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General Educational Development (GED) and Educational Attainment Equivalency for Demographically Adjusted Norms†

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Abstract

Objective: To investigate whether the General Educational Development (GED) certificate should be considered equivalent to a standard 12-year high school education when performing demographic corrections on neuropsychological performance levels. If the GED certificate and high school diploma reflect comparable levels of educational achievement, then performance on the Test of Premorbid Function (TOPF) and selected WAIS-IV indices should not differ between groups.

Method: Archival neuropsychology data were reviewed to identify patients who either (1) did not complete high school and did not subsequently obtain a GED, (2) did not complete high school but subsequently obtained a GED, or (3) completed high school and did not obtain any further formal education. Most patients were programmatic referrals for epilepsy surgery evaluation, although referrals from the general neurology clinic were also included. The primary dependent measures were the TOPF and WAIS-IV Full Scale IQ (FSIQ).

Results: High school graduates obtained higher scores on the TOPF ($p < .01$, partial $\eta^2 = 0.16$) and FSIQ ($p < .01$, partial $\eta^2 = 0.14$) as compared to both GED subjects and subjects withdrawing from high school with no GED. The non-GED group and the GED group did not differ from each other.

Conclusions: These findings demonstrate that the GED is not equivalent to a standard 12-year high school education when characterizing educational background. Although these data do not address what the appropriate year equivalent should be for the GED when adjusting performance for educational background, using 12 years will likely identify more areas of neuropsychological weakness simply by suggesting higher levels of premorbid ability.

Keywords: General Educational Development (GED); Education; Equivalence; Demographically adjusted norms

Introduction

Level of education is an important factor influencing neuropsychological test performance, and normative adjustments that incorporate education level are often employed when interpreting neuropsychological results and estimating cognitive reserve. Unfortunately, little research has addressed the equivalence between seemingly comparable metrics of educational background, namely the General Educational Development (GED) certificate and the standard high school diploma. No consensus exists for translating a GED into appropriate years of education when performing demographic corrections with test performance. Common approaches include (1) treating the GED as standard high school completion reflecting 12 years of education, (2) using the number of years of schooling successfully completed prior to obtaining the GED, or (3) assigning the GED a lower education equivalent than 12 years (e.g., GED is considered as 10 years of education regardless of years completed). This approach of equating the GED to a high school education is not limited to individual patient assessment. In population

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studies, GED recipients are often grouped into a single category with high school graduates (e.g., Heckman, Humphries, & Kautz, 2014; Zajacova & Montez, 2017).

The purpose of this study is to investigate whether the GED should be considered equivalent to a 12-year high school education when performing demographic education adjustments during neuropsychological assessment. If the GED and high school diploma reflect comparable levels of educational achievement, formal estimates of premorbid function (i.e., Test of Premorbid Function, TOPF) should not differ between groups. Similarly, given WAIS-IV Full Scale IQ's (FSIQ) strong correlation with education level and premorbid functioning (Pearson Assessment, 2009), GED recipients and high school graduates should not differ on measures of general cognitive function. However, if a GED certificate does not represent educational achievement comparable to a high school diploma, then we would expect the GED group to perform more poorly on TOPF and FSIQ.

Methods

After obtaining Emory University and Mercer University IRB approval, subjects were identified from neuropsychology reports. A total of 2,058 neuropsychological records from patients tested between January 1, 2012 and December 15, 2017 were examined to identify subjects who were administered both the TOPF and the WAIS-IV and who could be classified into one of three mutually exclusive education categories: (1) did not complete high school and did not subsequently obtain a GED, (2) did not complete high school but subsequently obtained a GED, or (3) completed high school and did not obtain any further formal education. Reasons that either the TOPF or WAIS-IV were not administered included different test versions during transition to current tests across the departmental neuropsychology service, and programmatic evaluation needs in which the WASI-II rather than the WAIS-IV was administered (i.e., DBS evaluation). Our search yielded a final study eligible subject pool of $n = 205$.

