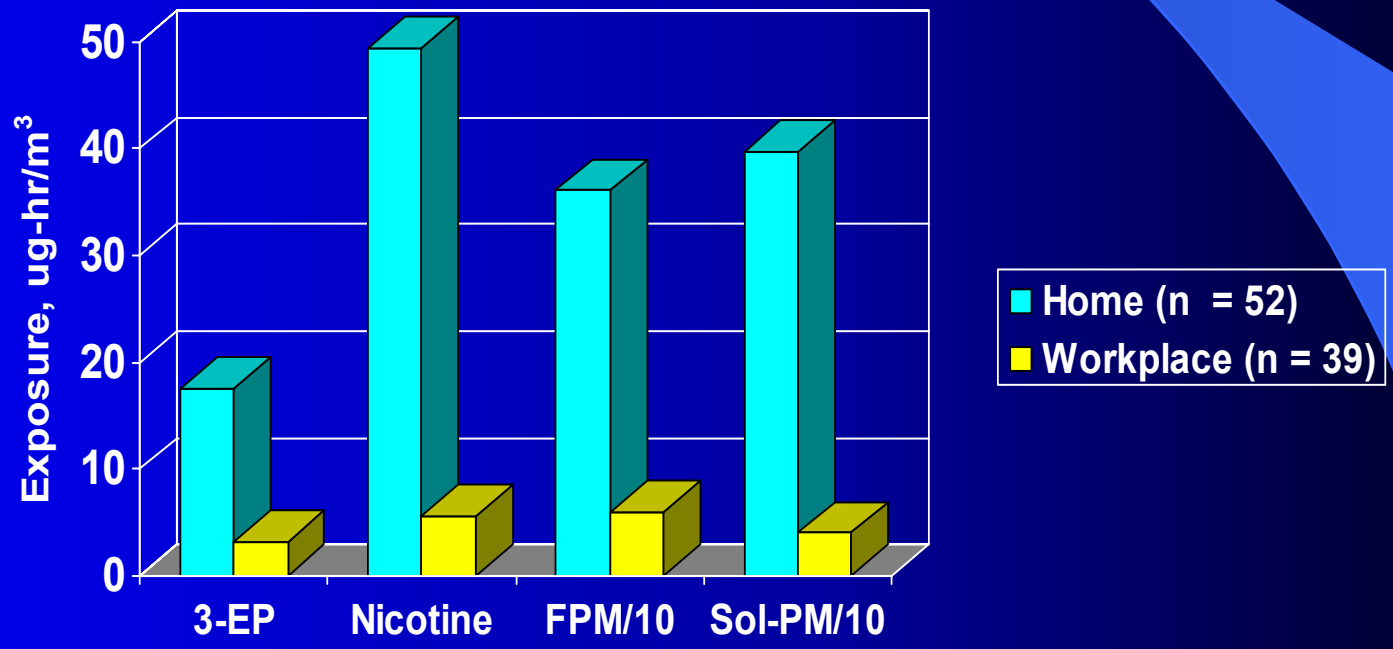


Concentrations of Selected ETS Markers: Confirmed Smoking/Non-Smoking Locations 95th Percentile 24-hr TWA Levels, ug/m^3



Median ETS Exposures* in Environments Where Smoking is Unrestricted

Exposure = Concentration x Time



* *Smoking confirmed by diary reports*

95th Percentile ETS Exposures* in Environments Where Smoking is Unrestricted

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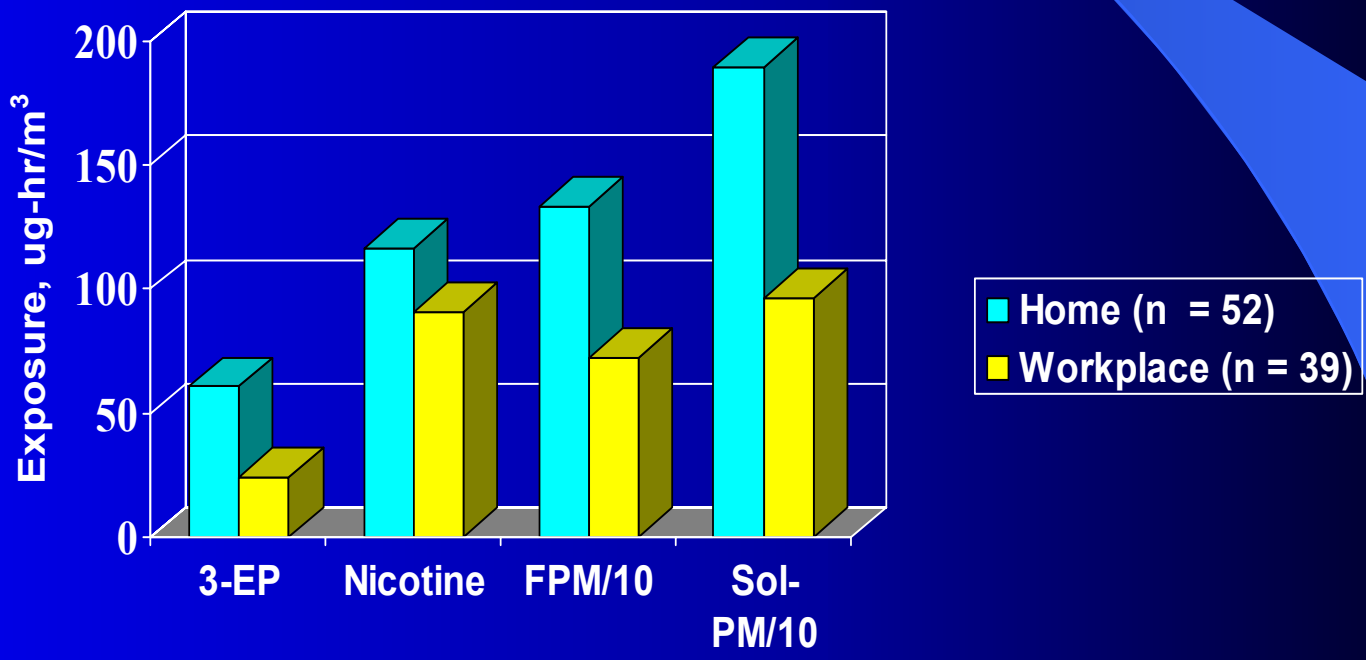
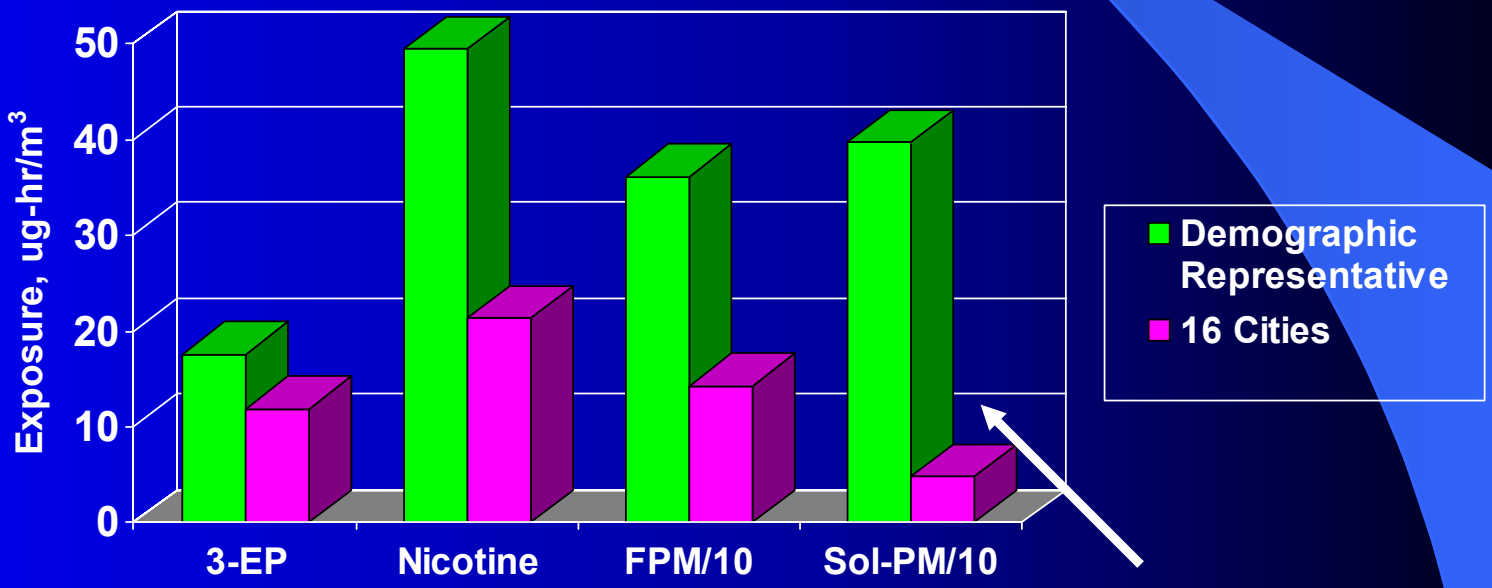


