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# Personal characteristic differences among Doctor of Physical Therapy students with unique sociodemographic factors

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## Abstract

**Background** The Association of American Medical Colleges suggests an Experiences-Attributes-Metrics framework for holistic review, but there is minimal research on demographic and personal characteristic attributes and the interplay between these Attributes subcategories. Understanding how personal attributes may vary among students considered represented and those considered underrepresented in one or more categories is critical to avoid unintentionally perpetuating practices that favor represented groups. This study explored differences in six personal characteristics either consistently related to academic performance or deemed positive professional traits based on diversity characteristics (categories of underrepresentation), age, and sex.

**Methods** Three cohorts of first-year Doctor of Physical Therapy students at a single institution were invited to participate in this prospective, observational study. Participants completed six surveys: PROMIS<sup>®</sup> General Self-efficacy, PROMIS<sup>®</sup> Anxiety, 12-item Grit Scale, Perceived Stress Scale-10 (PSS-10), Brief Resilience Scale (BRS), and PROMIS<sup>®</sup> Positive Affect. T-tests and ANOVAs (or nonparametric equivalents) were used to examine differences in these measures by number of diversity characteristics, age, and sex. Multivariate linear regression was used to determine if diversity characteristics explained additional variance in each of the personal attribute scores after controlling for age and sex.

**Results** One Hundred and Forty Five students participated (80.7% female, 77.9% < 25 years old, 51% 0 diversity characteristics). Students with more diversity characteristics and males reported higher self-efficacy and resilience ( $p$ 's < 0.05). Females reported higher anxiety ( $p$ 's < 0.01). Diversity characteristics explained additional variance in self-efficacy (3.3%,  $p$ =0.02) and resilience (2.5%,  $p$ =0.05) after controlling for age and sex. Grit, perceived stress, and positive affect did not show any group differences.

**Conclusions** Underrepresented students demonstrated higher self-efficacy and resilience than their represented peers, qualities that may be important to overcome challenges prior to and during graduate school. Males exhibited higher self-efficacy and resilience, but lower anxiety than females which is generally consistent across higher education. Grit, perceived stress, and positive affect were similar across all students and may be less useful to create a diverse learning environment. Further studies should investigate differences in attributes among admitted and unadmitted students and the relationship to future performance for admitted students.

**Keywords** Diversity, Holistic admissions, Attributes, Characteristics, Demographics, Physical therapy

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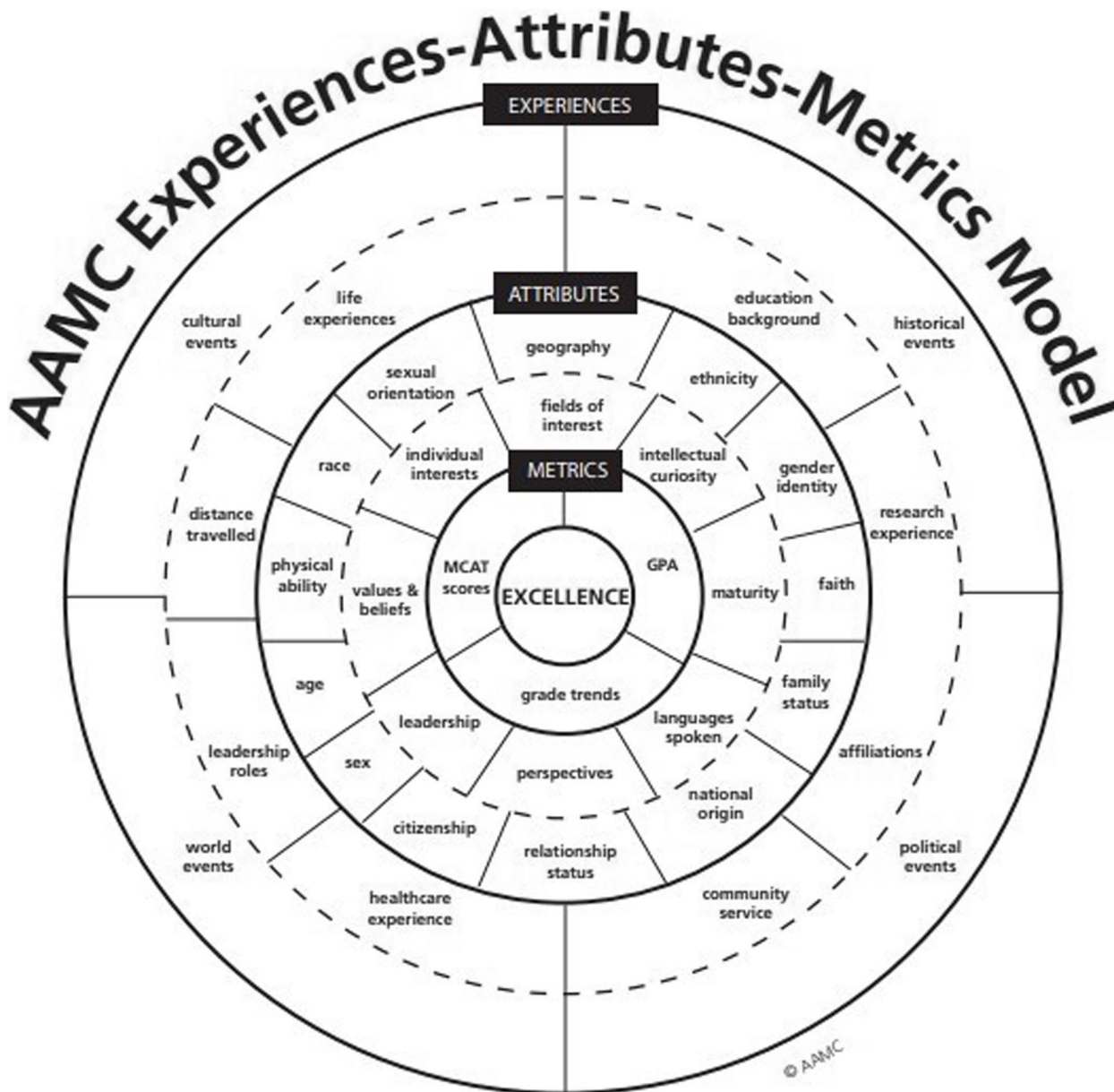


