ITALIAN JOURNAL OF PUBLIC HEALTH

Intelligence, academic achievement, and pediatric injury among a large sample of kindergartners

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Abstract

Objectives: Previous work reports mixed results on the roles of intelligence and academic achievement on child injury risk. Some early research offered evidence of links between lower levels of intelligence and higher rates of pediatric injury, but other work has suggested there is no relation between the variables. This study investigated the matter further, in the context of a large sample and with strong statistical power.

Methods: Data from a national sample of 8002 kindergartners in the United States, all from low-income families, were analyzed. Intelligence was estimated using the Peabody Picture Vocabulary Test-Revised and academic achievement with the Reading and Mathematics scales of the Woodcock Johnson Psycho-Educational Battery-Revised. Mothers reported whether children had experienced an injury in the previous year that required professional medical attention.

Results: Results of both bivariate and multivariate ordinal logistic regression models suggest higher levels of reading achievement and of mathematics achievement were associated with slightly reduced risk of pediatric injury. Intelligence was not related to injury history.

Conclusions: Academic achievement, but not intelligence, appears to relate in a small but statistically significant inverse manner with risk for pediatric injury among kindergartners from a low-income background. Possible mediators include children's ability to learn and remember safety-related rules or the fact that parents who encourage learning in the household might also safeguard children more effectively.

Key words: injury, safety, intelligence, academic achievement, kindergartners

Unintentional injury is the leading cause of mortality for children ages 1-18 in the United States and much of the world [1,2]. A sizable body of literature has emerged to describe psychosocial risk factors for injury [3], but there are several variables that remain poorly understood as potential risk factors for pediatric injury.

One question that remains unresolved in the literature is the roles of intelligence and academic achievement on children's unintentional injury risk. From the perspective of face validity, one can imagine how both intelligence and achievement could contribute to child safety. More capable children might remember and learn safety-related rules more effectively. They may also have parents and other adult supervisors who are more knowledgeable and proactive about appropriate safety-related manipulations to a child's environment (e.g., use of car seats; installation of stair gates).

The existing empirical literature provides mixed evidence of an effect of intelligence or academic achievement on child injury risk. Early research offered evidence of a correlational link between lower levels of intelligence and higher rates of pediatric injury [4,5]. In one study [4], for example, data were collected from the families and teachers of 684 children previously classified into low, medium, or high injury risk based on reviews of health insurance records. Mothers' ratings of school achievement (effort and performance in school) were significantly and negatively related to injury risk. Teacher reports of achievement in school were related to injury in the expected direction, but were not statistically significant.

To the contrary, two large studies in the early 1980s reported no correlational links between intelligence testing and injury history [6,7]. Using data from almost 1000 children in the Dunedin Multidisciplinary Child Development Study, Langley and colleagues found no relations between scores on the Reynall Developmental Language Scale (at ages 3 and 5) or the Stanford-

Binet intelligence test (at age 5) and injuries during the first 5 years of life [6]. A second study of 180 children found no association between WPPSI intelligence scores at age 6 and injuries over the next three years [7].

More recently, Lawlor and colleagues reported the results of a large cohort study in Scotland (N = 11,103) [8]. They found a negative relation between intelligence, as measured at ages 7, 9, and 11, and adult (ages 25-54) admission to the hospital to treat unintentional injury. Another recent report found negative relations between IQ measured in late adolescence or early adulthood and hospital admission due to injury over the subsequent few decades [9]. Other recent studies have considered injury risks in children with disabilities. Reports found no increased injury risk in children with learning disorders [10] but a slight increase in risk among children with mental retardation [11].

Altogether, the reports are rather inconclusive. The significant results that do emerge always point to increased risk for injury among individuals with lower levels of intelligence or achievement. Those results also tend to emerge among large sample sizes, indicating the possibility of a small but potentially meaningful effect size. The present study was designed to provide further evidence concerning the possible role of intelligence and achievement on child injury risk. We utilized a large dataset to provide strong statistical power that could detect small effect sizes. We hypothesized that both intelligence and academic achievement would be inversely related to injury risk.

Methods

Data Source and Sample

Data came from the National Head Start/Public School Early Childhood Transition Demonstration Study, a multi-site randomized longitudinal investigation examining the implementation of a comprehensive Head Start-like transition program [12]. The cross-sectional data used in the present report come from an assessment of the children in kindergarten. A sample of 8002 was available without missing data points. The primary criteria for admittance into Head Start programs is the families' income level, which must fall below federal guidelines for poverty based on family size. Thus, all children in the study were from low-income families. Many were extremely impoverished.

The sample was highly diverse racially, ethnically, culturally, and geographically, and included children in both rural and urban settings. Children were recruited from 31 data collection sites across the United States. When English proficiency was limited, assessments were conducted in the native language of the family.

