JECT. 2007;39:243–248
The Journal of The American Society of Extra-Corporeal Technology

An Analysis of Perfusion Technology Preadmission Factors Effects on Academic Success, Perfusion Certification Achievement, and Career Placement

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Presented at the 45th International Conference of the American Society of Extra-Corporeal Technology, Atlanta, Georgia, April 25–28, 2007.

Abstract: This retrospective study was designed to evaluate the contribution of grade point average (GPA) and the Wechsler Adult Intelligence Scale-Revised (WAIS-R) practical scores toward predicting perfusion academic success, career placement as a clinical perfusionist, and certification success or failure. The files of 95 students enrolled in the perfusion technology program at Carlow University-University of Pittsburgh Medical Center School of Cardiovascular Perfusion (CARLOW-UPMC) from 1995 through 2005 were reviewed to obtain admission and academic data. The independent variables used were WAIS-R practical results of the picture completion (PC), picture arrangement (PA), block design (BD), object assembly (OA) and digit symbol (DS) tests, undergraduate grade point average (UGPA), science grade point average (SGPA), and anatomy and physiology grade point average (APGPA). The dependent variables used were perfusion grade point average (PGPA), career placement status as a clinical perfusionist (CAREER), and success or failure on the American Board of Cardiovascular Perfusion (ABCP) certification examination. The research plan consisted of logistic and multiple linear regression analyses to determine which of the WAIS-R and GPA independent variables were significantly associated with the dependent variables. UGPA, SGPA, and APGPA all correlate at the 5% level with success achieving high PGPA. WAIS-R measures were not significant indicators of academic success. PGPA, UGPA, SGPA, and APGPA did not significantly correlate with any of the tested WAIS-R scores. PC, BD, and OA scores correlate well with CAREER. OA and DS scores correlate at the $p = 0.05$ level with ABCP certification success. **Keywords:** Wechsler Adult Intelligence Scale-Revised, grade point average, career placement, American Board of Cardiovascular Perfusion. *JECT. 2007;39:243–248*

The evolution of perfusion education from informal on-the-job instruction to its current hospital- or university-based sponsorship has occurred over a 44-year period. The challenges institutions face, which are responsible for the delivery of health care, in turn affect the development of perfusion technology curriculums. "The strength of the perfusion profession is tied to the success of perfusion education programs" (1).

Today, perfusion students are younger than in the past, and a much higher percentage are entering perfusion technology as their first health career. "This challenging student population will result in graduates with a narrower discipline focus than the multi-skilled graduates of earlier years" (2). Some perfusion educators are challenged to meet market place demands, with younger candidates drawn from a smaller pool of applicants. One topic that has surfaced in discussions with perfusion leadership is the need to recruit high-quality candidates to enter the profession. Program directors state that it is increasingly difficult to fill all the available positions in perfusion schools and that this will lead to a perfusion shortage that may be overwhelming to centers that render cardiac services (3). Applicant selection, recruitment, and retention of prospective perfusion technology candidates directly affect the longevity of the profession.

Most allied health professions require a challenging combination of cognitive knowledge, psychomotor skill and clinical decision-making (4). The cardiovascular perfusion curriculum not only requires obtaining a strong knowledge base in a relatively short period but also developing manual dexterity and decision-making ability necessary for sound clinical competency (2). Perfusion programs are encouraged, because of the demands placed on allied health professions, to use highly predictive and

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The author has reported no material, financial or other relationship with any healthcare-related business or other entity whose products or services are discussed in this paper.

valid criteria to select the most qualified applicants. Admissions decisions must be based on the best data available to reduce the risk of attrition and to increase the number of graduates entering the profession. This study provides an initial investigation into the potential use of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) as a predicative measure for academic success.

This study was developed as an investigation that would establish a framework by which other accredited perfusion programs could investigate further possible correlations that may or may not exist between grade point average (GPA), cognitive ability scores of the WAIS-R, and a candidate's outcome on the American Board of Cardiovascular Perfusion (ABCP) certification exam. Background information from these facts could be examined by other perfusion educators in future studies in an attempt to identify patterns of special cognitive ability, measured by the individual WAIS-R practical tests, which might be related to ABCP certification.

REVIEW OF THE LITERATURE

Research regarding admission standards and practices within the perfusion community has not been well documented or formerly researched. Individual perfusion schools select candidates based on criteria validated by other relevant allied health educators. To that end, a literature search aimed at allied health education revealed a number of key academic predictors of success. They include academic standings qualified by GPA, science grade point average (SGPA), standardized test scores, and achievement in certain science coursework. A literature search of various allied health professions with this cognitive information included physical therapy training, occupational therapy instruction, medical school edification, and nursing education (5–12).