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**Background**

In 2013, the American Association of Medical Colleges (AAMC) put forth a holistic admissions framework that balances an applicant’s experiences, attributes, and academic metrics (Fig. 1) with the goal of considering the many ways a person might add value as both a student and a professional [1].

Experiences entails a student’s path thus far in life and encompasses examples such as employment history, research background, and life experiences. Attributes is subdivided into demographic factors (e.g., first generation college student, race/ethnicity, age, sex, etc.) and personal characteristics (e.g., empathy, resilience, curiosity, etc.). Academic metrics includes grades, grade trends,



Adapted from Workforce America: Managing Employee Diversity as a Vital Resource, McGraw Hill Publishing, 1990.

**Fig. 1** Association of American Medical College’s Experiences-Attributes-Metrics framework for holistic review [1]. Permission was granted for reproduction based on this being a scholarly work

and standardized test scores [1]. The goals of this holistic approach are two-fold: 1) to create a learning community of students with wide-ranging backgrounds, experiences, and perspectives and 2) to generate a diverse pool of providers capable of meeting the complex healthcare needs of all communities [1, 2].

The American Physical Therapy Association (APTA) and American Council of Academic Physical Therapy (ACAPT) share the goal of increasing provider representation in the physical therapy profession [3–6]. Both medicine and physical therapy view professional diversity through a broad lens that includes unique experiences and perspectives as well as multiple demographic factors [1, 3]. Through the work of the Diversity Task Force, the APTA and ACAPT have intentionally generated an expanded definition of underrepresented minorities (URMs) in physical therapist (PT) education to include four categories: racially and ethnically underrepresented, educationally disadvantaged, economically disadvantaged, and geographically underrepresented to portray many aspects of diversity [3]. Utilizing AAMC's Experiences-Attributes-Metrics (E-A-M) model, the four URM categories fall under Attributes in the demographic factors subcategory [1]. In PT education, extensive literature has been dedicated to understanding academic metrics as predictors of academic performance outcomes [7–16], but there is little research on which specific experiences or attributes to include in holistic admissions, nor the interplay between these categories and/or subcategories. Consideration of interrelationships is needed to avoid perpetuating biases that may not be immediately apparent and to understand the relationship between attributes and race/ethnicity since race-conscious admissions were struck down by the United States Supreme Court in 2023 (SFFA vs UNC, Case 21–707, 2022; SFFA vs Harvard, Case 19–2005, 2022). For example, historically, academic metrics such as the Graduate Record Examination (GRE) have been the primary consideration for admission in PT education programs [17–19]. White and Asian students, as well as native English speakers, score higher than other racial/ethnic groups or non-native English speakers on the GRE [20, 21]. As these racial and ethnic differences in standardized testing became apparent, many institutions transitioned to broader admissions criteria to develop a more complete picture of applicants. A narrow focus on academics may reduce the likelihood that URM students, who would otherwise be good candidates, are admitted into PT programs. Other programs existing in states where race-based admissions were outlawed prior to the 2023 Supreme Court decision have used the demographic attribute of socioeconomic status as a partial proxy for race/ethnicity to promote diversity [22]. Even though Attributes is a cornerstone of the E-A-M model,

to date, there is a dearth of literature available to guide the holistic review and ensure that new criteria don't mirror the pitfalls of standardized test scores. The goal of this study was to examine how personal characteristics may vary among students with unique sociodemographic attributes as a starting point for elucidating how the Attributes category could inform admissions practices.

