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Smoking Mediates the Relationship between Adverse Childhood Experiences and Chronic Obstructive Pulmonary Disease in the BRFSS Data

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Background: Child Maltreatment

- Federal and self-reported data show child maltreatment ranges from 0.9 to 52.1 percent in the US

- Lifetime cost of $210,012 per non-fatal victim

(Administration for Children and Families, 2012; Fang, et al., 2012; Felitti et al., 1998)

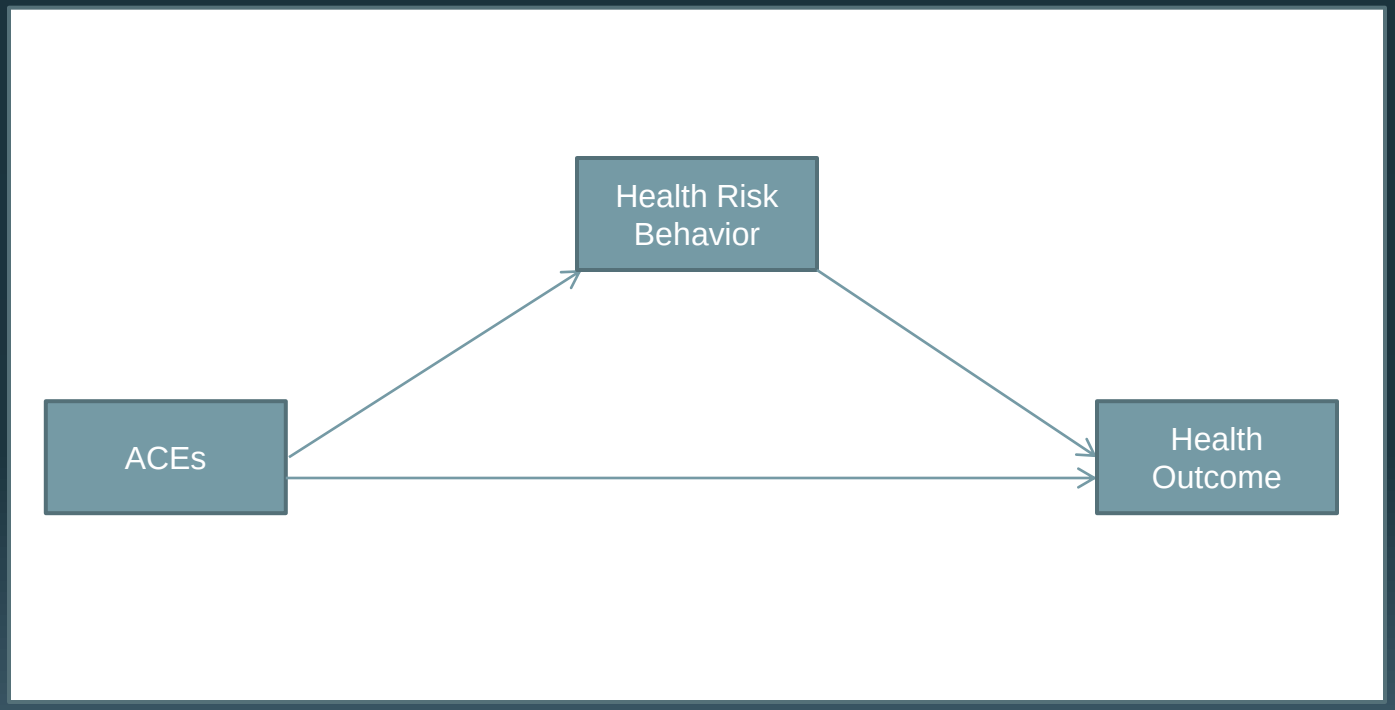
Background: Child Maltreatment

- Kaiser Permanente-based ACE Study, other clinical studies, and population-based studies using data from the Behavioral Risk Factor Surveillance System (BRFSS) show adverse childhood experiences (ACEs) are associated with
  - Health risk behaviors
  - Health outcomes

(Anda et al., 1999; Anda et al., 2008; Felitti et al, 1998; Ford et al., 2011)

Background: Mediation

- Health risk behaviors may mediate the relationship between ACEs and health outcomes



(Baron & Kenny, 1986; Chapman et al., 2013; Dong et al., 2003; Dong et al., 2004)

This Study

- Examines the association between ACEs and COPD, with smoking as a mediator of the relationship
- Makes a unique contribution
- Assesses high-cost public health issues
  - COPD cost the US an estimated 49.9 billion dollars in 2010
  - Smoking cost 193 billion dollars per year between 2001-2004

(CDC, 2008; NHLBI, 2009)

Capstone Project: Hypotheses

- Evaluate the hypothesis of a relationship between adverse childhood experiences (ACEs) and chronic obstructive pulmonary disease (COPD).

- Assess the hypothesis of smoking as a mediator in the ACE-COPD causal pathway, accounting for unique and significant variance.

- Evaluate the hypothesis that smoking will only partially mediate the ACE-COPD relationship, and ACEs will continue to account for unique and significant variance after including smoking in a mediational model.

Methods: Procedures

- BRFSS data downloaded, cleaned, and screened
- Descriptive statistics and demographics examined
- ACE prevalence estimates derived
- Mediation models tested

Methods: Data Source

- Data were collected from five states in which an eight category ACE module was included in the 2011 Behavioral Risk Factor Surveillance System (BRFSS)
  - Minnesota
  - Montana
  - Vermont
  - Washington
  - Wisconsin

Methods: ACE Categories

- Verbal Abuse
  (How often did a parent or adult in your home…)
  More than once ever swear at you, insult you, or put you down?

- Physical Abuse
  (Before age 18, how often did a parent or adult in your home…)
  Once or more than once ever hit, beat, kick, or physically hurt you in any way?
  Do not include spanking

- Sexual Abuse
  (How often did anyone at least 5 years older than you or an adult…)
  1. One or more than once ever touch you sexually?
  2. Once or more than once try to make you touch them sexually
  3. Once or more than once force you to have sex?

- Witnessed Household Domestic Violence
  (How often did your parents or adults in your home…)
  Once or more than once ever slap, kick, punch or beat each other up?

(Ford et al., 2011)

Methods: ACE Categories

- Household Substance Abuse
  (did you live with anyone who…)
  1. Was a problem drinker or alcoholic?
  2. Used illegal street drugs or who abused prescription medication?
- Mentally Ill Household Member
  Did you live with anyone who was depressed, mentally ill, or suicidal?
- Parental Separation or Divorce
  Were your parents separated or divorced?
- Incarcerated Household Member
  Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?
- Categorical ACE Score (0-8)

(Ford et al., 2011)