We then excluded subjects with evidence suggesting cognitive decline ($n = 17$). Given the TOPF was co-normed with WAIS-IV for prediction accuracy, patients who had TOPF versus FSIQ discrepancy scores (i.e., patients with TOPF $\geq$ 15 points compared to FSIQ) were excluded to avoid including subjects with generalized cognitive decline (Berg, Durant, Banks, & Miller, 2016; Pearson Assessment, 2009). Epilepsy surgery candidates comprised the largest group of excluded patients ($n = 6$), with other excluded diagnoses including multiple sclerosis, stroke, and probable Alzheimer's disease. Subjects with reported learning disabilities and those who attended special education classes were also excluded ($n = 31$). Six additional subjects were excluded since their ages fell outside the range for WAIS-IV demographic correction. The final sample consisted of 151 subjects (no certificate/no diploma $n = 36$; GED certificate $n = 31$; high school diploma without additional formal education $n = 84$). Our primary dependent measures were TOPF and FSIQ. We also studied all WAIS-IV index scores (Verbal Comprehension Index, VCI; Perceptual Reasoning Index, PRI; Working Memory Index, WMI; and Processing Speed Index, PSI) to further characterize the relationship of education classification on more discrete cognitive domains.

Results

Subjects were predominantly female ($n = 94$, 62.3%), white ($n = 89$, 58.9%), right-handed ($n = 135$, 89.4%), with a mean age of 40.29 years ($SD = 14.21$). The last grade completed included eighth grade ($n = 8$, 5.3%), ninth grade ($n = 9$, 6.0%), 10th grade ($n = 28$, 18.5%), and 11th grade ($n = 22$, 14.6%). Most referrals were for epilepsy surgery evaluation ($n = 111$, 73.5%), with the remaining subjects referred from the general neurology service to provide further diagnostic clarity ($n = 40$, 26.5%). Subjects in the no certificate/no diploma group were predominantly referred for epilepsy surgery evaluation ($n = 25$, 69.4%), male ($n = 19$, 52.8%), African American ($n = 19$, 52.8%), with a mean age of 40.75 years ($SD = 15.28$). Subjects in the GED group were predominantly referred for epilepsy surgery evaluation ($n = 23$, 74.2%), female ($n = 22$, 70.9%), white ($n = 20$, 64.5%), with a mean age of 38.29 years ($SD = 14.72$). Subjects in the high school group were predominantly referred for epilepsy surgery evaluation ($n = 61$, 72.6%), female ($n = 56$, 66.7%), white ($n = 50$, 59.5%), with a mean age of 40.94 years ($SD = 14.16$).

We used independent one-way ANOVAs to test for group differences for both our primary and secondary measures and used Welch's adjusted F ratio if the homogeneity of variance assumption was violated. When group differences were demonstrated, post-hoc tests were performed to identify the source of the group differences using Tukey's HSD.

TOPF and FSIQ

Because the assumption of homogeneity of variance was not met for the TOPF [Levene's Test of Homogeneity of Variances: $F(2, 148) = 3.36$, $p = .037$], we used Welch's adjusted F ratio. Homogeneity of variance assumption was not violated for FSIQ. Significant group differences were present for both FSIQ [$F(2, 148) = 12.04$, $p < .001$, partial $\eta^2 = 0.14$] and TOPF [$F(2, 148) = 14.59$, $p < .001$, partial $\eta^2 = 0.16$]. Means and standard deviations are presented in Table 1.

Post-hoc HSD comparisons indicated that TOPF for both the GED ($M = 78.32$, $SD = 6.95$) and no certificate/no diploma groups ($M = 77.31$, $SD = 8.08$) were significantly lower ($p < .01$) than high school graduates ($M = 85.88$, $SD = 10.75$). Post-hoc analysis for FSIQ demonstrated the same pattern, with high school graduates ($M = 84.11$, $SD = 11.62$) performing significantly higher ($p < .01$) than GED ($M = 76.90$, $SD = 8.25$) and no certificate/no diploma groups ($M = 74.72$, $SD = 9.74$). Performance did not differ on either TOPF or FSIQ between the two non-high school education groups (see Fig. 1).

VCI, PRI, WMI, and PSI

Analyses were conducted contrasting group differences on the WAIS-IV secondary measures. Since the assumption of homogeneity of variance was not met for VCI [Levene's Test of Homogeneity of Variances: $F(2, 148) = 4.34$, $p = .015$], we used Welch's adjusted *F* ratio. Homogeneity of variance was met for PRI, WMI, and PSI. Fig. 2 shows group differences on index scores. Post-hoc comparisons using Tukey's HSD for WAIS-IV indices showed similar results to the FSIQ scores, with the high school group performing significantly higher than the other two groups (which were not different from each other) on VCI ($p < .05$, partial $\eta^2 = 0.08$), PRI ($p < .05$, partial $\eta^2 = 0.10$), and WMI ($p < .01$, partial $\eta^2 = 0.10$). In contrast, high school graduates performed significantly higher ($p < .01$, partial $\eta^2 = 0.07$) than the no certificate/no diploma group for PSI but did not differ from those obtaining a GED. Means and standard deviations of index scores are included in Table 1.