Measures

Demographics. Mothers reported children's gender and ethnicity.

Health Insurance. Mothers reported whether or not they had health insurance coverage for their child. This variable was included because presence of health insurance might influence a parent's decision to visit a medical professional following a child's injury.

Family Income. Annual family income was estimated based on parent report of income within a series of 12 progressively larger monthly income ranges. The median of the reported range was used, and then multiplied by 12 to obtain annual income.

Intelligence. Intelligence was estimated using the Peabody Picture Vocabulary Test-Revised [13]. The Peabody, an assessment of verbal intelligence often used as a proxy for general intelligence, correlates significantly with the vocabulary scale of the Stanford-Binet IV ($r = .60$, $p < .01$) [14] and with verbal and full scale scores on the Wechsler Preschool and Primary Scale of Intelligence-Revised ($r = .36$, $p < .01$ and $r = .34$, $p < .01$, respectively) [15].

Achievement. Academic achievement was measured using the Reading and Mathematics scales of the Woodcock Johnson Psycho-Educational Battery-Revised [16]. Separate scores were obtained for each domain based on performance on two subtests each (letter-word identification and passage comprehension for reading; calculation and applied problems for mathematics). Internal reliability of all four subtests is excellent (alphas > .84) [17].

Injury. Mothers reported whether children had experienced an injury in the previous year that required professional medical attention.

Statistical Analysis Plan

Analyses proceeded in three steps. First, we considered basic descriptive correlation data. Second, we computed three separate bivariate ordinal logistic regression models predicting injuries (0 vs. 1 vs. 2+) based on standardized measures of intelligence, reading achievement, and mathematics achievement. Third, we computed three multivariate ordinal logistic regression models. The models each included one relevant standardized intelligence/achievement measure, but they also included

the standardized demographic covariates. Intelligence and achievement measures were not placed simultaneously into models due to collinearity concerns.

Results

Descriptive data are presented in Table 1. As shown, the sample was 52.22% male and had a mean age of 5.73 years (SD = 0.37). The children experienced a mean of 0.41 injuries requiring professional medical treatment in the past year (SD = 1.10; 76% had 0 injuries, 16% had 1 injuries, 5% had 2 injuries, and 3% had 3 or more injures). Intelligence and achievement scores both fell below the average population scores. The population mean of both the Peabody and the Woodcock-Johnson is 100 (SD = 15), so this sample had scores that were approximately one standard deviation below the population on the Peabody and the Woodcock-Johnson mathematics subtest, and about 2/3 of a standard deviation below the population mean on the Woodcock-Johnson reading subtest. This finding is consistent with other research among low-income samples [18].

Table 2 displays correlations between all independent variables as well as the dependent injury variable. As expected, the intelligence and achievement scores correlated with each other and with family income. There also was a slight trend for girls to have higher achievement (but not intelligence) scores. As supported by a broader literature, injuries were somewhat more likely among boys, families with health insurance, and lower income families.

The primary hypothesis was tested using bivariate ordinal logistic regression models predicting child injury with standardized intelligence and achievement scores (See Table 3). Both reading achievement (OR = 0.89, CI = 0.85-0.94) and mathematics achievement (OR = 0.92, CI = 0.87-0.97) were negatively associated with injury history. Intelligence was not related to injuries.

Finally, we constructed three multivariate ordinal logistic regression models (See Table 4). Each included one standardized measure of intelligence or achievement and the standardized covariates of interest (gender, income, health insurance). Both reading achievement (OR = 0.91, CI = 0.87-0.96) and mathematics achievement (OR = 0.94, CI = 0.89-0.99) remained slight negative predictors of reduced injury risk after covariates were included. Intelligence again did not emerge as a statistically significant predictor of pediatric injury. Male gender, presence of health insurance, and greater family income were also statistically significant predictors of injury in all 3 models.

Discussion

Taken together, the results suggest academic achievement but not intelligence plays a small but meaningful role in predicting risk for pediatric injury among kindergartners from low-income families. Those children with higher levels of reading and mathematics achievement were less

Table 1. Descriptive Data, N = 8,002.

Variable	Mean (SD)
Child Gender (1=male, 2=female)	52.22% male
Child Age (years)	5.73 (0.37)
Health Insurance (0=no, 1=yes)	89.42% yes
Annual Family Income ($)	14,747 (11,758)
Child Injuries (count)	0.41 (1.10)
PPVT (standard score)	85.45 (16.67)
WJ Reading (standard score)	91.90 (12.33)
WJ Mathematics (standard score)	85.06 (16.00)

Table 2. Correlation Matrix, N = 8,002.