* *Smoking confirmed by diary reports*

Median Away-from-Work ETS Exposures* in Environments Where Smoking is Unrestricted

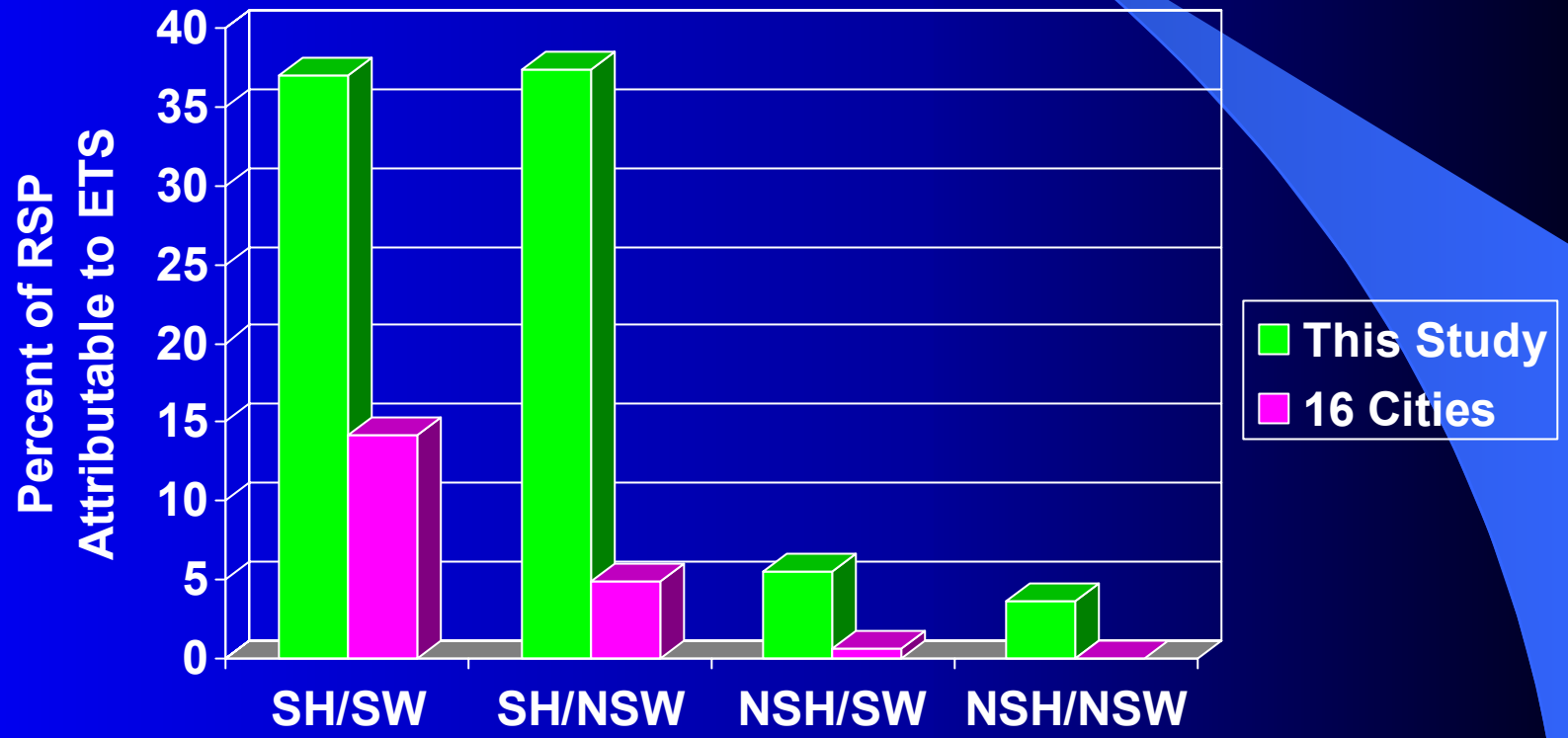
This Study vs. "16 Cities"

Exposure = Concentration x Time



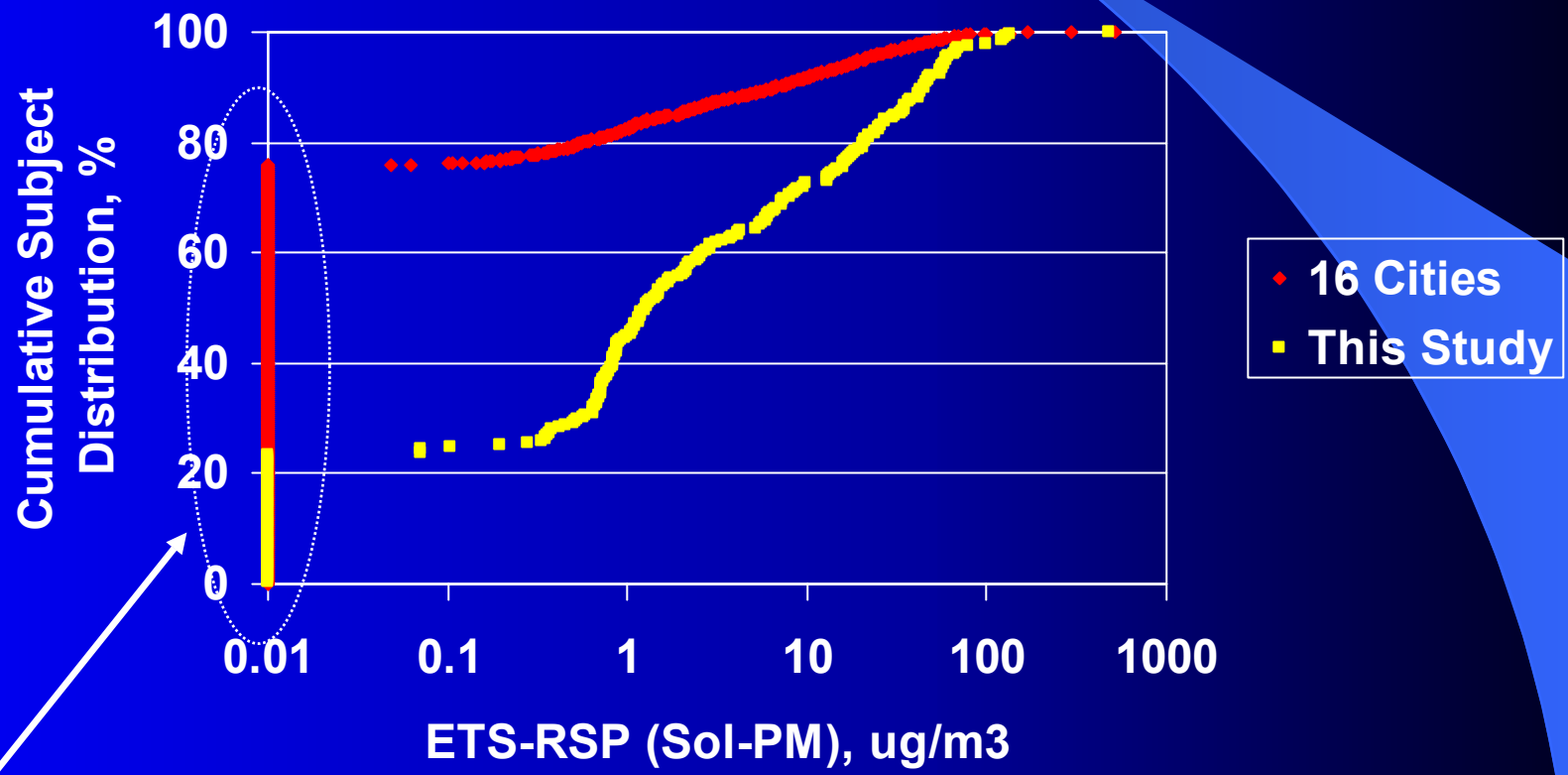
Note large difference in ETS-specific particles

