Abstract Title Page

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Title: Comparison of Chronic and Acute Models of Risk on Mathematics Achievement and Growth

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Abstract Body

Limit 4 pages single spaced.

Background / Context:

Description of prior research and its intellectual context.

The rate of poverty for children in the United States is far higher than for other advantaged nations (Payne & Biddle, 1999) with an estimated 13.3 million children, 18% of all children, living below the poverty threshold (U. S. Bureau of the Census, 2008). An estimated 5.8 million children live in extreme poverty where their families earn less than $10,600 per year (U. S. Bureau of the Census, 2008).

Impoverished children are at a greater risk than their advantaged counterparts and face additional challenges including parental distress, lack of health insurance, chronic health problems, a cumulative risk stress, and a higher exposure to adversity (Masten, Miliotis, Graham-Bermann, Ramirez, & Neemann, 1993; Payne & Biddle, 1999). A review by Crooks (1995) found that poverty puts children at risk for poor school performance by depressing cognitive function and attention; increasing drop-out rates, absences, and grade repetition; reducing literacy skills and work habits; and lowering academic performance. These early cumulative academic risks may spill over or cascade into other domains and have a profound impact on salient competencies that arise in late adolescence and early adulthood (Masten, Desjardins, McCormick, Kuo, & Long, 2009).

The situation for homeless or highly mobile children (HHM) is far bleaker. Nationwide there is an estimated 800,000 homeless children on any given night with a total of at least 1.35 million homeless children during a calendar year (National Center on Family Homelessness, 2008). Children that are HHM are at an extreme risk for health problems, physical disabilities, poor self-control, malnutrition, developmental delays, anxiety, and depression (Miller & Lin, 1988; Rafferty & Shinn, 1991). They experience additional behavioral problems including nightmares, phobias, food hoarding, psychogenic water drinking, and extreme mood liability (Whitman, Accardo, Boyert, & Kendagor, 1990). They have several risk factors associated with academic and behavioral problems such as chronic poverty, single-parent families, unemployed and poorly educated parents, elevated lead levels, heightened mobility, and histories of exposure to family and neighborhood violence (Rafferty & Shinn, 1991; McChesney, 1993; Masten, 2008). Homeless children are more likely to have developmental delays than other children, twice as likely to have a learning disability, and twice as likely to repeat a grade due to frequent absences and moving between schools (Bassuk & Rosenberg, 1990; Fox, Barrnett, Davies, & Bird, 1990; Rafferty & Shinn, 1991; Zima, Bussing, Forness, & Benjamin, 1997).

Recently the federal government has turned their attention on academic achievement attributable to disparities in risk, as recent studies have found an association between high-risk students and achievement (Okpala & Okpala, 2001). A recent report by the National Center for Homeless Education has shown a decline in the number of proficient HHM students in reading (from 49% to 45%) while showing a modest increase in mathematics (45% to 46%) (National Center for Homeless Education, 2008). While HHM students have shown a marginal increase in mathematics proficiency, it is clear that these high-risk students are behind the more advantaged students.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

The current study had two primary aims. The first aim was to examine HHM status as a risk factor for mathematic achievement over time, beyond the risk associated with poverty, indexed by qualifying for Federal free or reduced-price meal programs. The second aim was to examine whether the nature of this risk includes aspects that are chronic, acute, or both. Longitudinal achievement data spanning five years of assessment, beginning in the Fall of 2005, which was the ending point for the data analyzed by Obradović and colleagues (2009) in the same school district. The current analyses employed an accelerated longitudinal design (Helms, 1992) to examine growth from 3rd to 8th grade, pooling 5 waves of longitudinal test data that were available. All analyses used multilevel models (Fitzmaurice, Laird, & Ware, 2004) to examine differences in initial achievement levels and in growth over 3rd through 8th grades.

