THE EFFECTS OF PREGNANCY SMOKING IN NORTHEAST TENNESSEE: FINDINGS AND POTENTIAL SOLUTIONS

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OVERVIEW

- Previous studies linking prenatal cigarette exposure to child outcomes
- Regional data on pregnancy smoking
- TIPS – pregnancy smoking intervention program
- TIPS participants: Smoking-related outcomes at birth
- TIPS participants: Smoking-related outcomes at 15 months
WHAT DO WE KNOW?

- Pregnancy smoking leads to poor birth outcomes.
- Biggest impact has been seen on birth weight (250-400gm).
- Prenatal cigarette exposure also predicts preterm delivery, low Apgar scores, and NICU admission.
WHAT DO WE KNOW?

- Pregnancy smoking also affects growth and health into childhood
- Growth effects continue into childhood, even after controlling for postnatal smoke exposure
- By age 7, exposed children with prenatal smoke exposure still have not caught up in stature
WHAT DO WE KNOW?

- Smoking during pregnancy also linked to:
  - SIDS
  - Asthma
  - Allergies
  - Respiratory infections
  - Ear infections

- Effects are evident even without, or controlling for, postnatal smoke exposure
WHAT DO WE KNOW?

◆ Many studies have linked prenatal smoke exposure to developmental problems

◆ Effects seen include cognitive and language delays, and behavioral and emotional problems

◆ Magnitude of effects is as large or larger than effects seen for other prenatal exposures; due to the relative prevalence of cigarette smoking, these effects are much more common
WHAT DO WE KNOW?

- Several studies have noted a decrease in overall IQ of nearly 10 points due to prenatal smoke exposure
- Language delays of a year or more have been noted
- Rates of attention problems, including a 50% increased rate of ADHD diagnosis have been reported in many studies
WHAT DO WE KNOW?

- Children with prenatal cigarette exposure have elevated levels of depression and anxiety disorders.
- Substantially increased rates of conduct problems, including ODD and encounters with juvenile authorities.
- Greatly increased risk for later smoking and substance use, and increased likelihood of addiction.
WHAT DO WE KNOW?

- How does prenatal smoke exposure impact later development?
- Decreased oxygenation; effects of nicotine and other chemicals on the development of neurotransmitters and receptor sites
- We also know that the amount of cigarette exposure and the timing of the exposure are important
WHAT DO WE KNOW?

- Dose response effect identified: More cigarettes per day = worse outcomes
- No real threshold – effects and low levels and problems with accuracy of exposure estimates
- Greatest effects seen at a half a pack/day or more
WHAT DO WE KNOW?

- There is not yet a definitive answer on how the timing of pregnancy smoking impacts outcomes.
- For most exposures, early pregnancy exposure is more harmful than later exposure.
- For cigarette exposure, this does not appear to be the case for all outcomes.
- Effects on growth and health appear to occur mostly with late pregnancy exposure; small scale studies and animals models.
- However, some evidence suggests that early exposure may have more subtle effects; but reports are mixed.
WHAT DO WE KNOW?

- What we know about dose and timing are important for intervention efforts.
- Quitting smoking by 20-27 weeks may lead to significant health benefits.
- Also even cutting down on the number of cigarettes/day can be beneficial.
- Further research is needed.
PRELIMINARY WORK

- Nationally, 12% of pregnant women smoke
- In Tennessee, rate is 17%
- Suspected the rate in NE TN was much higher, but in 2007 no published data; small scale practice-based studies suggested 25% or more
- Undertook a delivery chart review at local hospitals to find out regional rates
## PRELIMINARY WORK

### Local Pregnancy Smoking Rates by Delivery Hospital and Year

<table>
<thead>
<tr>
<th>Hospital</th>
<th>2006</th>
<th>2007</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>JCMC</td>
<td>31.4%</td>
<td>33.0%</td>
<td>↑1.6%</td>
</tr>
<tr>
<td>JCSH</td>
<td>14.5%</td>
<td>17.1%</td>
<td>↑2.6%</td>
</tr>
<tr>
<td>Indian Path</td>
<td>29.7%</td>
<td>37.5%</td>
<td>↑7.8%</td>
</tr>
<tr>
<td>Sycamore Shoals</td>
<td>42.5%</td>
<td>37.6%</td>
<td>↓4.9%</td>
</tr>
</tbody>
</table>
PRELIMINARY WORK

- Is smoking a significant predictor of child outcomes in the region?
- Looked all singleton births at JCMC & JCSH in 2006 & 2007
- Sample contained 4144 women and their newborns, representative of regional demographics
- Data extracted from electronic delivery logs at each facility
**PRELIMINARY WORK**