Holistic admissions practices have been promoted as a method to improve representation in PT education and, ultimately, the profession to create a diverse learning environment and a culturally competent workforce [2, 4–6]. Of the 261 accredited PT programs (as of December 2022) [23], four have reported on their implementation of holistic admissions, indicating that incorporating and heavily weighting non-academic metrics matriculated more diverse cohorts [17, 18, 22, 24]. Attributes evaluated included leadership [17, 18, 24], persistence [24], "positive personal qualities" [18], and "individual attributes" [22], without further clarification. Urban Universities for Health Equity through Alignment, Leadership and Transformation of the Health (HEALTH) Workforce in conjunction with AAMC provide some guidance stating selected attributes should promote diversity of thought, perspectives, and experiences and be rooted in evidence that these factors are linked to an applicant's potential for success as a student and professional [2, 25].

We utilized the direction from the Urban Universities for HEALTH and AAMC to select personal characteristics for this study, including those most often related to academic performance or those identified as positive professional traits. Reviews and meta-analyses in educational psychology literature have identified several personal characteristics consistently correlated with academic success including self-efficacy, grit, and anxiety. In higher education, self-efficacy and grit are positively correlated with performance while anxiety typically demonstrates an inverse relationship [26, 27]. Literature in Doctor of Physical Therapy (DPT) students is generally consistent with higher education for self-efficacy [28] and grit [29–32], however, the relationship between anxiety and performance in DPT students does not mirror findings in other student populations [33–35]. Perceived stress in DPT students demonstrates mixed results when correlated with performance [33, 36, 37]. Additional personal attributes such as resilience and positive affect have not been evaluated in the context of academic success but have been identified as positive professional traits in DPT students and may contribute to professional success [38].

However, DPT students are not a monolith, and some literature suggests personal characteristic differences between represented and URMs and between the sexes. For example, in a study by Macauley and colleagues [39],

there were significant differences among first generation and non-first-generation health professions students' reported anxiety. Being a first-generation college student was a significant predictor of anxiety on three measures. Female physical therapy students consistently report significantly higher anxiety than their male counterparts [33–35, 39]. In a separate survey of medical students, Black students were at 66% greater risk of reporting anxiety symptoms than White students [40]. There are similar differences reported for self-efficacy [41, 42], stress [43, 44], and resilience [45] among people with unique demographic factors. If attributes are to be included in the holistic review process, any potential differences in personal characteristics among students with unique demographic factors must be evaluated to inform the process. Therefore, the primary aim of this study was to examine potential differences in six personal characteristics (self-efficacy, anxiety, grit, perceived stress, resilience, positive affect) in DPT students based on number of diversity characteristics (categories of underrepresentation), age, and sex. The secondary aim was to determine if the number of diversity characteristics predicted the six personal attribute scores, after controlling for age and sex.

## Methods

This study was approved by the Institutional Review Boards at Duke University (Pro00106069) and Rocky Mountain University of Health Professions (Pro2022-164).

### Study design

This study was a cross sectional analysis from a prospective, observational cohort. Study participants were recruited from three cohorts of DPT students from a single, private university from August 2020 through 2022. All students were admitted via a holistic admissions process that valued and heavily-weighted applicant experiences and attributes in addition to consideration of their academic metrics. Upon starting the program, all first-year students were informed of the study via an in-class announcement and email invitation explaining the study purpose, data to be collected, and that participation was voluntary. For those that chose to participate, informed consent was obtained prior to any data collection.

### Data collection

#### Procedures

Data for this study were collected from two sources: 1) Physical Therapy Centralized Application Service (PTCAS) data and 2) REDCap electronic survey tools [46, 47]. Demographic data was extracted from PTCAS and included date of birth, sex, race/ethnicity, economic disadvantage, and educational disadvantage. Consented

participants responded to a series of six REDCap surveys collecting self-reported data for the six personal characteristic variables.

### Sociodemographic factors

Age, sex, and diversity characteristics are all considered sociodemographic factors. Age was calculated from the PTCAS date of birth and the survey completion timestamp for each participant. Sex was determined from the participant's PTCAS response to this category. The choices were male, female, or decline to state. Number of diversity characteristics was derived by aggregating student responses to a series of questions in PTCAS regarding race and ethnicity, economic disadvantage, and educational disadvantage. Students reporting their race/ethnicity as Hispanic, Black, American Indian, or Pacific Islander, were considered underrepresented. Students that responded "Yes" to any of the questions regarding economic or educational disadvantage were considered underrepresented in the respective category (Supplement 1). A diversity characteristics score was derived for each participant ranging from zero to three based on the number of categories where they identified as underrepresented. Geographic underrepresentation data is not collected by nor considered in the program and was not incorporated in this study.

Participants were stratified based on their number of diversity characteristics. Groupings were zero, one, and two or more diversity characteristics. Fewer participants had two or three diversity characteristics, so these categories were collapsed for statistical analyses.

### Personal characteristics

We administered six standardized surveys to measure the constructs of self-efficacy, anxiety, grit, stress, resilience, and positive affect. We purposefully selected measurement instruments that were non-proprietary, relatively quick to complete, and easy to score to reduce barriers to future confirmatory research or translation to practice.