Methods: Covariates

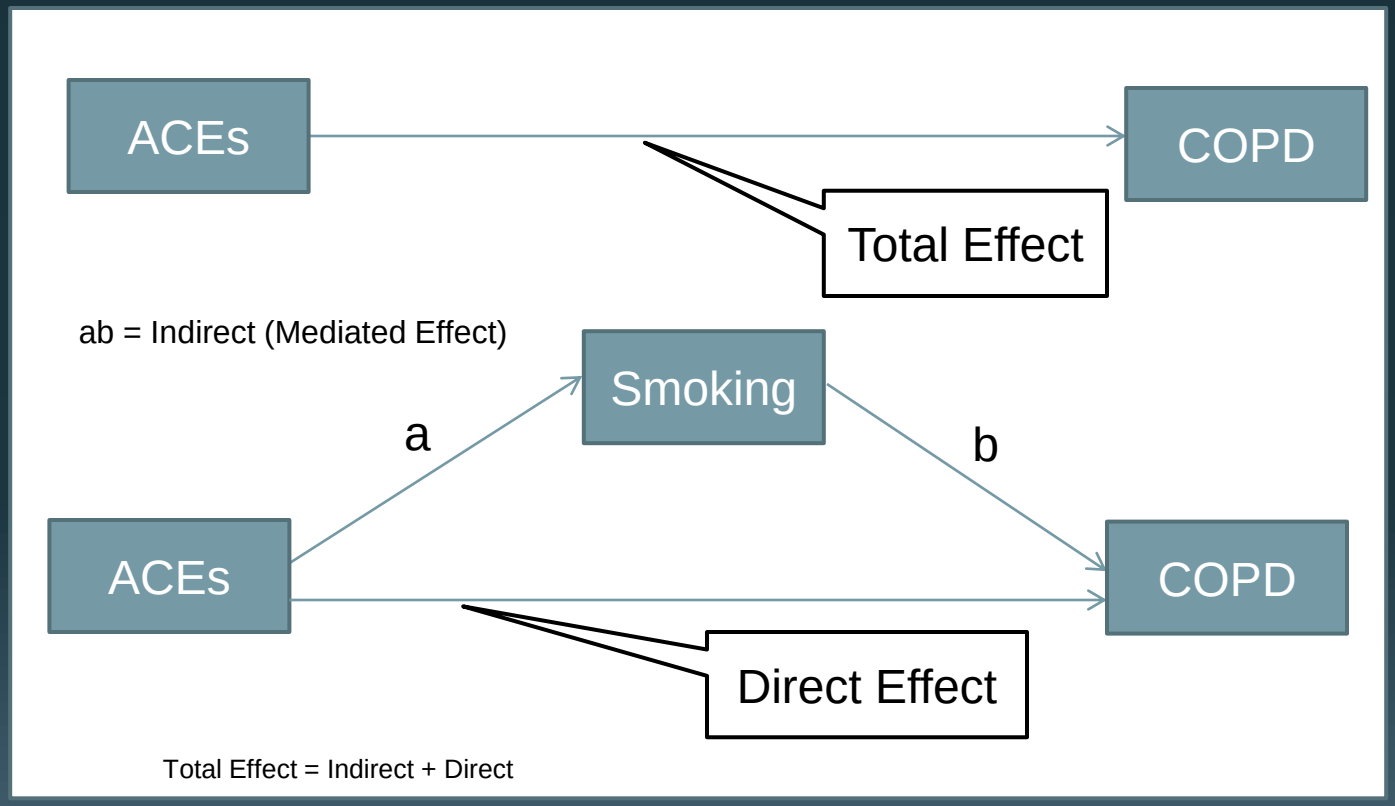
- Identified through review of the ACE and COPD literature
- Examination of bivariate relationships
- Factors included
  - Age
  - Sex
  - Race/ethnicity
  - Body mass index
  - Education
  - Income
  - Marital status
  - Asthma

Methods: Smoking (Mediator)

- Smoking variable reduced to two categories
  - “Current Smoker”
  - “Former/Never Smoker”

Methods: Mediation

- Mediators account for unique and significant variance



(Baron & Kenny, 1986; Hayes, 2009)

Methods: Mediational Analysis

- Logistic regression models were developed to test the mediational hypothesis-that smoking would partially mediate the ACE-COPD relationship and included
  - Categorical ACE score (0, 1, 2, 3, ≥4) and eight ACE categories
  - Smoking status
  - Covariates included age, sex, race/ethnicity, body mass index, education, income, marital status, and asthma

(Baron & Kenny, 1986)

Results: Demographics

Characteristics	Sample Size (n)	Prevalence (%)
Age group (years)		
40-54	11,663	32.2
55-64	10,960	30.2
65-74	7,741	21.4
≥75	5,871	16.2
Gender		
Men	14,917	41.2
Women	21,318	58.8
Race/Ethnicity		
White	33,047	91.9
Non-White	2,929	8.1
Education		
Did not Graduate from High School	1,827	5.0
Graduated High School	9,936	27.5
Attended College or Technical School	10,462	28.9
Graduated from College or Technical School	13,971	38.6
Household Income		
< $10,000	1,073	3.3
$10,000 - < $15,000	1,510	4.7
$15,000 - < $20,000	2,038	6.3
$20,000 - < $25,000	3,240	10.0
$25,000 - < $35,000	4,340	13.4
$35,000 - < $50,000	5,423	16.8
$50,000 - < $75,000	5,789	17.9
≥ $75,000	8,919	27.6
Marital Status		
Married/A Member of an Unmarried Couple	21,996	60.8
Divorced/Widowed/Separated/Never Married	14,155	39.2
Body Mass Index (kg/m^2)		
Underweight (<18.5)	483	1.4
Normal Weight (18.5-24.9)	11,432	32.8
Overweight (25.0-29.9)	13,252	38.0
Obese (≥30.0)	9,700	27.8
Smoking Status[b]		
Current	4,994	13.8
Former	12,733	35.3
Never	18,344	50.9
Asthma		
No	31,875	88.2
Yes	4,266	11.8
Chronic Obstructive Pulmonary Disease		
No	33,850	93.4
Yes	2,385	6.6

Results: ACE Prevalence

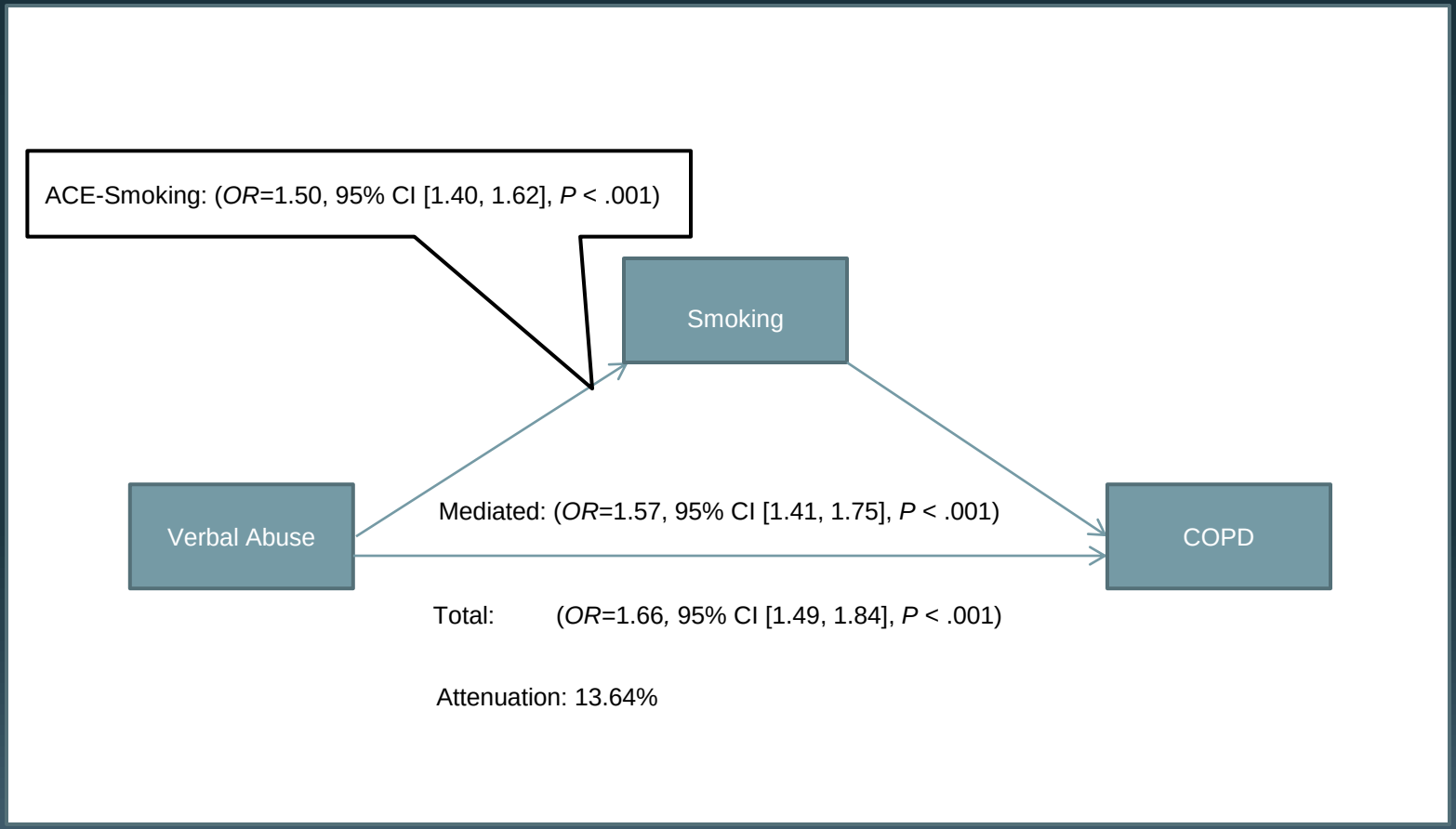
Adverse Childhood Experiences (ACEs)	Sample Size (n)	Prevalence (%)
ACE Categories		
Abuse	12,557	34.7
Verbal Abuse		
(How often did a parent or adult in your home…)		
More than once ever swear at you, insult you, or put you down?	9,389	25.9
Physical Abuse		
(Before age 18, how often did a parent or adult in your home…)		
Once or more than once ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.	5,411	14.9
Sexual Abuse	4,461	12.3
(How often did anyone at least 5 years older than you or an adult…)		
1. Once or more than once ever touch you sexually?	3,879	10.7
2. Once or more than once try to make you touch them sexually? [a]	2,638	7.3
3. Once or more than once force you to have sex?	1,407	3.9
Household Dysfunction	15,455	42.7
Witnessed Domestic Violence		
(How often did your parents or adults in your home…)		
Once or more than once ever slap, kick, punch or beat each other up?	5,203	14.4
Household Substance Abuse	9,406	26.0
(Did you live with anyone who…)		
1. Was a problem drinker or alcoholic?	8,646	23.9
2. Used illegal street drugs or who abused prescription medication?	2,170	6.0
Mentally Ill Household Member		
Did you live with anyone who was depressed, mentally ill, or suicidal?	5,167	14.3
Parental Separation or Divorce		
Were your parents separated or divorced?	5,915	16.3
Incarcerated Household Member		
Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?	1,127	3.1
ACE Score		
0	16,834	46.5
1	7,946	21.9
2	4,413	12.2
3	2,797	7.7
4	1,891	5.2
5	1,241	3.4
6	721	2.0
7	315	0.9
8	77	0.2