- 25% of the women self-reported as smokers at delivery
- The rates of low birth weight and preterm deliveries were much higher than national averages

<table>
<thead>
<tr>
<th>Birth Outcome</th>
<th>Non-Smokers</th>
<th>Smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (gm)</td>
<td>3299</td>
<td>2965</td>
</tr>
<tr>
<td>LBW (%)</td>
<td>8.6%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Birth Length (in)</td>
<td>19.8</td>
<td>19.2</td>
</tr>
<tr>
<td>Gestational Age (wks)</td>
<td>38.4</td>
<td>37.7</td>
</tr>
<tr>
<td>PTB (%)</td>
<td>11.1%</td>
<td>18.8%</td>
</tr>
<tr>
<td>NICU Admission (%)</td>
<td>7.5%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

All differences significant at p<.05 after control for background factors

Prenatal Care Provider Survey

Sent survey to all 46 obstetricians in the 6 county area of NE TN

Survey adapted from one used in OH

Asked about pregnancy smoking practices and beliefs, and adherence to ACOG recommendations (5A’s: Ask, Advise, Assess, Assist, Arrange)

Surveys were returned by 30 physicians (65%)
**ASK**
How often do you inquire about smoking status during prenatal visits?

- **27%**

**ADVISE**
How often do you give clear, strong advice to quit to pregnant smokers?

- **63%**

**ASSESS**
How often do you assess whether a pregnant smoker is willing to make a quit attempt?

- **20%**

**ASSIST**
How often do you assist pregnant patients by encouraging the use of problem solving skills for smoking cessation?

- **17%**

**ARRANGE**
How often do you use counseling to help pregnant smokers quit?

- **3%**
Only 50% of the respondents felt there was SIGNIFICANT VALUE in spending time addressing smoking.

Only 40% were VERY CONFIDENT in their ability to recommend behavior change related to smoking.

Only 53% felt that recommending behavior change was likely to be effective.

Only 43% believed that pregnancy smoking could lead to SIGNIFICANT fetal effects.
Reasons for not using the 5 A’s included:
- lack of time
- not believing that efforts would produce behavior change
- belief that it was more important to address other health behaviors including other substance use,
- not knowing where to send patients for additional cessation assistance

Obstetric providers in NE TN fall well short of ACOG recommendations related to pregnancy smoking

This is particularly concerning given the high rates of pregnancy smoking and the known harmful short and long term effects

THE INTERVENTION

- In January of 2007, the Tennessee Governor’s office strengthened efforts to improve birth outcomes in the region and funded the Tennessee Intervention for Pregnant Smokers (TIPS) program for four years; recently refunded through December 2012

- TIPS is a multi-faceted approach that aims to reduce pregnancy smoking rates and improve birth outcomes in the 6 counties of NE TN

www.etsu.edu/tips
THE INTERVENTION

The program involves:

1) **Physician training** in providing smoking cessation counseling as a routine part of prenatal care

2) **Nurse training** in providing smoking cessation counseling as part of inpatient & outpatient services

3) Provision of prenatal counseling and case management services

4) Provision of a **hospital-based counselor/case manager** for admitted high-risk women and those immediately post-partum

5) **Education and training programs** for nursing, public health, respiratory therapy, and medical students

6) Community-based **education and cessation workshops**

7) Development of **self-help materials**

6 FT staff, 2 PT staff; 2 FTE+ in students each term
THE INTERVENTION

All TIPS services are/were available to prenatal patients in NE TN who:

- Are Current smokers
- Are Exposed to significant secondhand smoke
- Are Former smokers ≤ 2 years smoke-free

Trained prenatal care providers offer:

- Brief smoking cessation advice and assistance (5 A’s)
- Referrals to TIPS Case Managers

Case Managers provide:

- Smoking cessation counseling & support
- TIPS self-help materials
- Support for the reduction of life stressors including domestic violence
- Referrals to other needed services
THE INTERVENTION

- Substantial research component – to evaluate project AND permit long term study of effects of prenatal smoke exposure

- Phase I (1st 3.5 years)
  - In depth interviews in 1st and 3rd trimesters: detailed demographics and smoking history, alcohol and substance abuse, depression, IPV, social support, stress, self-esteem, smoking effects knowledge, ADD screen, temperament, religiosity; biochem verification
  - Briefer interviews at 6 wks and 6 mo post-partum; medical chart reviews

- Phase I (Years 3.5 on)
  - Briefer interviews 4 times during pregnancy; 6 wk, 6 mo PP; medical chart reviews

