

# The Developmental Epidemiology Strategy for Prevention Research

An integration of:

- Community epidemiology
- Life Course Development
- Preventive Intervention Trials

*Sheppard G. Kellam, M.D.*

*AIR Center for Integrating Education and*

*Prevention Research in Schools,*

*Professor Emeritus JHU Bloomberg School of Public Health*

*Presentation for Institute of Medicine*

*Committee on Prevention of Mental Disorders*

*Washington DC, October 30, 2007*

## AUTHORS

Sheppard Kellam, American Institutes for Research

C. Hendricks Brown, University of South Florida

Jeanne Poduska, American Institutes for Research

Wei Wang, University of South Florida

Peter Toyinbo, University of South Florida

Hanno Petras, University of Maryland

Holly Wilcox, Johns Hopkins University

Nicholas Ialongo, Johns Hopkins University

Carla Ford, American Institutes for Research

Amy Windham, American Institutes for Research

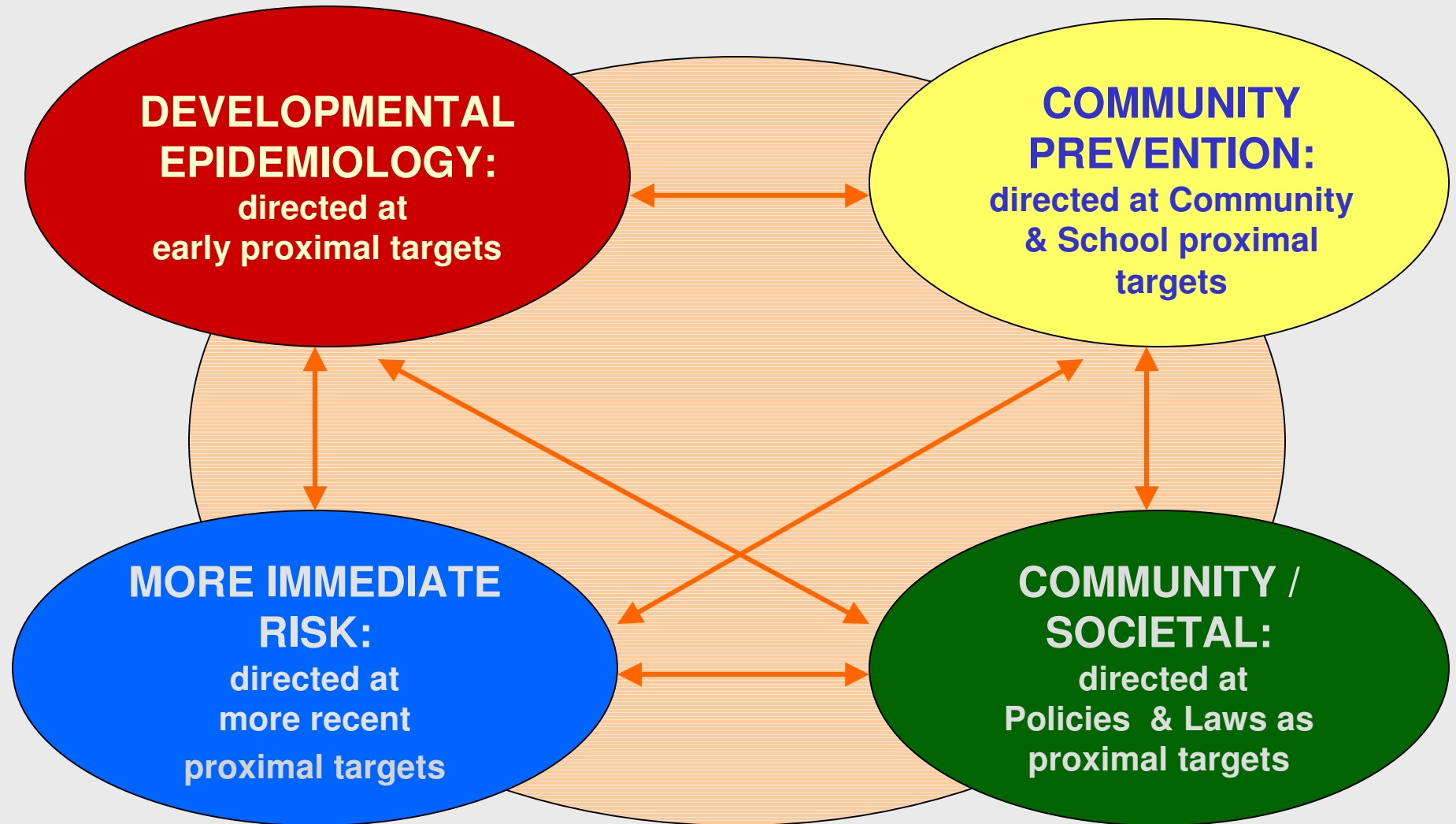
**We are deeply indebted to the staffs from NIDA, NIMH, and NICHD and to the scientific peer reviewers for support of the Baltimore Prevention Trials since 1984.**

The 1<sup>st</sup> generation research reported here was supported by NIMH Grants R01 MH 42968, P50 MH 38725, R01 MH 40859, and T32 MH018834, with supplements from NIDA for the cited research grants. The current 3<sup>rd</sup> generation trial was first supported by NICHD R21 040051 and the full trial by NIDA RO1 15409 and RO1 019884. New methodology was supported by NIMH and NIDA through R01MH40859.

## Developmental Epidemiology based Randomized Preventive Trials

- § One of a set of current prevention research strategies
- § Intervention is directed at early risk factor to reduce risk and improve developmental trajectories and outcomes
- § Defining population helps control selection bias
- § Allows study of means, but also variation in developmental paths and in impact—  
"who benefits and under what conditions"
- § Periodic follow-up to determine impact on paths and outcomes—main effects and variation

# Prevention Research Strategies



# Two Main Functions of Developmental Epidemiology Based Randomized Trials

- 1) *Theory building and testing*:** to test the role of early antecedents along developmental paths in the etiology of outcomes.
- 2) *Developing Effective Prevention Programs*:** to test the utility of directing interventions at early antecedents to prevent the outcomes.

## Early Risk in Prevention and Education Research

- § Over the last four decades much has been learned about early risk factors and paths leading to drug abuse, and other behavioral, mental health, and school problems.
- § Most if not all are strongly related to school failure, also a major risk factor for later drug abuse, alcohol, tobacco, depression, and other problem outcomes.
- § Aggressive, disruptive behavior as early as 1<sup>st</sup> grade has been repeatedly found a risk factor for later drug and alcohol abuse and disorders, delinquency, violence, tobacco use, high risk sex, and other high risk behaviors.

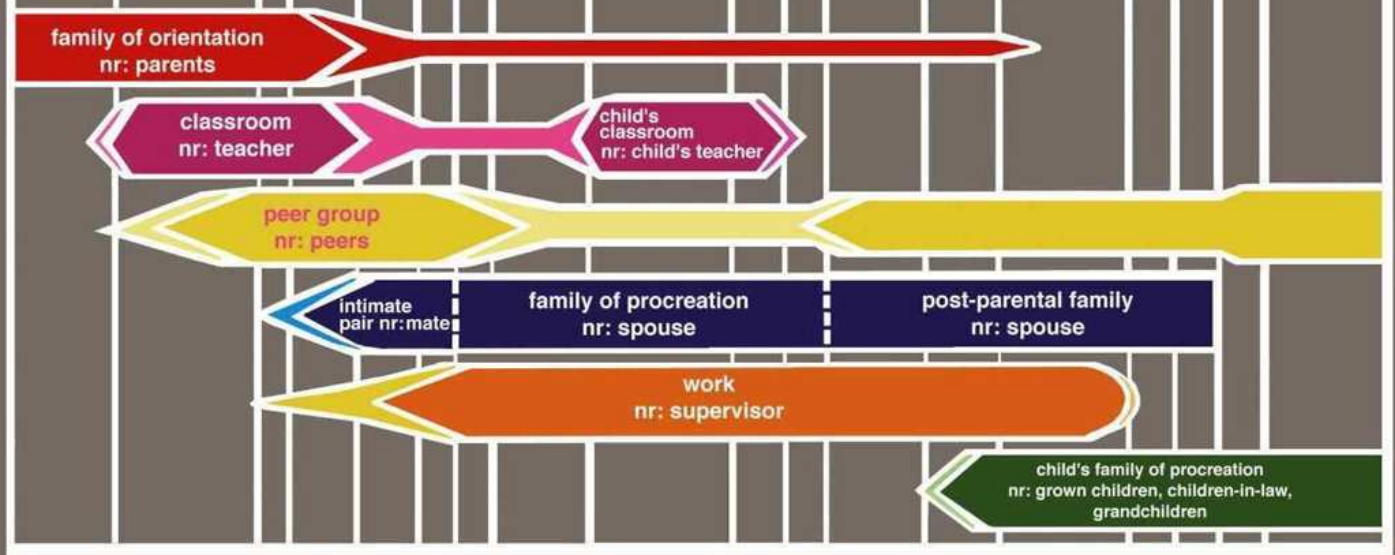
stages of life

infancy and early childhood    middle childhood    adolescence    early adulthood    middle age    old age

major life changes



social fields and natural raters



# LIFE COURSE-SOCIAL FIELD CONCEPT

Kellam, S.G., et al. (1976)- Mental Health and Going to School: The Woodlawn Program of Assessment, Early Intervention, and Evaluation. University of Chicago Press. Revised 1989

# The Baltimore Education and Prevention Partnership

- § The Baltimore City Public School System (BCPSS) has collaborated in 3 generations of education and prevention field trials.
- § They were directed at helping children master key social task demands in 1<sup>st</sup> grade classroom.
- § Interventions were tested separately, then together.
- § The 1<sup>st</sup> generation will be our main focus today, where the Good Behavior Game (GBG) was tested by itself and the children, now young adults, were recently followed to ages 19-21.



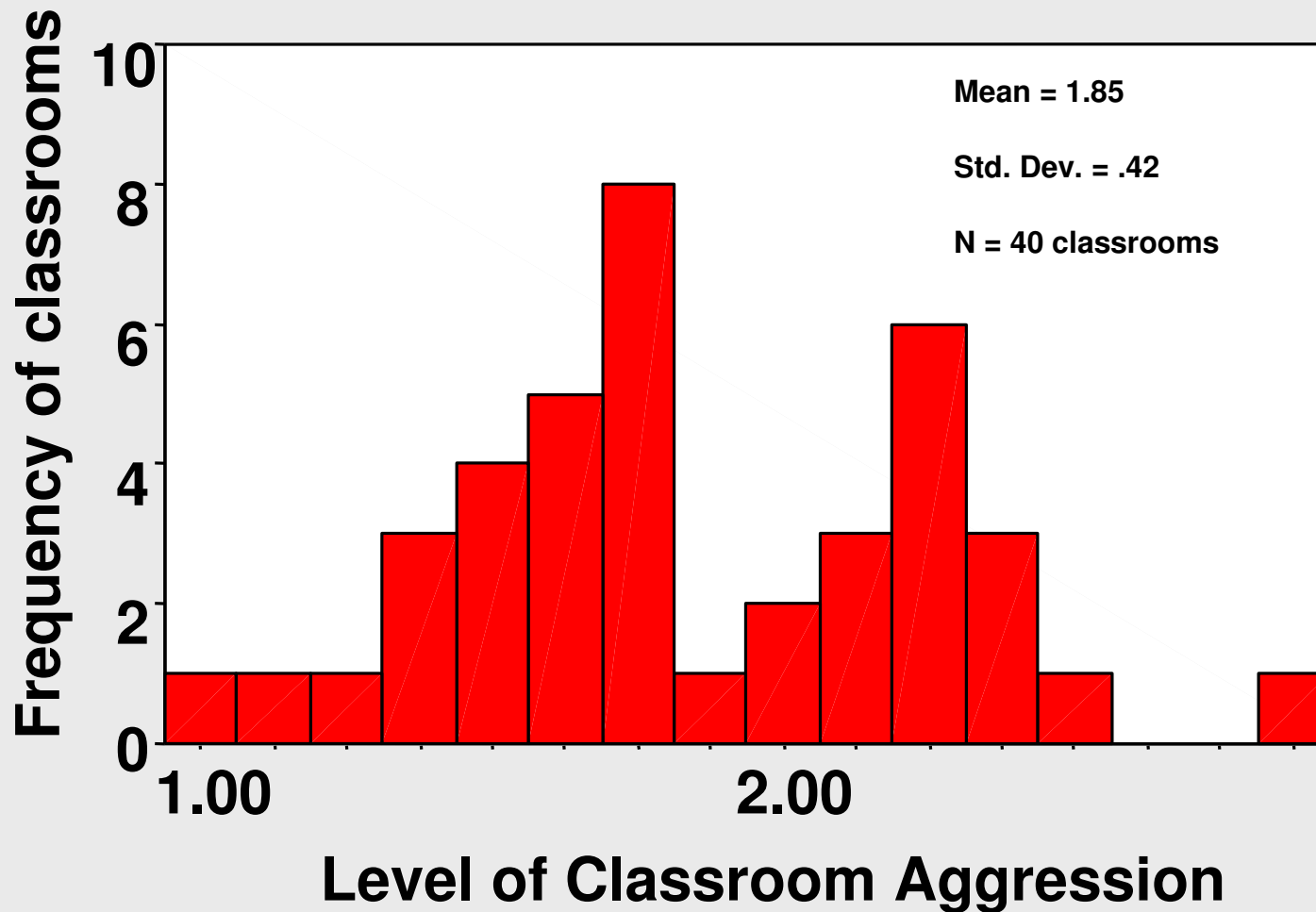
# **Baltimore City Public School System Partners 2004-5**

- § **Patricia Welch, Ph.D., Chair, BCPSS Board of School Commissioners**
- § **Bonnie Copeland, Ph.D., Chief Executive Officer**
- § **Linda Chinnia, Chief Academic Officer**
- § **Ben Feldman, Ed.D., Research, Evaluation and Accountability Officer**
- § **Sue Cutter, Area 1 Interim Academic Officer**
- § **James Smith, Area 2 Academic Officer**
- § **Brenda Kelly, Ph.D., Coordinator, Early Childhood Education**
- § **Gwen Cleage, Curriculum and Instruction Officer**
- § **La Verne Sykes, Director, Parent and Community Involvement**
- § **Deborah Wortham, Ph.D., Director of Professional Development**
- § **Tom Bowmann, Director, Elementary Curriculum**
- § **Marietta English, President, Baltimore Teachers Union**
- § **James Gittings, Public School Supervisors and Administrators Association**
- § **20 Schools, Principals, and Teachers Areas 1 & 2**

# High Risk Children in Well vs Poorly-Managed Classrooms (control classrooms)

- § If the top 25% of children on aggressive behavior were in disrupted classrooms, their risk of severe aggressive behavior by middle school was up to 59 times the average child's.
- § If similar children were in well-managed classrooms, the risk was up to 2.7 times the average child's.