Setting:
The setting for this study was a large, urban school district (LUSD)

Population / Participants / Subjects:
There were a total of 26,474 3rd through 8th grade students in the LUSD that participated in this study. This study focused particularly on at-risk students, especially HHM students. LUSD determined HHM status for each student at the time of enrollment and continuously throughout the school year. Children qualified as HHM if they lived in any of the following conditions: (a) in a shelter, motel, vehicle, or campground; (b) on the street; (c) in an abandoned building, trailer, or other inadequate accommodation; or (d) doubled up with friends or relatives because they could not find or afford housing. HHM students were identified at a Student Placement Center, in schools, or while staying in shelters by MPS or shelter staff. Students who were identified as HHM at any point during a school year were included in the HHM group for that year. Classification in any of the other risk groups was based on eligibility for the National School Lunch Program. Thus a student who at any time qualified for HHM was classified in that group; one who qualified for free meals (FM) but not HHM was classified in the FM group; and one who qualified for reduced-fee meals (RM) but not FM or HHM was classified as RM. All remaining students were included in the General group.

Intervention / Program / Practice:
Students completed the math portions of the Computer Adaptive Levels Tests (CALT) (Northwest Evaluation Association, 2005). The CALT is a nationally normed adaptive test calibrated to each student's achievement level. The CALT consists of three testlets of 13 multiple-choice items. The difficulty level of each testlet is further calibrated to the student's performance: students who do well on a testlet are administered more difficult items in the next testlet; students who do poorly on a testlet receive less difficult items subsequently. Students receiving services for limited English proficiency were allowed to take the paper version of the math section translated into Hmong, Spanish, or Somali.

In Fall 2009, LUSD began to administer the Measures of Academic Progress (MAP) reading and math assessments to replace the CALT. The MAP is also a nationally normed adaptive test developed by the Northwest Evaluation Association that dynamically adapts to a student's response. When a student answers a question correctly, the test presents a more challenging item. A student who answers a question incorrectly receives an easier item. Raw scores on the CALT and MAP are converted to scale scores via item response theory scaling procedures. A recent technical study (Chan, 2010) demonstrated the statistical equivalence between the MAP and the CALT.

Research Design:
We utilized a longitudinal design for this study in order to track and characterize growth patterns in mathematics.

Data Collection and Analysis:
Data Collection: Demographic and school-based variables were collected by LUSD. Data on child's sex and primary ethnicity (American Indian, African American, Asian, Hispanic, and White) were recorded. About a quarter (27.0%) of students in the district dataset qualified for English language learner (ELL) services. About 19% of students qualified for special education services. Attendance records for each student are maintained by LUSD. Given our emphasis on HHM students, we computed a variable reflecting the overall proportion of days attended (total number of days attended / total number of days enrolled). This approach is employed by LUSD research staff to reflect students' attendance without over-penalizing HHM students who are more likely to move into or away from the district during the school year.

Data Analysis: A number of covariates were included in all models to control for factors related to both achievement and risk (Clotfelter, Ladd, & Vigdor, 2009; Gibb, Fergusson, & Horwood, 2008; National Research Council, 2002; Obradović, et al., 2009; Sirin, 2005), this included gender, ELL status, special education eligibility, ethnicity, and risk group. Additionally, there was a dynamic HHM that was allowed to vary from grade to grade. Male, White HHM students that were not in special education, not ELL were selected as the baseline group. Random effects for intercept and slope were used to account for initial individual variability and trajectory.

We used a multimodel inference approach in which a number of alternative models were compared to determine relative fit and plausibility of the models (Anderson, 2008; Burnham & Anderson, 2004). Nine models were considered to examine the shape of the growth curve (linear, quadratic, or a log transformation of grade) and the effects of risk on intercept and growth. Models differed by whether they contained control variables only (intercept and slope), included additional risk effects for intercept only, and included additional risk effects for the intercept and the growth curve (slope/trajectory). We evaluated model fit based on the Akaike information criteria (AIC) (Akaike, 1973, 1974).

Chronic-risk analyses. The first set of analyses focused on students who were ever identified as HHM compared to students from families with different income levels. These analyses involved the entire sample of students who completed standardized achievement tests in math. Students were divided into the four mutually exclusive risk groups described above: (a) HHM (13.8% of the sample); (b) Free Meals (57.2%); (c) Reduced-Price Meals (3.7%); and (d) General (25.3% of the sample).