- All singleton children eligible for developmental assessment at 15 months: health and environment, cognitive, language, behavioral, motor, assessments; maternal assessment of verbal IQ and psychosocial factors including parenting
THE INTERVENTION

- **Phase I (1\textsuperscript{st} 3.5 years)**
  - Over 1200 women received case manager services; 5000+ received care from trained providers
  - 405 TIPS-eligible women (plus 176 non-smoker controls) participated in the research
  - Of the 581 research participants, maintained over 400 to 6 mo PP

- **Phase II**
  - Over 1000 received case manager services
  - 482 participated in the research
  - Developmental assessment: 200+ tested to date; finding about 70%, of those over 90% are participating
A recent meta-analysis of pregnancy smoking cessation interventions revealed a 15.1% quit rate by delivery for interventions comparable to or more intense than the TIPS equivalent of 4 or more Case Manager sessions (Lumley et al., 2008).
INTERVENTION SUCCESS

- Pregnancy smoking rates by delivery dropped 21% across all practices with case management services.

- Working with a case manager over multiple sessions was most effective for smoking cessation, quit attempts, and reduction.

- Also important to success were the provision of:
  - stress management assistance
  - mental health referrals
  - family smoking cessation efforts
# INTERVENTION SUCCESS

## Birth Outcomes by Quit Status

<table>
<thead>
<tr>
<th>Birth Variables</th>
<th>Quit Smoking (n=307)</th>
<th>Kept Smoking (n=801)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low birth weight (%)</td>
<td>11.0%</td>
<td>17.3%</td>
<td>.009</td>
</tr>
<tr>
<td>Preterm birth (%)</td>
<td>14.5%</td>
<td>16.0%</td>
<td>.075</td>
</tr>
</tbody>
</table>
Over 280 health care professionals, and over 1,000 health professions students have received TIPS training. These professionals have since provided prenatal care to over 10,000 women. Quit rate of 10% for pregnant women who received smoking cessation counseling from OBs trained by TIPS (up to 2yrs after). Re-surveyed all OBs 5 years later: (65% response rate) - Significant increase in knowledge of pregnancy smoking dangers - No substantial change in screening and intervention behaviors. Nursing student training (800+): - Increase in knowledge, skill, and comfort 4 months later - Almost half still not confident in skills to independently intervene.
Since the beginning of the TIPS project in mid-2007, pregnancy smoking rates in the region have decreased 23%, compared to a statewide decrease of only 2.1% during that time.

Also during that time, preterm birth rates have dropped 24.6%, and low birth weight rates have dropped 19.4%. Statewide, rates on low birth weight births have only dropped only 4.2%.
INTERVENTION SUCCESS

So, for a $2 million investment, the TIPS program has led to a region-wide $9.5 million reduction in newborn hospital costs, untold additional savings in long-term health and educational expenses, and significantly improved quality of life for women and children in Northeast Tennessee.
What is the impact of pregnancy smoking relative to the use of other substances?

Intervention resources have necessarily been devoted to helping substance using pregnant women, BUT the vast majority of pregnant women who successfully quit using illicit drugs continue to smoke.

Health providers often fail to adequately address smoking during pregnancy with these women.
Recent population-based study found that elimination of smoking would have a much greater impact on decreasing poor birth outcomes than elimination of any other substance.

However, few studies have quantified the relative impact on birth outcomes of different prenatal exposures.

Such information in the regional population is essential.
Looked at the data from TIPS research participants

Restricted the sample to infants who had biological testing for substances at delivery (meconium)

Final sample contained 265 infants:
- No cigarette/no drug use (n=46)
- Cigarette use only (n=75)
- Illicit drug use only (n=21)
- Cigarette & illicit drug use (n=123)

Drugs examined included amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, and opioids
# BIRTH OUTCOMES

## Substance Use Group Differences on Primary Birth Outcomes

<table>
<thead>
<tr>
<th>Substance Use Group</th>
<th>Birth Weight (gm)</th>
<th>Gestational Age (wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cig/No Drug</td>
<td>3232</td>
<td>38.9</td>
</tr>
<tr>
<td>Cigarette Only</td>
<td>3068</td>
<td>38.7</td>
</tr>
<tr>
<td>Illicit Drug Only</td>
<td>3054</td>
<td>38.1</td>
</tr>
<tr>
<td>Cig AND Drug</td>
<td>2954</td>
<td>38.5</td>
</tr>
<tr>
<td>F, p</td>
<td>3.70, p=0.012</td>
<td>0.89, p=0.447</td>
</tr>
</tbody>
</table>