Comparison of Median RSP Fraction Attributable to Environmental Tobacco Smoke
This Study vs "16 Cities"



A Much Larger Fraction of Subject Population Had Discernable Levels of ETS-RSP in This Study

16 hour Away from Work Levels of Sol-PM for Subjects with Average Cotinine < 15 ng/mL



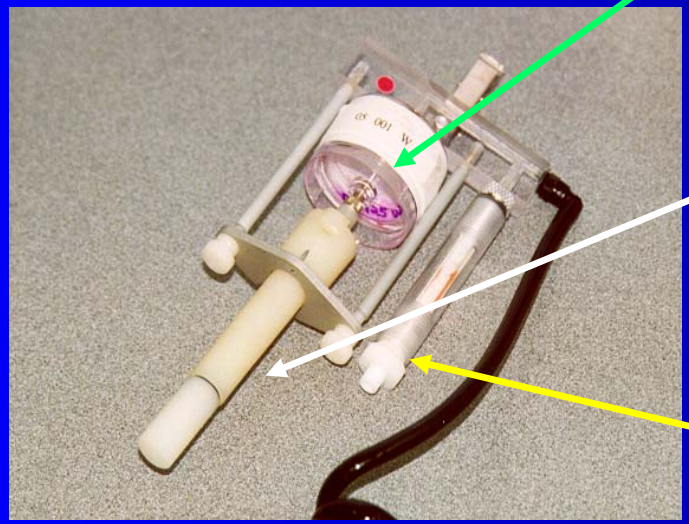
Data points below solanesol LOD

We ***Speculate***: Opaque Filter Holders May Mitigate Post-Collection Degradation of Solanesol

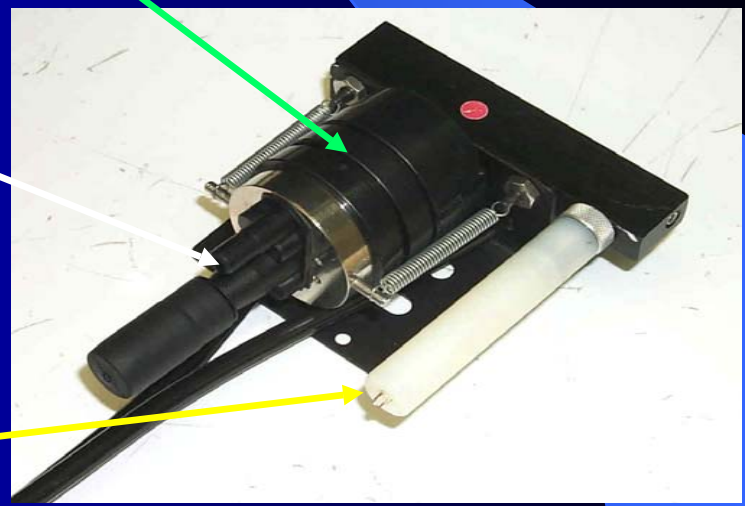
Filter Holder

Cyclone Separator

XAD-4 Vapor Collection Cartridge



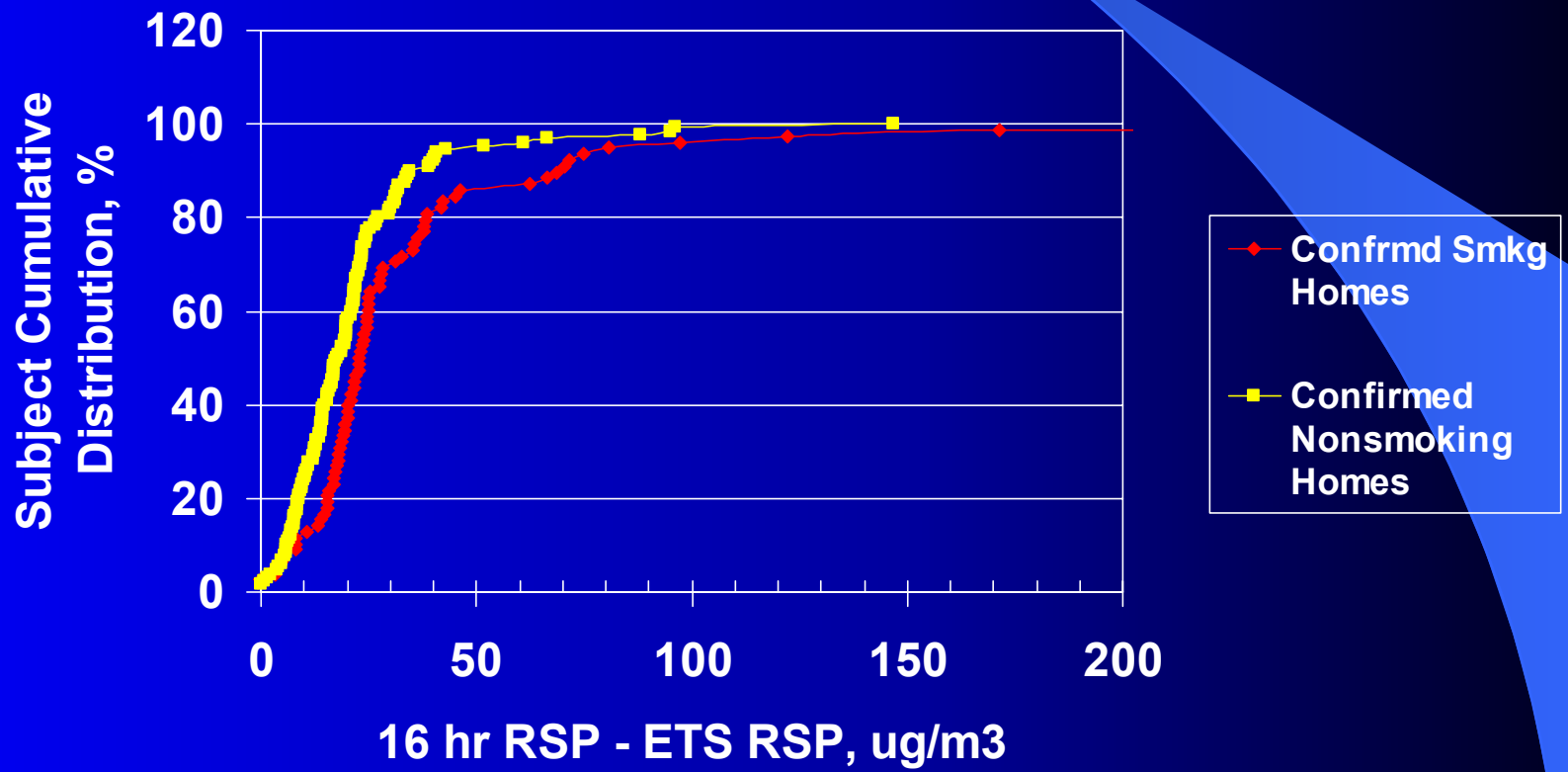
Clear plastic filter holder used in 16 Cities Study



Opaque plastic filter holder used in This Study

16 Hour Personal Concentrations: RSP minus ETS-RSP

Does ETS-RSP Account for all the Differences between Smoking and Non-Smoking Home Environments?



