Evidence for Health Effects From Work in Hog Confinement Barns and Living Near a Hog Farm

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The Fundamental Questions

Hog-farm neighbors complain of various health problems that they attribute to this environmental exposure.

If the health of neighbors is affected then people who work on the farms should have more severe symptoms of the same type because the workers get similar, but much heavier exposures. Also, there should be objective measures of illness present in the neighbors.

Does this occur?

How does living near hog farms affect quality of life?

The Issue of Hog Confinement is Highly Political

- Emotional factors often play a large role in how the information is presented by scientists and others.

Concentrated Animal Feeding Operations (CAFOs)

- Includes hog confinement facilities
  - The Environmental Protection Agency says that a CAFO is an animal feeding operation that contains more than 1,000 animal units
    - Examples: 1000 feeder cattle, 2500 mature pigs, 100,000 laying hens

CAFO – Hog Confinement

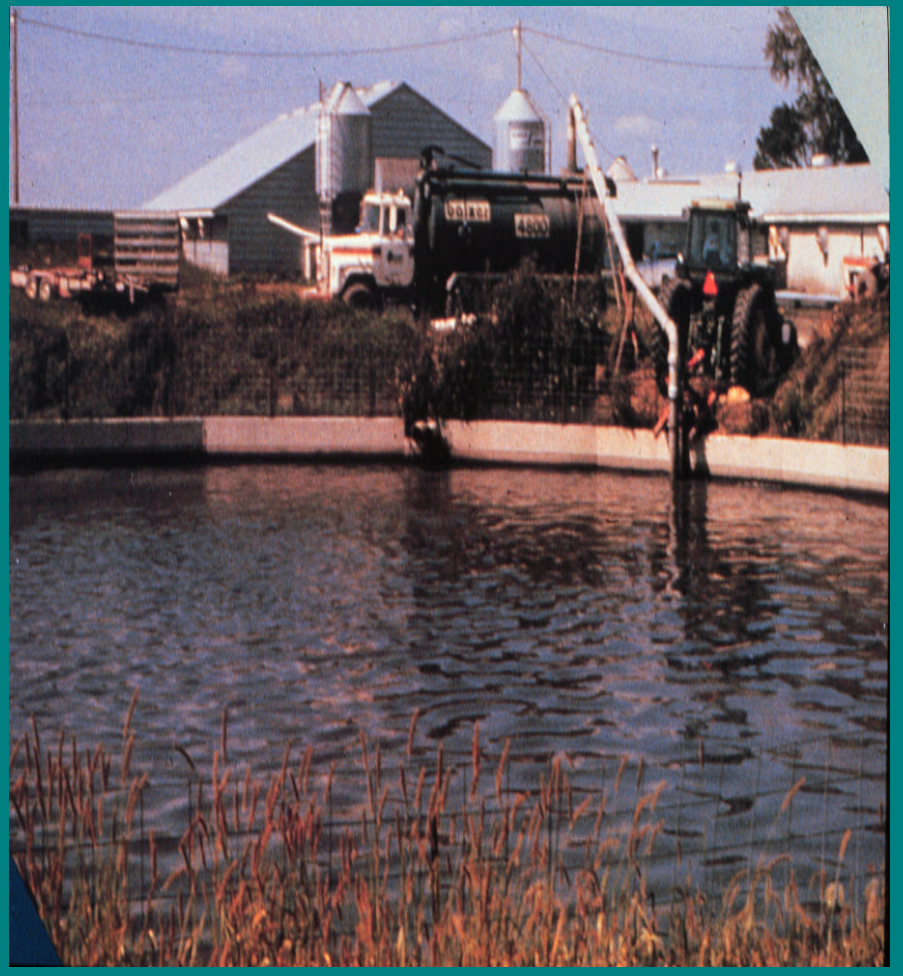
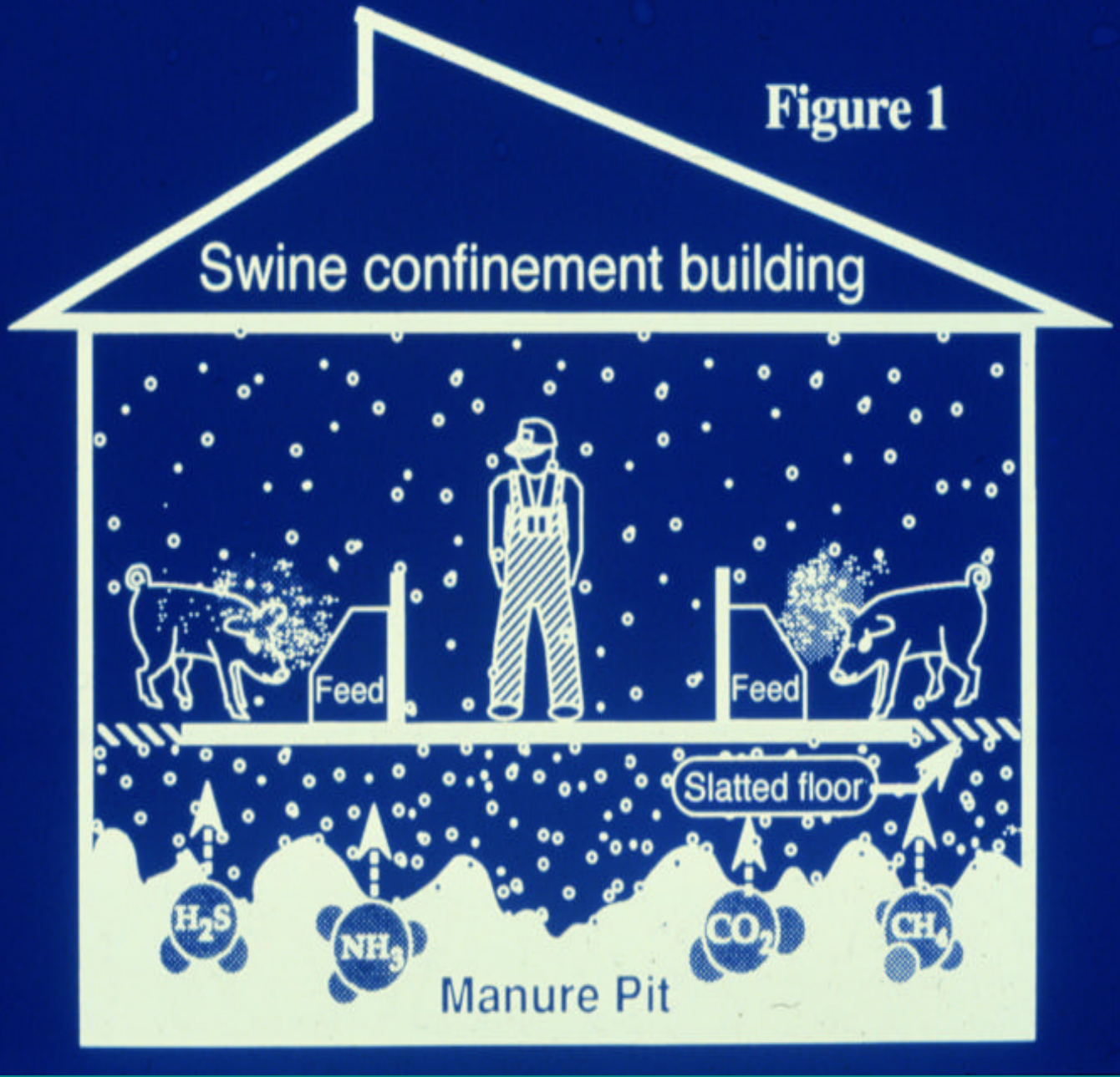


Figure 1


Swine confinement building
Feed
Feed
Slatted floor
H_2S
NH_3
CO_2
CH_4
Manure Pit

CAFOs – Neighborhood Health Issues

- Effects on neighbors
  - A variety of medical complaints (headaches, breathing problems etc.) and depressed mood have been reported in several small studies
  - Possible causes of the complaints:
    - Odors, flies, dust, noise, sight of dead pigs, anger toward the CAFO owners

Hog Confinement Worker Health

- There is a lot of evidence that workers have far greater health risks than neighbors but this gets little attention in the press
- Main problems identified include breathing disorders, musculoskeletal problems, hearing loss, needlesticks
- Infections are less common