Criteria that have traditionally been used to predict academic success include preadmission GPA, American College Testing Program (ACT) scores, Graduate Record Examination (GRE) scores, interview ratings, letters of recommendation, and Allied Health Professions Admissions Tests (AHPAT) scores. Balogun (13) found that GPA and AHPAT scores were the most reliable preadmission predictors of academic success for physical therapy students. A summary of the most common cognitive and noncognitive factors used in the selection of allied health students are presented in Table 1 (5).

Schools of allied health need a valid and reliable index of ability for all applicants. Cognitive tests for selecting candidates generally depend on the results achieved on Medical College Admission test (MCAT), ACT, and Undergraduate Grade Point Average (UGPA). Most research has studied the relationship between admissions criteria and future academic performance. Results from this literature have been somewhat mixed, although the most consistent findings include a strong relationship between a variety of prerequisite GPA and academic performance measures in the professional phase of the allied health profession (9,12–16). Preadmission standardized tests, such as the ACT and GRE, correlated with professional academic performance. Stronger relationships resulted when test scores were coupled with prerequisite GPA. Reported studies seem to support prior academic achievement and ability test scores as valid predictors of success in allied health endeavors. Predicting performance on various allied health care examinations for certification or licensure has been a topic of interest among educators for a number of years (7,8,17).

All of the studies concluded that it is possible to predict the students who are at risk for failing to meet academic or certification standards. Traditional predictors, such as UGPA, grades in prerequisites or other selected courses, and entrance examinations are the variables that consistently show valid and reliable correlations. Other demographic variables show promise for adding to predictability; however, future research involving these factors is necessary before definitive conclusions can be drawn.

Table 1. Comparison of the rankings in admissions decisions among select allied health programs.

1.	Overall grade point average
2.	Grade point average in foundation courses: biology, chemistry, physics, and anatomy and physiology
3.	Letters of recommendation
4.	Performance on admission personal interview
5.	Quality of personal goal statement
6.	Volunteer work in a field setting
7.	Prior work experience
8.	Standardized test scores
9.	Student's character
10.	Increase diversity among students
11.	Student's participation in extracurricular activities
12.	Student's desire to work in an underserved community
13.	Participation in academic summer enrichment program
14.	High school grade point average

MATERIALS AND METHODS

The subjects used in this study were 95 undergraduate perfusion candidates enrolled at Carlow University from 1995 through 2005. All candidates met the requirements for eligibility for certification through the ABCP. The perfusion program is accredited and approved by the Commission on Accreditation of Allied health Education (CAAHEP). Perfusion students in this study were admitted to college level courses according to college criteria of cut-off scores on the SAT in math and English, and high school or relevant academic GPA. Admission to the perfusion major requires a 2.5 GPA when the student makes

application to the clinical perfusion practicum. For progression in the program, students must maintain a minimum of a C in all perfusion technology courses.

One measure of intelligence and three measures of achievement are used in the student selection process at Carlow University-University of Pittsburgh Medical Center School of Cardiovascular Perfusion (CARLOW-UPMC). The measure of intelligence is the WAIS-R practical test. This practical test yields scores for picture completion (PC), picture arrangement (PA), block design (BD), object assembly (OA), and digit symbol (DS). The measure of academic achievement used was preadmission GPA from undergraduate studies at Carlow University. Student selection is based largely on these scores and grades and a combination of non-academic factors such as personal essays, prior medical experience, interviews, and reference letters. These non-academic factors have not been addressed in this study because they are subjective measures that may be inconsistent. Success in the program is assessed by overall program grades and success achieving certification on the ABCP examination.

This study investigated the relationship between a perfusion candidate's cognitive abilities as judged by the WAIS-R scores and their outcomes on the ABCP certification exam. It was my hypothesis that there would exist statistical differences between those candidates passing the ABCP certification examination and those failing when examined in regard to their UGPA and WAIS-R practical section scores. I also believed that there would be a relationship between the candidates' outcomes on the ABCP certification examination and the candidates' WAIS-R practical scores in the following subtests: PC, PA, BD, OA, and DS.

Twelve research questions were developed that hypothesized the predictive value of the UGPA, SGPA, and Anatomy and Physiology GPA (APGPA) when Perfusion GPA (PGPA), professional employment as a perfusionist (career), ABCP certification, and significant WAIS-R scores were used as indicators of success.

Undergraduate academic information and WAIS-R subtest results were received in a coded form from CARLOW-UPMC school of cardiovascular perfusion. This information allowed us to make explicit assumptions as to the relation and pattern of academic admission variables as it relates to success on the ABCP certification examination. This final examination was determined as a method by which a novice perfusionist may be determined to be adequately prepared to enter the field of perfusion technology as an entry level professional.