Effect for birth weight controlled for significant confounders (education, preeclampsia, race): F=4.55, p=0.004
Effect of Illicit Drug Use on Birth Weight

Adjusted Birth Weights for the 198 Smokers:

- Smoked Only (n=75) 3065 gm
- Smoked AND Used Marijuana (n=39) 3068 gm
- Smoked AND Hard Illicit Drug Use (n=84) 2902 gm
- Test for group difference: F=3.39, p=.036
- Adjusted Birth Weight Difference = 163 gm

Interpretation: Compared with those who both smoked and used hard illicit drugs, those who smoked but DID NOT USE HARD ILLICIT DRUGS had a 163gm gain in adjusted birth weight – a 5.6% difference.
BIRTH OUTCOMES

Effect of Smoking on Birth Weight

Adjusted Birth Weights for the 105 Hard Illicit Drug Users:

- Hard Drug Use Only (n=21) 3207 gm
- Hard Drug Use AND Smoked (n=84) 2890 gm
- Test for group difference: F=6.28, p=.014
- Adjusted Birth Weight Difference = 317gm
- Interpretation: Compared with those who both smoked and used hard illicit drugs, those who used hard illicit drugs BUT DID NOT SMOKE had a 317 gm gain in adjusted birth weight – an 11.0% difference.
BIRTH OUTCOMES

Effect of BOTH Smoking AND Hard Illicit Drug Use on Birth Weight

Adjusted Birth Weights:

- No smoking/No Drug Use (n=46) 3248 gm
- Smoked AND Hard Drug Use (n=84) 2896 gm

Test for group difference: F=17.42, p<.001

Adjusted Birth Weight Difference = 352gm

Interpretation: Compared with those who both smoked and used hard illicit drugs, those who USED NEITHER SUBSTANCE had a 352 gm gain in adjusted birth weight – a 12.2% difference.
BIRTH OUTCOMES

- Pregnancy marijuana use did not adversely impact birth weight BEYOND the effects of cigarette smoking.
- So, for pregnant women who both smoke and use marijuana, quitting marijuana use while continuing to smoke will not lead to improved birth outcomes.
Pregnancy smoking had twice the impact on birth weight as illicit drug use.

So, pregnancy smoking may be at least as detrimental to the developing fetus as the use of many illicit drugs.

Need to direct more attention to increasing pregnancy smoking cessation efforts.

Pregnant women should be strongly advised of the risks of continued smoking, and should be assisted in their efforts to eliminate the use of ALL substances, including tobacco.

Project participants are invited to participate in our developmental follow-up study when the children are 15 months of age.

Assessment takes about 2.5 hours, in addition to the questionnaires the mothers are asked to complete prior to the appointment.

Child lab assessments include:
- Battelle
- REEL-3
- Test of Sensory Function

Parent report of child development:
- Infant Toddler Sensory Profile
- CSBS DP Infant-Toddler Checklist
- Toddler Behavior Assessment Questionnaire
DEVELOPMENTAL TESTING

- Approximately 70% of eligible participants have been located at 15 months; over 90% have participated
- To date, have tested over 200 children
- Data from first 142 on select outcomes presented here (85 smoking at conception)
- Findings preliminary until all 250+ are tested and data finalized
## BACKGROUND DIFFERENCES

<table>
<thead>
<tr>
<th>Background Factor</th>
<th>Quit Smoking (n=35)</th>
<th>Kept Smoking (n=50)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age</td>
<td>23.1</td>
<td>23.8</td>
<td>NS</td>
</tr>
<tr>
<td>Maternal education</td>
<td>12.6</td>
<td>11.8</td>
<td>.019</td>
</tr>
<tr>
<td>Maternal marital status (% married)</td>
<td>40%</td>
<td>28%</td>
<td>.089</td>
</tr>
<tr>
<td>Parity</td>
<td>1.8</td>
<td>1.9</td>
<td>NS</td>
</tr>
<tr>
<td>Prenatal alcohol exposure</td>
<td>26%</td>
<td>22%</td>
<td>NS</td>
</tr>
<tr>
<td>Prenatal marijuana exposure</td>
<td>26%</td>
<td>44%</td>
<td>.067</td>
</tr>
<tr>
<td>Prenatal hard illicit drug exposure</td>
<td>10%</td>
<td>12%</td>
<td>NS</td>
</tr>
<tr>
<td>Postnatal smoke exposure</td>
<td>23%</td>
<td>52%</td>
<td>.006</td>
</tr>
<tr>
<td>Maternal IQ</td>
<td>96.3</td>
<td>94.5</td>
<td>NS</td>
</tr>
</tbody>
</table>
## GROWTH & HEALTH DIFFERENCES