Features of the Environment That Affect Worker Health

- Hog dust
  - **Feed particles**
  - **Fecal matter**
  - Bacteria, fungi
    - **Endotoxin**, peptidoglycan, fungal toxins (?)
  - Hair, skin particles
  - Insect parts

Features of the Environment That Affect Worker Health

- Gases
  - 138 identified of which only a few (see below) have been linked to worker health problems
  - Many different gases contribute to the unique odor associated with hog farms
    - **Ammonia**
    - **Hydrogen sulfide**
    - **Carbon monoxide**
    - Methane
    - Carbon dioxide

Features of the Environment That Affect the Workers' Airways

- What correlates with a cross-shift drop in lung function (FEV1):
  - Total dust > 2.5 mg/m^3
  - Ammonia > 7.0 ppm
  - Endotoxin > 0.1 mcg/m^3 or 100 EU/m^3
    - Reynolds et al, Am J Ind Med 29:33, 1996
  - Note: A drop in lung function between the beginning and end of a shift is a measure of effect of the work environment on the lung

Symptoms Experienced by 35 Veterinarians Associated with Work in Confinement Swine Facilities

Symptom	% Positive Response
Irritation of nasal passages	74%
Coughing	74%
Tightness of chest	63%
Irritation of eyes	57%
Excess sputum and phlegm production	54%
Headache	40%
Nausea	14%