# Classroom Levels of Aggressive, Disruptive Behavior 8-10 Weeks After Random Assignment in First Grade (control classrooms)



# Impact of Poorly Managed Classrooms on Teachers

- § The number-one reason for teacher burn-out is the inability to manage classrooms.
- § Teachers need tested tools to manage classrooms, i.e., to teach children how to be students.
- § A large portion of 1<sup>st</sup> grade teachers need such tools, e.g. ~50% in Baltimore.

# Goals of the Good Behavior Game (GBG)

- § Provide teachers a classroom-wide method to socialize children into the role of student
- § Reduce classroom aggressive, disruptive behavior among children to enhance classroom teaching and learning
- § Prevent later drug abuse, delinquency, school failure and other problem outcomes

# The History of the Good Behavior Game (GBG), a Universal Classroom-wide Program

- § The GBG was originally developed by Barrish, Saunders, & Wolfe at the University of Kansas in the late 1960s
- § The GBG had been replicated over 18 times in smaller efficacy trials prior to the Baltimore large scale developmental epidemiological trial.

# Design of 1<sup>st</sup> Generation Baltimore Trial: Two Separate Classroom Interventions Aimed at Aggressive Behavior and Poor Achievement

- § 41 1st grade classrooms in 19 schools
- § **Across schools:** 3 or 4 schools in each of 5 low to low/mid SES urban areas were matched. 70% African American. Schools in each set were randomly assigned either to the standard program (control); or to an enhanced curriculum (Mastery Learning--ML); or to a classroom behavior management program (Good Behavior Game--GBG).
- § **Within intervention schools:** Children were balanced across all 1st grade classrooms. 1st grade classrooms and teachers were randomly assigned to standard program classrooms or to intervention classrooms.

# Study Design cont.

- § In the 1<sup>st</sup> generation, the GBG trial was done over 1<sup>st</sup> and 2<sup>nd</sup> grades in 2 consecutive first grade cohorts.
- § 1<sup>st</sup> cohort with 40 hours of teacher training and support thru the year. This was the effectiveness trial, and will be our focus today.
- § 2<sup>nd</sup> cohort with same teachers with little training and support, tested the sustainability of results.

# Children, Classrooms, and Teachers in GBG or in 3 Types of Controls

- 922 Children in GBG Classrooms or in 3 Types of Control classrooms  
(ML intervention children omitted)
- GBG Intervention: 8 GBG classrooms in 6 schools
- 3 Types of Controls:
  - 6 Internal GBG Control classrooms in the 6 GBG schools,
  - 7 Internal ML Control classrooms in 7 schools where ML was tested,
  - 11 External Control classrooms in 7 schools where no intervention was implemented.

# GBG Implementation

- § In Baltimore, the GBG consists of dividing the 1<sup>st</sup> grade class into 3 heterogeneous teams.
- § Each teacher exhibits a large poster that states proper student behaviors, i.e., classroom rules.
- § Teams are rewarded for each child's pro-social behavior, and not rewarded when a child is disruptive. It is "group contingent."

# GBG Implementation (cont'd)

- § Early in the year, the GBG was played systematically for ten minutes, 3 times a week, and the time extended over the year.
- § Rewards were more abstract as the year went on. It was carried out in first and second grades.

# Measure of Early Classroom Aggressive, Disruptive Behavior

For this presentation a sub-set of *Teacher's Observations of Classroom Adaptation (TOCA R)*, a measure of each child's social adaptation to classroom rules for student behavior

- § Structured 2 hour interview with the teacher, not a checklist
- § Ratings were obtained for each child in the classroom in fall and spring of 1st and 2nd grades, and thereafter in spring of 3<sup>rd</sup>-7<sup>th</sup> grades
- § TOCA Aggressive, Disruptive Items on 6 point scales: (1) breaks rules, (2) harms others and property, (3) breaks things, (4) takes others property, (5) fights, (6) lies, (7) teases classmates (8) yells at others, (9) stubborn, (10) trouble accepting authority

# The Young Adult Follow-up Data

- § One 2 Hour (average) telephone interview with each respondent ages 19-21 (suicidality 2<sup>nd</sup> at age 23).
- § Developmental behavioral, psychological and psychiatric status, WHO version of the CIDI for diagnoses.
- § Juvenile court, prison, and school records.
- § Social adaptational status in social fields of parental family, school, work, intimate relations, marital family if any, peers.

## Balance on Baseline Teacher Ratings and Young Adult Follow-up Status for those Present in Fall of First Grade in 1985 (N = 922)

- No significant difference in mean score on a number of baseline measures for followed-up vs not followed-up:
  - Aggressive / shy behavior
  - concentration problems
  - Self reports of anxiety / depressive symptoms
  - Reading / Math achievement

## Balance on Baseline Teacher Ratings and Young Adult Follow-up Status for those Present in Fall of First Grade in 1985 (N = 922)

- Overall
  - 90% had teacher ratings baseline aggressive behavior
  - 75% interviewed at young adult follow-up
  - Higher attrition rate for males (34%M vs 17%F)
  - White middle class & Greek/Italian low/middle class more likely to be lost to follow-up
- GBG vs Internal GBG control:
  - No difference in rate of attrition

# Core Hypotheses:

- Social maladaptive 1<sup>st</sup> grade males who are aggressive, disruptive will respond positively to teacher's use of the Good Behavior Game to teach social adaptive responses to the social task demands of the classroom.
- Improved social adaptation early will lead to lower risk in later stages of life in the same and other social fields.
- Children without early higher levels of this risk factor will respond less, both boys and girls.

## Analyses of Long-Term Impact of GBG: Aims and Procedures

Test hypothesized impact as a function of baseline aggressive, disruptive behavior and gender

Use multilevel and mixed models addressing child and classroom and school random effects

Use growth mixture models to examine how GBG modifies growth trajectories of aggressive behavior and affects distal outcomes

# Drug and Alcohol Dependence

## Special Issue

***Effects of a Universal Classroom Behavior Management Program in First and Second Grades on Young Adult Behavioral, Psychiatric, and Social Outcomes***

Sheppard G. Kellam et al, in press

***Impact of the Good Behavior Game, a Universal Classroom-Based Behavior Intervention, on Young Adult Service Use for Problems with Emotions, Behavior, or Drugs or Alcohol***

Jeanne Poduska et al, under review

***Developmental Courses Leading to Antisocial Personality Disorder and Violent and Criminal Behavior: Effects by Young Adulthood of a Universal Preventive Intervention in First- and Second-Grade Classrooms***

Hanno Petras et al, under review

***The Impact of Two Universal Randomized First- and Second-Grade Classroom Interventions on Young Adult Suicidality***

Holly C. Wilcox et al, under review

***Methods for Testing Theory and Evaluating Impact in Randomized Field Trials: Intent-to-Treat Analyses for Integrating the Perspectives of Person, Place, and Time***

Hendricks Brown et al, under review

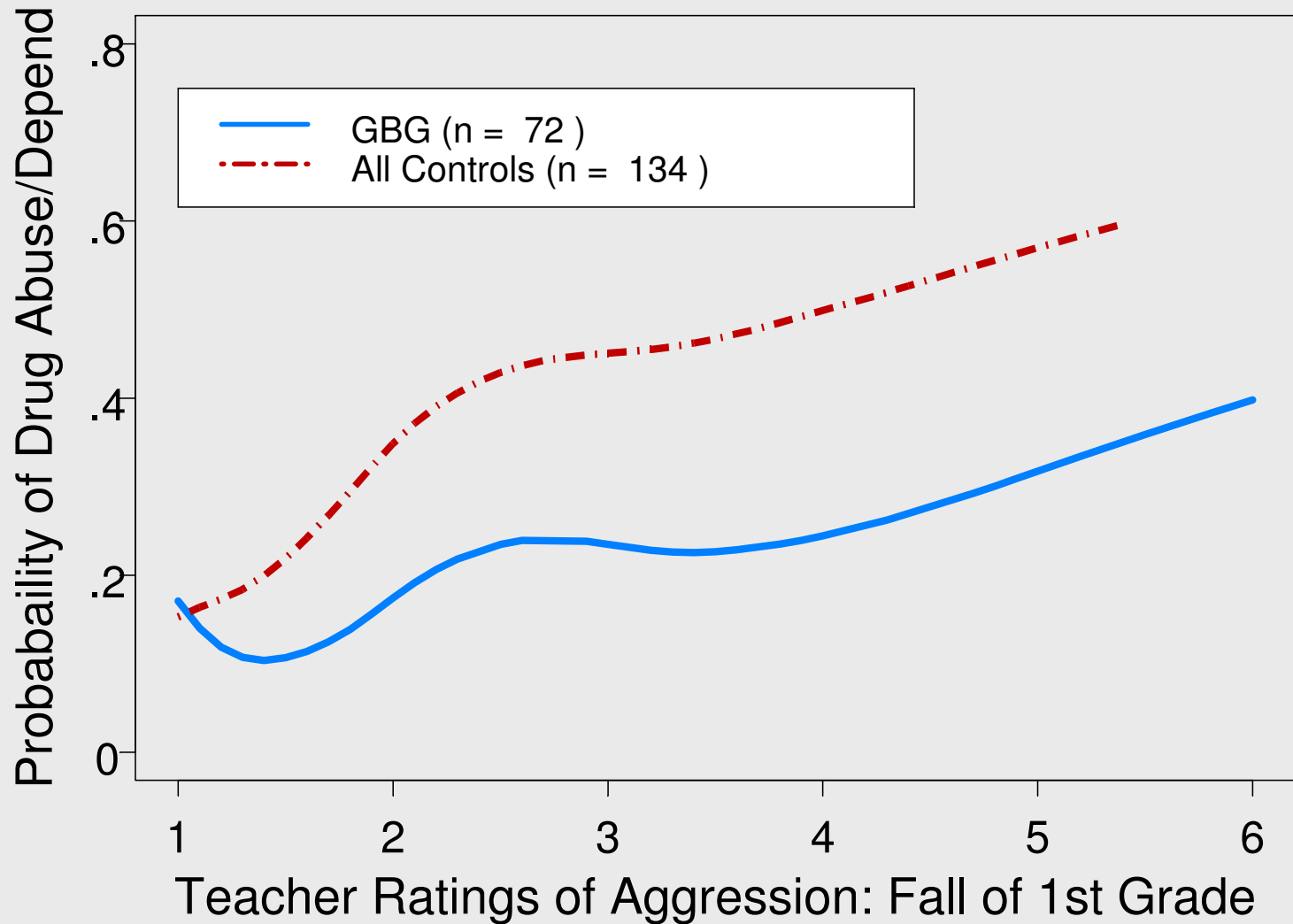
# Variation in GBG Impact by Age 19-21 by Fall of 1<sup>st</sup> Grade Level of Aggressive/Disruptive Behavior and Gender: Using Generalized Additive Mixed Models

Analyses included Fall 1<sup>st</sup> Grade Aggressive/Disruptive Behavior, Gender, and tests for clustering (random effects at classroom and school levels).