### Self-efficacy

Self-efficacy is a construct that focuses on a person's belief that they can achieve what they set out to do because they control their thoughts and actions [48]. We utilized the PROMIS<sup>®</sup> General Self-Efficacy scale which is based upon Bandura's theory of self-efficacy and was designed to measure this construct. It is a 10-item scale that measures a person's belief or confidence in their ability to perform particular behaviors [49]. A summed score is calculated then translated into a T-score, with 50 being the population mean and a standard deviation of 10 [50]. Higher scores indicate greater self-efficacy. This measure has demonstrated internal consistency reliability

(Cronbach's  $\alpha=0.94$ ) and convergent validity with five other measures of related constructs, all of which had significant Pearson correlations [49].

### **Anxiety**

Anxiety can be transient such as test anxiety (i.e., state) or a recurrent personality characteristic (i.e., trait) [33]. Anxiety was evaluated using the PROMIS® Anxiety scale, which measures anxiety over the past seven days without distinguishing between state and trait anxiety. Rather, individuals are asked to rate feelings such as fear, nervousness, and anxiety [51]. A T-score was automatically calculated [51], and higher scores indicate greater anxiety. The PROMIS® Anxiety scale has demonstrated internal consistency reliability. It also demonstrates convergent validity with the general distress (anxiety) portions of the Mood and Anxiety Symptom Questionnaire. Content validity was established through nine experts [52].

### **Grit**

Grit is a term coined by Duckworth and is defined as “perseverance and passion for long-term goals” [53]. It is measured using the 12-item Grit Scale, where individuals are asked to rate statements about work ethic and commitment. Six of the items are related to “consistency of interests,” while the additional six are related to “perseverance of effort.” An overall grit score between 1 (not at all gritty) and 5 (extremely gritty) was generated. The 12-item Grit Scale has demonstrated internal consistency (Cronbach's  $\alpha$  range = 0.77–0.85) and predictive validity for GPA [53].

### **Stress**

Stress occurs as a short-term response to an external trigger. Additionally, stress is related to one's perception: two people may not be equally stressed by the same trigger. The Perceived Stress Scale (PSS-10) evaluates the frequency of feelings and thoughts about stressful activities or events over the past month [43]. A final summed score ranging from 0 to 40 was generated, with higher scores indicating greater levels of perceived stress. The PSS-10 has demonstrated internal and test/retest reliability and construct validity [43].

### **Resilience**

Resilience refers to how a person handles and adjusts to major challenges in their life [54]. In a review of 19 resilience measures, the Brief Resilience Scale (BRS) was identified as one of three measures with the best psychometric properties [54]. The BRS measures “the ability to bounce back or recover from stress” [55]. A resilience score between 1 and 5 was calculated, with higher scores indicating greater resilience. The BRS has demonstrated

internal consistency (Cronbach's  $\alpha$  range = 0.80–0.91), convergent validity, and predictive validity for outcomes such as stress, anxiety, and positive affect [55].

### **Positive affect**

The PROMIS® Positive Affect scale assesses “feeling and mood associated with pleasure, joy, elation, contentment, pride, affection, happiness, engagement, and excitement” [56]. A T-score was automatically calculated. Higher scores indicate greater positive affect. The PROMIS® Positive Affect scale has demonstrated internal consistency reliability [56].

### **Data analysis**

All statistical analyses were conducted using IBM SPSS® Statistic version 25.0 (IBM Corporation, Armonk, NY). Descriptive statistics were used to report the mean and standard deviation for continuous variables and frequencies and percentages for categorical variables. T-Tests or Mann–Whitney U tests for nonparametric data examined differences between age groups: younger (< 25 years) and older ( $\geq$  25 years) students on personal attributes as well as sex on personal attributes. Multiple one-way ANOVAs or Welch's test for nonparametric data examined differences in how students with zero, one, or two or more diversity characteristics reported the six personal attribute variables. Finally, multivariate analyses were completed via linear regression to determine if diversity characteristics explained additional variance in each of the personal attribute scores after controlling for age and sex.

## **Results**

### **Participant demographics**

A total of 145 (50.5%) of enrolled students responded to the surveys. Participant demographics by age, sex, and diversity characteristics are summarized in Table 1 which also offers a comparison to the corresponding applicant pool. The sample was 80.7% female and 77.9% of respondents were under 25 years old. There was minor variation in the number of participants that responded to each survey.