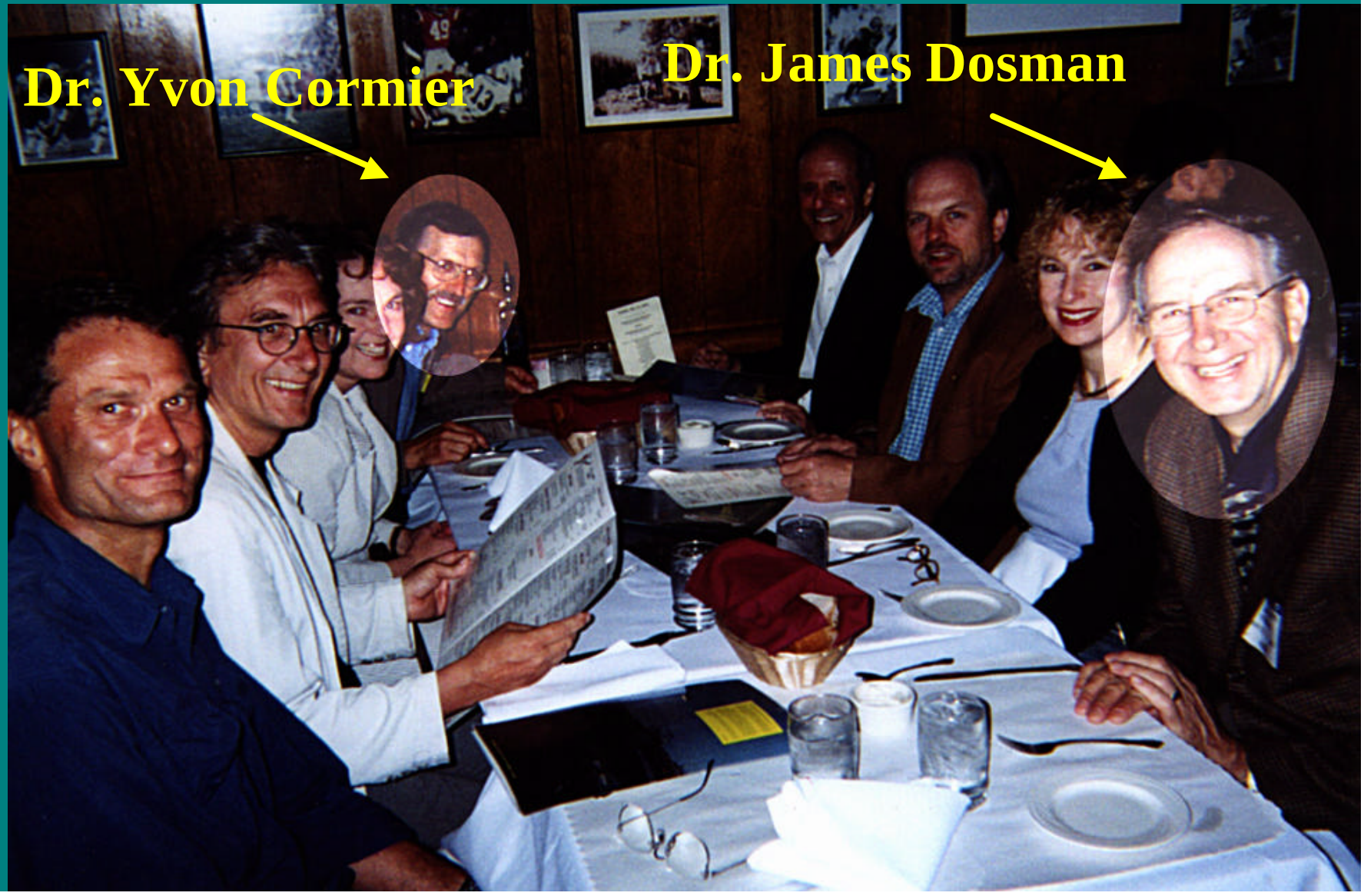
From Donham, 1977

Symptom Prevalence in Hog and Control Farmers

	Hog Farmers	Control Farmers
Number	53	43
Symptoms		
Cough	57%	21%
Sputum	32%	12%
Chronic bronchitis	26%	7%
Wheeze	26%	12%
Rhinitis	47%	21%
Flu-like complaints	21%	7%

From Holness and Nethercott, 1989

Canadians Who Study Health Effects of Hog Confinement



Airway Disease Symptoms in Hog Confinement Workers

- About 30% of workers have these symptoms
- Lung-function test results often normal
  - Some nonsmoking workers will have mild airway obstruction on spirometry (a lung-function test)
  - Airway obstruction is more severe in smokers
- See a cross-shift decline in lung function
  - Is associated with elevated dust, ammonia levels
  - It is unclear if this can result in severe airway obstruction

Case history: Doug J.

- 40-year-old swine-confinement-facility manager with 15 years of work experience who complains of cough, chest tightness and shortness of breath with exertion when he is working. He also sometimes has a cough at night.

Doug J.: Additional information

- Lifelong nonsmoker, no prior history of asthma
- Grew up on a farm, attended college, then worked on farms
- Works in the hog barns 3+ hours per day
- Has not used any inhalers
- Normal lung sounds, chest X-ray

U.N.M.C. PULMONARY MEDICINE SECTION PULMONARY PHYSIOLOGY LABORATORY
DRS. S. BUCHALTER, A. FLOREANI, C. PIQUETTE, S. RENNARD, R. ROBBINS,
D ROMBERGER, J. SISSON, J. SPURZEM, A. THOMPSON, S. VON ESSEN

ID: 66 39 61 Date: 5-Apr-95

Race: Caucasian Height: 178 cm Weight: 81.5 kg Sex: M
Room: CLINIC BSA: 2.ØØ Age: 37 yr
Dr. : RENNARD Technician: TSP

		PRE-BRONCH			POST-BRONCH		
		Pred	Actual	%Pred.	Actual	%Pred.	%Chng
LUNG MECHANICS							
FVC	(L)	5.24	5.72	1Ø9			
FEV1	(L)	4.28	3.99	93			
FEV1/FVC	(%)	82	7Ø				
FEF 25%	(L/sec)	7.98	5.61	7Ø			
FEF 5Ø%	(L/sec)	5.28	3.21	61			
FEF 75%	(L/sec)	2.18	1.35	62			
FEF MAX	(L/sec)	8.42	8.94	1Ø6			
FEF 25-75%	(L/sec)	4.36	2.81	64			
FEF 75-85%	(L/sec)		Ø.85				
FIVC	(L)		5.39				
FIF 5Ø%	(L/sec)	5.32	7.Ø1	132			
FEF 5Ø%/FIF 5Ø%		Ø.99	Ø.46				
LUNG DIFFUSION							
DLCOunc(ml/min/mmHg)		39.6Ø	42.4Ø	1Ø7			
ALVEOLAR VOLUME	(L)	6.94	7.88	114			
DL/VA(ml/min/mmHg/L)		5.71	5.38	94			