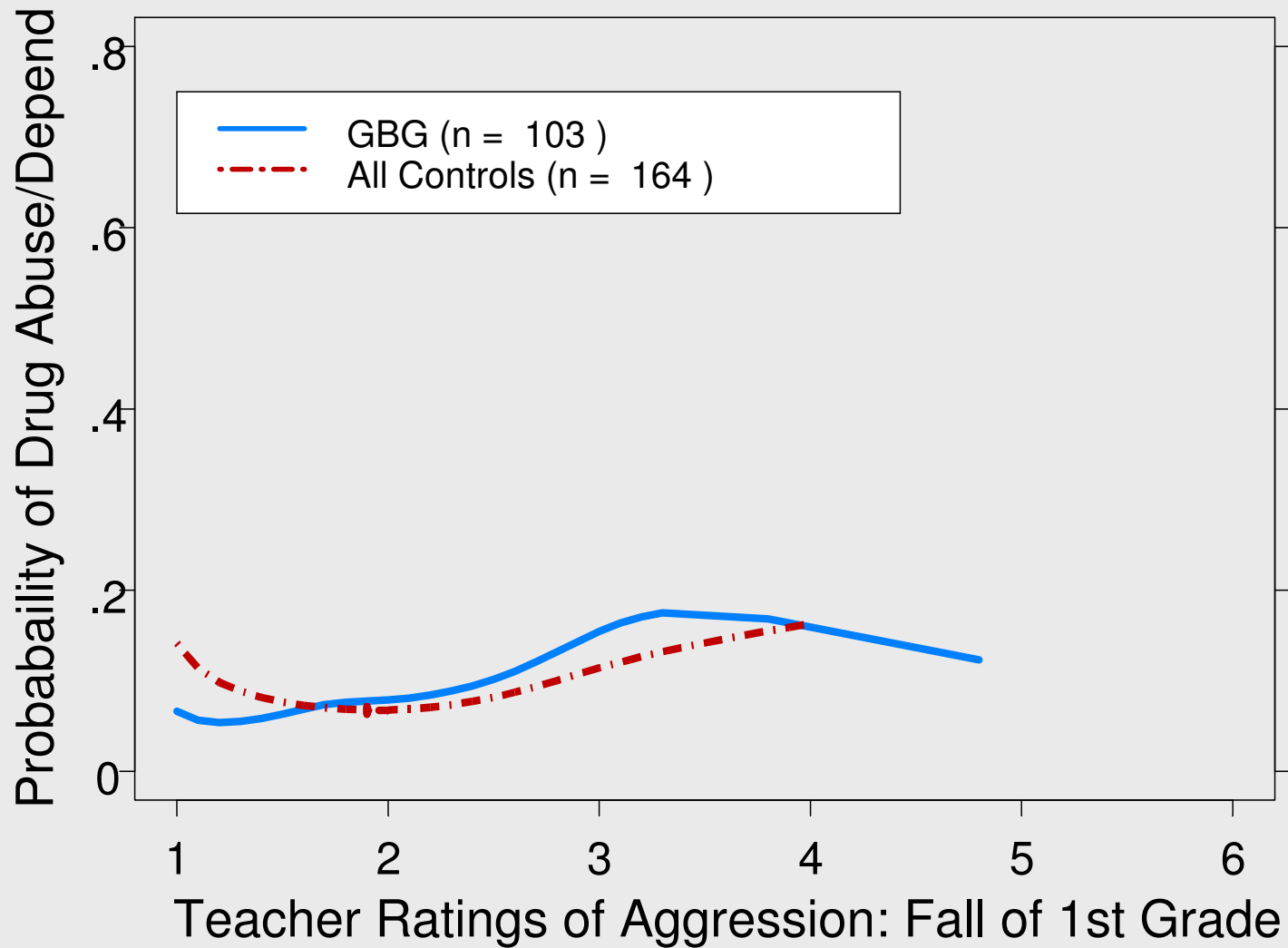
P values are all  $<.05$  for males, not females, taking into account baseline aggressive/disruptive behavior, gender, random effects at classroom and school levels.

Except for high school graduation where there was significant school level random effects and not overall significance.

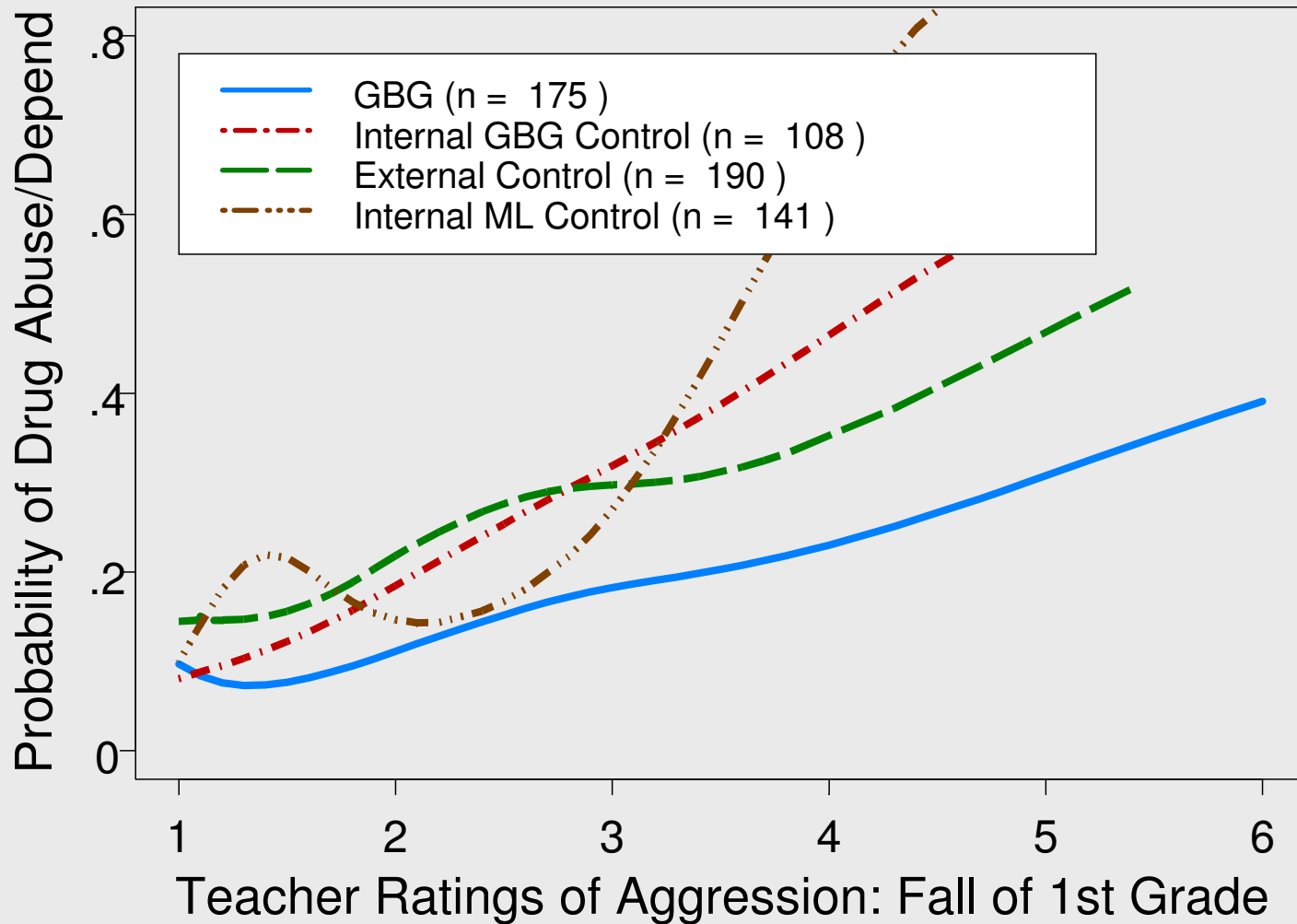
# GBG vs All Controls on Drug Abuse or Dependence Disorders for Males



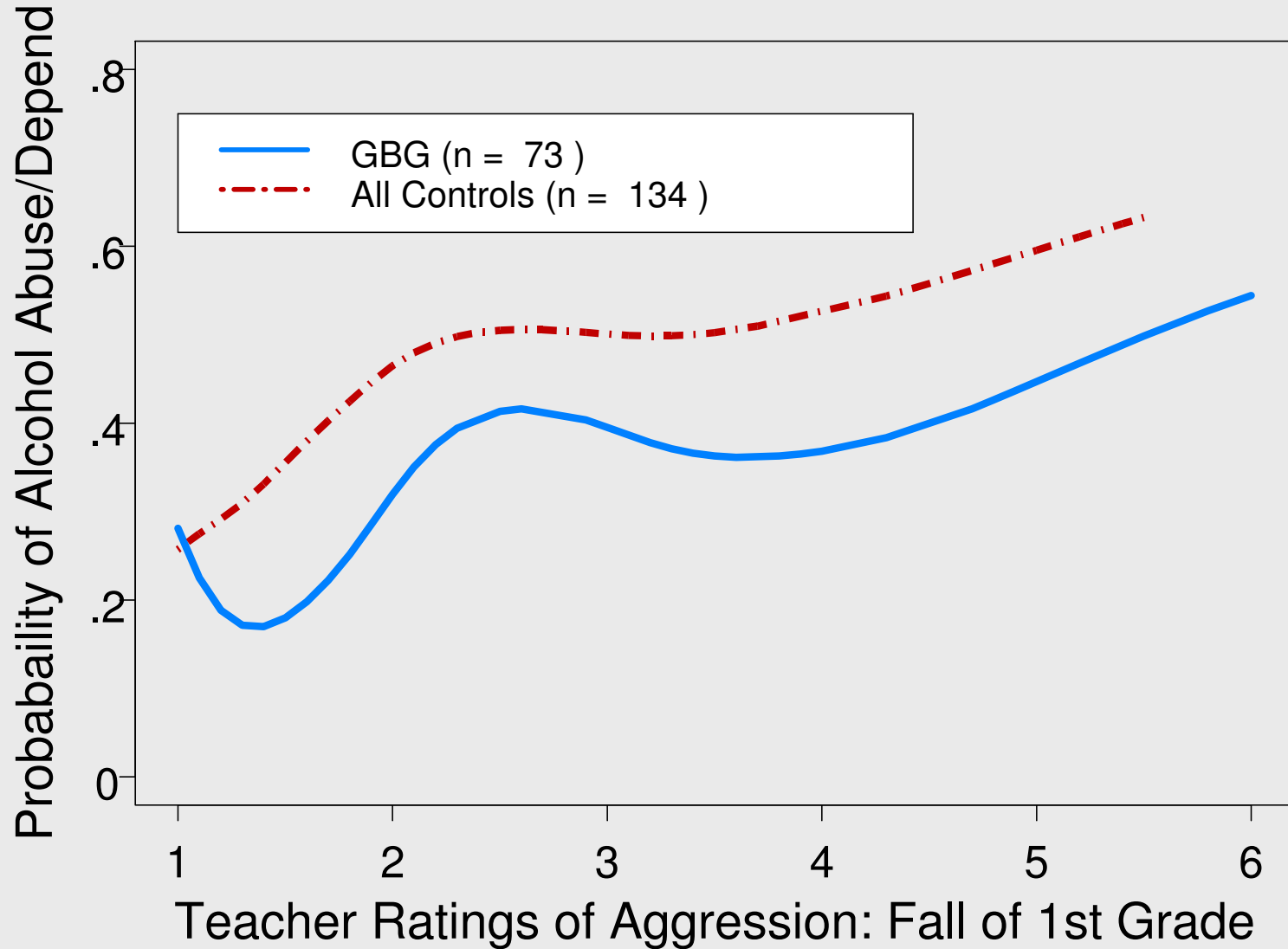
## GBG vs All Controls on Drug Abuse or Dependence Disorders for Females