The records maintained by CARLOW-UPMC school of cardiovascular perfusion were the primary source of data used in this analysis. This research study and method of data collection met the criteria for review established by the Institutional Review Board of the University of Pittsburgh Medical Center, Duquesne University, and Carlow University.

These linkages between the students' academic admission variables and their outcome on the ABCP certification examination have been determined by performing multiple logistical regressions on parametric and nonparametric measures while controlling for multiple comparisons. The data were entered into the SPSS 12.0 for Windows statistical package for data analysis.

The independent variables in this study included the mean, median of distribution, and frequency of the candidates' overall UGPA, SGPA, APGPA, and WAIS-R practical scores in the following subtests: PC, PA, BD, OA, and DS. These independent variables were selected to compare admission demographics of the sample to that of the total population of all candidates taking the certification examination to gain information to predict the success of applicants in perfusion technology.

The dependent variables in this study included the students' academic success at CARLOW-UPMC School of Perfusion, cumulative results on the two-part ABCP certification examination, and career appointment as a clinical perfusionist. Numerical values were used for the academic success variables GPA, pass or fail was used for the certification variable, and yes or no was used for the program completion variable.

Two instruments used in this study included the WAIS-R and the ABCP certification examination.

The research plan consisted of logistic and multiple linear regression analyses. Using binary logistic models and multiple linear regression models, four separate phases of regression models were used for each of the independent variables and dependent variables. Significant independent variables were identified using a p value of .05 or lower.

RESULTS

UGPA, SGPA, and APGPA all correlated well with success achieving equally high PGPA. These predictor variables are statistically significant predictors for the dependent variable PGPA, all at the 5% level (Table 2).

WAIS-R measures were not significant indicators of academic success or failure. PGPA, UGPA, SGPA, and APGPA did not significantly correlate with any of the tested WAIS-R practical measure scores (Table 2).

PA scores were not significant indicators for the dependent variables PGPA, career, or ABCP (Table 2).

The PC, BD, and OA independent variables were statistically significant predictors for the dependent variable career, all at the 5% level (Table 2). Based on the results of this study, there was a predictive value using select performance scores on the WAIS-R to predict professional employment as a clinical perfusionist.

Table 2. Conclusion matrix of the dependent and independent study variables.

Variable	Question	PC	PA	BD	OA	DS	UGPA	SGPA	APGPA
PGPA	1								
	4						<.001		
	7							<.001	
	10								<.001
Career	2	.03		.04	.01				
	5				.05				
	8				.04				
	8	.03		.04	.01				
	11				.04				
	11	.04		.03	.01				
ABCP	3					.04			
	3				.05	<.001			
	6					.01			
	9					.01			
	12					.01			
	12				.05	.01			

The OA and DS independent variables were statistically significant predictors for the dependent variable ABCP, all at the 5% level (Table 2). Based on the results of this study, there was a predictive value using select performance scores on the WAIS-R to predict certification success or failure.

DISCUSSION

Dr David Wechsler, a clinical psychologist, developed the Wechsler intelligence scales in 1939 as a measure of intellectual performance in adults. He defined intelligence as an individual's ability to adapt and constructively solve problems in the environment. Wechsler viewed intelligence in terms of intellectual performance rather than capacity. His rationale for intelligence suggests that it really does not matter how much intelligence one has to adapt to the environment; what matters is how well one uses intelligence (18).

The Wechsler scales have two batteries of subtests grouped into two general areas: verbal scales and performance scales. The verbal scales measure general knowledge, language, reasoning, and memory skills. The performance scales measure spatial, sequencing, and problem-solving skills. The battery of tests consists of six verbal and five performance tests. They include an information test, a general comprehension test, a memory span test, an arithmetical reasoning test, a similarities test, vocabulary test, PA, PC, BD, OA, and DS.

The PA test consists of a series of pictures that, when placed in the right sequence, relay a story. The pictures are presented to the subject in a disarranged order. The candidate is asked to put them together in the right order so that they make a sensible story. This subtest measures general observation abilities, common sense, social intelligence, awareness to details, and the ability to comprehend and size up a situation. Based on the result of this study, PA practical scores were not significant predictors of PGPA, career or ABCP.

The PC tests require the subject to discover and name the missing part of an incompletely drawn picture. This measure effectively measures a subject's ability to comprehend and size up a total situation. The subject must understand the whole and must get the idea of the story before he or she is able to accomplish the task. The subject is called on to assess and evaluate the total situation. The subject matter of this test nearly always involves some practical situation. The understanding of these situations has been referred to as social intelligence. It is the type of test that effectively measures a subject's ability to comprehend and size up a total situation and measures ability to observe details and recognize specific features of the environment. The examinee must identify the missing part from a set of pictures. In a broad sense, the test measures the ability of the individual to differentiate essential from non-essential details (18). Based on the results of this study, PC was a statistically significant predictor for the dependent variable career.