Doug J.: Summary

- This picture is most consistent with the asthma-like syndrome
- Management of this problem:
  - Wear a respirator
  - Improve air quality in the barns
  - Inhalers
  - Consider changing professions (This man is now a teacher and his symptoms have persisted)

Asthma-like Syndrome

- Cough, chest tightness, dyspnea on exertion, wheezing associated with being inside the hog barn
- May also have symptoms at night, daytime symptoms when away from work
- Better after days/weeks away from work

Asthma-like Syndrome

- Chest X-ray normal
- Spirometry may show mild (5-18% below normal) airway obstruction but is often within normal limits
- This is not occupational asthma

Asthma in Swine-Confinement Workers

- Asthma is an inflammatory disorder with reversible airway obstruction, often with allergy to specific antigens
- 5-10% of the population is asthmatic
- Asthma is not more common in farmers than in the general population
- Fewer than 10 people in the world are described in published reports as having allergy to pigs causing asthma

Hog Farmer With Asthma

- Symptoms of airway obstruction predate work in confinement
- Moderate, reversible airway obstruction on spirometry

Asthma in Swine Confinement Workers

- Persons with pre-existing asthma are likely to have more difficulty with their disease as a result of the exposure to dust and ammonia

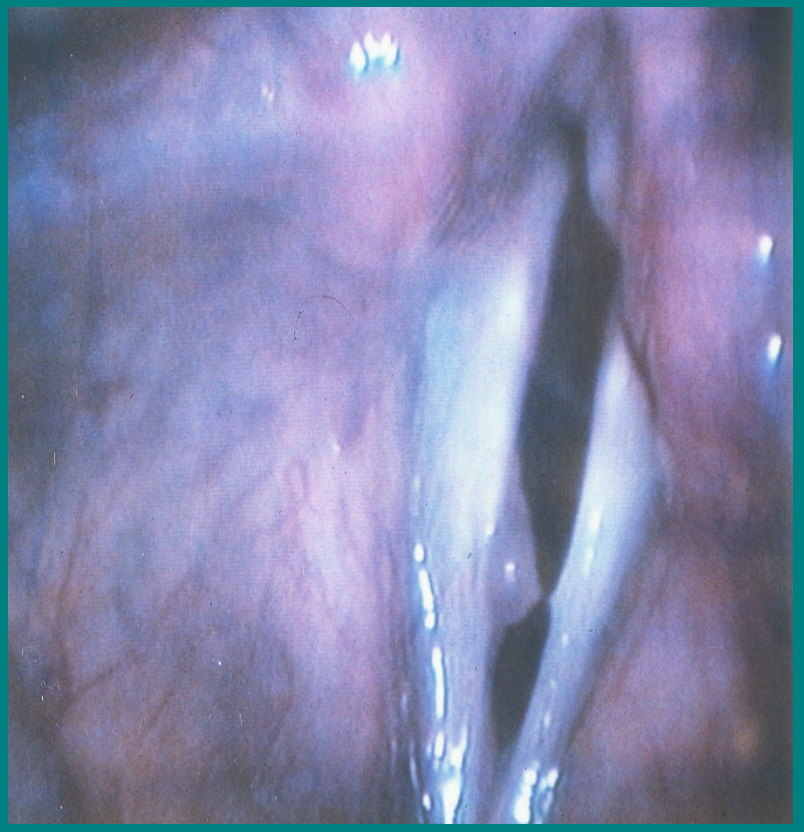
- Work in this environment can contribute to exacerbations of asthma

Features of Mucous Membrane Irritation Syndrome

- Rhinitis – nasal stuffiness, drainage
- Burning and dryness of eyes
- Hoarseness
- Burning sensation in the throat

Mucous Membrane Irritation Syndrome

- May be associated with visible inflammation of the vocal cords, as in the hog farmer seen on the right



Acute Bronchitis

- Acute bronchitis: There is no official definition but most clinicians describe it as being an acute illness associated with cough productive of sputum.
- Appears to be work-associated in some swine confinement workers

Chronic Bronchitis

- World Health Organization definition for chronic bronchitis: daily sputum production for at least 3 months of the year for at least 2 years
  - More common in hog confinement workers than in the general population
  - There is no evidence that this progresses to severe disease unless the worker also smokes

