



Blood Pressure and School Performance

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Journal Title: Psychosomatic Medicine

Volume: Volume 76, Number 2

Publisher: Lippincott, Williams & Wilkins | 2014-02-01, Pages 163-164

Type of Work: Article | Post-print: After Peer Review

Publisher DOI: 10.1097/PSY.0000000000000033

Permanent URL: <https://pid.emory.edu/ark:/25593/tw1m6>

Final published version: <http://dx.doi.org/10.1097/PSY.0000000000000033>

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Accessed October 18, 2019 1:14 AM EDT



Published in final edited form as:

Psychosom Med. 2014 February ; 76(2): 163–166. doi:10.1097/PSY.0000000000000033.

Blood Pressure and School Performance

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In a recent article published in *Psychosomatic Medicine*, Berendes et al. reported results of a study comparing ratings of quality of life and levels of distress of children with and without elevated blood pressure (BP), an analysis of participants in the German Health Interview and Examination Survey for Children and Adolescents (KiGGS).¹ They report that the children with elevated BP had evidence of better well-being, lower distress, and better academic success compared to children without elevated BP. These conclusions are counterintuitive and go against the growing knowledge base associating hypertension with a host of cognitive and emotional issues.^{2, 3} The observed findings may partially reflect methodological aspects of this study and consequently the interpretation of the results and translation of these findings to clinical practice may be problematic.

Based on their bivariate analysis, the authors determined that participants with elevated BP had a lower rate of an “irregular school career” compared with participants without elevated BP (14 vs. 17%). Irregular school career is defined as having to repeat one or more years at school. The authors interpret this finding as meaning that participants with elevated BP had “better academic success.” Unfortunately, the authors do not report multivariate analyses with irregular school career as the dependent variable, so we do not know the impact of potential confounding variables on this finding. Furthermore, there are no objective measures of school achievement in the study to support the assertion that this finding represents better academic performance of the elevated BP group. A recent *New York Times* article reporting on the study was titled “Hypertension in Youths Is Tied to School Success,”⁴ a title that may be misleading as the participants were not hypertensive nor did the study examine direct evidence of school success. This summary of the research findings is not directly supported by the observed findings and may result in inaccurate inferences of the investigation. While the authors cannot be held responsible for the misreporting of their findings in a non-scientific article, the title of this newspaper article underscores the problem of using the term hypertension with insufficient precision.

In fact, we have shown that children with confirmed, sustained hypertension may be at risk for cognitive problems:³ (1) Children with primary hypertension had an increased prevalence of the diagnosis of learning disability, with an odds ratio 4-fold higher than non-

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Conflicts of Interest and Source of Funding: Dr. Lande is funded through NHLBI, grant R01HL098332, titled, “Executive function in children with hypertension.” Drs. Kupferman, Adams, Hooper and Batsky are co-investigators on that grant.

hypertensive children.⁵ (2) Children with primary hypertension had lower parent ratings of executive function compared with that of matched normotensive controls.⁶ (3) Children with primary hypertension had diminished cerebrovascular reactivity as demonstrated by studies of transcranial Doppler.⁷ (4) Children with hypertension secondary to chronic kidney disease (CKD) had decreased performance on Performance IQ compared to that of children with CKD who do not have hypertension.⁸ Furthermore, children with primary hypertension are frequently obese and therefore are at increased risk of sleep disordered breathing/obstructive sleep apnea and the metabolic syndrome, both comorbidities that are themselves associated with academic difficulties.^{9, 10}

We have also found that children with confirmed obesity-associated hypertension are at increased risk of Internalizing scores in the clinical range on the Child Behavior Checklist, a finding that seems to contradict the suggestion of better well-being in the study by Berendes et al. We found that there was an interaction between hypertension and obesity on Internalizing behaviors, with Internalizing scores increasing with increasing body mass index percentile in hypertensive but not normotensive subjects.⁶ Consideration of the relative impacts of obesity, sleep disordered breathing, and sociodemographic factors (e.g., maternal education) further highlights the importance of using multivariate methods to describe the relationship between cognition and hypertension.

The article notes that the participants in KiGGS had their BP measured twice at a single session and the mean of the two blood pressure readings was used for the analysis. Unfortunately, this method is not optimal for reliable measurement of BP in research studies in children. The first BP reading is often higher than the child's usual BP, and therefore not representative. Because of this well known phenomenon, it is common practice to discard the first BP reading in studies of BP in children, and also to take at least three readings.¹¹ The limited number of readings and the fact that the first BP was not discarded by Berendes et al. likely explains why elevated BP occurred twice as frequently as expected. Their method increases the likelihood that the elevated BP group represents many children with white coat hypertension rather than sustained hypertension.

As another source of potential error, subjects' BP were obtained by an oscillometric automated device. Oscillometric BPs are known to overestimate the subjects' BP leading to misclassification of BP status.¹² Because oscillometric methods may overestimate BP, the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents recommends that elevated measures obtained by oscillometric devices should be confirmed by auscultation.¹³

The diagnosis of hypertension is properly defined as the presence of elevated BP on at least three separate occasions over time, not at a single session.¹³ Most children with an initial elevated BP will not prove to have hypertension upon repeated measurements.¹¹ In their article, Berendes et al. sometimes refer to the subjects with elevated BP as "hypertensive participants" or "hypertensive adolescents," which is incorrect and potentially misleading. Their findings pertain to children with elevated BP at a single session and should not be generalized to children with confirmed sustained hypertension. Additionally, while the sample size showing these results was quite large and, in fact, a strength of the study, the authors did not provide any effect size estimates showing the magnitude of their findings. An informal calculation points to these effect sizes being quite small, despite statistical significance, which implies relatively little in the way of clinical significance.

To summarize, we wish to emphasize that the majority of participants with elevated BP in the report by Berendes et al did not have confirmed sustained hypertension, but instead elevated BP at a single session. We therefore suggest caution in extrapolating the results to

children with sustained hypertension and in interpreting the findings to mean that confirmed hypertension is associated with better school performance.

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