Comparison of Salivary Cotinine Levels and Nicotine Exposure

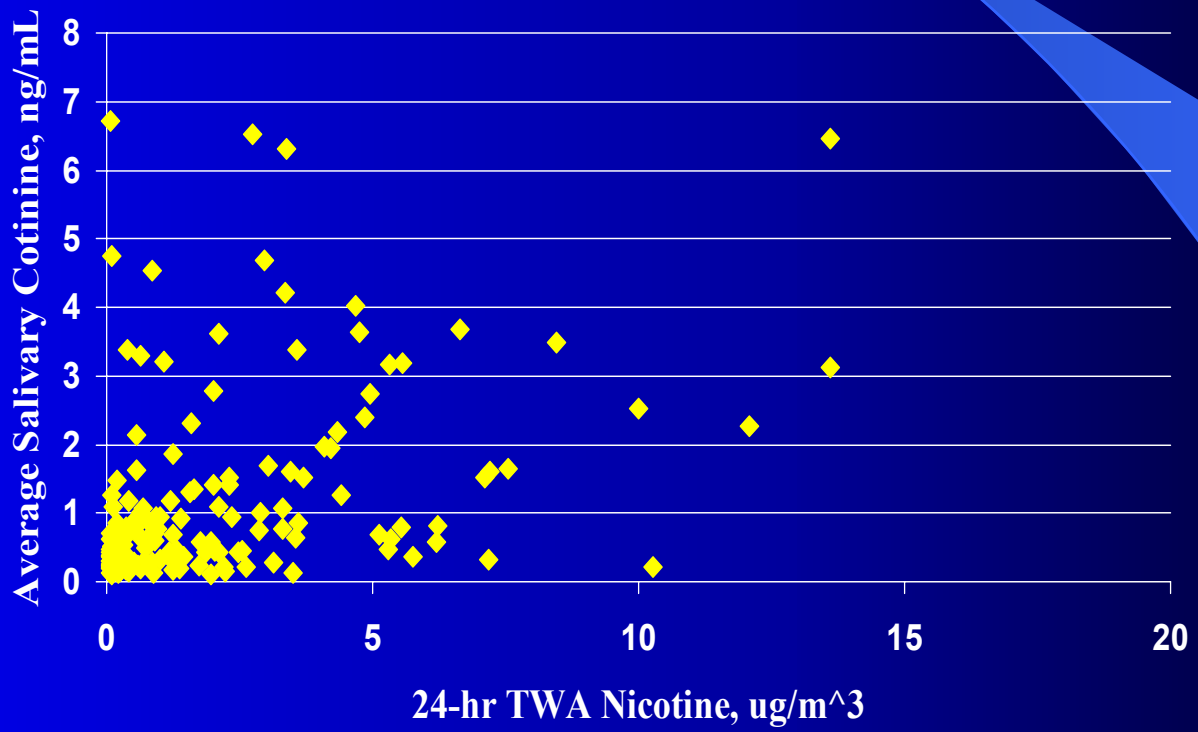
Cell Classification by Screening Questionnaire and Diary Observations

Cell No.	*Away-from-Work Environment*	*Work Environment*	*No. of Participants*	*Median Nicotine, 24-hr TWA, ug/m3*	*Median Cotinine, ng/mL*
1	S	S	27	2.25	0.57
2	S	NS	22	1.30	0.66
3	NS	S	53	0.36	0.58
4	NS	NS	44	0.05	0.23

Average Salivary Cotinine Level as a Function of Nicotine Exposure

All Subjects with Both Markers above LOQ

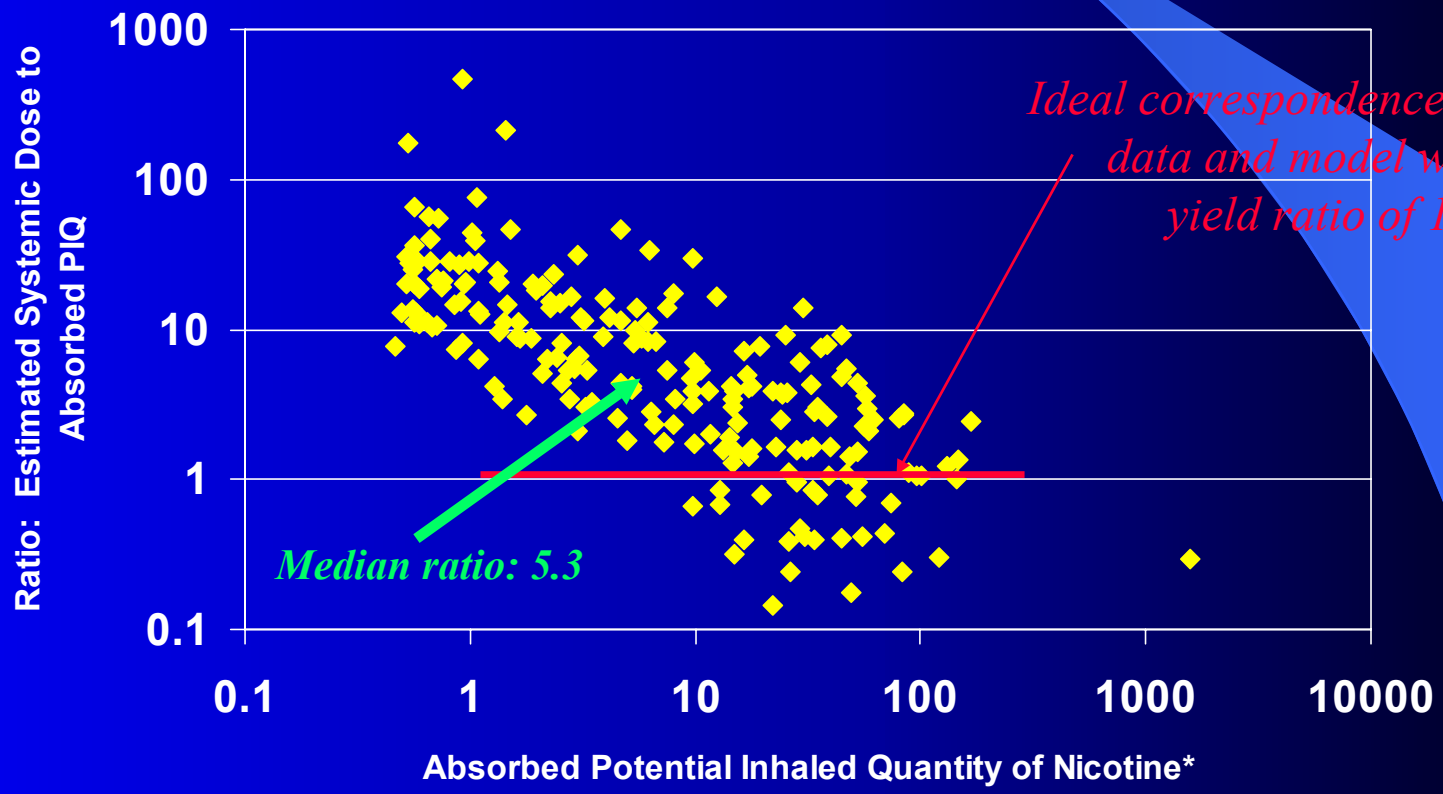
Nicotine: 0.063 ug/m^3; Cotinine: 0.10 ng/mL



$R^2 = 0.17$ with one point removed

Is Benowitz (1996) Model of Estimated Nicotine Exposure Based on Serum or Saliva Cotinine Confirmed by this Data Set?