(Felitti et al., 1998; Ford et al., 2011)

Results: ACE-COPD Prevalence

Adverse Childhood Experiences (ACEs)	Sample Size (n)	Prevalence (%)
ACE Categories		
Abuse	1093	45.8
Verbal Abuse	845	35.4
Physical abuse	603	25.3
Sexual Abuse	507	21.3
Household Dysfunction	1326	55.6
Witnessed Domestic Violence	527	22.1
Household Substance Abuse	892	37.4
Mentally Ill Household Member	469	19.7
Parental Separation or Divorce	545	22.9
Incarcerated Household Member	168	7.0
ACE Score		
0	831	34.8
1	472	19.8
2	310	13.0
3	255	10.7
4	171	7.2
5	153	6.4
6	121	5.1
7	52	2.2
8	20	0.8

Results: Mediational Analysis



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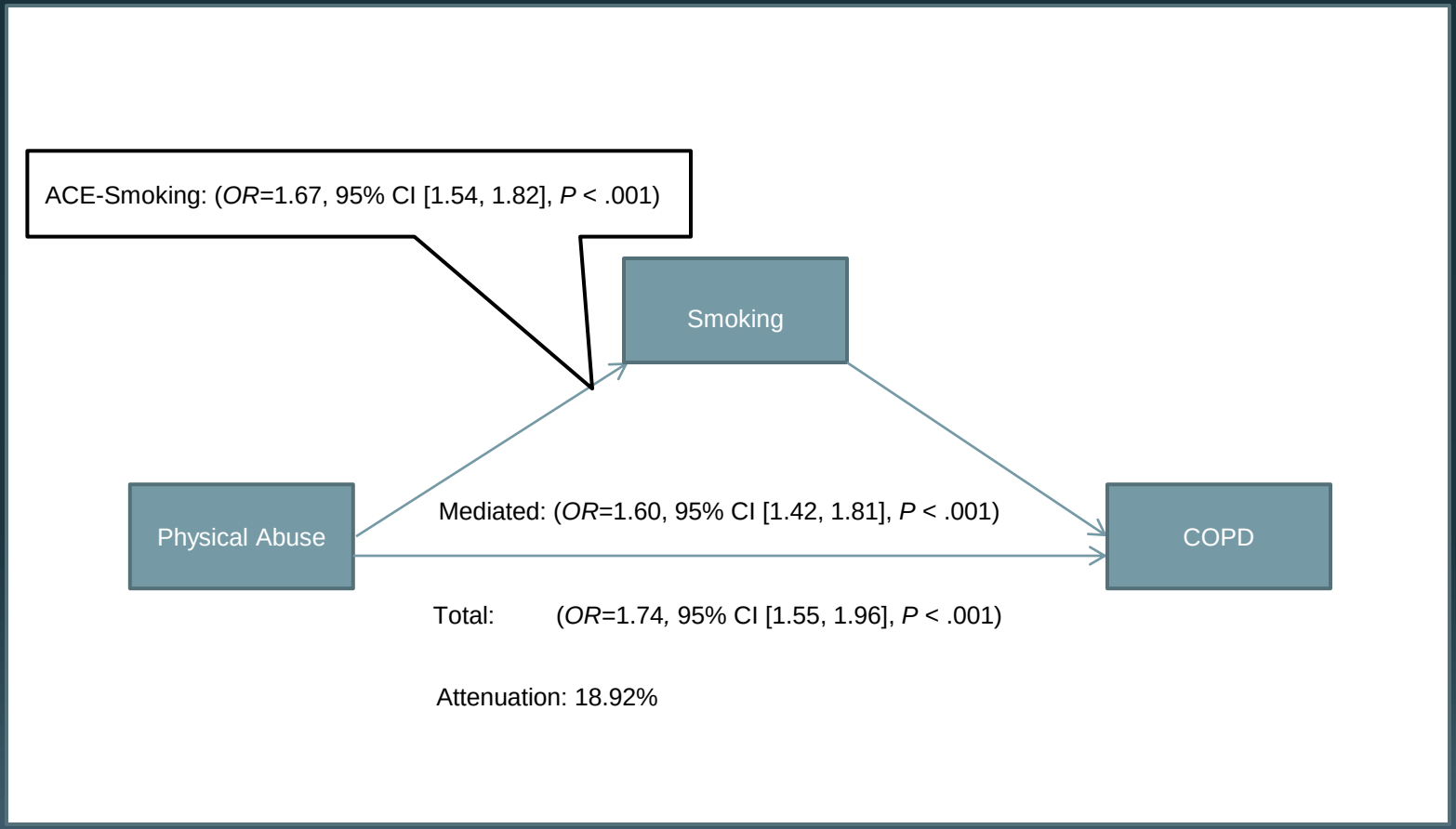