Organic Dust Toxic Syndrome (ODTS)

- ODTS is a systemic illness experienced after exposure to large quantities of organic dust by inhalation
- Seen after work in swine confinement barns, after cleaning grain bins, unloading silos
  - 30% of livestock/grain farmers get this
- Exposure to endotoxin is a cause of ODTS

Organic Dust Toxic Syndrome

- Symptoms begin 4-12 hours after heavy organic dust exposure
  - Consist of headache, muscle aches, fatigue, fever, occasionally also cough
  - Often confused with influenza
- Illness self-limiting over 1-3 days

Neighborhood Health Effect

- There is growing concern about the impact on human health of living near hog barns.
  - There are many issues to consider:
    - Economic
    - Social
    - Direct health effects

Neighborhood Health Effect

- Factors important in neighborhood health effect
  - Physical response to dust, gases released from hog confinement facilities
  - Emotional response to odor
    - Odor intensity can be measured by olfactometers, or using trained panelists
    - A physical reaction to odor effect on the brain could occur but is difficult to measure

Response to Odors

- Persons who report symptoms from odors generally find problems with many types of odorous compounds
- Main complaints: eye, nose and throat irritation, headache, drowsiness

Responses to Odors

- Sensory irritation in the nose
  - Example: ground pepper, formaldehyde
- Alterations of brain activity
  - Effects on memory, including aversive conditioning
  - Alterations in mood

Responses to Odors

- Adaptation
  - If one is exposed to an odor constantly, one has reduced ability to perceive it
  - Intermittent exposure induces a higher odor sensitivity