Discussion

This study demonstrates that despite obtaining a GED certificate, performance levels on both the TOPF and WAIS-IV FSIQ are lower compared to patients completing a standard high school curriculum. These data also indicate that there is no performance benefit of obtaining a GED compared to subjects who did not obtain a GED after leaving high school. High school graduates scored higher than both GED certificate and no certificate/no diploma groups on the TOPF and FSIQ, which were our primary dependent measures, and also on VCI, PRI, and WMI, but not PSI. Across all measures, GED recipients performed no better than those who did not complete high school and did not obtain a GED.

Table 1. Means and standard deviations of test scores for each educational group

	No certificate/no diploma (*N* = 36)		GED (*N* = 31)		High School (*N* = 84)	
	M	*SD*	*M*	*SD*	*M*	*SD*
TOPF	77.31	8.08	78.32	6.95	85.55	10.75
FSIQ	74.72	9.74	76.90	8.25	84.12	11.62
VCI	78.33	11.00	79.52	8.03	85.61	12. 91
PRI	80.86	10.04	83.77	9.16	89.60	12.88
WMI	79.61	12.17	78.29	9.49	87.04	12.91
PSI	76.64	11.35	80.77	12.75	85.35	14.20

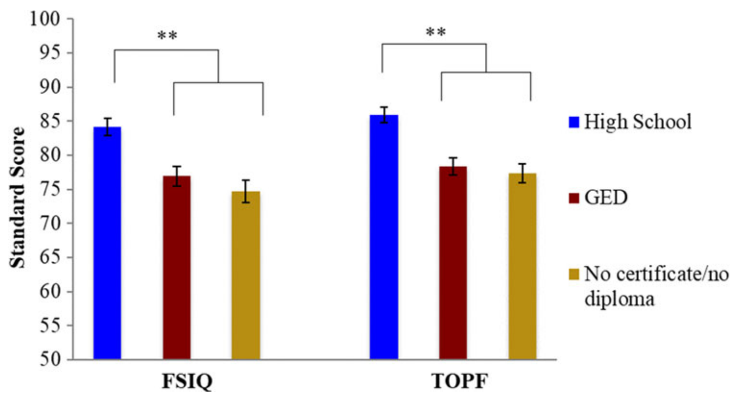

Fig. 1. Standard scores for FSIQ and TOPF for each educational group. Error bars represent standard error of the mean. $^{**}p < .01$.

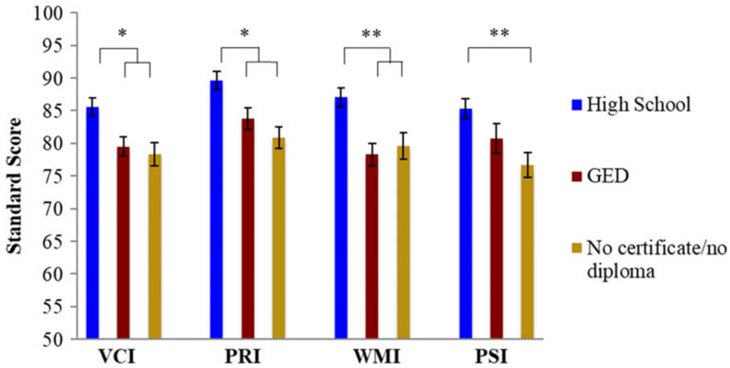

Fig. 2. Standard scores for WAIS-IV indices for each educational group. Error bars represent standard error of the mean. $^{**}p < .01$; $^{*}p < .05$.

Although GED is often referred to as the General Equivalency Diploma, GED stands for the General Educational Development certificate, a misinterpretation that has likely contributed to the GED being considered equivalent to a high school diploma. The GED was established in 1942 to provide military personnel, who were unable to complete high school due to their World War II participation, a means to demonstrate high school level proficiency for college placement; although it was not intended as a high school credentialing instrument, the GED was developed by the American Council on Education by United States Armed Forces Institute for military use (Tyler, 2005; Quinn, 2003). GED eligibility was first extended to the civilian population in New York in 1947, and subsequently to all remaining states and the District of Columbia. Interestingly, New York was the last state to issue GEDs to veterans but the first state to issue GEDs to non-veterans (Quinn, 2003).