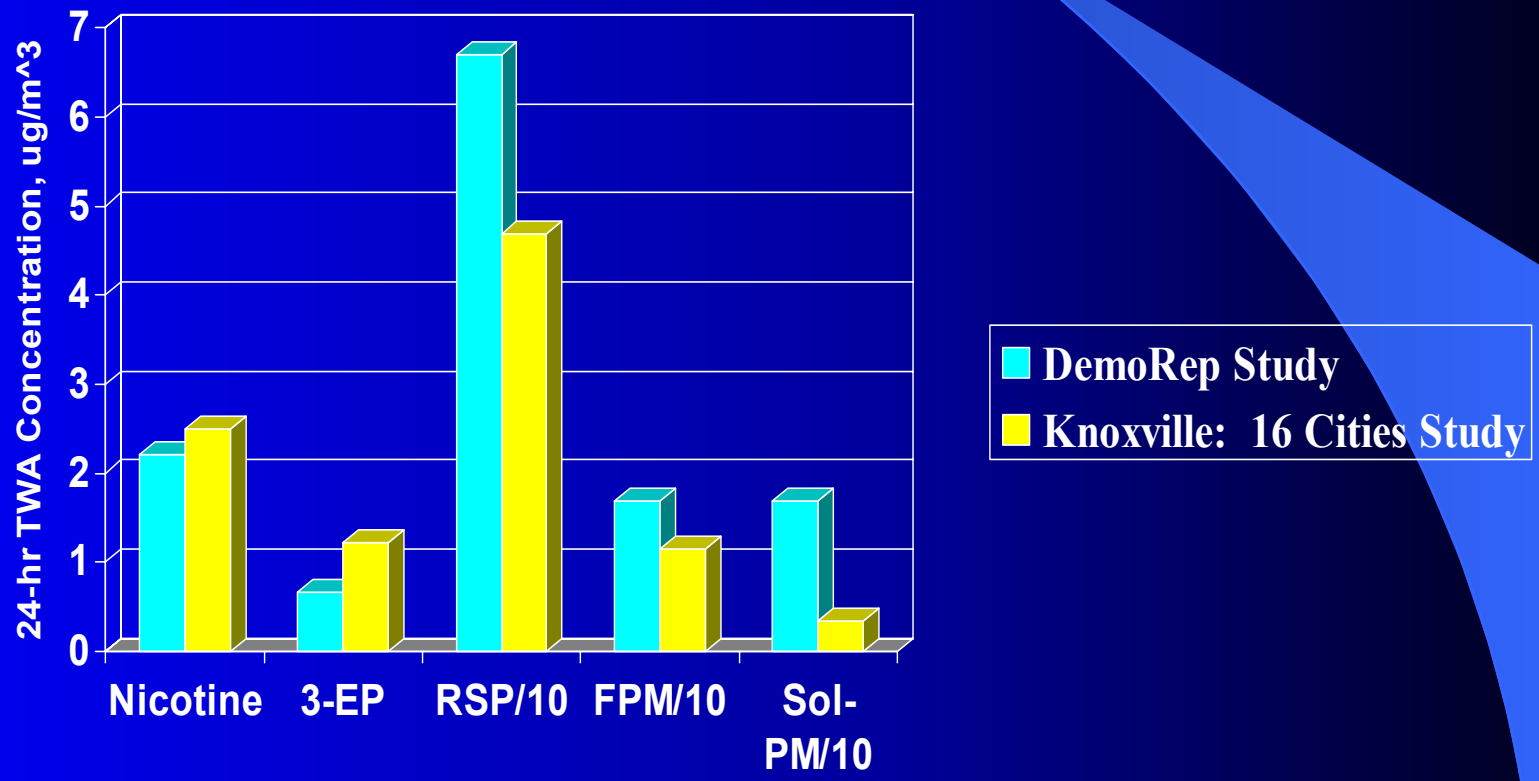
1 ng/mL salivary cotinine equivalent to 64 ug of nicotine intake?



* Absorbed estimated at 71% of inhaled dose.

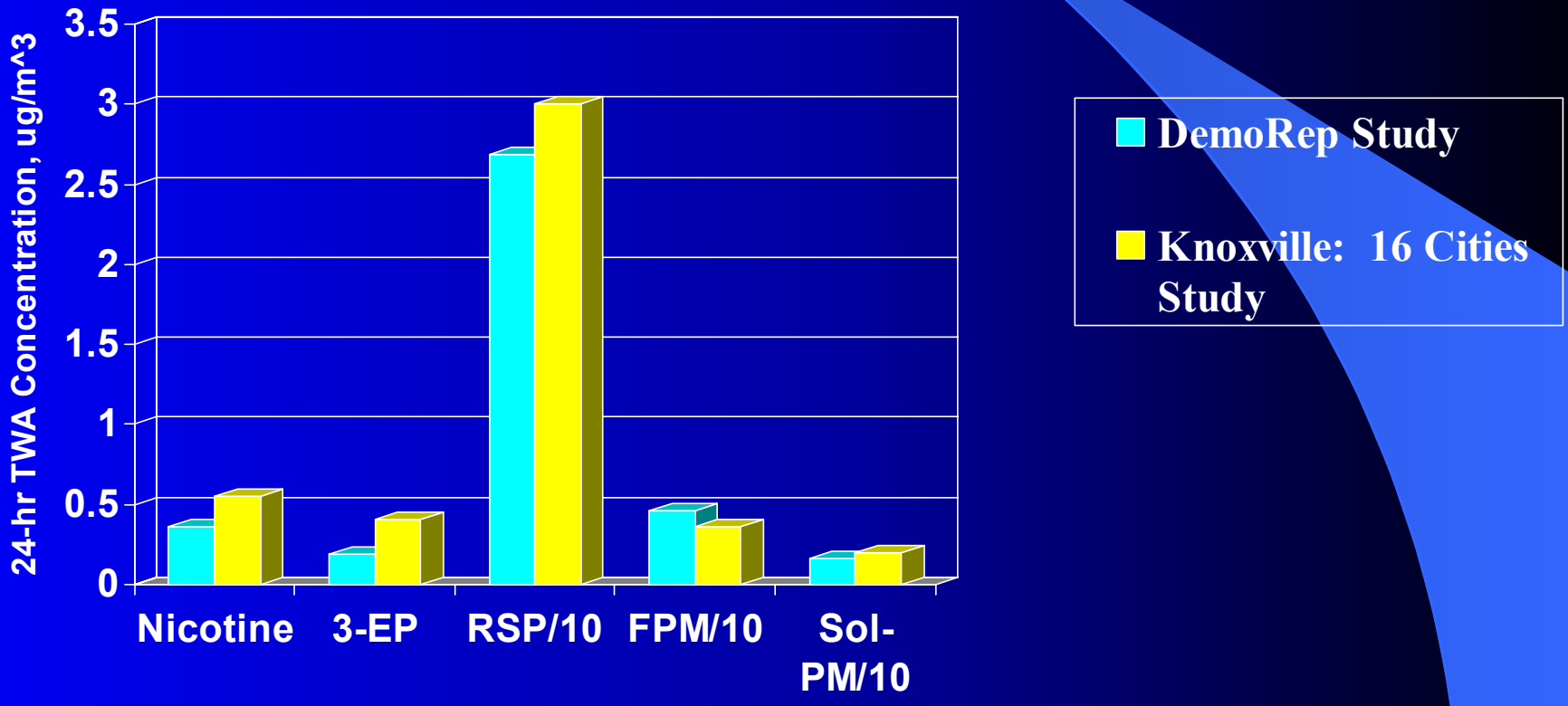
Comparison of Knoxville Data: 16 Cities vs. This Study

Median Cell 1 24-hr TWA Concentrations



Comparison of Knoxville Data: 16 Cities vs. This Study

Cell 3 Median 24-hr TWA Concentrations



Observations and Conclusions

- Recruiting subjects for exposure studies to match population demographics can be challenging, but CAN be done.
- The perception and reality of ETS exposure is frequently incongruent: reporting that one works in a smoking workplace and actually seeing smoking products is two different things.
- There exist general trends of more ETS exposure with increasing time spent around smokers.
- “Away-from-work” (eg. Home) appears even more dominant an exposure venue than in the 16 Cities Study.