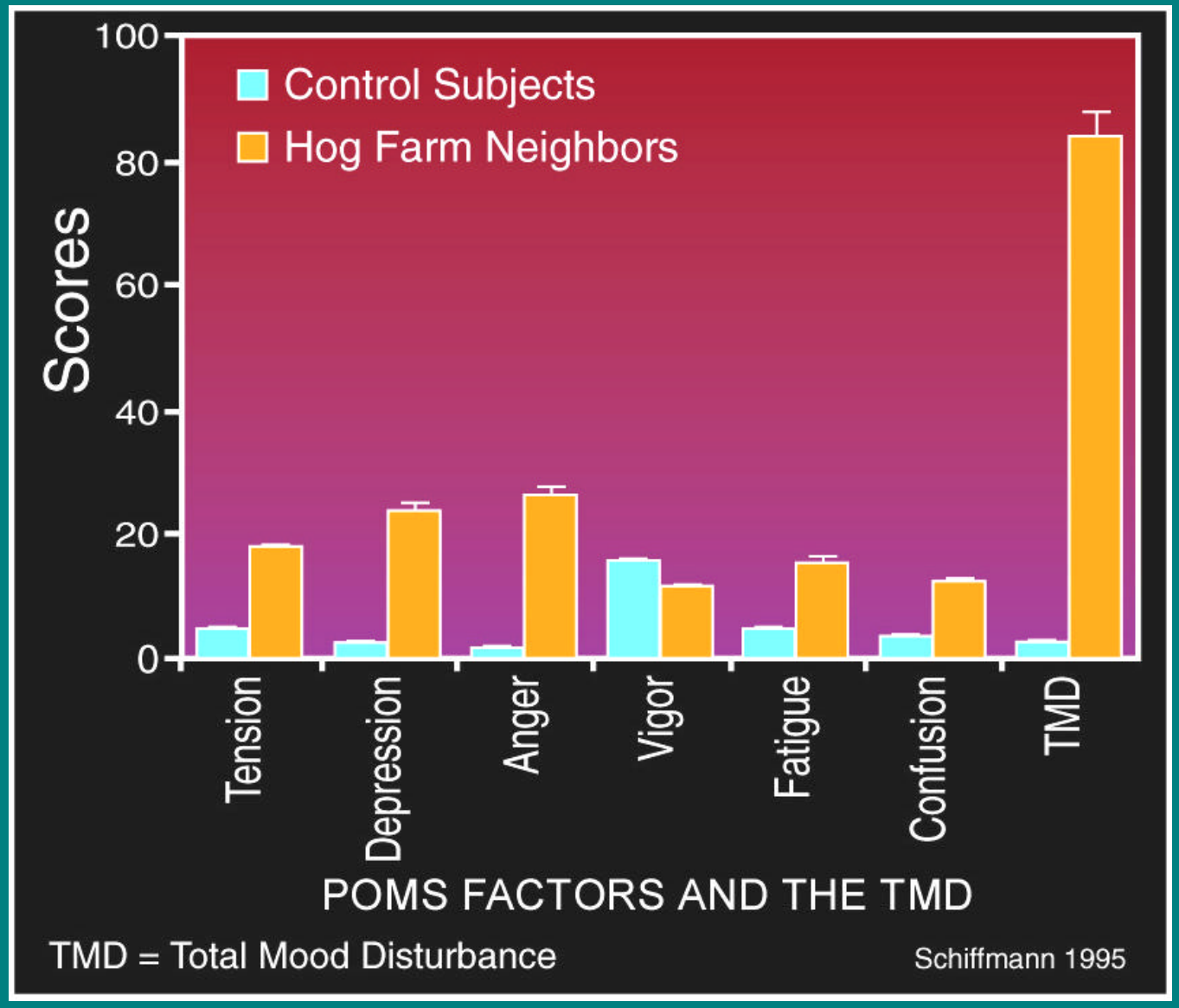
Neighborhood Health Effect

- Studies on persons living in the neighborhood:
  - Schiffman et al. Brain Research Bulletin. 1995; 37(4):369-375
  - Thu et al. Journal of Agricultural Safety and Health. 1997; 3(1):13-26
  - Reynolds et al. Journal of Agromedicine. 1997; 4(1/2):37
  - Wing and Wolf. Environmental Health Perspectives 2000; 108:233-238

Neighborhood Health Effect