There are multiple reasons why a GED certificate may reflect a less robust educational background than a standard high school education. Level of education is one of the many factors contributing to cognitive reserve, that is, the apparent benefit of stimulating life experience that mitigates against the magnitude of cognitive impairment associated with brain disease compared to patients from less enriched backgrounds with comparable lesion burdens (Stern et al., 2018). However, the GED primarily is awarded based upon performance on a standardized multiple-choice test in few content areas. Like many standardized measures, there is a cottage industry of formal preparatory courses and books that teach specifically to GED test content. Thus, a GED, which can be attempted multiple times if not initially passed, cannot reflect the breadth of educational experience associated with a high school diploma. Although some might assert that more cognitively able patients tend to go further in school due to their academic success, thereby introducing a systematic bias in the performance levels of patients who did not complete high school, the critical contrast in this study is the comparison of patients who did not complete high school but subsequently obtained a GED to patients who completed high school without further formal education, thus diminishing the relevance of this concern.

Though beyond what can be suggested based upon the current data, similar issues are confronted with patients with multiple post-baccalaureate degrees. For example, should a person obtaining two master's degrees be considered to have 18 years of education or 20 years? Informal surveying suggests that most neuropsychologists would treat this situation by using 18 years, reflecting the highest degree obtained. However, neuropsychologists who would suggest 20 years as the proper choice rather than highest degree argue that the total number of years is relevant, and in the context of establishing cognitive reserve in which diversity of stimulating experience is relevant, two master's degrees may reflect a greater breadth and richer educational background than other advanced degrees such as Ph.D. or M.D. in which the final school years are often spent outside the classroom and focused instead on narrow research or clinical issues.

The use of 12 years to estimate premorbid function has potential significance when making inferences regarding education since this methodology will tend to yield lower demographic corrections. Consider the following hypothetical example derived from Heaton, Miller, Taylor, and Grant's (2004) demographic corrections for commonly used neuropsychological measures. A 76-year-old African American male with a history of hypertension, hyperlipidemia, and Type II diabetes is referred for evaluation of possible cognitive decline. He obtained a GED after dropping out of high school during the ninth grade to help support his family, and is now retired for approximately 10 years from working in construction. On neuropsychological testing, he obtained a score of 27/60 on the Boston Naming Test (BNT), a total of 14 words generated on the Controlled Oral Word Association (COWA), and eight different animal names generated during a single 60-second trial. If his GED is considered to be equivalent to 12 years of school, then the performance levels may be diagnostically relevant (BNT = 4th percentile, COWA = 5th percentile, Animal fluency = 8th percentile). In contrast, if performance levels are estimated using 8 years of education, reflecting the last year of school completed, a different performance profile is observed (BNT = 16th percentile, COWA = 16th percentile, Animal fluency = 16th percentile). Although performance levels should never be interpreted in isolation, using 12 years to generate normative performance levels suggests decline across multiple relevant neuropsychological tests, whereas using the number of school years successfully completed yields a very different clinical inference.

There are several limitations to this study given its retrospective nature examining archival data and the sample of patients that included a large number of programmatic evaluations for possible epilepsy surgery, although all subjects in the study were patients referred by neurologists. Unfortunately, clinical information regarding age of seizure onset, epilepsy syndrome, and seizure frequency was not characterized in this database. Thus, it is possible that there may have been a systematic group difference in seizure characteristics across groups, although we consider this to be unlikely since epilepsy surgery candidates were equally represented across all groups and that these programmatic referrals were for the same clinical indication. In addition, these factors are secondary to the overall issue to investigate whether a GED certificate can be considered equivalent to a high school diploma when performing demographic test correction equivalent (i.e., rejecting the null hypothesis that there is no difference between groups), although future research into various clinical and disease effects on estimates of premorbid function will address issues of generalizability of these findings to other neurological conditions and cognitively normal subjects without neurologic disease.

Because of their chronic condition, some epilepsy patients may have left school due to frequent seizures rather than simply by choice, thereby making the number of years of schooling more reflective of their educational background compared to subjects who had a more normal developmental history. However, the primary group comparison contrasted those subjects (epilepsy or not) who subsequently obtain a GED compared to subjects completing a standard high school curriculum. Ideally, future studies can be of sufficient size so that groups can be carefully matched on factors such as diagnosis, medication burden, and disease severity. However, since the primary variable of interest is estimated premorbid function using TOPF, the specific clinical presentation should be unlikely to meaningfully affect our results unless patients with expected performance interactions with the TOPF are included (e.g., patients with left perisylvian lesions from stroke).