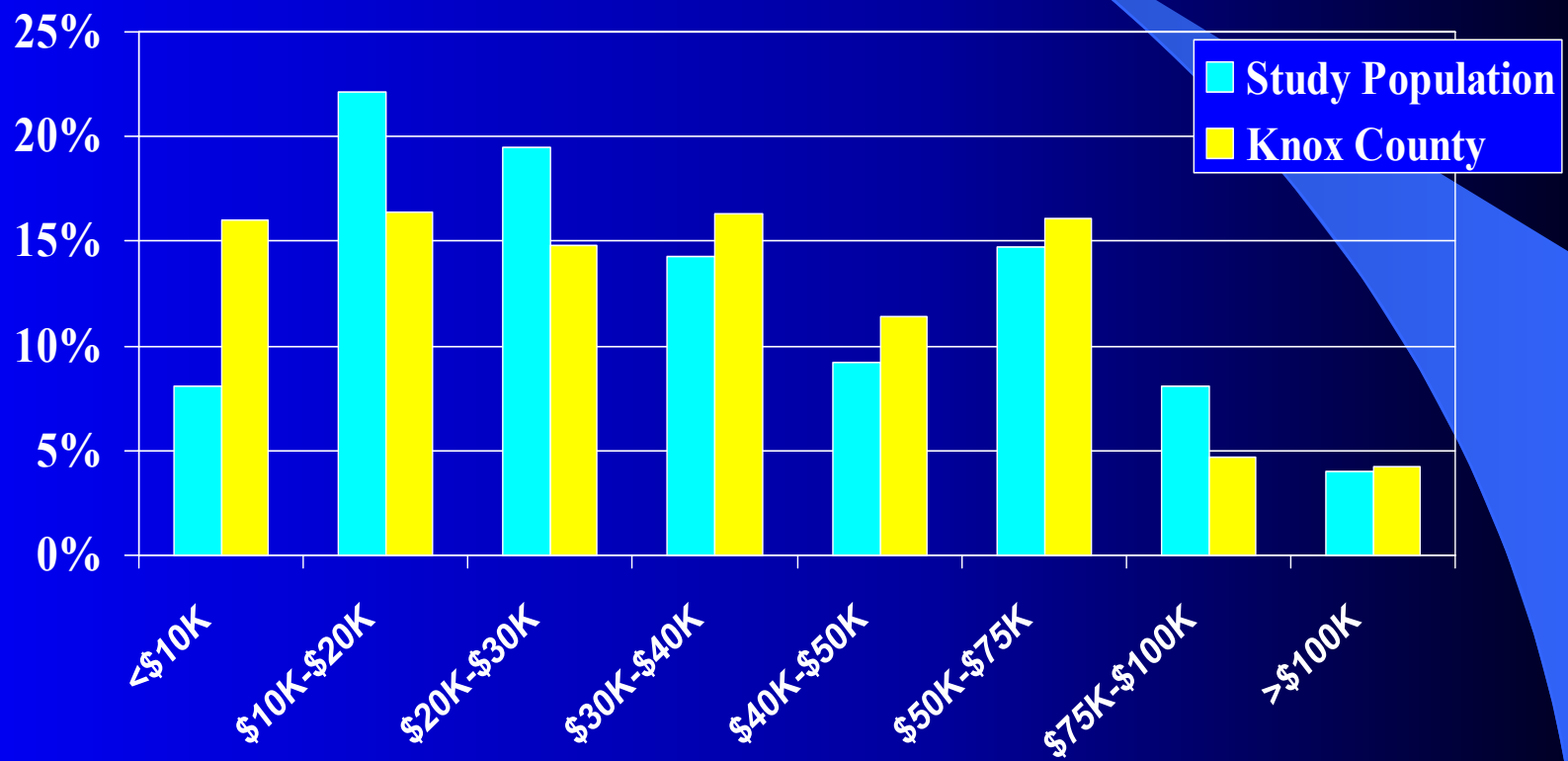
Observations and Conclusions:

continued

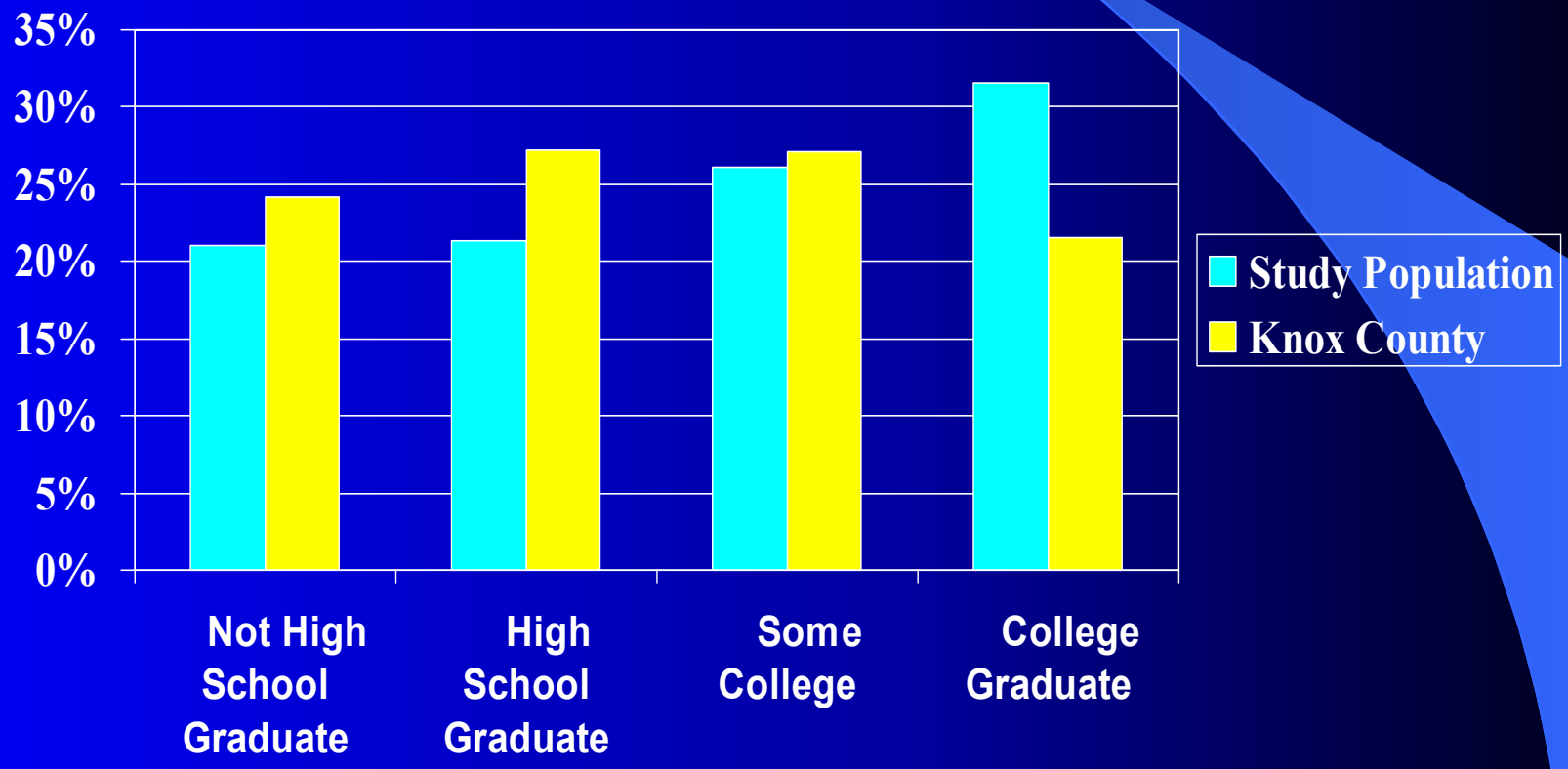
- Estimated misclassification rates for never-smokers appear to be much higher than in 16 Cities Study.
- The fraction of RSP attributable to ETS appears to be substantially greater than that previously observed.
- Group-wise salivary cotinine appears to be less well correlated with nicotine exposure than for 16 Cities Study.
- This data set not supportive of rule of thumb model for exposure extrapolation from cotinine levels.
- Direct comparisons of TWA ETS levels between City #1 (Knoxville) in 16 Cities Study with this study are mixed.