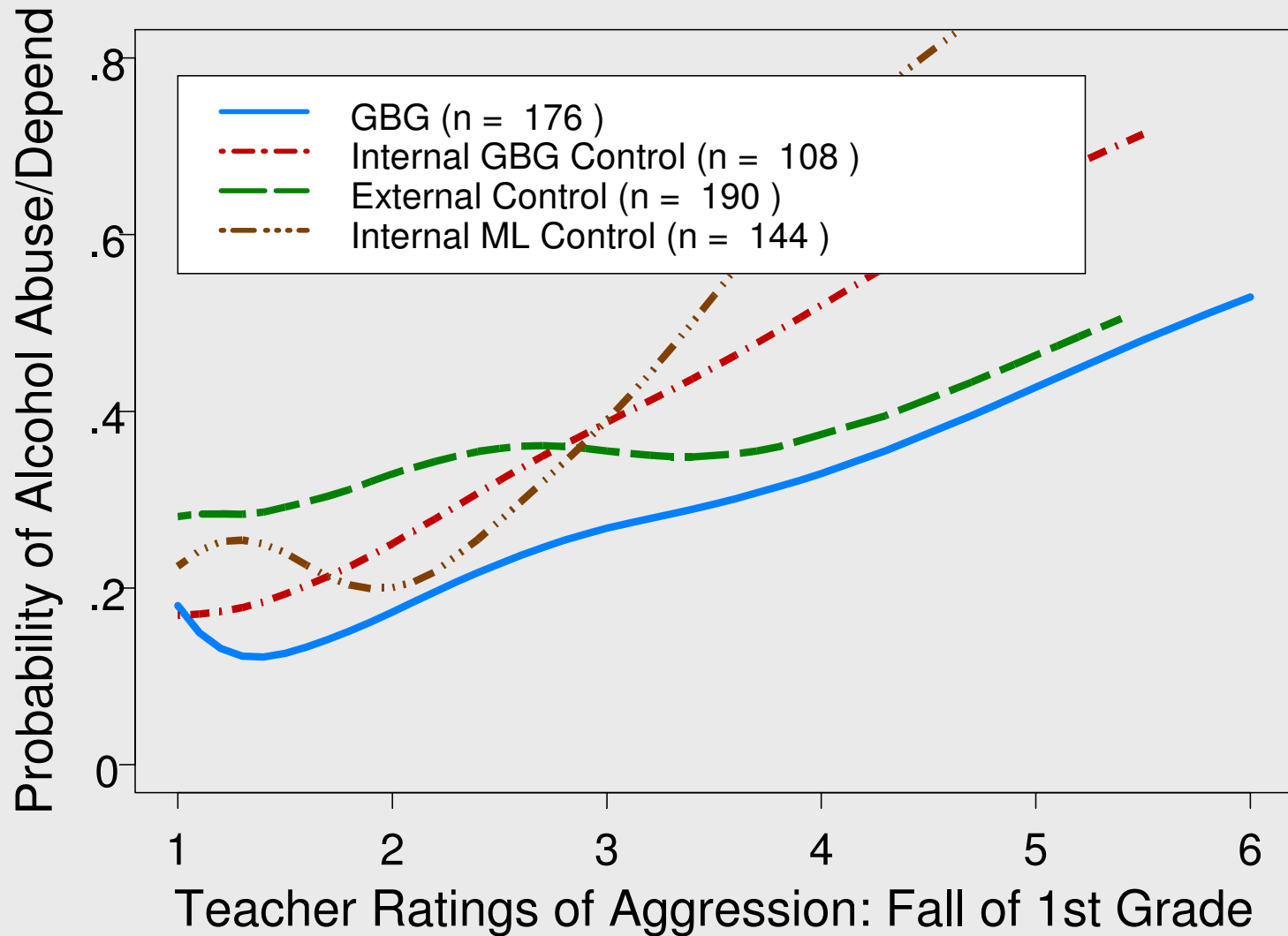
# GBG vs Each Control on Drug Abuse or Dependence Disorders for Males and Females



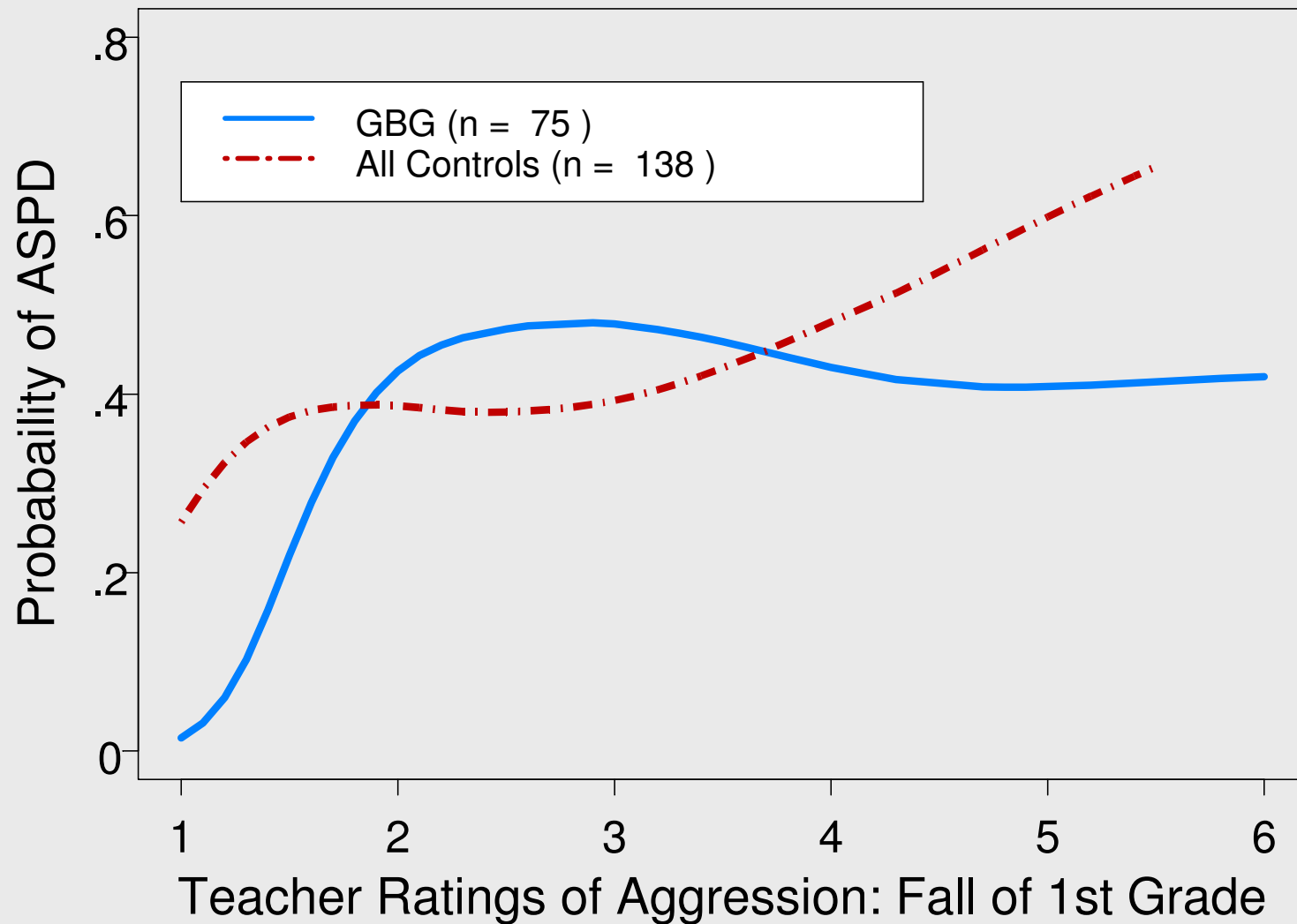
# GBG vs All Controls on Alcohol Abuse or Dependence Disorders for Males



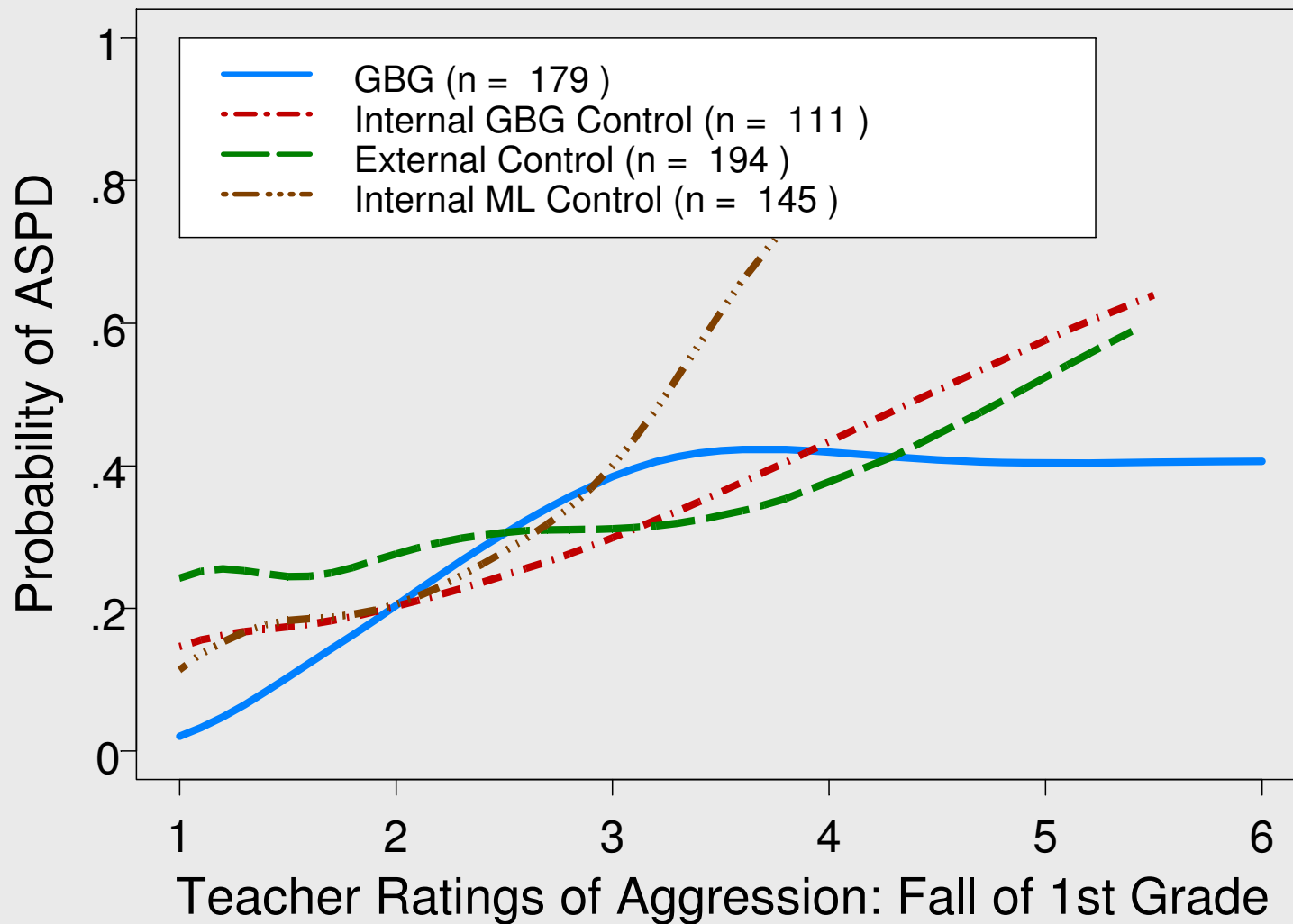
# GBG vs Each Control on Alcohol Abuse or Dependence Disorders for Males and Females



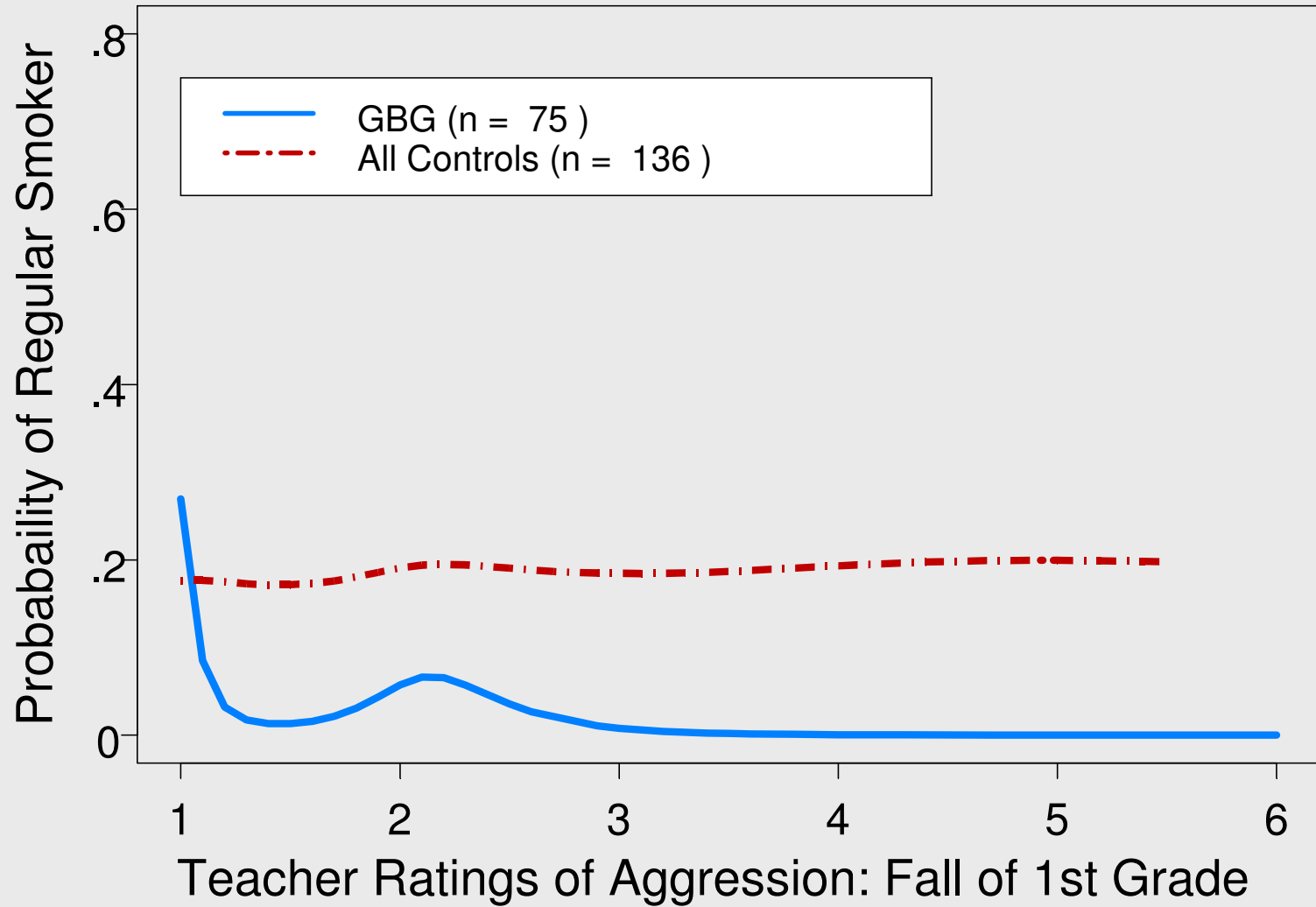
## Impact of GBG Done in 1<sup>st</sup>-2<sup>nd</sup> Grades on ASPD in Males by Ages 19-21 (all controls combined)