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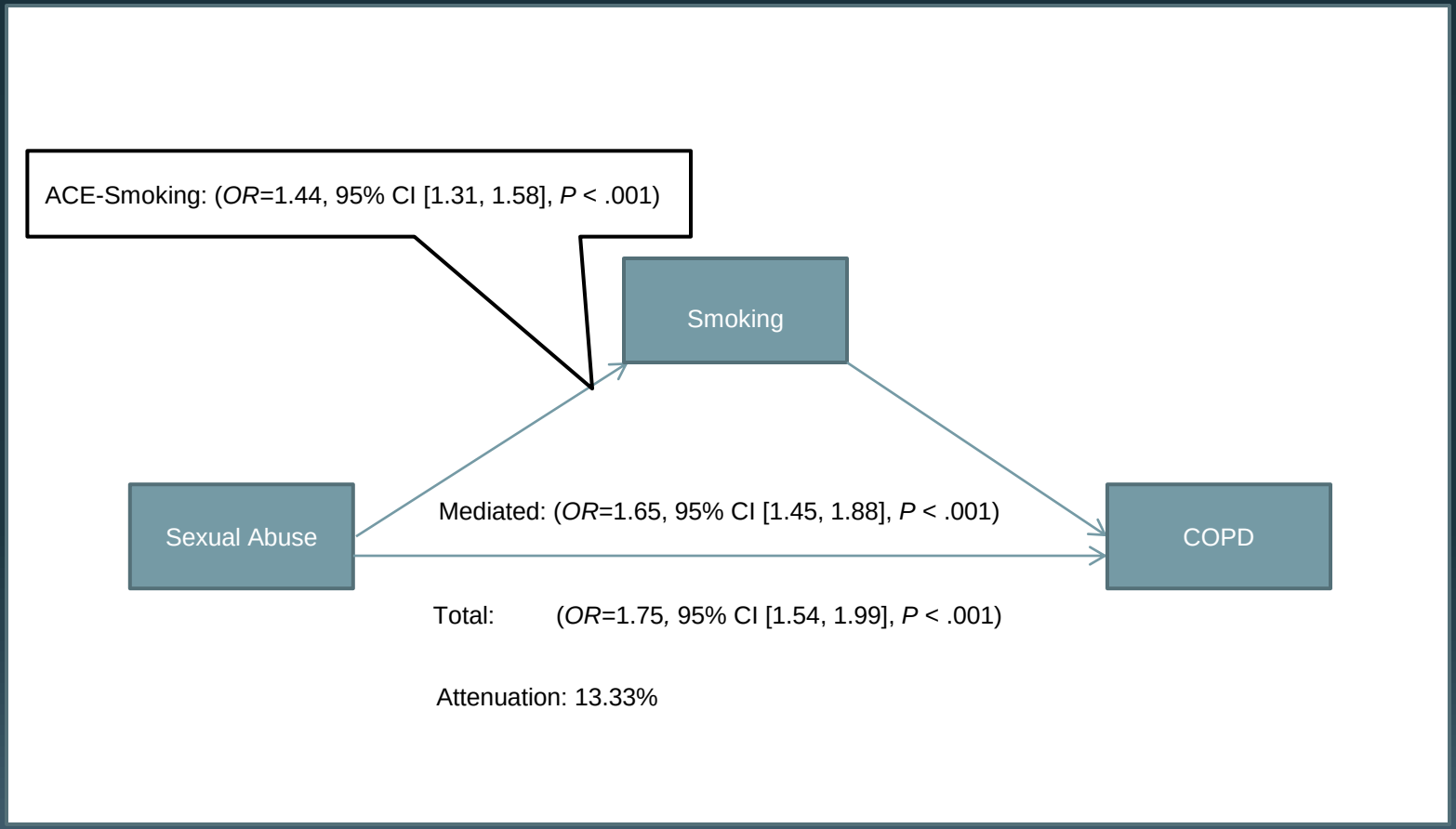

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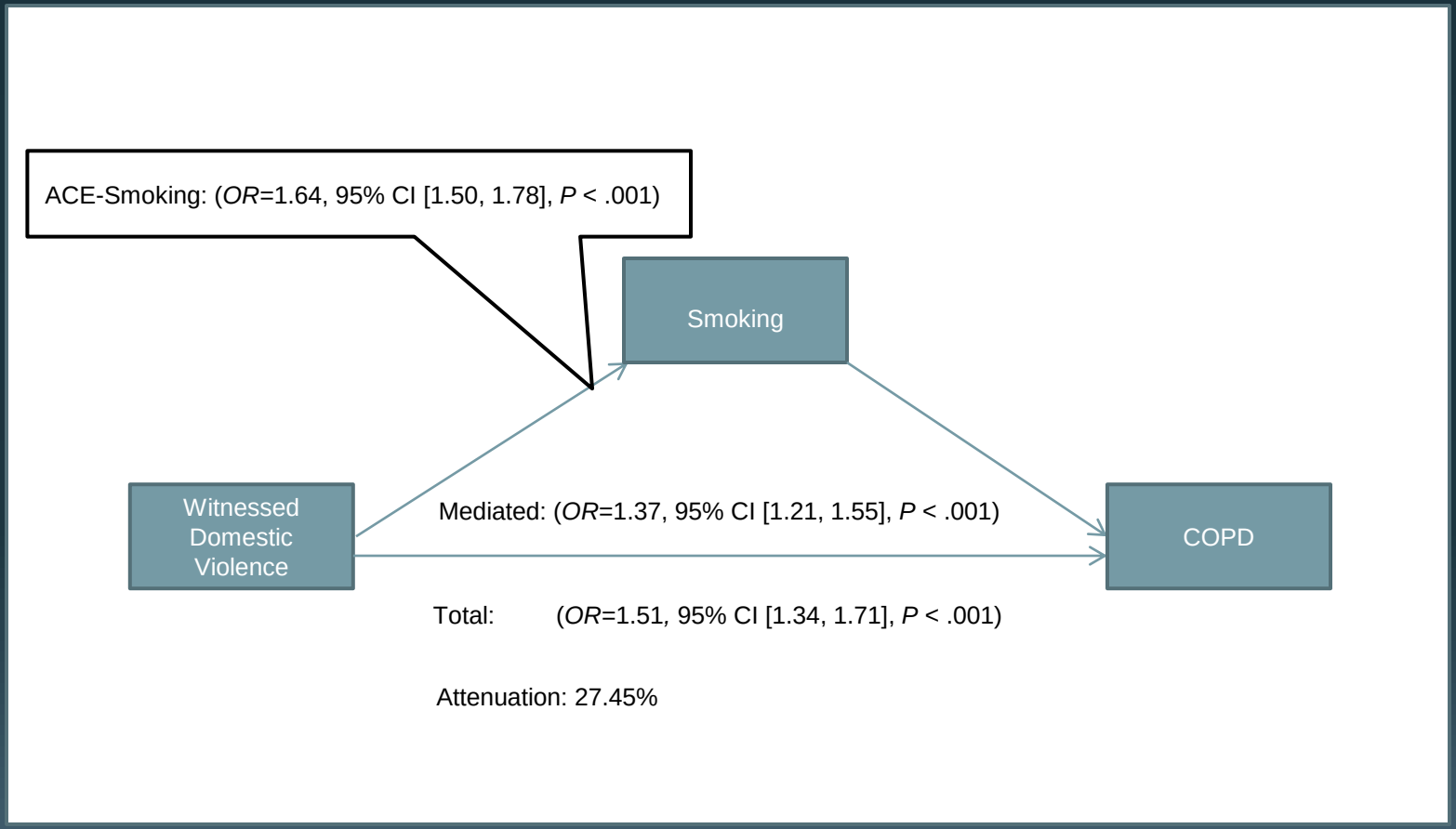

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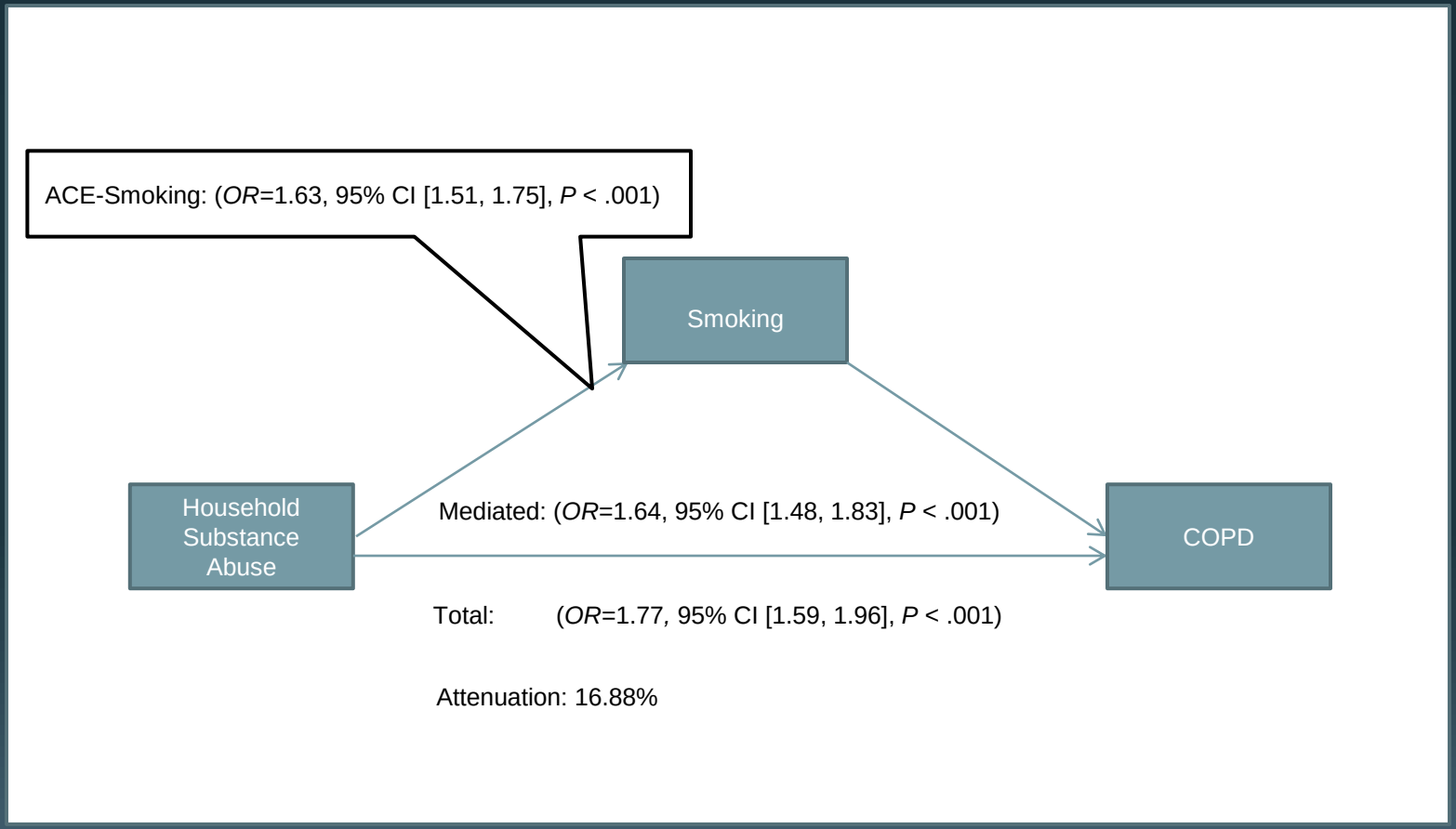