Acute-risk analyses. The second set of analyses involved examining the dynamic impact of HHM on achievement. These analyses considered only students who were identified as HHM during the 2004 – 2005 through 2008 – 2009 school years with corresponding achievement data (N = 3,436 for math). HHM status was tied to achievement scores taking a 1-year lag approach. HHM status during any given year was linked to academic achievement scores measured during the fall of the subsequent school year (e.g., achievement during the fall of the 2005-2006 school year was linked to HHM status during the 2004-2005 school year).

Findings / Results:
Chronic-Risk Analyses. Model comparison results of the chronic- and acute-risk analyses are provided in Table 1. The best fitting model was the quadratic polynomial. Coefficients for the best fitting model are presented in Table 2. As expected, the income-based risk groups varied with respect to math achievement in 3rd grade. Intercept differences are noted for Risk comparisons in the first column of Table 2. Consistent with the expectation that HHM-status represents a level of risk beyond poverty, the HHM group had the lowest levels of math achievement at the intercept when compared to the Free Meals group, to the Reduced Price Meals group, and to the General group. The Free Meals group had the next lowest levels of achievement, below that of the Reduced Price Meals group and below the General group. The General group showed the highest level of achievement. Fixed effects terms comparing risk groups on the quadratic polynomial revealed that the math achievement scores of the students in the Free Meals group accelerated at a different rate when compared to the General group. The only pronounced growth difference for the HHM group was in relation to the General group. We found no other pronounced effects of risk-group on growth. Figure 1 depicts observed means for risk groups for math achievement, plotted against the national norm for comparison.

Acute-Risk Analyses. Two dynamic risk models had relatively better fit predicting math achievement. The model that included control variable effects and intercept effects for the dynamic risk variable provided a better fit to the data than 7 of the 8 other alternative models (weight of evidence = 0.18). Meanwhile, the model that also included both intercept and slope effects provided the best fit among all models considered (minimum ΔAIC = 3; weight = 0.82). Both of these models should be considered likely candidates for adoption as the best fit for the data. The model with the great weight of evidence was adopted model predicting math achievement and is presented Table 3. An intercept effect and a quadratic slope effect of dynamic HHM status were found. During years in which students were identified as HHM, mean levels of math achievement were lower and slope accelerated at a slower rate. This supports the hypotheses.

Conclusions:
Homelessness and high residential mobility represent a substantial risk for lower academic achievement among students in 3rd through 8th grades in this large, urban school district. This was a salient issue with nearly 14% of all students in this district identified as HHM at some point over the course of 6 years. The risk associated with HHM-status has a clear chronic component where students who are ever HHM show markedly lower levels of achievement across 3rd through 8th grades, with no differences in growth compared to any other group of students. HHM students, as a group, underperform compared to more stably housed peers in reading and math achievement over time. Gaps appear and persist for the HHM group even when compared to peers who qualified for free meals based on low income. This suggests that HHM-status is a marker for high chronic risk.

Appendices

Appendix A. References

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Appendix B. Tables and Figuress

Table 1. Fit statistics and relative model fit weights of evidence. All models included the same set of control effects and only the risk effects as indicated.

Static Risk Models

Risk Effect	Curve	AIC	Δ AIC	Weight
None	Linear	451,450	5,329	< 0.01
None	Log	447,976	1,855	< 0.01
None	Quadratic	447,662	1,541	< 0.01
Intercept	Linear	450,132	4,011	< 0.01
Intercept	Log	446,592	471	< 0.01
Intercept	Quadratic	446,266	145	< 0.01
Intercept, Trajectory	Linear	449,968	3,847	< 0.01
Intercept, Trajectory	Log	446,465	344	< 0.01
Intercept, Trajectory	Quadratic	**446,121**	**0**	**> 0.99**

Dynamic Risk Models

Risk Effect	Curve	AIC	Δ AIC	Weight
None	Linear	53,030	472	< 0.01
None	Log	52,621	63	< 0.01
None	Quadratic	52,573	15	< 0.01
Intercept	Linear	53,016	458	< 0.01
Intercept	Log	52,609	51	< 0.01
Intercept	Quadratic	52,561	3	0.18
Intercept, Trajectory	Linear	53,012	454	< 0.01
Intercept, Trajectory	Log	52,608	50	< 0.01
Intercept, Trajectory	Quadratic	**52,558**	**0**	**0.82**

Note: AIC = Akaike Information Criteria; Δ AIC = difference in AIC relative to the best fitting model; Weight = Weight of evidence.