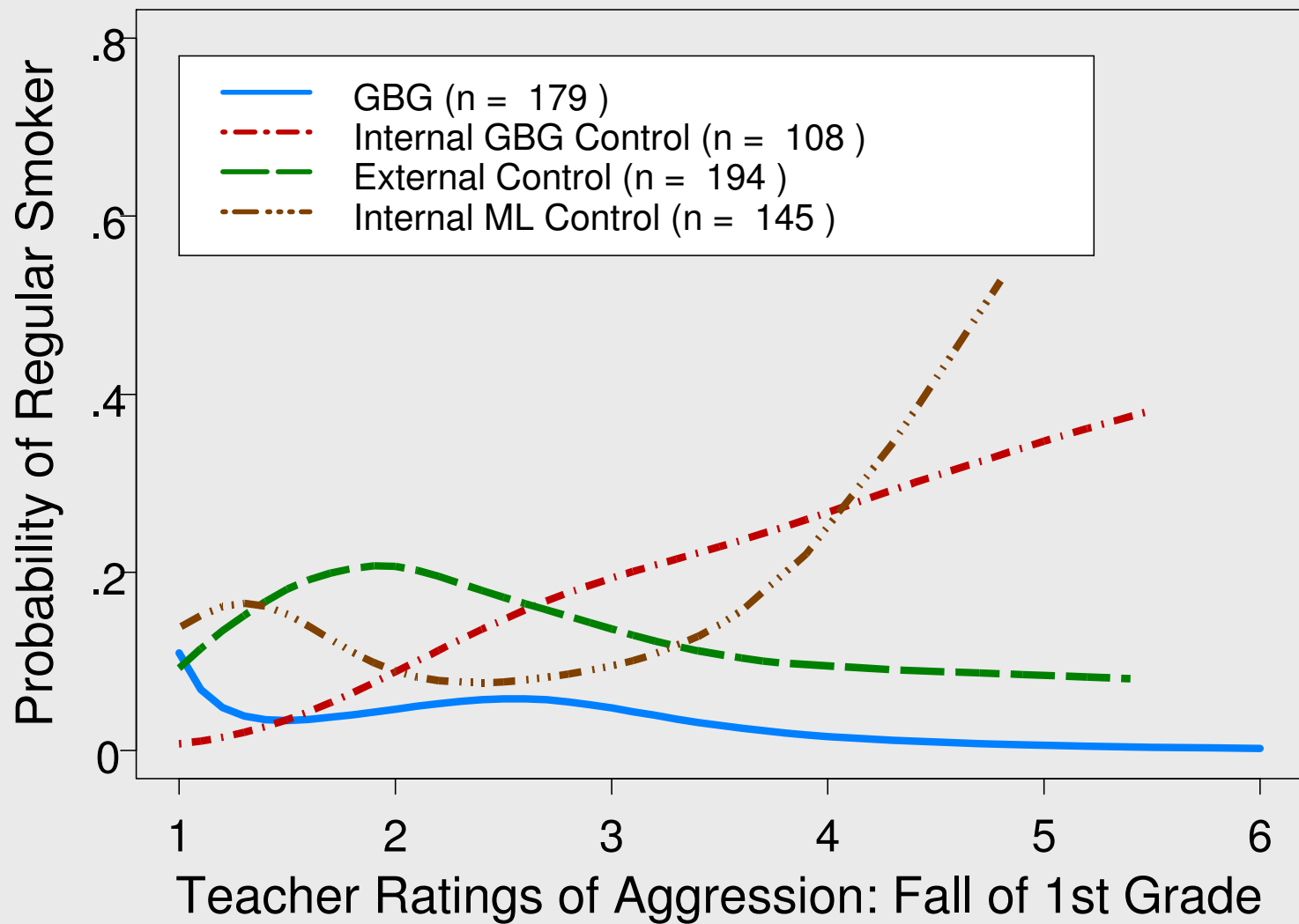
# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades vs All Controls on ASPD in Males and Females by Age 19-21



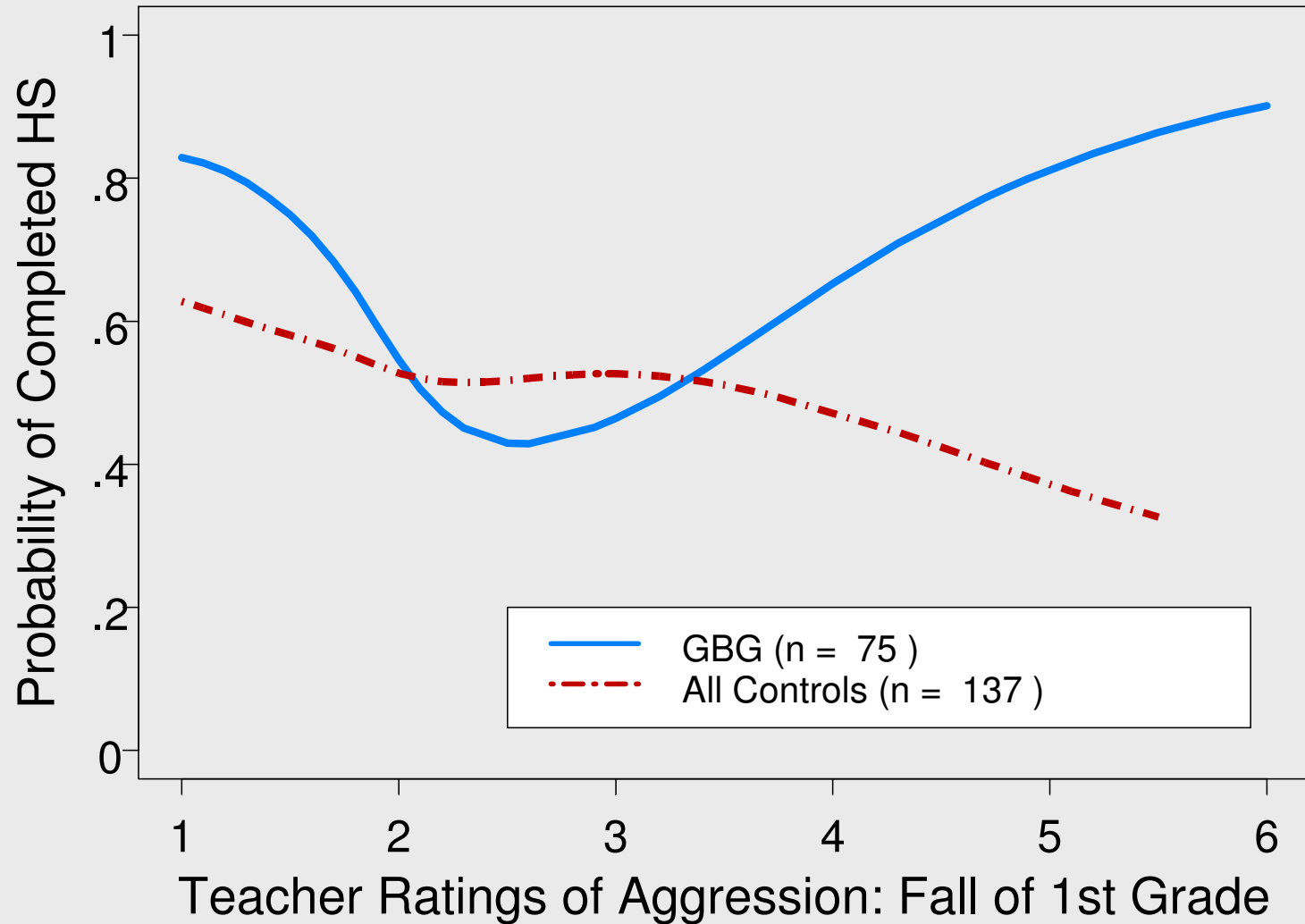
## Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Regular Smoking by Males by Age 19-21 (all controls combined)



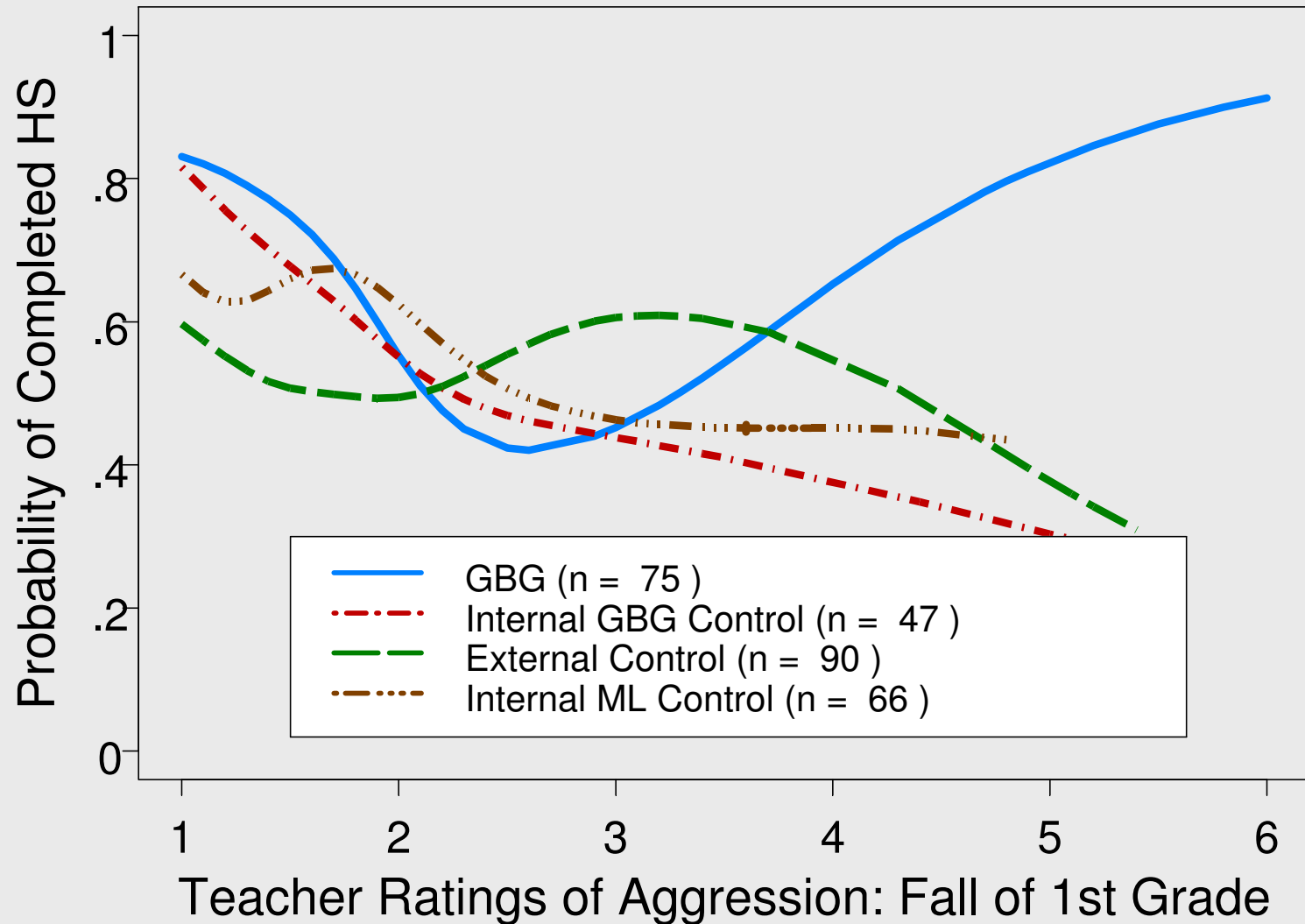
# GBG vs Each Control on Regular Smoking for Males and Females