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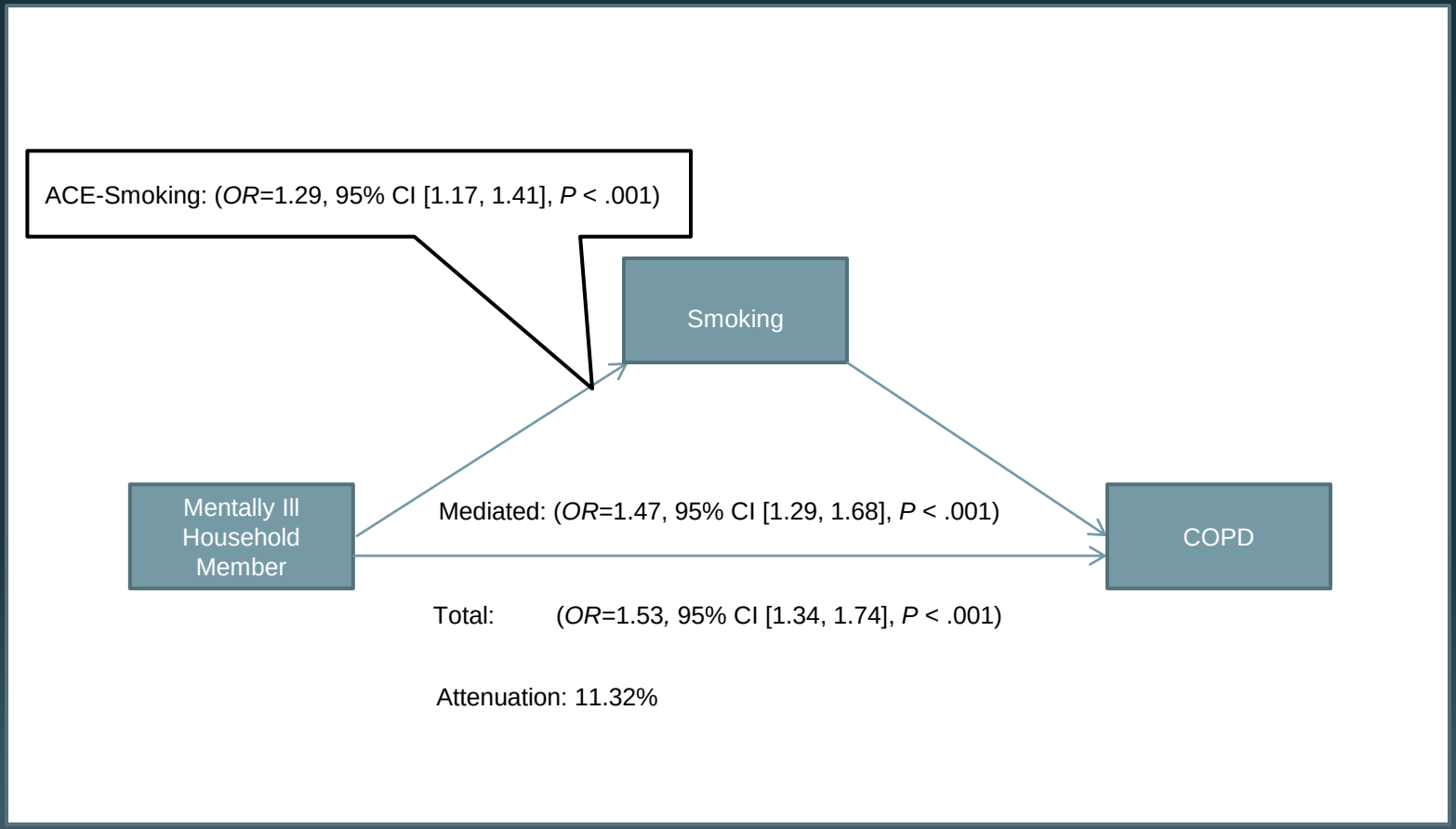

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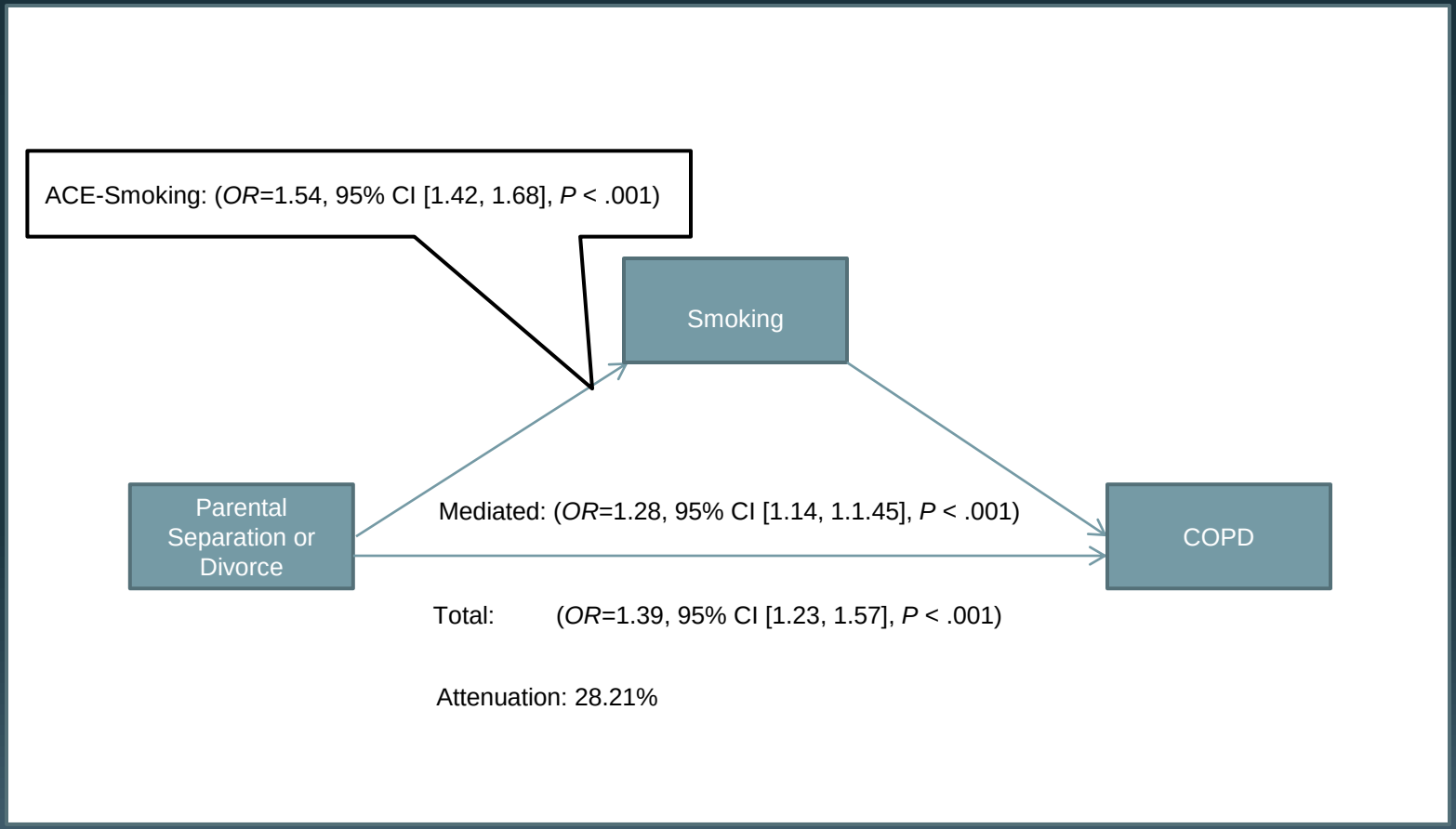