- Schiffman and colleagues studied 44 neighbors of large-scale hog confinement operations in North Carolina. Results were compared to a control group.
  - Used the Profile of Moods States questionnaire
  - Found more tension, anger and depression in the hog-facility neighbors
  - Also more confusion and fatigue, less vigor

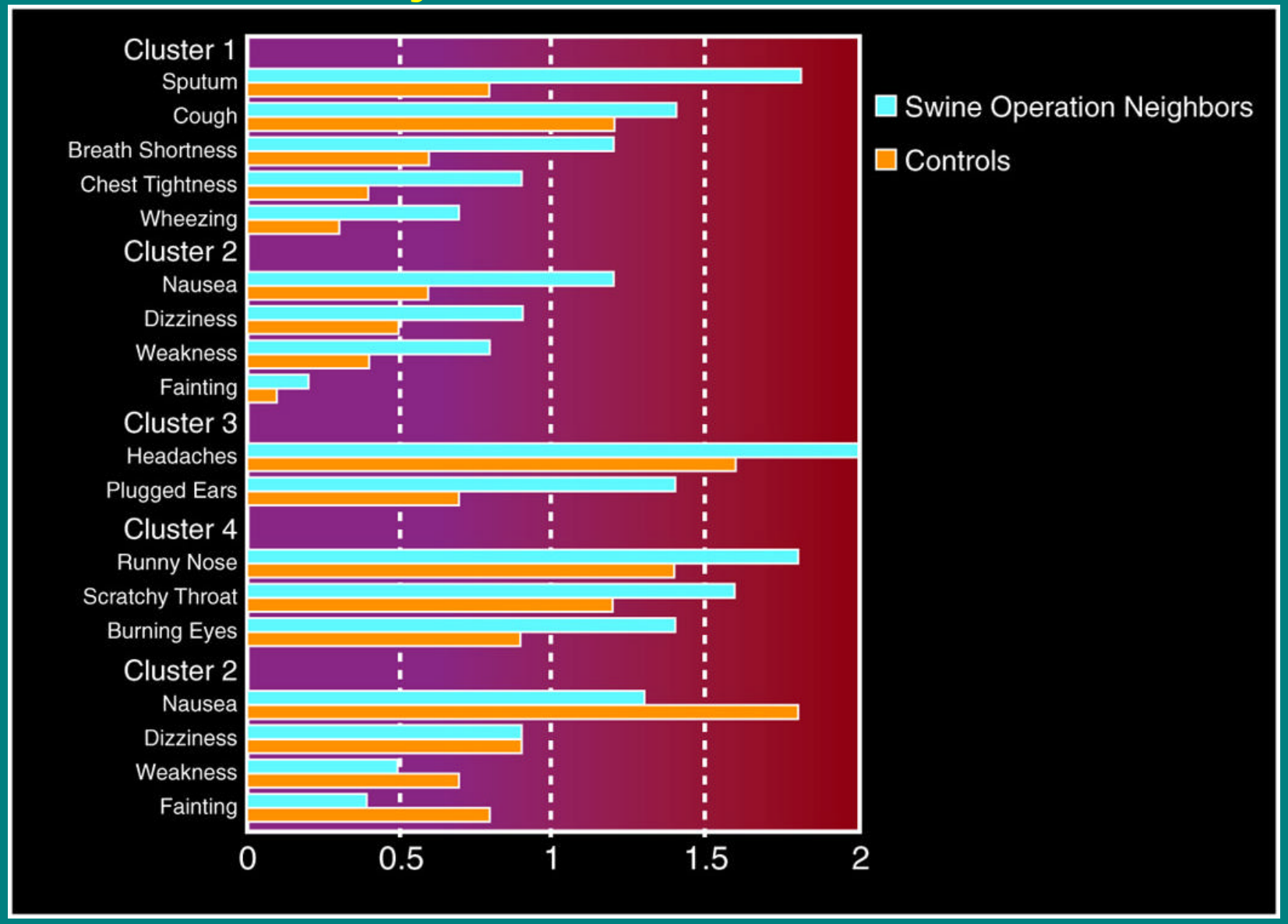
Profile of Mood States Scores in North Carolinians Living Near Hog Farms