Demographic Data Behind this slide

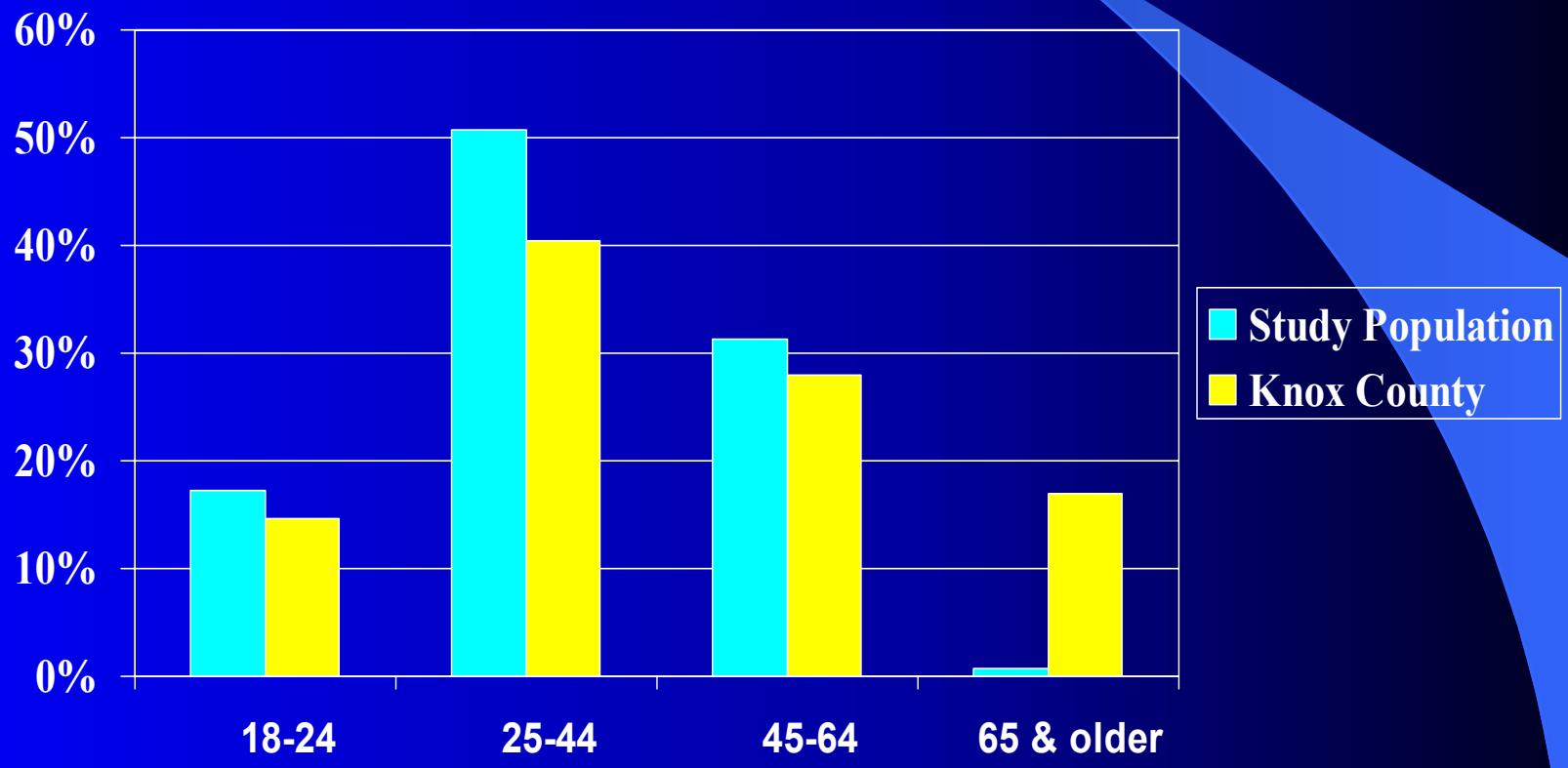
Income Distribution



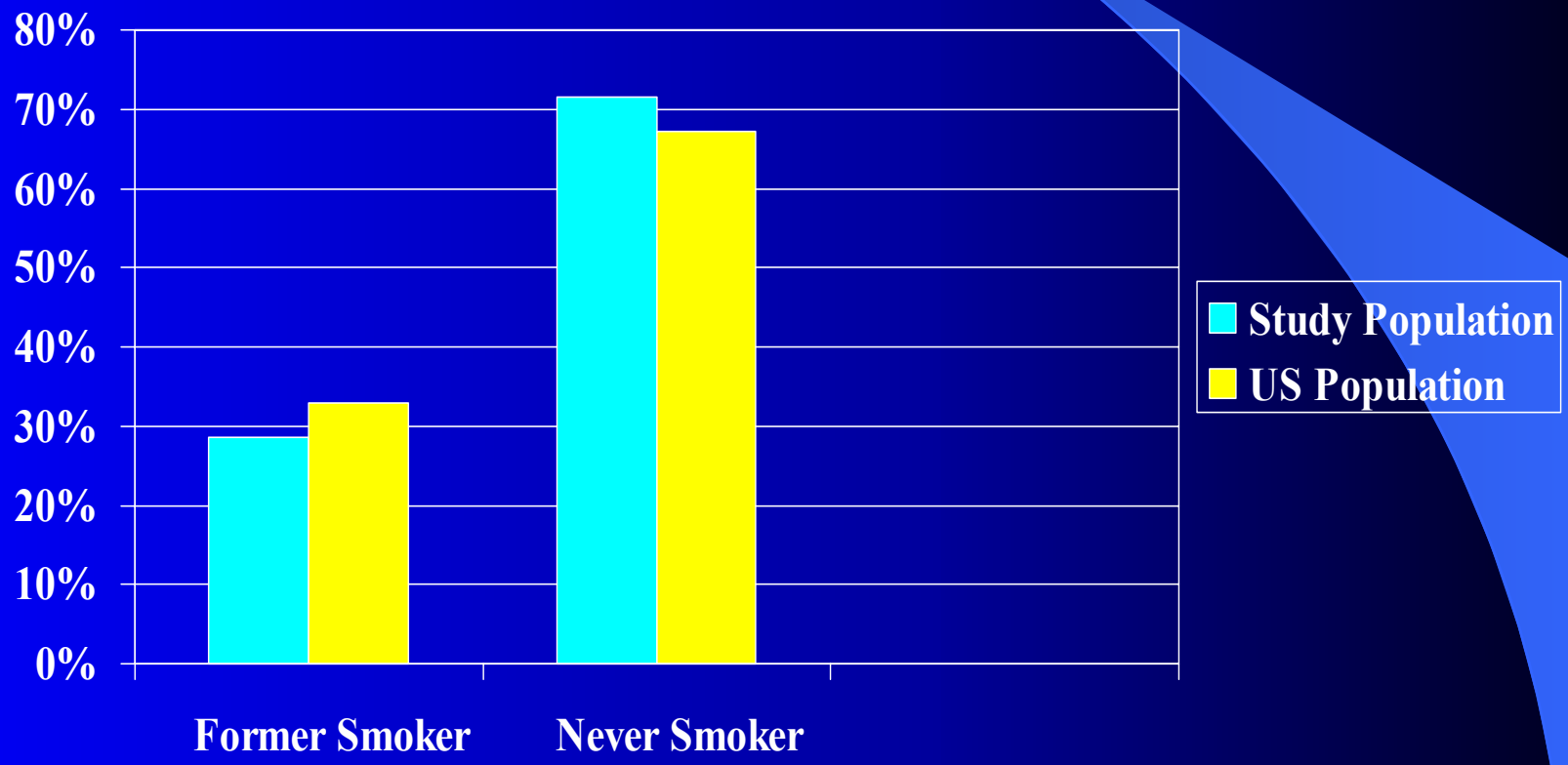
Educational Attainment Distribution



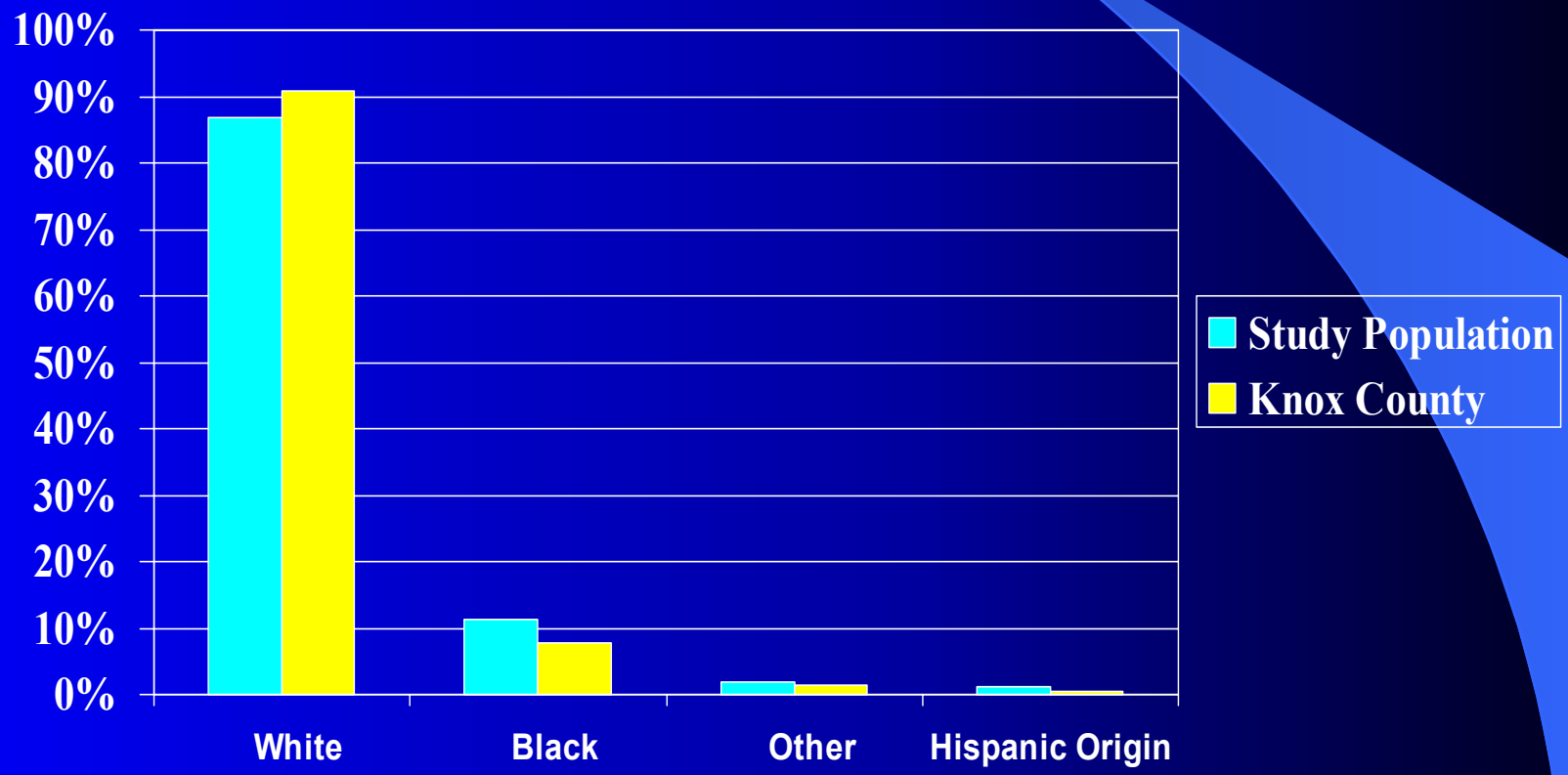