Included in the BD test are nine red and white square blocks and a spiral booklet of cards showing different color designs that can be made with the blocks. The examinee must arrange the blocks to match the design shown on the cards. Each item is scored for accuracy and speed of arrangement completion. Success with the BD is dependent on the individual's ability to analyze the whole into its component parts. The OA and the BD tests seem to get at some sort of creative ability. These tests are observably influenced by a person's occupation (18). The BD test is a comprehensive measure of non-verbal intelligence. It correlates well with comprehension, information, and vocabulary tests and is a measure of general intelligence that evaluates spatial problem solving and manipulative abilities and part to whole organization skills. One can learn about the subject by watching how they

take the test. Attitudes and emotional reactions can be observed during the examination process. Temperamental traits, persistence, and impulsiveness are observed during the examination process. Low scores are attributed to poor visual motor organization. Based on the results of this study, BD was a statistically significant predictor for the dependent variable career.

The DS test or substitution test measures intellectual ability. Older, neurotic, and unstable people do poorly on this test. Poor concentrators are judged by this measure. Emotional reactivity to persistent effort can be observed. The subject is required to associate certain symbols with certain other symbols, and the speed and accuracy with which he does it serve as a measure of his intellectual ability. The roles that visual acuity, motor coordination, and speed play in the performances of the task are in question. Individuals with specific motor disabilities affect the performance of these tasks (18). Based on the results of this study, DS was a statistically significant predictor for the dependent variable ABCP.

The OA test requires putting things together into a familiar configuration. The test consists of various figure form boards cut up asymmetrically into pieces, which the subject is required to reassemble. The OA measures the thinking and working habits of the subjects. People with artistic and mechanical ability seem to do very well on this test. The test is of value in revealing the capacity to persist at a task. Based on the results of this study, OA was a statistically significant predictor for the dependent variables career and ABCP.

Perfusion technology programs must be accountable to the students and the community of interest to which they serve. Admissions decisions must be based on the best data available to reduce the risk of attrition and to increase the number of graduates entering the profession. This study provided an initial investigation into the potential use of the WAIS-R as predictive measure of academic success and offers the following conclusions.

1. Standardized tests like the WAIS-R offer a few advantages for the selection of students. The first is that the users have access to reference norms showing how often each score on the measure compared to other similar groups or individuals. The second advantage is the test should have clear evidence that they can predict performance in a variety of settings. For example, this research shows a significant relationship between performances on select WAIS-R practical scores and perfusion abilities. Future research aimed at establishing a link between ideal perfusion ability and abilities measured by the WAIS-R may identify ideal candidates for perfusion technology.
2. It must be stressed that it is not always sensible to use ability tests as the sole selection identifier. It may be that some of the skills required cannot be measured or identified by this specific test. Other batteries of tests are available that measure wide ranges of psychological variables that may or may not lead to ideal candidates. This spectrum of tests adds time and expense to candidate selection. If the consequences of choosing the wrong individual are not important, the cheaper form of evaluation may be indicated. However, if perfusion educators are committed to identifying the most suited candidates for the limited number of positions, it may be appropriate to use other tests.
3. General ability is not the only variable that affects performance. Motivation also plays a large part, and future job knowledge may well overtake cognitive ability as the best predictor of performance after an individual has been performing as a career perfusionist. A carefully chosen ability test can provide a useful and inexpensive means of predicting how well an applicant is likely to perform on the ABCP examination or as a career perfusionist. The value motivation plays regarding performance cannot be measured in most cognitive ability tests (19).

There are a small number of perfusion technology programs within the United States. A sample of perfusion candidates and graduates from a variety of perfusion programs across the country would appropriately represent the perfusion population. The population of students used for this research involved one perfusion program over a 10-year period. This population focused only on graduates from CARLOW-UPMC. Future research should also focus on the national pool of candidates that fail to complete the training, ultimately never entering the perfusion profession.

The attributes necessary for career success as a perfusionist are subjective in nature and are best judged by peers within the perfusion community. Because there are a limited number of perfusion technology programs in America, development of a survey that focuses on characteristics necessary for perfusion academic and clinical success may identify key attributes necessary for career success. Future research that identifies characteristics essential for clinical competency and academic success would be of great value to the perfusion community.

Research should also be conducted that identifies students that may not pass the ABCP examination. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research. Hospital accreditation agencies require that employees be certified or in the process of becoming certified perfusionists to be used. Perfusion educators should graduate academically and clinically sound candidates that have the greatest potential, not only to complete the training, but pass the certification and/or licensure require-

ments. Future research should focus on identifying the most suited candidates for the limited number of perfusion positions.

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