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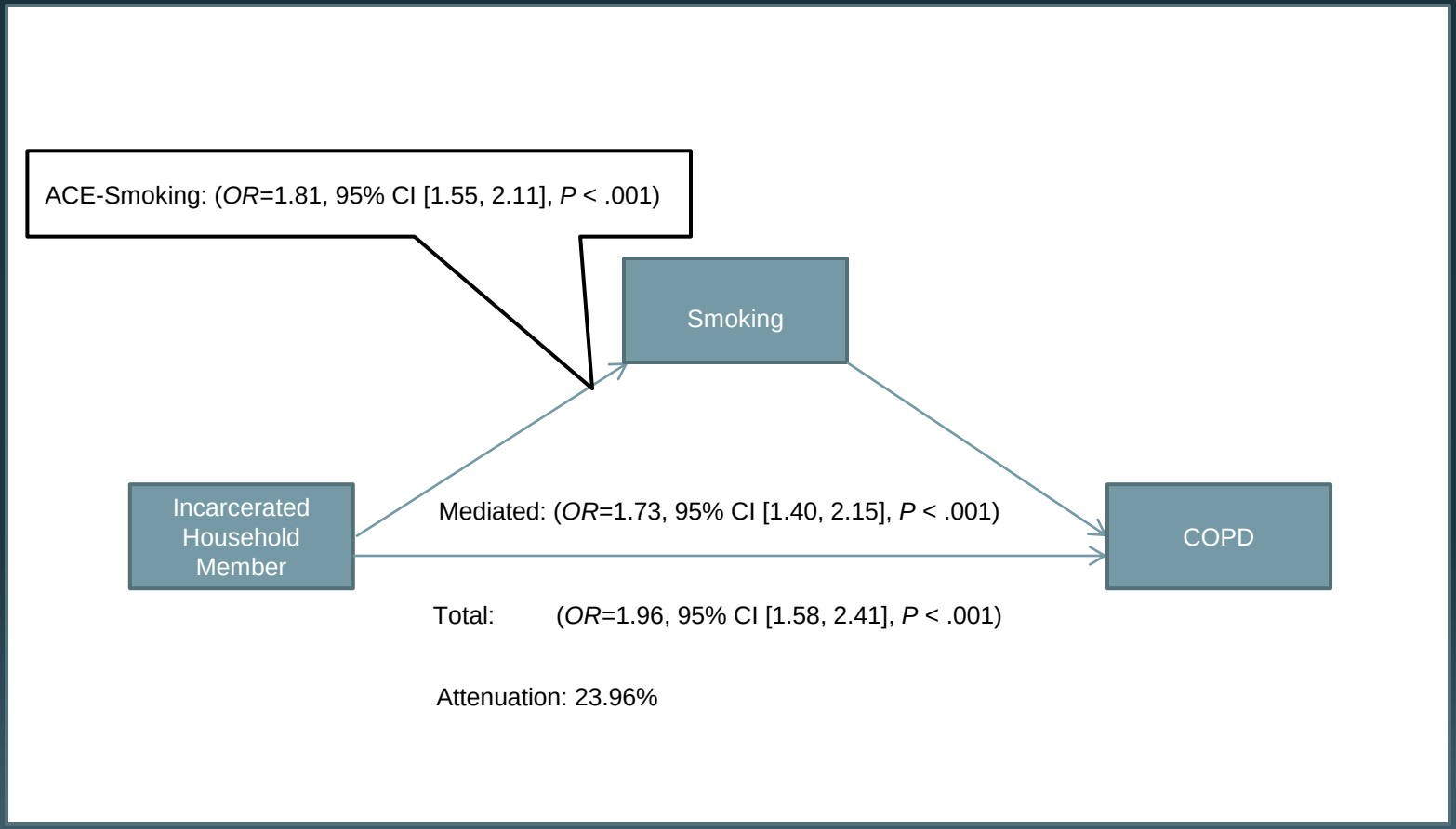

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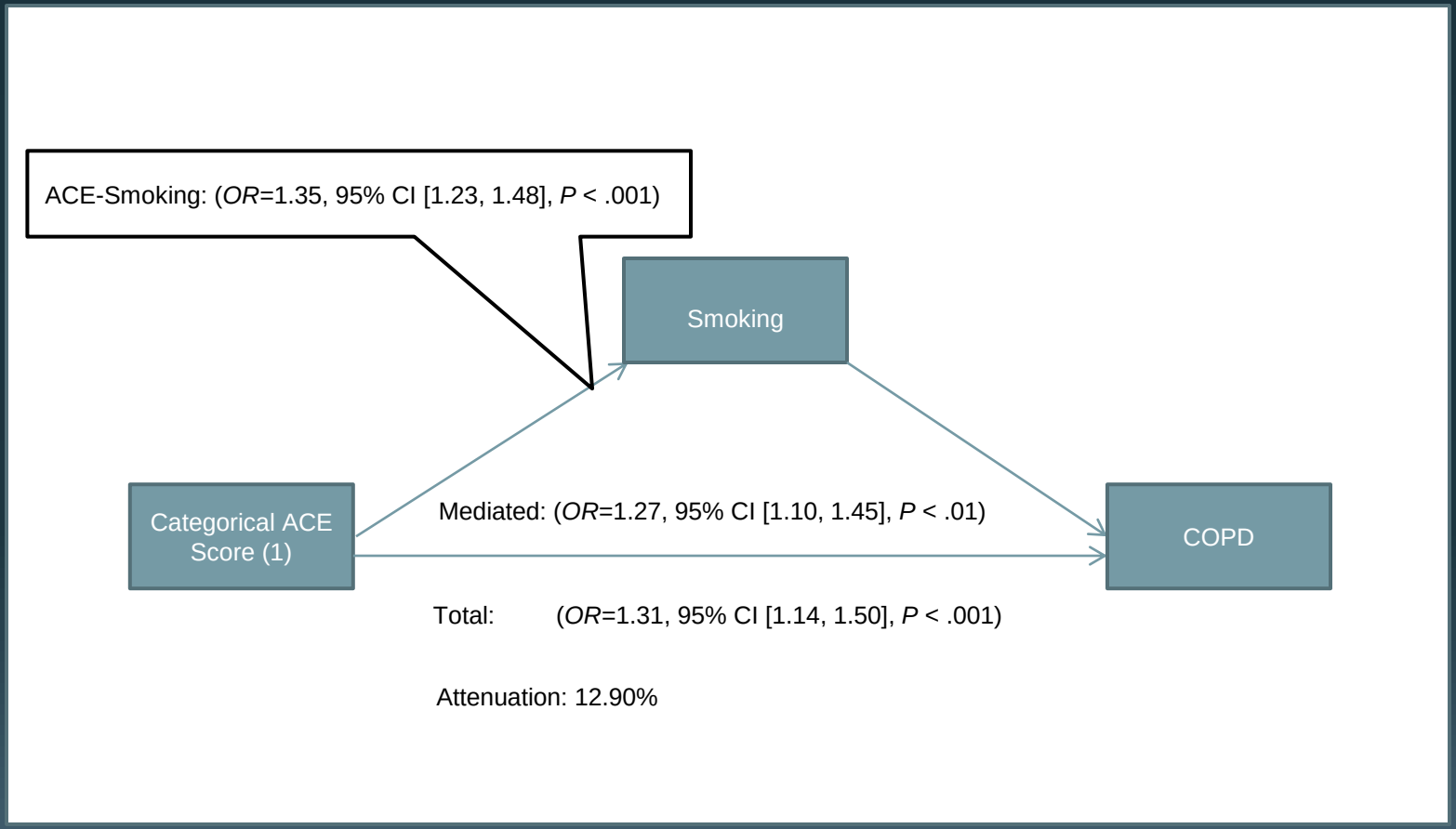