Additionally, important demographic information was not obtained. For instance, social economic status (SES) was not recorded so we were unable to examine whether SES was a moderating variable regarding GED equivalence. Finally, education level including obtaining a GED certificate was self-reported and not independently verified. Unfortunately, our sample size was not sufficient to allow us to examine potential performance differences at different years of education for subjects not completing high school.

Despite these limitations, the study provides insight into factors associated with determining the equivalence of different types of education. Future research should explore other educational parameters (i.e., online education, home-schooling, etc.) since web-based curricula are expected to continue to increase both in traditional and non-traditional educational environments.

Our study supports using the number of completed years of regular academic coursework as the most appropriate metric to reflect educational achievement (Heaton et al., 2004). Compared to Heaton and colleagues (2004), however, other systems are not as explicit. The 2004 Joint Committee on Testing Practices guidelines recommend that the nature of content, norms, or comparison groups, other technical evidence, and benefits and limitations of test results be incorporated into test interpretation (Code of Fair Testing Practices in Education, 2004). This language appears purposely vague to facilitate clinical judgment and flexibility in interpretation. Although norming often incorporates number of years of academic coursework completed (Heaton et al., 2004), as noted by Manly (2005), the use of demographic correction with neuropsychological testing is simply a proxy to correct for differences in cultural, socioeconomic, and education backgrounds. Because these distinctions are not always clear, a more scientific approach to future test standardization may be to use formal estimates such as the TOPF to adjust for differences in educational background differences when interpreting neuropsychological test performance (O'Bryant et al., 2007). Until that time exists, we suggest clinical judgment be used to determine what normative values appear to be most clinically relevant for patient characterization and, in particular, neuropsychological performance of patients with GEDs be demographically corrected by formal years of education completed.

Conflict of interest

None declared.

References

Berg, J., Durant, J., Banks, S. J., & Miller, J. B. (2016). Estimates of premorbid ability in a neurodegenerative disease clinic population: Comparing the Test of Premorbid Functioning and the Wide Range Achievement Test, 4th Edition. *The Clinical Neuropsychologist*, *4*, 547–557. doi:10.1080/13854046.2016.1186224.

Code of Fair Testing Practices in Education. (2004). Washington, DC: Joint Committee on Testing Practices. Retrieved from https://www.apa.org/science/programs/testing/fair-testing.pdf

Heaton, R. K., Miller, S. W., Taylor, M. J., & Grant, I. (2004). *Revised comprehensive norms for an expanded Halstead-Reitan Battery: Demographically adjusted neuropsychological norms for African American and Caucasian adults scoring program*. Lutz, FL: Psychological Assessment Resources.

Heckman, J., Humphries, J., & Kautz, T. (2014). *The myth of achievement tests: The GED and the role of character in American life*. Chicago, IL: University of Chicago Press.

Manly, J. J. (2005). Advantages and disadvantages of separate norms for African Americans. *The Clinical Neuropsychologist*, *19*, 270–275.

O'Bryant, S. E., Lucas, J. A., Willis, F. B., Smith, G. E., Graff-Radford, N. R., & Ivnik, R. J. (2007). Discrepancies between self-reported years of education and estimated reading level among elderly community-dwelling African-Americans: Analysis of the MOAANS data. *Archives of Clinical Neuropsychology*, *22*, 327–332.

Pearson Assessment. (2009). *Advanced clinical solutions for the WAIS-IV and WMS-IV: Clinical and interpretive manual*. San Antonio, TX: NCS Pearson.

Quinn, L. M. (2003). *An Institutional History of the GED*. ETI Publications. Paper 112. Retrieved from http://dc.uwm.edu/eti_pubs/112

Stern, Y., Arenaza-Urquijo, E. M., Bartres-Faz, D., Belleville, S., Cantilon, M., Chetelat, G., et al. (2018). Whitepaper: Defining and investigating cognitive reserve, brain reserve, and brain maintenance. *Alzheimer's & Dementia*. doi:10.1016/j.jalz.2018.07.219Advance online publication.

Tyler, J. H. (2005). The General Educational Development (GED) credential: History, current research, and directions for policy and practice. In Comings J., Garner B., Smith C., Comings J., Garner B., & Smith C. (Eds.), *Review of adult learning and literacy: Connecting research, policy, and practice*, *Vol. 5*, pp. 45–84). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Zajacova, A., & Montez, J. K. (2017). The health penalty of the GED: Testing the role of noncognitive skills, health behaviors, and economic factors. *Social Science Quarterly*, *98*, 1–15. doi:10.1111/ssqu.12246.