
ORIGINAL ARTICLE

Grit and chiropractic students' academic performance: a cross-sectional study

Elina A. Pulkkinen, MChiro and Pablo Perez de la Ossa, PhD

Objective: Previous investigations have studied the relationship between grit and academic performance, and it has been reported that grittier students perform better academically. The objectives of this study are to measure chiropractic students' grittiness and to explore the correlation between grit and academic performance.

Methods: We distributed the Short Grit Scale (Grit-S) questionnaire to chiropractic students in electronic form. We included questions about their previous grade point average and the number of times they had retaken examinations. We scored the overall Grit-S scale and the Consistency of Interest and Perseverance of Effort subscales. A 2-tailed *t* test and 1-way analysis of variance were used to determine differences between groups.

Results: The response rate was 87% ($n = 110$). The mean grit score (3.44 ± 0.60) was similar to the general population and slightly lower than other healthcare professionals. The students who had a grade point average between <80% but less than 90% obtained significantly higher grit scores compared to those who had a grade point average <60% but less than 70%. Similarly, students who had no examination retakes had higher grit scores compared to those who took 4 or more exam retakes. We observed these differences in the overall and subscales scores. No other group showed any difference.

Conclusion: The results of this research showed that the grittier students performed better academically than the less gritty students. Grit scores can potentially be used to identify the students at risk of failing or dropping out. The role and potential application of grit in chiropractic education, student support, and admission procedures should be further evaluated.

Key Indexing Terms: Chiropractic; Health Occupations Students; Academic Performance; Personality; Personal Autonomy.

J Chiropr Educ 2021;35(1):124–130 DOI 10.7899/JCE-19-8

INTRODUCTION

The observation that some students perform better academically than others of equal intelligence is of considerable interest to researchers. Different traits, such as extraversion and self-confidence, have been suggested as possible explanations.¹ Previous investigations have studied the relationship between grit and academic performance, and it has been reported that grittier students perform better academically.² Grit has been defined as "Perseverance and passion for long-term goals," which involves long-term stamina to work toward goals and the ability to maintain effort when faced with setbacks.² It has also been shown that grit predicts life success, such as job retention and graduating from high school.³ One study did not find a correlation between grit and academic performance but rather found that the students who were grittier and had better academic performance were more likely to pursue postgraduate training.⁴ Grit is one narrow aspect of conscientiousness that is composed of several facets, such as

discipline and self-control.^{1,5} What distinguishes grit from other facets of conscientiousness is the extreme stamina regarding a particular interest and effort toward this interest.³ A recent study found that the dorsomedial prefrontal cortex mediates the relationship between grit and academic performance, while another explained the etiology of grit on the basis of nonshared environmental and genetic factors.^{6,7}

The literature on chiropractic students' academic performance and the factors contributing to it are scarce. To our knowledge, the grit of chiropractic students has not previously been studied. It is important to know whether grit plays a role in explaining why some students succeed and others fail in their studies. The objectives of this study were to measure chiropractic students' grit at the Barcelona College of Chiropractic (BCC), its correlation with academic performance, and to explore its possible applications.

METHODS

This was a cross-sectional study based on a self-administered electronic survey. The study was reviewed and approved by the BCC Ethics Committee prior to its commencement.

We prepared a 12-item questionnaire. This questionnaire includes demographic questions (sex, age, previous studies, and current academic year) followed by the 8 questions of the Short Grit Scale (Grit-S). Grit-S was developed and validated in 2009 by Duckworth and Quinn⁸ to measure trait-level perseverance and passion for long-term goals. It is based on the original Grit Scale, but it has 4 fewer items and better psychometric properties.¹ An 8-item Grit-S retains the structure of the original scale with 2 subscales, Perseverance of Effort and Consistency of Effort. The Grit-S uses a 5-point Likert scale, with 5 being “extremely gritty” and 1 “not at all gritty.” Four of the items are reversed, 2 for each subscale.⁸ We prepared the questionnaire in a bilingual form. We used the original English version of Grit-S, but we annexed the translated and validated Spanish version of Grit-S.⁹

A pilot test was conducted on 6 students, 4 of whom expressed concerns about responding to the questionnaire. We opted to remove any identification and asked students to self-report their final grade point average (GPA) from the previous academic year in percentage using 10% bands. We included the “still pending” option for those students who had failed a module from the previous year. Self-reporting is used widely in studies about academic performance. In a meta-analysis of 37 independent samples, the authors described a high correlation between actual and self-reported GPA. The accuracy of self-reported GPA is lower in cases of students with the lowest grades who could obtain some gain from misrepresenting their grades.¹⁰ In our study, no personal data were collected so students could not get any benefit from misrepresenting their academic results. In addition, students were asked to report the total number of examinations they had retaken (ie, resits) during their studies at the BCC.