Neighborhood Health Effect

- Thu and colleagues studied 18 persons living within 2 miles of a hog confinement facility as well as matched control subjects
  - Found more of the following symptoms: cough, sputum production, chest tightness and wheezing. Also nausea, dizziness, weakness and fainting as well as headaches and plugged ears
  - Data shown on the following 2 slides

Frequency of Physical Symptoms Experienced by Rural Residents



Neighborhood Health Effect

Note: A p value of less than .05 is considered significant

Cluster 1: respiratory symptoms	2.12	p = .02
Cluster 2: nausea, dizziness, weakness, fainting	1.83	p = .04
Cluster 3: headaches and plugged ears	1.67	p=.06
Cluster 4: burning eyes, runny nose, sore throat	1.18	P=.12

Neighborhood Health Effect

- Reynolds could measure hog dust and endotoxin 60 meters outside a facility
- Ammonia concentrations were 0.25 ppm (large farms) to 0.14 ppm (small hog farms) 60 meters from facility
  - Recall that 7.0 ppm was the threshold for illness in the barns.

Neighborhood Health Effect

- Wing and Wolf conducted 155 interviews on quality of life of persons living near hog farms, cattle farms, or neither in North Carolina
- Found more respiratory and mucous membrane complaints in those near hog farms
- Quality of life (number of times could open windows, go outside) reduced in hog-farm neighbors

Summary-1

- Approximately 1/3 of hog confinement workers report breathing problems consisting of the asthma-like syndrome, chronic bronchitis or the mucous membrane irritation syndrome
- There are no published reports of negative effects of their work exposures on mood
- No mention of dizziness, headaches or weakness is made in descriptions of workers' complaints, unlike in neighbors

Summary-2

- Some of the symptoms in the neighbors and the workers are similar, particularly those in reference to breathing and mucous membrane irritation
- However, the levels of ammonia documented near the barns are unlikely to cause respiratory problems given what we know about the workers

Summary-3

- Evidence from air sampling near hog barns provides limited support for dust and gases causing neighbors' symptoms.
- It is more likely that brain responses to odors explain most of the neighbors' symptoms
- There is good evidence that hog-barn odors affect quality of life

Summary-4

- Other emotional reactions may explain some of the findings, such as anger over changes in the community secondary to the presence of large hog farms
- Firm conclusions on neighborhood health effects of large-scale hog confinement facilities cannot be drawn until more information is available
- There is an urgent need for more large, well-designed studies in this area