Table 2. Parameter estimates (standard errors) for adopted (best fitting) static-risk models.

	Fixed Effects		
	Intercept	Linear Slope	Quadratic Trajectory
Risk			
HHM vs. General	9.60 (0.39)	0.54 (0.27)	0.09 (0.05)
HHM vs. Reduced	5.70 (0.56)	-0.16 (0.40)	0.09 (0.08)
HHM vs. Free	2.80 (0.31)	-0.06 (0.22)	-0.01 (0.04)
Free vs. General[a]	6.80 (0.28)	0.60 (0.20)	0.10 (0.04)
Free vs. Reduced[a]	2.90 (0.50)	-0.10 (0.35)	0.09 (0.07)
Reduced vs. General[a]	3.90 (0.51)	0.70 (0.36)	0.00 (0.07)
Ethnicity (White vs. ...)			
American Indian	-6.66 (0.49)	-0.03 (0.34)	-0.08 (0.07)
African American	-8.61 (0.29)	-0.61 (0.20)	-0.07 (0.04)
Asian	-3.06 (0.42)	0.24 (0.29)	0.01 (0.06)
Hispanic	-5.13 (0.38)	0.45 (0.26)	-0.20 (0.05)
Sex (Male vs. Female)	-1.31 (0.19)	-0.32 (0.13)	0.03 (0.03)
ELL (No vs. Yes)	-6.21 (0.31)	-0.99 (0.22)	0.15 (0.04)
Special Ed. (No vs. Yes)	-8.98 (0.24)	-0.92 (0.17)	-0.05 (0.03)
Attendance[b]	37.50 (2.48)	-2.79 (1.83)	1.32 (0.34)
Unconditional Effects	159.06 (2.32)	13.53 (1.72)	-2.01 (0.32)

	Variance Components
Intercept (Std.Dev)	111.82 (10.57)
Linear Slope (Std.Dev)	8.55 (2.92)
Quadratic Slope (Std.Dev)	0.23 (0.48)
Intercept, Quadratic Slope Covar.	0.01
σ^2	28.75 (5.36)

	Model Fit
Akaike Information Criterion	446,121

Table 3. Parameter estimates (standard errors) for adopted (best fitting) dynamic-risk models for HHM students.

	Fixed Effects		
	Intercept	Linear Slope	Quadratic Trajectory
HHM Dynamic Effects	-1.78 (0.47)	1.18 (0.45)	-0.22 (0.09)
Ethnicity (White vs. ...)			
American Indian	-4.15 (1.48)	-0.17 (1.08)	0.12 (0.21)
African American	-5.79 (1.25)	-1.95 (0.91)	0.37 (0.17)
Asian	-9.59 (2.04)	-1.14 (1.48)	0.44 (0.28)
Hispanic	0.12 (1.80)	-0.95 (1.31)	0.12 (0.25)
Sex (Male vs. Female)	-0.63 (0.60)	0.01 (0.44)	-0.04 (0.08)
ELL (No vs. Yes)	-9.06 (1.30)	-0.76 (0.93)	0.19 (0.18)
Special Ed. (No vs. Yes)	-8.24 (0.66)	-0.94 (0.48)	-0.01 (0.09)
Attendance[a]	20.14 (5.23)	-0.83 (3.90)	0.79 (0.71)
Unconditional Effects	173.03 (5.00)	12.23 (3.72)	-1.80 (0.67)

	Variance Components
Intercept (Std.Dev)	114.52 (10.70)
Linear Slope (Std.Dev)	8.17 (2.86)
Quadratic Slope (Std.Dev)	0.06 (0.25)
Intercept, Quadratic Slope Covar.	-0.73
σ^2	35.04 (5.92)

	Model Fit
Akaike Information Criterion	52,558

Figure 1. Variability among HHM students for math achievement. Individual math achievement trajectories of HHM students are depicted in black. The white dashed line represents the mean level of math achievement based on national norms. The white dotted line is one standard deviation below the national norm mean.