Variable	2	3	4	5	6	7
1. Child Injuries	-.06**	.04**	-.04**	-.01	-.04**	-.02*
2. Child Gender (1=male, 2=female)		.01	-.00	.00	.09**	.05**
3. Health Insurance (0=no, 1=yes)			-.00	.00	.01	-.02
4. Family Income (monthly, $)				.25**	.13**	.18**
5. PPVT (standard score)					.28**	.45**
6. WJ Reading (standard score)						-.53**
7. WJ Mathematics (standard score)						

** $p < .01$.

Table 3. Bivariate ordinal logistic regressions predicting child injury, N = 8,002.

Standardized Predictor	OR	95% CI
PPVT	1.02	(0.97, 1.07)
WJ Reading	0.89**	(0.85, 0.94)
WJ Mathematics	0.92**	(0.87, 0.97)

OR = Odds Ratio. CI = Confidence Interval.
** $p < .01$.

Table 4. Multivariate ordinal logistic regressions predicting child injuries, N = 8,002.

	PPVT		WJ Reading		WJ Mathematics	
Standardized Predictor	OR	95% CI	OR	95% CI	OR	95% CI
Child Gender (female > male)	0.83**	(0.78, 0.87)	0.83**	(0.79, 0.88)	0.83**	(0.78, 0.87)
Family Income	0.91**	(0.86, 0.96)	0.93**	(0.88, 0.98)	0.93**	(0.88, 0.98)
Insurance (yes > no)	1.13**	(1.07, 1.19)	1.13**	(1.07, 1.19)	1.13**	(1.06, 1.19)
PPVT	1.04	(0.99, 1.10)	--	--	--	--
WJ Reading	--	--	0.91**	(0.87, 0.96)	--	--
WJ Math	--	--	--	--	0.94*	(0.89, 0.99)

OR = Odds Ratio. CI = Confidence Interval.
* $p < .05$. ** $p < .01$.

likely to have experienced an injury requiring professional medical attention in the past year than children with lower levels of achievement. This relation remained true after controlling for basic demographic characteristics.

Effect sizes in our analyses were small. We interpret the small effect sizes as an indication that academic achievement plays a minor but statistically significant role in the larger picture of risk for child injury. Existing literature supports the fact that pediatric injuries are caused by a very wide range of individual, interpersonal, environmental, and other factors [3]. Academic achievement may be among those factors.

Although not our primary hypothesis, we also found positive relations between health insurance and injury risk. One might assume that parents without health insurance will be more reluctant to seek professional medical treatment for their children following an injury, and our results support that possibility. It also is a finding that has been reported by others in the both the child [19] and adult [20] injury literatures.

One surprise in our results is the finding that academic achievement but not intelligence related to child injury risk. These results contrast with recent large cohort studies with adults [8,9] that report negative relations between child or early adult intelligence and unintentional injury risk in adulthood. Interpreting null results must be conducted cautiously, but our null results are consistent with some previous work focused on child injury risk [4, 6,7]. With the literature taken together, a picture emerges that intelligence may predict subsequent adult injury risk, but that academic achievement may be more relevant to injury risk in children. Further work should verify this trend in the existing literature.

Our results do not address directly the causal mechanism that may explain the links between academic achievement and child injury risk. We offer a few hypothesized mechanisms behind the relation. First, it may be that children with lower academic achievement levels have more difficulty learning and remembering safety-related rules, thus leading to higher injury rates. Second, parents who encourage and support learning and achievement in the home may be the same parents who safeguard and supervise their children more carefully. Future research should evaluate these and other potential mechanisms.

From a prevention perspective, identifying and

changing even minor predictors of pediatric injury could have a large impact. Thousands of children and their families would be spared from the associated pain, agony and distress. Injury prevention programs that have been shown to be successful often utilize multiple pathways to change child and adult behavior, and to change the environments children engage within [21]. If we recognize that children's ability to learn and remember rules – as assessed by reading and mathematics achievement – might play a role in the children's safety, then we might consider ways to make rules simpler to learn, comprehend, and obey. On a small scale the impact would be small, but if interventions were delivered across large geographic areas to large groups of children, the impact on injury reduction could be meaningful.

Like all research, this study had strengths and weaknesses. One of the strengths was that it utilized a large and diverse sample that offered the statistical power to identify small effect sizes. Weaknesses include the fact that data collection was entirely by parent-report and that the dataset did not offer information on potential mediating factors that might explain why academic achievement is related to pediatric injury risk. Future research should overcome these weaknesses and continue to explore relations between children's academic achievement and intelligence, and injury risk.

Acknowledgements and funding

Special thanks to Craig and Sharon Ramey for sharing data from their research and for their continued support of our secondary analyses. Original data collection was supported by funds from the Administration on Children, Youth and Families and the Civitan International Foundation. Secondary analyses were internally funded.

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