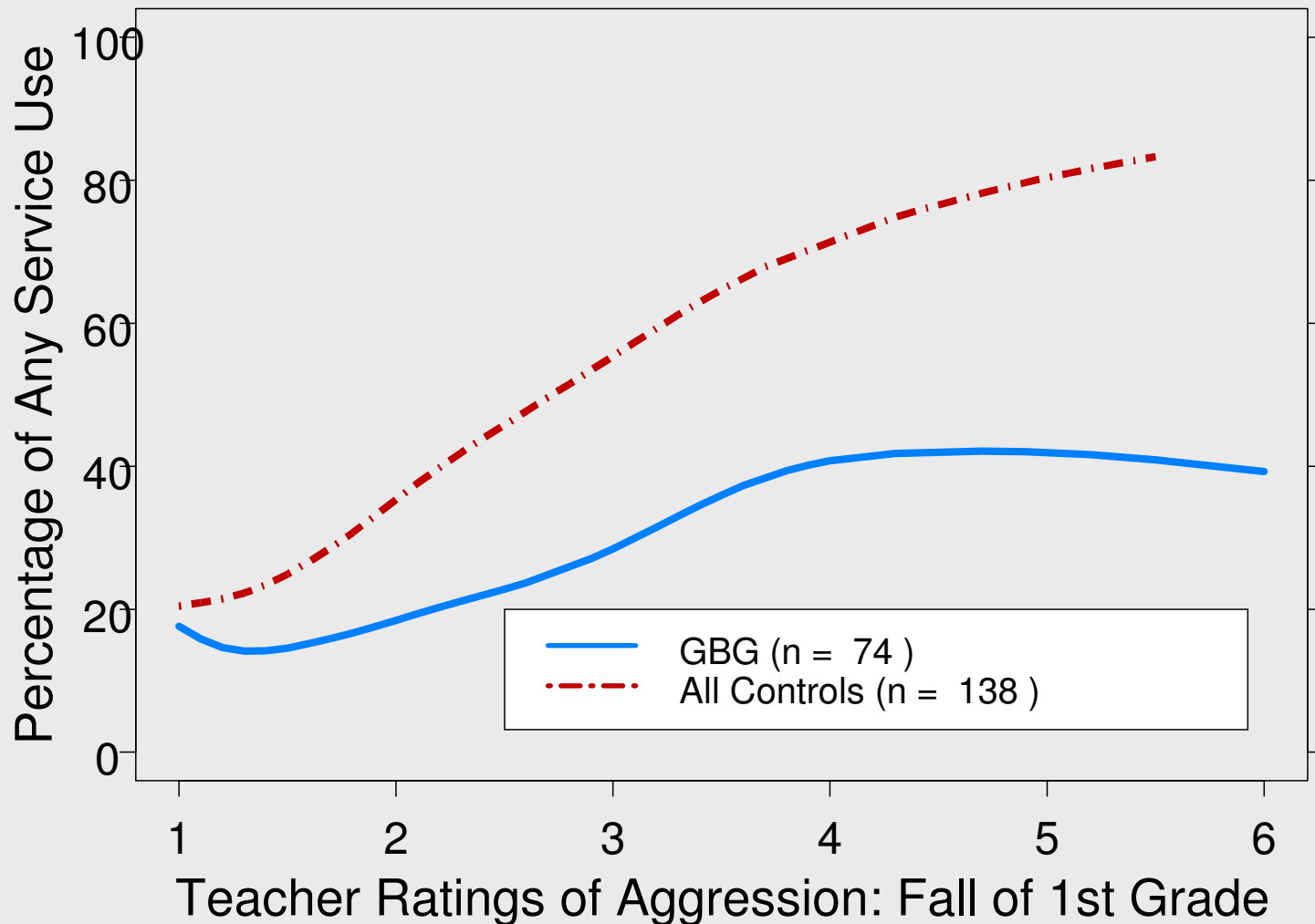
## GBG vs All Controls on Completion of High School by Males \*



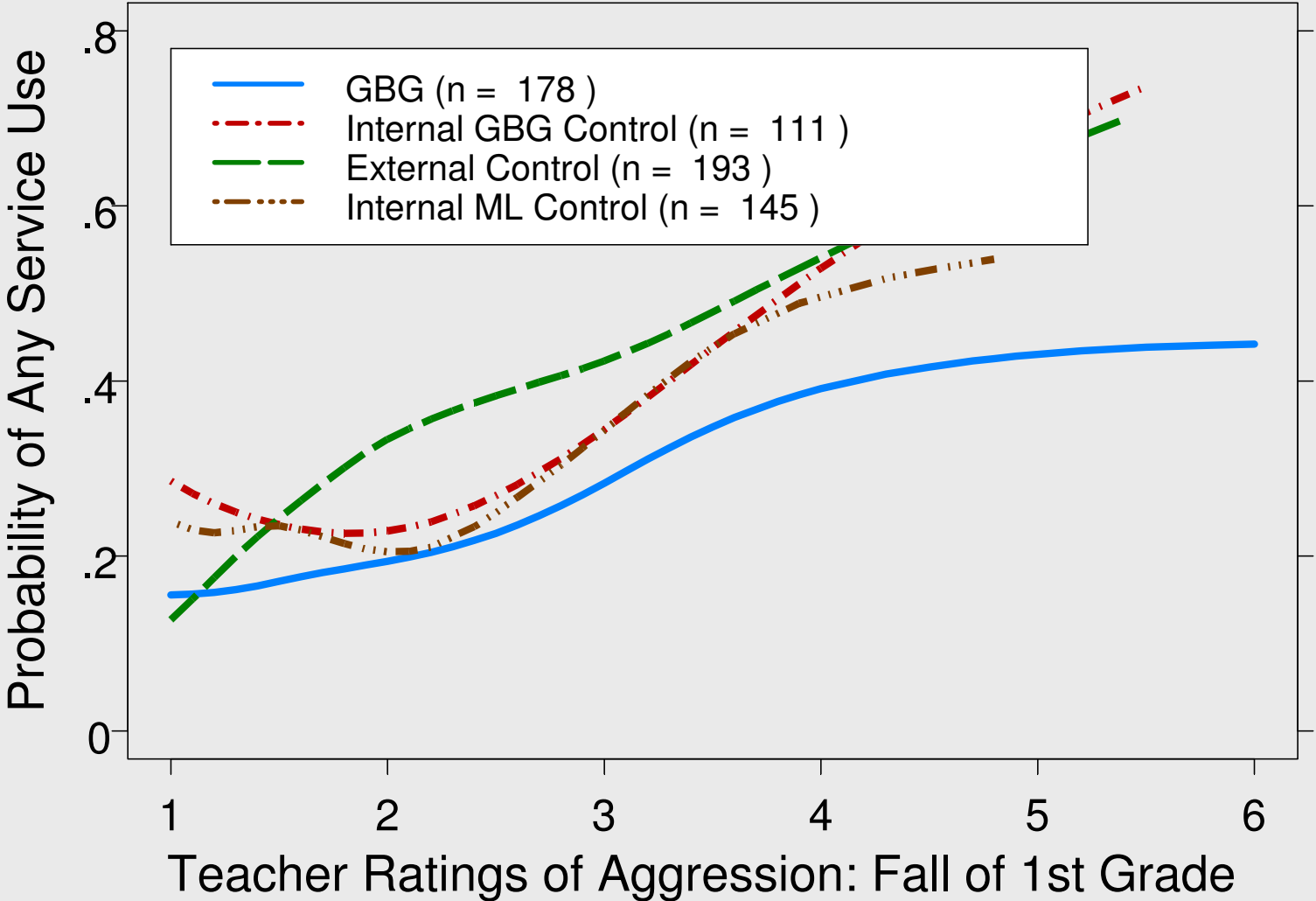
# GBG vs All Controls on Completion of High School by Males \*



# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Use of Services for Drug, Alcohol, Mental Health, and Behavioral Problems by Males Ages 19-21 (all controls combined)



# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Use of Services for Drug, Alcohol, Mental Health, or Behavioral Problems by Males and Females Ages 19-21

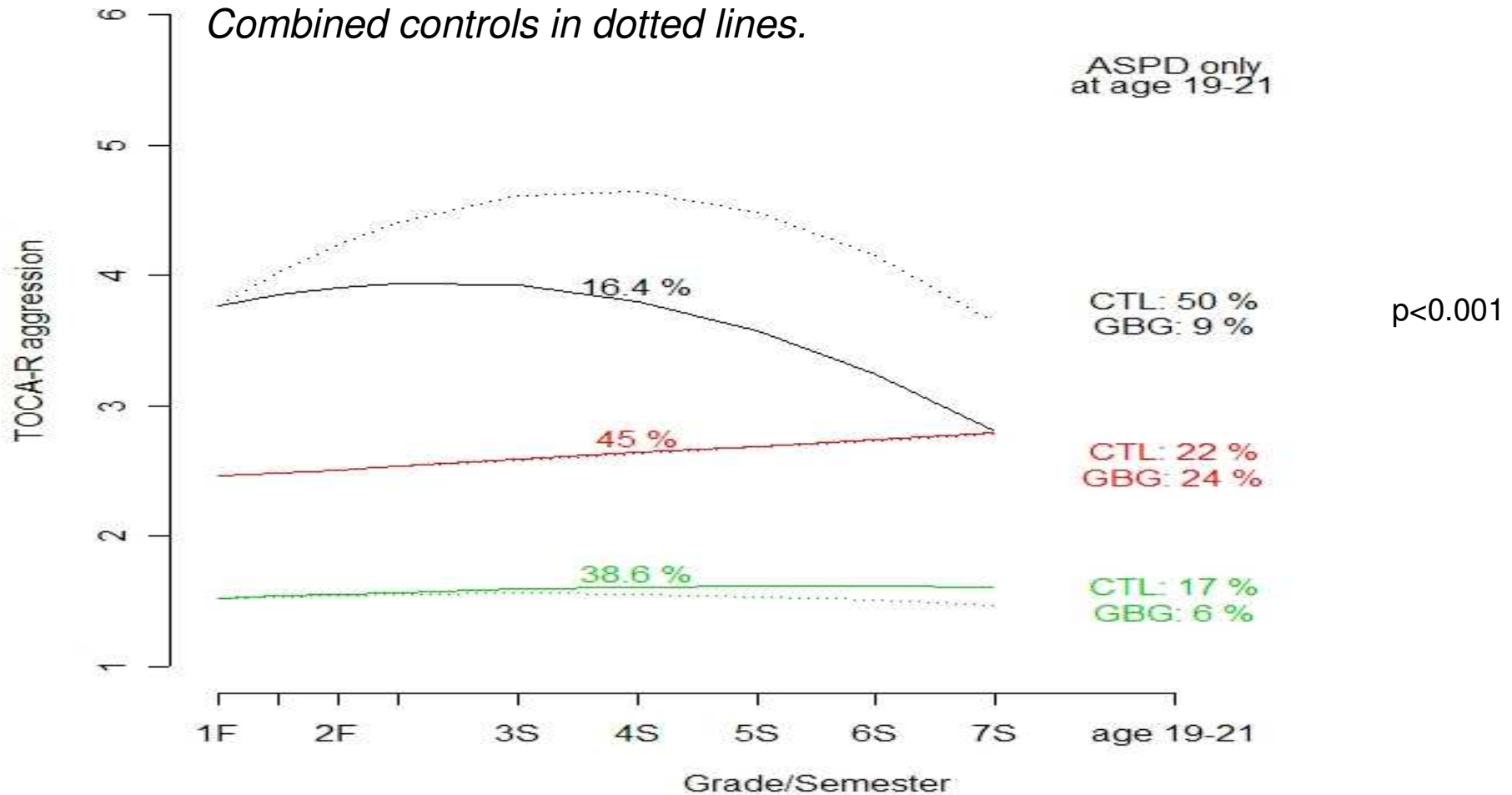


# General Growth Mixture Models (GGMM)

- Trajectories thru 7<sup>th</sup> Grade, not just Fall 1<sup>st</sup> grade, on outcomes age 19-21
- Heterogeneity in growth is captured through trajectory classes (categorical latent variable) and random effects *within* class
- Estimates trajectory shapes, class probabilities, and variation within class
- Covariates can be related to class probabilities as well as within-class variation.
- Classification (and prediction) of individuals
- Class membership can be related to distal outcomes
  