<table>
<thead>
<tr>
<th>Birth Variables</th>
<th>Quit Smoking (n=35)</th>
<th>Kept Smoking (n=50)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (gm)</td>
<td>3334</td>
<td>3071</td>
<td>.045</td>
</tr>
<tr>
<td>Low birth weight (%)</td>
<td>5.7%</td>
<td>12.2%</td>
<td>.096</td>
</tr>
<tr>
<td>Preterm birth (%)</td>
<td>5.7%</td>
<td>10.2%</td>
<td>NS</td>
</tr>
<tr>
<td>NICU admission (%)</td>
<td>6.1%</td>
<td>11.4%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: Means and percentages adjusted for maternal education and marital status, and for prenatal marijuana exposure
### GROWTH & HEALTH DIFFERENCES

<table>
<thead>
<tr>
<th>15 Month Variables</th>
<th>Quit Smoking</th>
<th>Kept Smoking</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=35)</td>
<td>(n=50)</td>
<td></td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>23.9</td>
<td>22.1</td>
<td>.076</td>
</tr>
<tr>
<td>Height (in)</td>
<td>30.6</td>
<td>28.9</td>
<td>.049</td>
</tr>
<tr>
<td>Hospitalization (% 1x+ since birth)</td>
<td>12.0%</td>
<td>25.7%</td>
<td>.009</td>
</tr>
<tr>
<td>Sick child visits (% 4x+ since birth)</td>
<td>20.0%</td>
<td>37.1%</td>
<td>.040</td>
</tr>
<tr>
<td>Respiratory infection (% 1+)</td>
<td>24.0%</td>
<td>48.6%</td>
<td>.017</td>
</tr>
<tr>
<td>Ear infection (% 1+)</td>
<td>51.4%</td>
<td>54.0%</td>
<td>NS</td>
</tr>
<tr>
<td>Diagnosed with allergies (%)</td>
<td>12.0%</td>
<td>22.9%</td>
<td>.091</td>
</tr>
<tr>
<td>Diagnosed with asthma (%)</td>
<td>11.4%</td>
<td>16.0%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: Means and percentages adjusted for maternal education and marital status, and for prenatal marijuana exposure, and postnatal smoke exposure.
### DEVELOPMENTAL OUTCOME DIFFERENCES

<table>
<thead>
<tr>
<th>15 Month Outcomes</th>
<th>Quit Smoking (n=35)</th>
<th>Kept Smoking (n=50)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Motor (%ile)</td>
<td>53.1</td>
<td>47.1</td>
<td>NS</td>
</tr>
<tr>
<td>Fine Motor (%ile)</td>
<td>63.0</td>
<td>55.3</td>
<td>.086</td>
</tr>
<tr>
<td>Receptive Language (%ile)</td>
<td>56.4</td>
<td>50.5</td>
<td>.079</td>
</tr>
<tr>
<td>Expressive Language (%ile)</td>
<td>51.4</td>
<td>44.8</td>
<td>.054</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>103.8</td>
<td>94.0</td>
<td>.032</td>
</tr>
<tr>
<td>Attention and Memory (%ile)</td>
<td>54.7</td>
<td>42.1</td>
<td>.025</td>
</tr>
<tr>
<td>Social-Adult Interaction (%ile)</td>
<td>78.3</td>
<td>71.9</td>
<td>.070</td>
</tr>
<tr>
<td>Social-Communication (%ile)*</td>
<td>48.2</td>
<td>34.9</td>
<td>.034</td>
</tr>
</tbody>
</table>

**Note:** Means and percentages adjusted for maternal education and marital status, and for prenatal marijuana exposure, and postnatal smoke exposure

* - All assessments were laboratory assessments with the exception of Social-Communication which was from the parent-report CSBS
CONCLUSIONS

- Smoking during pregnancy is highly prevalent in NE TN and contributes to poor birth outcomes
- WHEN evidence-based efforts are made, pregnancy smoking interventions can be highly effective at reducing smoking rates and improving outcomes
- Quitting smoking (and even cutting down) by the third trimester can lead to an improvement in birth outcomes, and better developmental outcomes at 15 months
- Prenatal cigarette exposure is just as harmful as exposure to alcohol, illicit drugs, and misuse of prescription drugs
ACKNOWLEDGEMENTS

- TIPS Project staff including Lana McGrady, MS, Jessica Scott, MA, Erin Chambers, MBA, Lee Cutshaw, BS, Laurie Webb, LMSW
- All of the TIPS participants and their children
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- Reference list available on request
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