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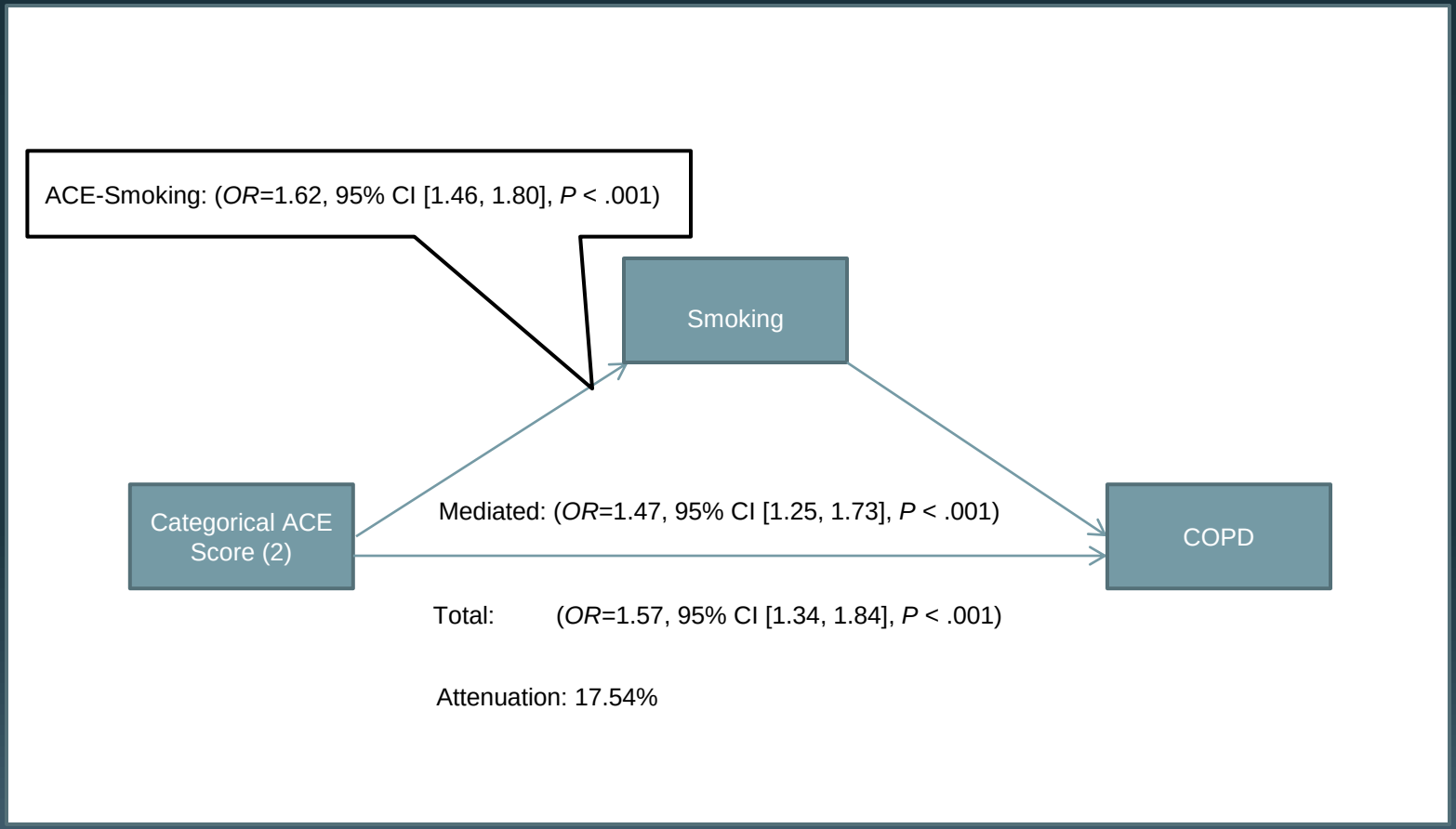

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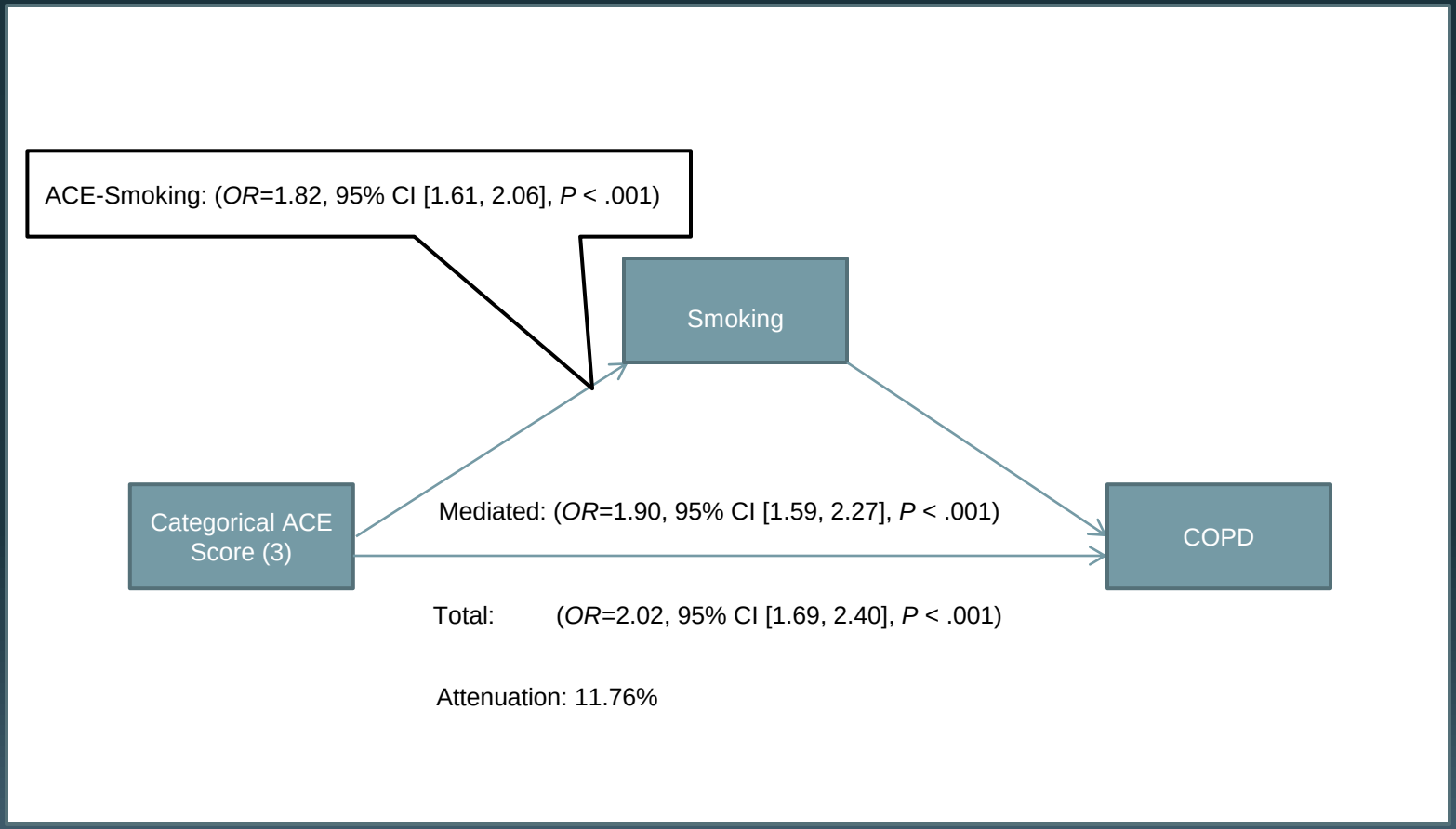