### **Personal attribute differences by sex and age**

Differences between male and female and older and younger students are presented in Tables 2 and 3, respectively. Male and female students differed in self-efficacy ( $p=0.004$ ), anxiety ( $p=0.002$ ), and resilience ( $p=0.001$ ) with males reporting higher self-efficacy and resilience while females reported higher levels of anxiety. All of these differences corresponded with medium effect sizes. There were no sex differences for grit, perceived stress, or positive affect ( $p's > 0.05$ ). There were no differences

**Table 1** Sociodemographic factors of total applicant pool and study participants

	Applicants Percentage (N)	Study Sample Percentage (N)
Sex		
Male	32.0% (699)	19.3% (28)
Female	68.0% (1486)	80.7% (117)
Age		
< 25 years	85.4% (1869)	77.9% (113)
≥ 25 years	14.6% (319)	22.1% (32)
Diversity Characteristics		
0	54.1% (1183)	51% (74)
1	30.4% (664)	34.5% (50)
2–3	15.5% (340)	14.5% (21)

**Table 2** Personal attribute scores by sex

	Total Sample N=145 Mean [SD]	Males N=28 Mean [SD]	Females N=117 Mean [SD]	p-value	Effect Size (Cohen's d)
Self-efficacy	48.1 [6.3]	51.1 [7.5]	47.3 [5.8]	.004**	.61
Anxiety	59.9 [6.5]	56.5 [7.3]	60.8 [6.1]	.002**	.67
Grit	3.85 [.38]	3.92 [.44]	3.84 [.37]	.300	.22
Perceived Stress	14.7 [5.6]	13.1 [6.4]	15.1 [5.3]	.098	.35
Resilience	3.50 [.68]	3.86 [.58]	3.41 [.67]	.001**	.70
Positive Affect	50.7 [8.4]	54.4 [10.6]	50.3 [8.4]	.226	.26

Range of scores: self-efficacy T score 0–100, anxiety T score 0–100, grit 1–5, perceived stress 0–40, resilience 1–5, positive affect T score 0–100

\*\* p-value significant at  $p < .01$

in any personal attributes between students who are younger than 25 and those who are 25 or older ( $p > 0.05$ ).

**Table 3** Personal attribute scores by age

	Total Sample N=145 Mean [SD]	Age < 25 N=113 Mean [SD]	Age ≥ 25 N=32 Mean [SD]	p-value	Effect Size (Cohen's d)
Self-efficacy	48.1 [6.3]	47.7 [6.2]	49.2 [6.5]	.228	.24
Anxiety	59.9 [6.5]	60.3 [6.2]	58.7 [7.5]	.215	.25
Grit	3.85 [.38]	3.83 [.36]	3.91 [.47]	.289	.21
Perceived Stress	14.7 [5.6]	14.8 [5.5]	14.4 [6.0]	.758	.06
Resilience	3.50 [.68]	3.47 [.67]	3.57 [.72]	.466	.15
Positive Affect	50.7 [8.4]	50.1 [7.1]	52.9 [11.6]	.183	.34

Range of scores: self-efficacy T score 0–100, anxiety T score 0–100, grit 1–5, perceived stress 0–40, resilience 1–5, positive affect T score 0–100

**Personal attribute differences by diversity characteristics**

Differences among students with zero, one, or two or more diversity characteristics are presented in Table 4.

When grouped by number of diversity characteristics, DPT students differed in self-efficacy ( $p = 0.001$ ) and resilience ( $p = 0.034$ ). The self-efficacy and resilience differences were both consistent with medium effect sizes. Scheffe’s post-hoc testing revealed that students with one diversity characteristic possessed greater self-efficacy than those with zero diversity characteristics. However, post-hoc testing was unable to determine where the group differences occurred in the analysis of resilience. In a follow-up exploratory analysis to investigate the potential impact of power, the groups were collapsed into dichotomous categories: no diversity characteristics (0) versus any diversity characteristics (1, 2, or 3). This exploratory analysis revealed that students possessing any diversity characteristics reported greater resilience compared to students with no diversity characteristics ( $p = 0.012$ , Cohen’s  $d = 0.423$ ), suggesting there may have been lower power to detect post-hoc differences across three groups.

**Determining personal attribute scores**

Six separate multivariate linear regressions (age + sex + diversity characteristics) were performed with self-efficacy, anxiety, grit, perceived stress, resilience, and positive affect as dependent variables (Table 5). We controlled for age and sex and these variables alone explained between 1.8% and 8.0% variance in the personal attributes of interest. Then, diversity characteristics contributed an additional 3.3 and 2.5% of variance only to self-efficacy ( $p = 0.02$ ) and resilience ( $p = 0.05$ ). Diversity characteristics did not contribute additional variance for anxiety, grit, perceived stress, or positive affect scores.