- Petras et al, under review

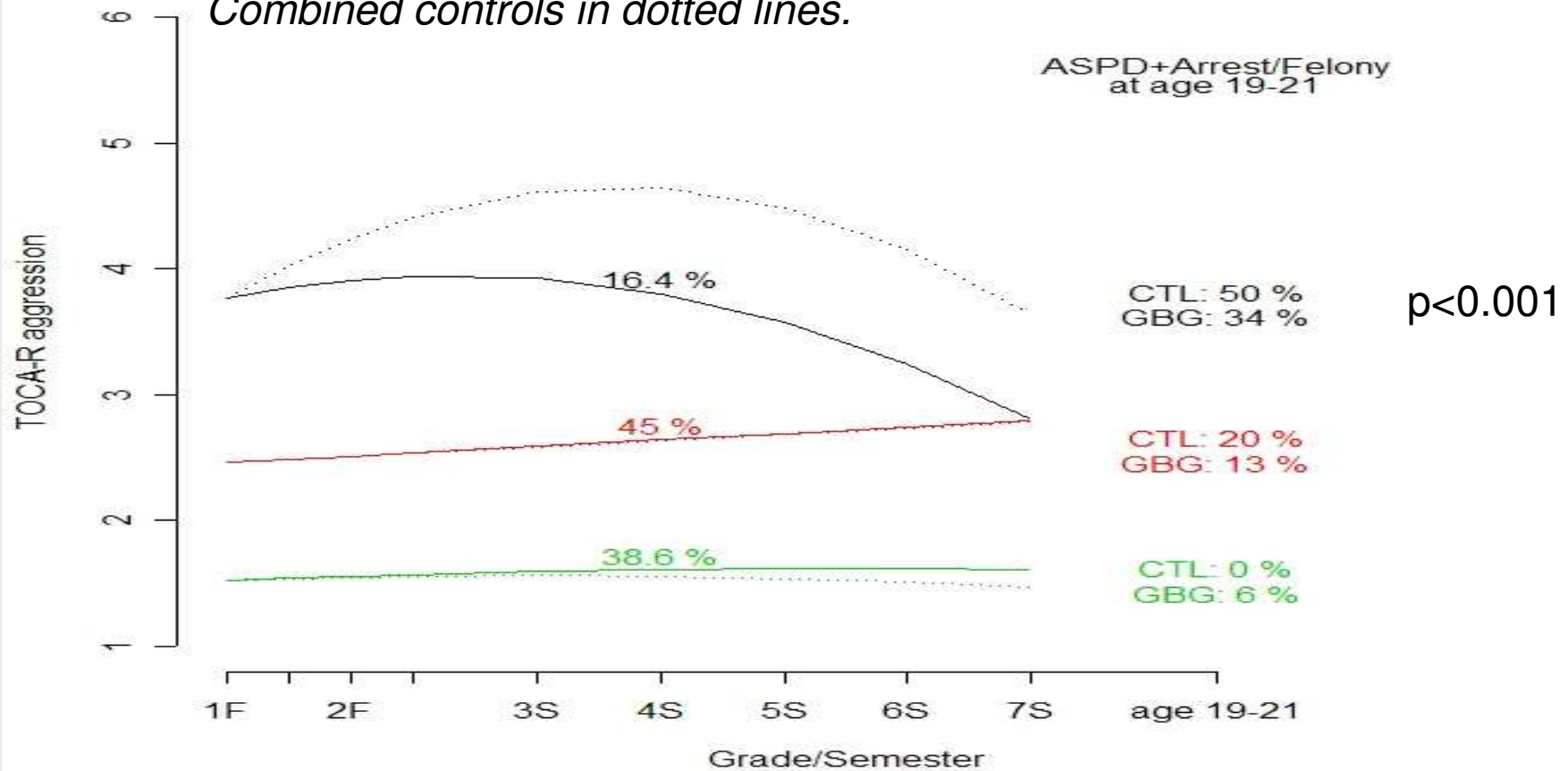
# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Trajectories and ASPD by Age 19-21 (GGMM, cohort 1 males N=199)

The GBG trajectory is shown in bold;  
Combined controls in dotted lines.



# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Trajectories and Juvenile Court and/or Adult Incarceration Records (GGMM Cohort 1 Males N=199)

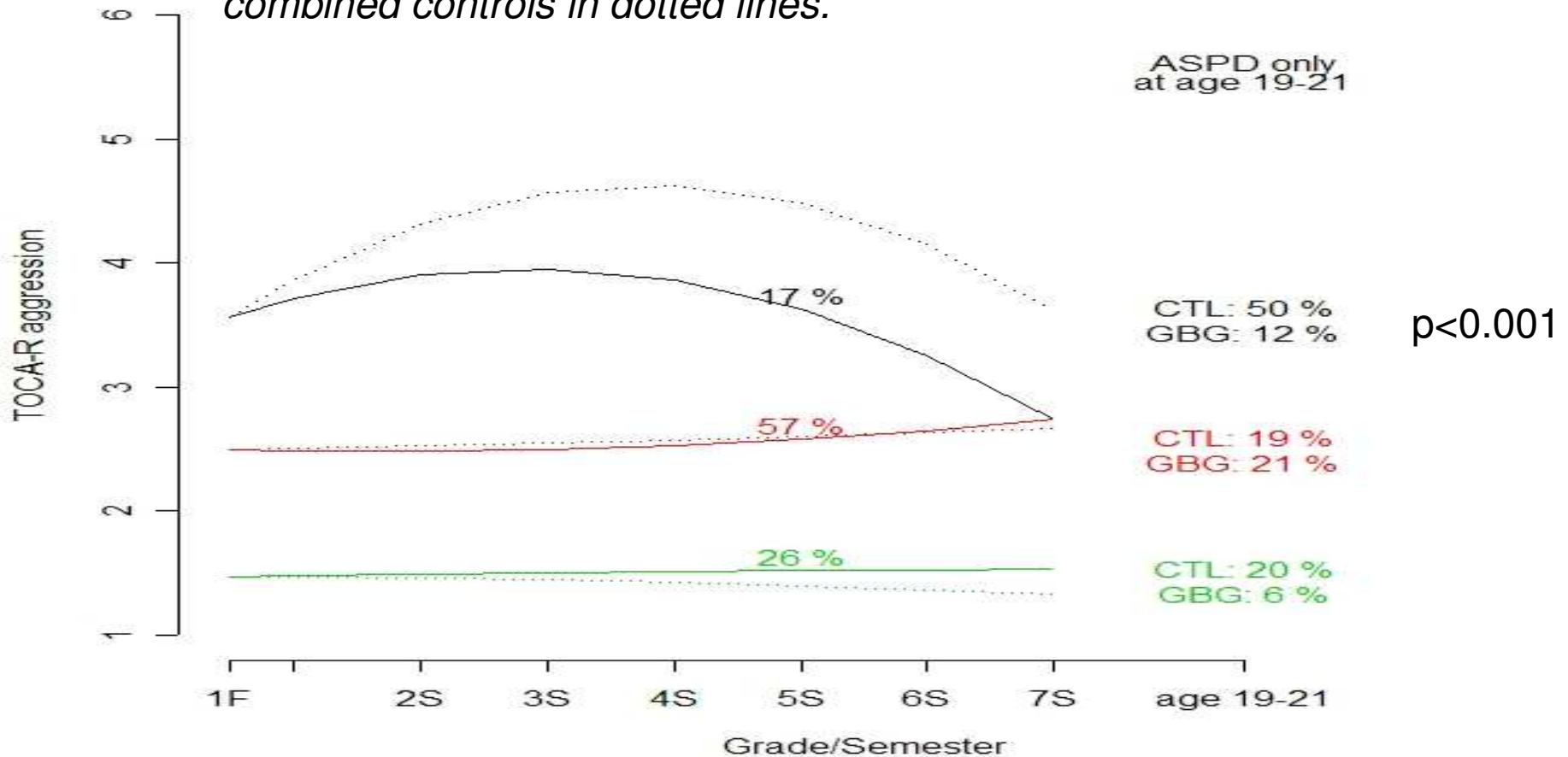
The GBG trajectory is shown in bold;  
Combined controls in dotted lines.



# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Trajectories and ASPD by Age 19-21

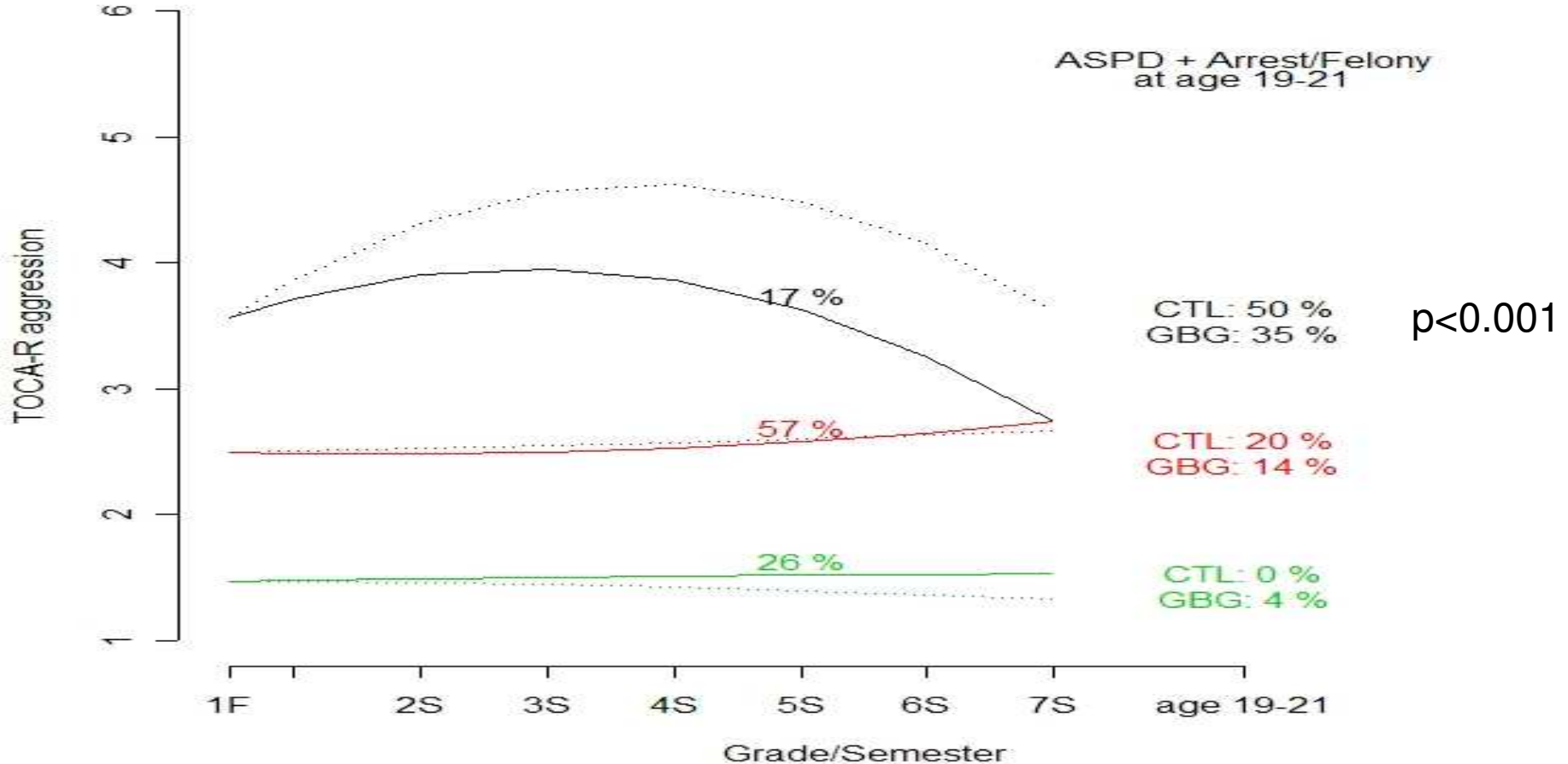
(GGMM cohort 2 males N=188)

*The GBG trajectory is shown in bold; combined controls in dotted lines.*



# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Trajectories and Juvenile Court and/or Adult Incarceration Records (GGMM Cohort 2 Boys N=188)

The GBG trajectory is shown in bold;  
Combined controls in dotted lines.