Age Distribution



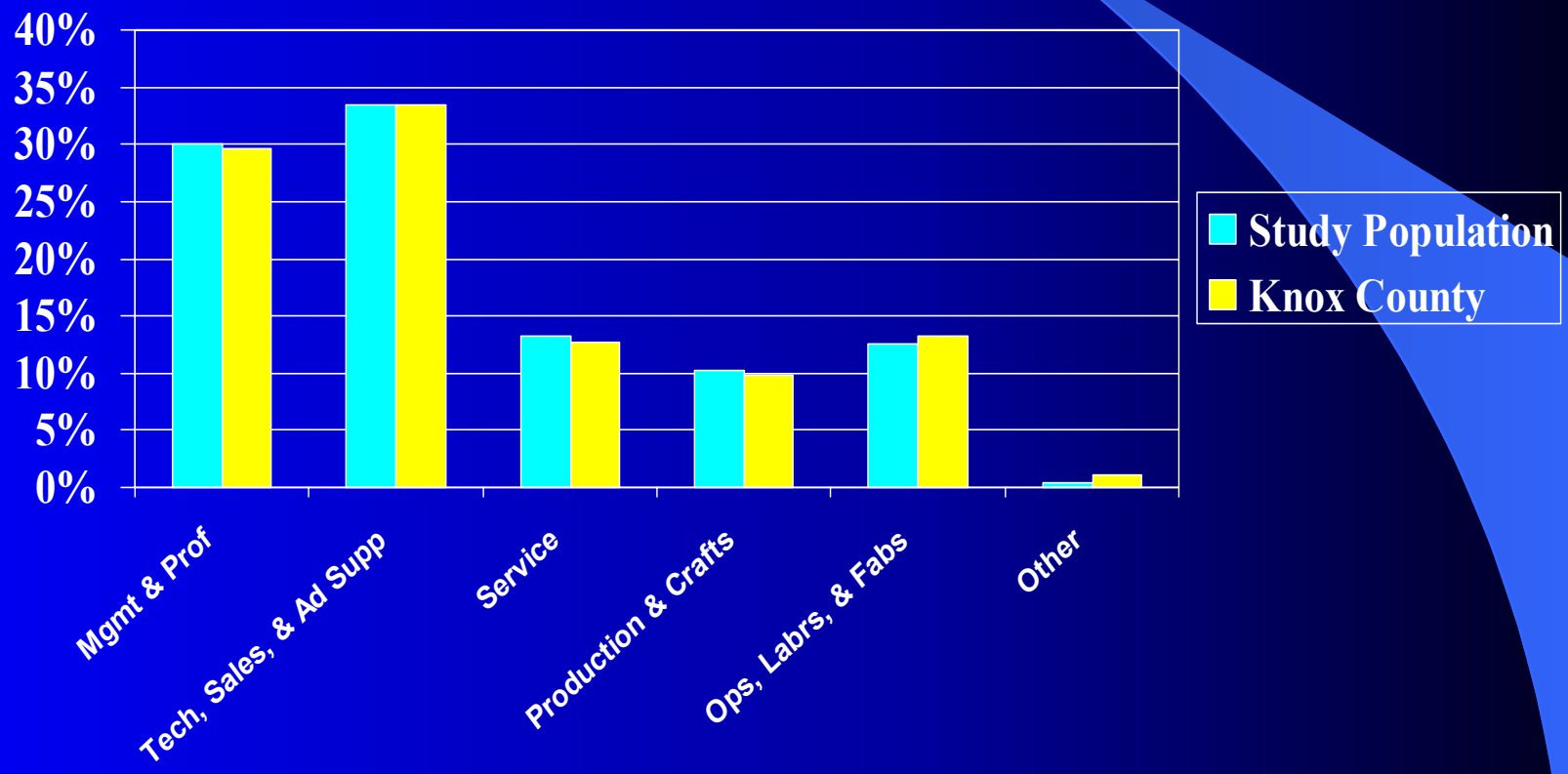
Previous Smoking Status Distribution



Racial Distribution



Occupational Category Distribution



Gender and Urban/Rural Distributions