**Table 4** Personal attributes scores by diversity characteristics

	Total Sample N = 145 Mean [SD]	0 Diversity Char N = 74 Mean [SD]	1 Diversity Char N = 50 Mean [SD]	2–3 Diversity Char N = 21 Mean [SD]	p-value	Effect Size (Cohen's f)
Self-efficacy	48.1 [6.3]	46.2 [5.6]	50.4 [6.6]	49.0 [6.0]	.001**	.297
Anxiety	59.9 [6.5]	60.8 [6.2]	58.9 [6.2]	59.5 [6.5]	.305	.017
Grit	3.85 [.38]	3.83 [.36]	3.61 [.63]	3.71 [.54]	.129	.121
Perceived Stress	14.7 [5.6]	15.4 [5.2]	14.4 [5.4]	13.1 [7.0]	.202	.093
Resilience (Welch's)	3.50 [.68]	3.36 [.72]	3.61 [.63]	3.71 [.54]	.034*	.189
Positive Affect	50.7 [8.4]	50.5 [7.9]	51.1 [8.6]	50.7 [8.4]	.937	0

Range of scores: self-efficacy T score 0–100, anxiety T score 0–100, grit 1–5, perceived stress 0–40, resilience 1–5, positive affect T score 0–100

\* p-value significant at  $p < .05$ , \*\*p-value significant at  $p < .01$

## Discussion

The AAMC's Experiences – Attributes – Metrics model provides guidance for holistic admissions, which values varied experiences, demographic factors, and personal characteristics in applications [1]. If PT programs are to utilize the E-A-M framework, there is a need to understand the relationship of these factors. The primary purpose of this study was to explore differences across six personal characteristic attributes among DPT students with unique sociodemographic attributes. Our study found that among admitted students, those with any diversity characteristics and males had higher self-efficacy and resilience while females reported higher anxiety. Since these attributes vary among subgroups of DPT students, they may contribute to generating a robust, heterogeneous learning environment, which is one of the core tenants of holistic admissions [2]. Bringing together people of diverse backgrounds, experiences, and perspectives generates unique opportunities for student and professional growth that is not possible with homogenous cohorts [2]. For admitted students there were no differences in grit, stress, or positive affect noted between males and females, older and younger students, or more or less diverse students. These attributes may have less influence on the learning environment since all students possessed similar levels.

Students with one diversity characteristic scored, on average, more than four points higher in self-efficacy than students with no diversity characteristics. Given that this corresponded with a medium effect size, it is likely to be a meaningful difference. This finding is consistent with a study from STEM in higher education where Hispanic and Black STEM students reported higher levels of self-efficacy than White students [42]. Accordingly, a possible explanation for these findings is that students admitted to DPT programs from underrepresented backgrounds may represent a subset of URM students that are characterized by lifelong elevated self-efficacy. Conversely,

sustained achievement along the path to graduate school may drive their growing self-efficacy over time. Regardless, high self-efficacy is a valuable trait in DPT students as it is correlated with academic success [28] but also positively influences motivation and academic persistence [57].

URM students with high self-efficacy are likely to enrich the learning community. These students tend to be role models for their peers, vocalizing their perceived capability and exhibiting perseverance through the rigorous coursework [48, 57, 58]. In addition to URM students, male study participants also demonstrated higher self-efficacy than female participants. This is consistent with previous studies in all stages of general education as well as specific STEM fields and may be due in part to how self-efficacy develops [41, 42]. Bandura theorized that self-efficacy is influenced by several sources including verbal and social persuasion, which involves external messaging people receive about their capabilities, and emotional state [48]. Children as young as six years old embrace gendered societal messaging about intellectual ability that favors males and could ultimately impact the development of their self-efficacy beliefs [59]. Additionally, an emotional state characterized by high anxiety weakens self-efficacy [48, 60]. This study found that females report higher anxiety than their male peers, consistent with the self-efficacy differences already noted. Given that high self-efficacy in males appears to be constant through most of the lifespan, it is assumed that differences between males and females would persist in applicants, not only matriculated students. Prioritizing self-efficacy in admissions could result in additional male applicants being admitted. Alternatively, different levels of self-efficacy could be considered for male and female applicants.

Resilience is considered a desirable trait for DPT students and could be considered in admissions metrics [38, 61]. A review of resilience in health professions students

**Table 5** Regression analyses for personal attribute scores

Predictors	Self-Efficacy <sup>a</sup>				Anxiety <sup>b</sup>				Grit <sup>c</sup>			
	$\beta$	<i>B</i>	SE	<i>p</i>	$\beta$	<i>B</i>	SE	<i>p</i>	$\beta$	<i>B</i>	SE	<i>p</i>
<i>R</i> <sup>2</sup>	.08				.067				.018			
	<i>F</i> (2, 139)=5.80, <i>p</i> =.004				<i>F</i> (2, 139)=5.04, <i>p</i> =.008				<i>F</i> (2, 140)=1.28, <i>p</i> =.28			
Age	.12	.26	.17	.13	.00	.01	.18	.96	.09	.01	.01	.30
Sex	-.21	-3.3	1.3	.01	.25	4.1	1.35	.00	-.07	-.07	.08	.41
<i>R</i> <sup>2</sup>	.11				.073				.032			
	<i>F</i> (3, 140)=5.72, <i>p</i> =.001				<i>F</i> (3, 140)=3.67, <i>p</i> =.014				<i>F</i> (3, 141)=1.54, <i>p</i> =.21			
Diversity Characteristics	.18	1.5	.65	.02	-.08	-.67	.69	.33	.12	.06	.04	.16

Note. All coefficients are from the Step 2 model.