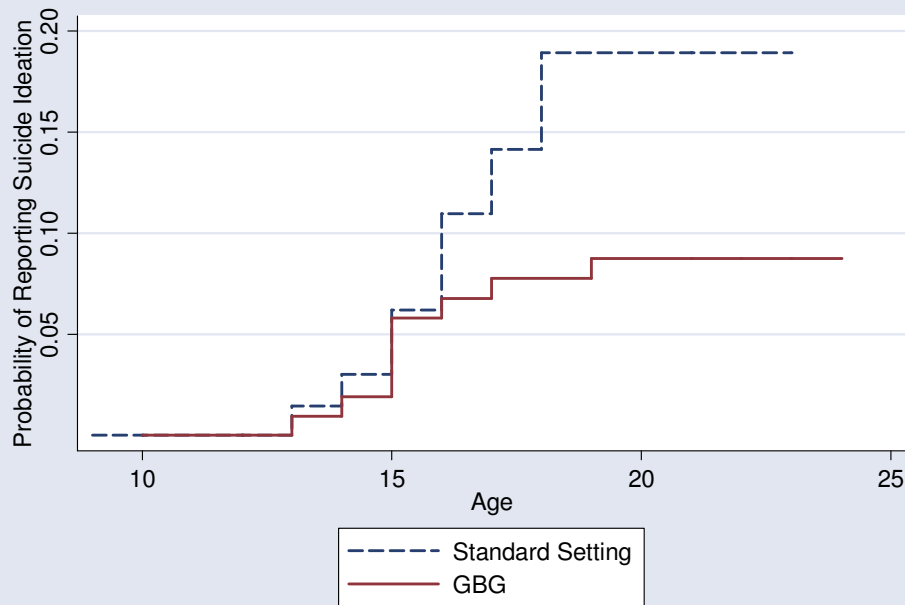
# **Statistical Methods for Suicide Ideation & Attempt Analyses**

## **Kaplan Meier Curves**

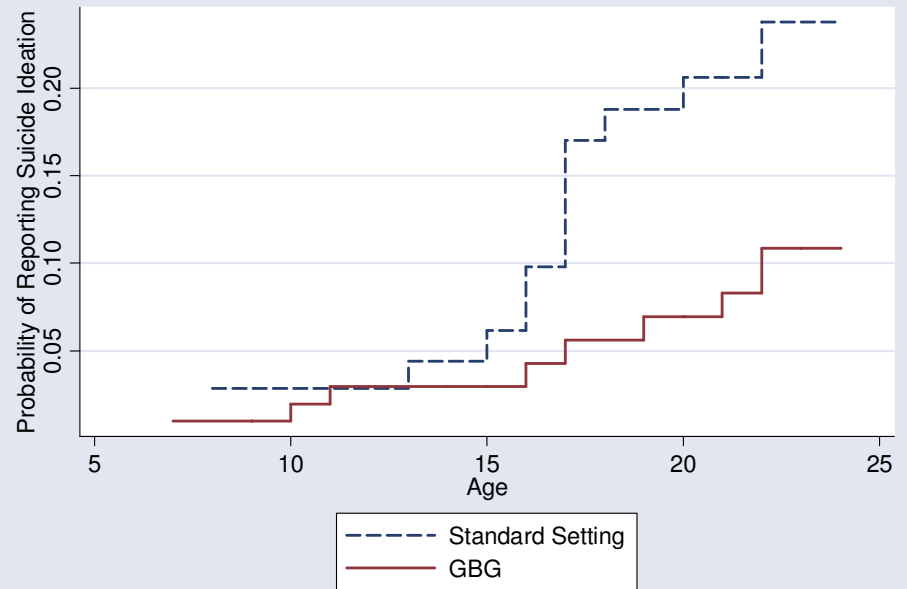
## **Discrete Time Survival Analysis (DTSA)**

- covariate adjustments**
- time measured in discrete units (i.e., age in years)**
- Wilcox et al, under review

# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Suicide Ideation by Age 19-23\*\*



**Females**

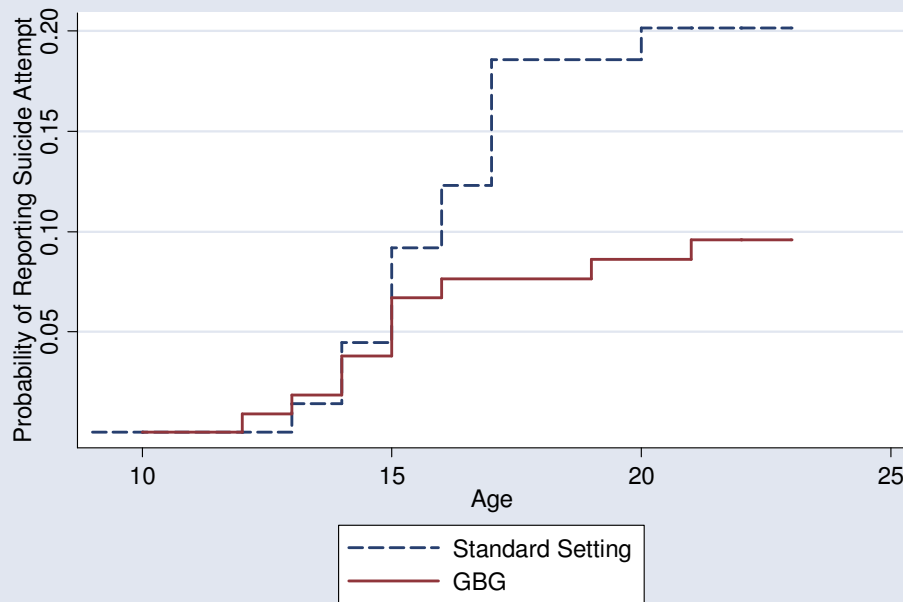


**Males**

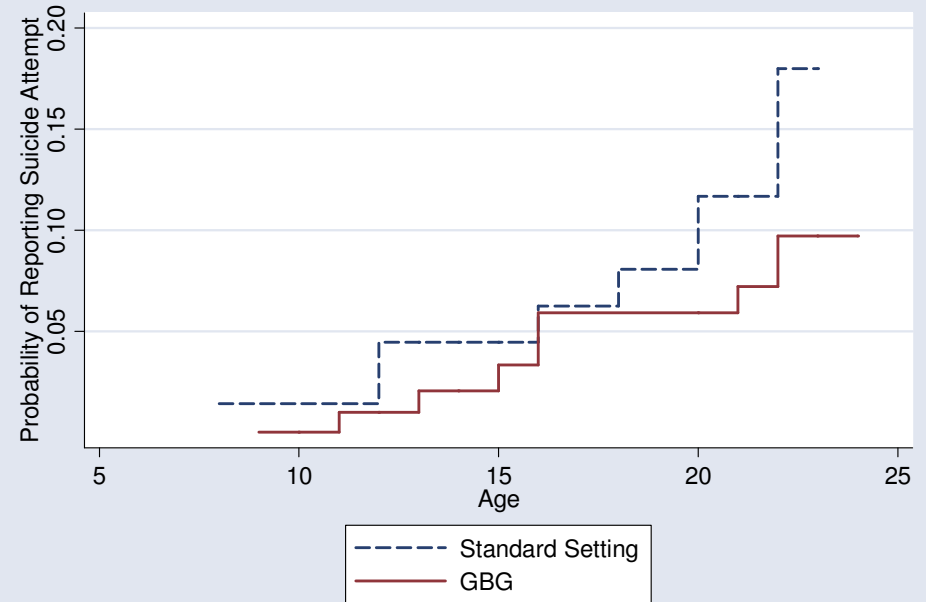
\* Not replicated in Cohort 2, although in the beneficial direction

\*\* 2<sup>nd</sup> young adult follow-up was done after the 1<sup>st</sup> at age 19-21

# Impact of GBG done in 1<sup>st</sup> and 2<sup>nd</sup> Grades on Suicide Attempts by Age 19-23\*\*



**Females**



**Males**

\* Not replicated in Cohort 2, although in the beneficial direction

\*\* 2<sup>nd</sup> young adult follow-up after the 1<sup>st</sup> at age 19-21

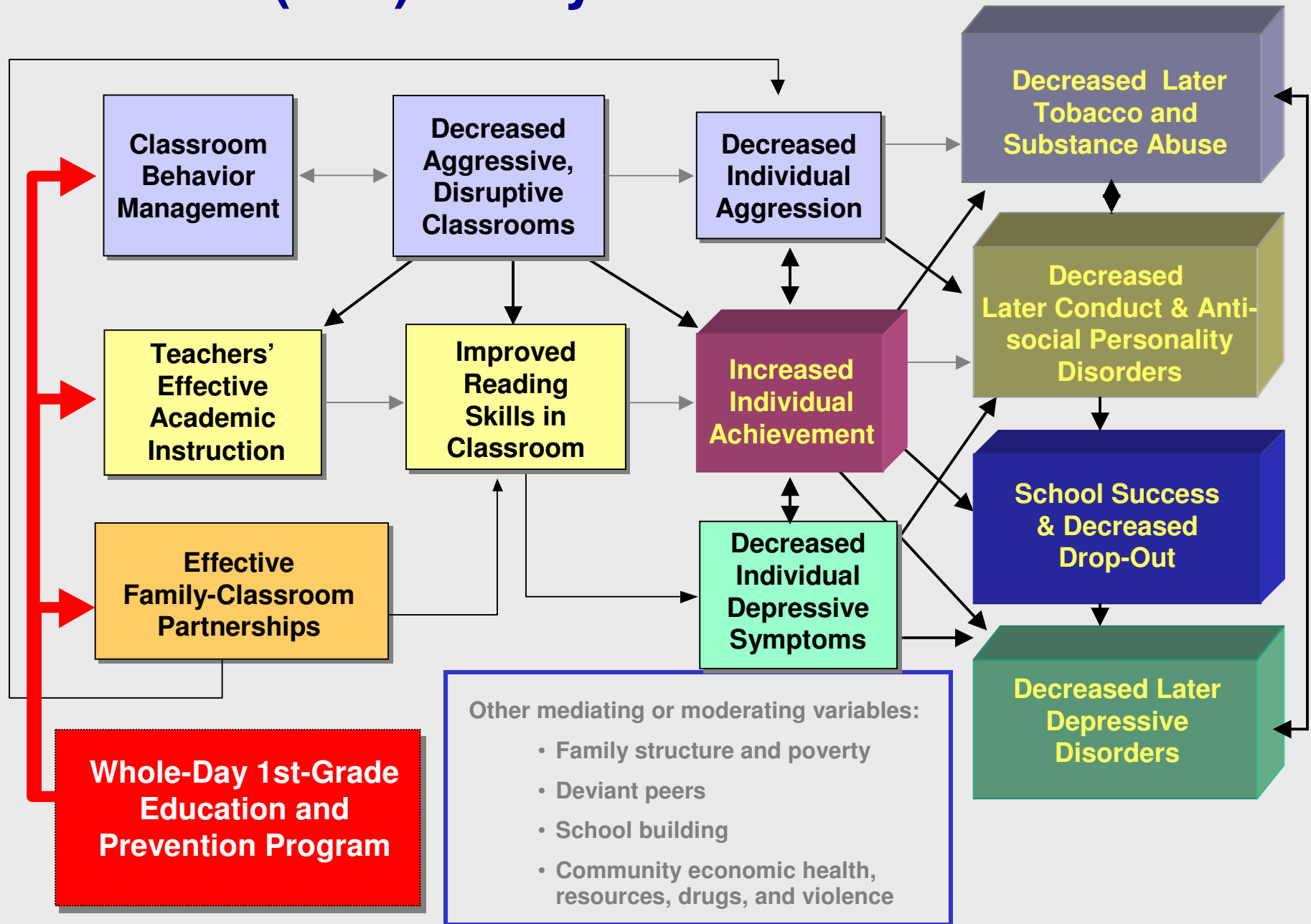
# Second Generation Ed/Prev Trial in Baltimore Schools

- In each of 9 schools one classroom had a combined curriculum/instruction (C&I) and (GBG) from first trial
- A 2<sup>nd</sup> classroom had a family/classroom partnership program (FCP) as a second intervention condition
- Children and teachers randomly assigned within nine schools to either of the two interventions or to the standard program classrooms
- **Results:** By middle school, combined GBG and C&I improved both achievement and behavior
- Family/classroom partnership by itself had modest impact

# Third Generation Ed/Prev Trial in Baltimore Schools

- Integrated three tested components into one *Whole-Day Program*: GBG+ Curric. & Instruction+ Fam/Classroom partnership.
- Eight development schools helped design and refine interventions and measures.
- Within 12 trial schools, random assignment of all 1st-grade children, teachers, and classrooms.
- Children in 12 *Whole-Day* 1st-grade classrooms are compared to children in 12 *standard program* classrooms.
- Followed children for effectiveness but also teachers for fidelity.

# Baltimore (WD) Analytic Model



# Inferences I: Integrating Public Health and Public Education

- § First grade classrooms are incredibly important to later behavioral, academic, and mental development.
- § Teachers need tested tools to manage classrooms, i.e., to teach children how to be students. It is not intuitive.
- § A large portion of 1<sup>st</sup> grade teachers (~50% in Baltimore) need such tools.
- § Higher risk children are at markedly increased risk in poorly managed classrooms but can improve with universal classroom interventions.

## Inferences II: Effectiveness vs Replication/Sustainability Trials

- § The results from the 1st generation's 1<sup>st</sup> cohort were encouraging—the effectiveness trial. The results from the 2<sup>nd</sup> cohort-- the “sustainability trial”-- revealed significant impact on drug abuse/dependence disorders but diminished impact in the same direction on other outcomes.
- § Continued mentoring and monitoring seems required for replication and going to scale.
- § We are currently testing a model based on multi-level institutional ownership, mentoring, and a system for continual monitoring.

# Inferences III

## History:

Prevention science has developed from:

- § research on early risks, mediators, and moderators along developmental paths
- § to efficacy trials
- § to effectiveness trials in the real world

## Next stages:

- § How to sustain fidelity of effective programs over replications and
- § how to disseminate system-wide with fidelity
- § And, finally, how to **sustain** effective programs with fidelity system-wide.

## Inferences IV: The Functions of the Developmental Epidemiological Prevention Strategy

- **Theory**—Yielded results consistent with an etiological role of early aggressive, disruptive behavior on adult externalizing outcomes.
- **Utility**—Directing a universal intervention at a shared early antecedent may improve the risk of the set of externalizing problem outcomes.