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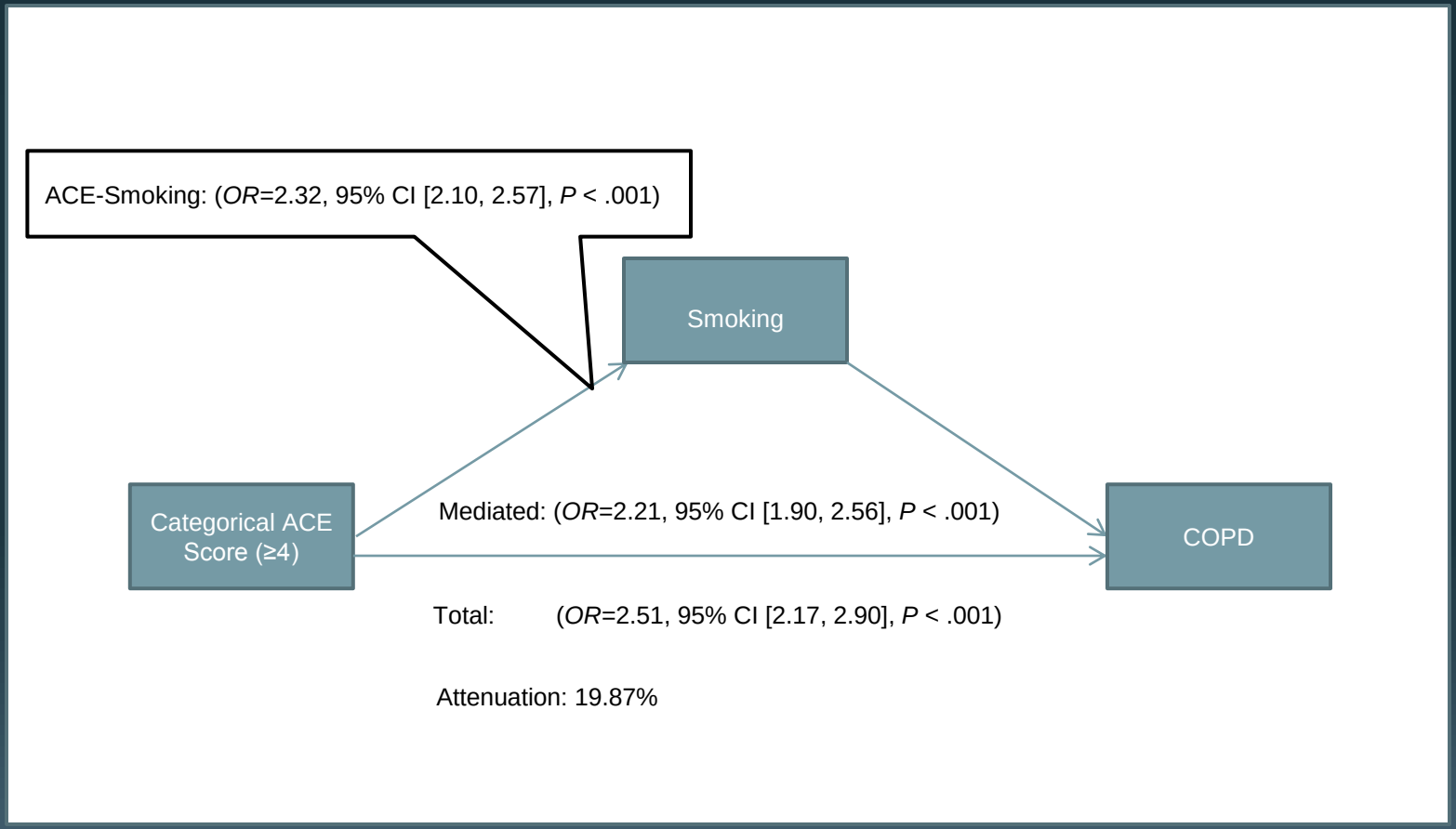

Discussion: Mediation

Relationships between ACEs and smoking

- Each individual ACE category and categorical ACE score was significantly associated with increased risk of smoking.

Relationships between ACEs and COPD

- In addition, individual ACE categories and categorical ACE score were related to increased likelihood of COPD.

Mediation effects

- Both the relationships between individual ACE categories and COPD and categorical ACE score and COPD decreased in regression models including smoking, compared to models excluding smoking status, but the ACE-COPD association remained significant even after addition of smoking.

- Therefore, both the individual ACE categories and categorical ACE score supported the hypothesis that smoking is a partial mediator of the ACE-COPD relationship. Retention of significance in the ACE-COPD relationship after adjusting for smoking suggests that ACEs account for unique and significant variance.

Discussion: Unique Variance in ACE-COPD Relationship

- Stress from exposure to adverse childhood experiences may account for unique variance in the ACE-COPD relationship
  - Trigger changes in the central nervous system, such as increased hypothalamic-pituitary-adrenal (HPA) axis activity that may alter lung development, as well as cardiopulmonary function
  - Lead to HPA dysfunction, decreasing cortisol, increasing inflammatory markers, and ultimately triggering asthma
  - Increase risk for upper respiratory infections, which may reduce lung capacity, and increase the likelihood of COPD in adulthood.

(Bremner & Vermetten, 2001; Cohen, 1996; Cohen, Tyrrel, & Smith, 1991)

Discussion: Study Limitations

Self-report

- Chronic obstructive pulmonary disease diagnosis
- Adverse childhood experiences

Confounding: from risk factors for COPD not controlled for in this study

- Genetics
- Occupational & environmental exposure to air pollution
- Malnutrition
- Childhood respiratory infections
- Tuberculosis

(Buist et al., 2007; Romieu & Trenga, 2001; Shaheen et al., 1995; Silverman & Speizer, 1996; Trupin et al., 2003)

Discussion: Study Limitations

Generalizability

- Five states were examined, limiting the generalizability to representative populations

Causality

- Retrospective cross-sectional study design limits causal inferences about the direction of the association between ACEs, initiation of smoking, and development of COPD
- Childhood sexual abuse has been associated with increased prevalence of early smoking initiation, after excluding individuals who started smoking before being abused

(Anda et al., 1999; Ford et al., 2011)

Discussion: Policy

- Our study and the ACE literature suggest that ACEs are associated with
  - Risky health behaviors
  - Harmful health outcomes
  - Significant economic costs
- Enactment of policies designed to prevent ACEs have the potential to improve population health and yield significant cost savings
  - Washington State is leading the way
    - House Bill 1965, enacted June 15, 2011, creates a private-public partnership between community public health networks, coalitions, and communities to reduce ACEs
    - In addition, Washington has created a fund for evidence-based home visiting programs and a program to ensure quality childcare and chances for learning in early childhood

(Kagi & Regala, 2012)

Discussion: Policy

- Maternal, Infant, and Early Childhood Home Visiting program (MIECHV)
  - Authorized by the Patient Protection and Affordable Care Act (2010), amending Title V of the Social Security Act
  - Partnership between Maternal Child Health Bureau and Administration for Children and Families, and grantees, including state, tribal, and non-profit organizations
  - Purposes Include:
    - "to improve coordination of services for at risk communities"
    - "to identify and provide comprehensive services to improve outcomes for families who reside in at risk communities"

Discussion: Recommendations

Public Health Practitioners can improve population health by

- Assessing the ACE environment in our local communities
- Using evidence-based programs
- Investing in early education of at risk children and parent coaching through visitation programs
  - HighScope Perry Preschool Program had a 7-12 dollar return for each dollar invested
  - Five-percent increase in male high school graduation rate will save Pennsylvania 182 million dollars in annual crime-related costs
- Build community capacity, a strategy associated with lower ACE prevalence, that emphasizes
  - shared focus
  - Collaborative leadership including the community
  - Constant learning
  - Emphasizes outcomes

(Alliance for Excellent Education, 2006; Hall et al., 2012; Heckman et al., 2010; Heckman, 2013; Porter, 2010)

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Acknowledgements

Questions & Answers