<sup>a</sup>Independent predictors included sex and diversity characteristics (Cohen’s *f*<sup>2</sup> = 0.12)

<sup>b</sup>Independent predictors included sex only. (Cohen’s *f*<sup>2</sup> = 0.08)

<sup>c</sup>No independent predictors (Cohen’s *f*<sup>2</sup> = 0.03)

$\beta$  = standardized coefficient, *B* = unstandardized coefficient, SE = standard error

Predictors	Perceived Stress <sup>d</sup>				Resilience <sup>e</sup>				Positive Affect <sup>f</sup>			
	$\beta$	<i>B</i>	SE	<i>p</i>	$\beta$	<i>B</i>	SE	<i>p</i>	$\beta$	<i>B</i>	SE	<i>p</i>
<i>R</i> <sup>2</sup>	.02				.07				.02			
	<i>F</i> (2, 138)=1.51, <i>p</i> =.23				<i>F</i> (2, 139)=5.41, <i>p</i> =.005				<i>F</i> (2, 139)=1.11, <i>p</i> =.33			
Age	.06	.11	.16	.48	-.02	-.01	.02	.79	-.08	-.22	.24	.37
Sex	.13	1.79	1.18	.13	-.25	-.43	.14	.00	-.10	-2.17	1.78	.23
<i>R</i> <sup>2</sup>	.04				.10				.02			
	<i>F</i> (3, 139)=2.04, <i>p</i> =.11				<i>F</i> (3, 140)=4.98, <i>p</i> =.003				<i>F</i> (3, 140)=.79, <i>p</i> =.50			
Diversity Characteristics	-.15	-1.06	.60	.08	.16	.14	.07	.05	.03	.36	.91	.70

Note. All coefficients are from the Step 2 model.

<sup>d</sup>No independent predictors (Cohen’s *f*<sup>2</sup> = 0.04)

<sup>e</sup>Independent predictors included sex and diversity characteristics (Cohen’s *f*<sup>2</sup> = 0.11)

<sup>f</sup>No independent predictors (Cohen’s *f*<sup>2</sup> = 0.02)

revealed that resilience is a protective factor that limits the impact of stress, promotes quality of life, and allows students to overcome personal, academic, and professional challenges [62]. We found that students with two or three diversity characteristics had greater resilience than students with one diversity characteristic and both groups had greater resilience than students with no diversity characteristics (*p* < 0.05). However, post hoc testing failed to determine the where the group differences occurred, indicating more subjects would likely be needed for this analysis. When students with any diversity characteristics were collapsed into a single category,

they were found to be more resilient than students with no diversity characteristics (*p* < 0.05). The corresponding medium effect size likely indicates a meaningful difference.

Resilience is also associated with bouncing back in the face of adversity. Students who are racial/ethnic minorities and/or those who have had more limited educational and economic opportunities than their peers have potentially faced greater hardship that has developed their resilience over time. This idea is consistent with work done in higher education that found first-generation college students to be more resilient than



non-first-generation students [45]. Male students were also found to have higher resilience than female students. Prior studies have typically confirmed this finding [55, 63–65], although a few have noted no difference between the sexes [31, 55]. Resilience has been cited as a positive professional trait [38, 61], suggested for inclusion in the E-A-M model by the AAMC [1], and even incorporated into some holistic admissions rubrics [24] for DPT students. If the differences in resilience extended beyond admitted students to the full applicant pool, inclusion of this attribute in admissions metrics could promote selection of underrepresented students and males. Much like students with high self-efficacy, students with high resilience are inclined to be positive examples for their peers when difficulties arise.

Anxiety was high in all categories of DPT students when compared to the general population, however, female DPT students reported even higher anxiety than males, both of which are consistent with previous research [33, 36, 66]. Conard and Schweizer [38] identified anxiousness/neuroticism as an undesirable personality factor that could be used in the selection of DPT students and may forebode academic trouble if it is not considered. Admissions committees that evaluate heightened anxiety as a negative factor should be wary of comparing applicants to normative data as this is likely to be high across the board. If anxiety is considered in admissions decisions as Conard and Schweizer [38] suggested, it may improve the likelihood that males are admitted. This highlights the importance of understanding differences in personal characteristic attributes by demographic factors prior to incorporating these attributes into holistic admissions practices.

The results of this study provide more granular data on differences in personal characteristics among various groups of DPT students, shedding light on the Attributes category of the E-A-M model. More information is needed to understand if the differences seen in self-efficacy and resilience based on diversity characteristics are unique to students that were admitted and matriculated into the program. Further work should examine potential differences in personal characteristics among non-admitted versus admitted students. It is possible that the personal characteristics of our study participants may not reflect the general applicant pool. While the primary purpose of this study was to explore differences in personal characteristic attributes among DPT students with more or fewer diversity characteristics, our findings also highlighted the important role of sex. In our analyses, diversity characteristics uniquely contributed to the variance in self-efficacy and resilience scores, but in these models as well as anxiety, sex was the strongest contributor. This sample was not large enough to explore interactions

between sex and diversity characteristics so further research with samples large enough that can be stratified into multiple categories is warranted.

To meet the goal of a more diverse profession that can address the complex healthcare needs of society, PT program admissions should be intentionally designed with scrutiny of the value, meaning, weighting, and implications of their chosen criteria. Our study found no differences in grit, perceived stress, or positive affect among any of the various groups of admitted students. If the same patterns exist in non-admitted students, then seeking students with high grit or positive affect, both considered desirable traits in DPT students, may not lead to the diversity of experiences, perspectives, and backgrounds needed to create a rich learning environment.

### Limitations

This study presents with some limitations. First, portions of data collection occurred during the Covid-19 pandemic when a significant portion of instruction was delivered remotely. This learning environment was unfamiliar for many students and may have affected their reporting of personal attributes (e.g., higher stress and anxiety). Second, we examined differences in students with either zero, one, or two to three diversity characteristics from the categories of race/ethnicity, educational disadvantage, and/or economic disadvantage. Defining diversity characteristics in this way created additional limitations. We collapsed two and three diversity characteristics into a single category for analysis based on preliminary data demonstrating that there tend to be fewer participants in these groups. Combining them was practical to perform the analyses and assumed equal weighting of these characteristics. However, this could mask any potential differences between those with two or three diversity characteristics. Furthermore, we combined all three potential diversity characteristics (i.e., race/ethnicity, educational disadvantage, economic disadvantage) into a single variable rather than creating distinct groups for all possibilities. This created three groups for comparison (zero, one, or two/three diversity characteristics) rather than the maximum possible eight groups if each potential combination of diversity characteristics were studied individually. Third, our conclusions regarding personal attributes are specific to how these constructs were measured in this study, including use of some instruments that asked how the respondent felt in the “past 7 days.” Use of different surveys of anxiety, positive affect, etc. may result in disparate findings. Another limitation is that all demographic data was voluntary reported by students through the PTCAS system during the application process. Applicants’ perceived safety and comfort in disclosing aspects of their identity may have altered their reporting of these

factors. Finally, participants are DPT students who have already been admitted to the program. While many personal characteristic differences among people with unique sociodemographic characteristics persist across populations (e.g., anxiety frequently found to be higher in females no matter the setting), this may not be the case for admitted versus non-admitted students. Admitted students may be inherently different from students who were not admitted, impacting the generalizability of the findings for making admission decisions.

Future research into personal attribute differences among unique DPT student populations should involve multiple institutions and larger samples to examine the intersectionality of each diversity characteristic and demographic factors. Additionally, it would be informative to know if the differences in self-efficacy and resilience seen between more and less diverse students are related to a particular URM category or some combination therein. Finally, future studies that determine the predictive validity of various personal attributes for academic and clinical performance will bolster the value of their inclusion or exclusion from holistic admissions.

## Conclusions

Creating evidence-informed approaches for holistic admissions requires data to inform how admissions criteria should be evaluated and applied. Ideally, PT program admission standards should be thoughtfully designed with well-articulated goals and evaluation of potential bias in their selected factors. In this sample, admitted URM DPT students and males reported higher ratings of self-efficacy and resilience while female respondents reported higher levels of anxiety. There were no differences in grit, perceived stress, and positive affect between any student groups. These findings provide direction for future research to determine if these personal factors differ among admitted and unadmitted students and how they are related to academic performance for admitted students.

## Abbreviations

AAMC	American Association of Medical Colleges
APTA	American Physical Therapy Association
ACAPT	American Council of Academic Physical Therapy
URM	Underrepresented minorities
PT	Physical therapist
E-A-M	Experiences, Attributes, Metrics
GRE	Graduate Record Examination
HEALTH	Health Equity through Alignment, Leadership and Transformation of the Health Workforce
DPT	Doctor of Physical Therapy
PTCAS	Physical Therapy Centralized Application Service
PSS-10	Perceived Stress Scale
BRS	Brief Resilience Scale

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-024-06007-8>.

Supplementary Material 1.

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None.

## Authors' contributions

KR and MH conceived of the study with further input and refinement of the study design by SG and KH. KR and MH developed the data capture tools. KR performed the initial data analysis and SG, MH, and KH contributed to interpretation of results. KR led the writing of the manuscript. All authors provided critical feedback and helped shape the research, data interpretation, and manuscript.

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## Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to potential for individual participant identification via specific sociodemographic characteristics in the context of the research setting but are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

This study was approved by the Institutional Review Boards at Duke University (Pro00106069) and Rocky Mountain University of Health Professions (Pro2022-164). Potential participants were informed of the study via an in-class announcement and email invitation explaining the study purpose, data to be collected, and that participation was voluntary. For those that chose to participate, informed consent was obtained prior to any data collection.

### Consent for publication

N/a.

### Competing interests

The authors declare no competing interests.

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