We distributed the Grit-S questionnaire in electronic form using Google Forms (Google Inc, Mountain View, CA). We included all students enrolled in the BCC and 1st-year graduates ($n = 126$). The study was presented in class, and an email was sent to all participants that included the objectives of the study and the link to the questionnaire. Participants were informed that the participation was voluntary and that all responses were anonymous. No personal data were collected. Two reminders were sent by email in the following weeks. Return of the questionnaire implied consent from the participant.

The minimum sample size was determined to be 71 participants. The sample size was calculated using G*Power V3.1.9.2 software (Universität Düsseldorf, Düsseldorf, Germany) comparing the general population⁸ and students' values previously published^{2,4} for a sample equally distributed among demographic groups, with and $\alpha = 0.05$, $\beta = 0.05$, and power = 0.95.

We scored the overall Grit-S scale and the Consistency of Interest and Perseverance of Effort subscales according to the authors' instructions.⁸ The statistical analysis was carried out using SPSS v.23 software (IBM Corp, Armonk, NY). To establish the reliability of the overall scores, we measured the coherence of each group of items by its internal consistency (Cronbach's α). Corrected item total correlations (r_{it}) were calculated to assess the contribution of each individual item to the valuation of the competency field as a whole.

Before group comparisons, all distributions were inspected by calculating the skewness and kurtosis. None of the distributions deviated significantly from normality. Uniformity of variance was determined using Levene's test. No significant differences were found, and parametric tests were deemed to be justified. A 2-tailed t -test was used to determine differences by gender. One-way analysis of variance (ANOVA) was used to determine differences among age groups, cohorts, previous studies, number of resits, and previous year's GPA. In the last case, we did not consider students with a GPA below 50% or “still pending,” as there was only 1 respondent in each group (Table 1). The difference among the groups was determined using a post-hoc Bonferroni test.

We calculated the correlation between GPA and number of resits and the scores obtained in the Grit-S questionnaire and its subscales. Self-reported GPA was expressed in bands of 10%. Number of resits were expressed as a discrete variable. Both were considered ranked variables and Spearman's rank correlation was used to calculate this correlation. Spearman ρ and p values were calculated for all cases.

RESULTS

The response rate for the survey was 87% (110/126). The characteristics of the participants are shown in Table 1. The survey had responses from all 5 cohorts included in the study. The mean age of the participants was 27.1 ± 6.84 , 54.5% of the participants were female, and 59.1% had high school as their highest level of education prior to entering the chiropractic program.

The overall results of the questionnaire are shown in Table 2. The mean grit score of the whole sample was 3.44 ± 0.60 . Consistency of interest scale showed a slightly lower value (3.14 ± 0.80). The Grit-S questionnaire showed good internal consistency (Cronbach's $\alpha = 0.703$). However, the Perseverance of Effort subscale showed a value below 0.7. The correlation analysis of the different items showed that question 2 (“Setbacks don't discourage me”) had a lower correlation value (r_{it}) compared to other items.

The detailed results of the Grit-S scale and Consistency of Interest and Perseverance of Effort subscales for sex, age groups, cohort, and previous studies are shown in Table 3. Females had higher grit scores than males (3.52 ± 0.62 and 3.34 ± 0.57 , respectively). All groups scored higher in the Perseverance of Effort subscale than in the Consistency of Interest subscale. However, none of the differences observed showed any statistical significance.

Table 1 - Participant Characteristics

	<i>n</i>	%
Gender		
Female	60	54.5
Male	50	45.5
Age		
<25	54	49.1
≥25–29	21	19.1
≥30	35	31.8
Cohort		
2	24	21.8
3	20	18.2
4	24	21.8
5	29	26.4
1st year graduate	13	11.8
Previous highest level of education		
High school	65	59.1
Bachelor	30	27.3
Master	7	6.4
PhD	1	0.9
Other	7	6.4
<i>N</i> of resit exams		
0	54	49.1
1	17	15.5
2	10	9.1
3	8	7.3
>3	21	19.1
GPA		
100–90	4	3.6
89–80	30	27.3
79–70	51	46.4
69–60	18	16.4
59–50	5	4.5
>50	1	0.9
Still pending	1	0.9

The comparison between Grit-S score and the number of resits is shown in Table 4. The Grit-S score showed a significant difference between students who had taken 0 and 4 resits. This result was reproduced when we considered the Perseverance of Efforts subscale, but not

with the Consistency of Interest. In all 3 cases, Spearman ρ coefficient showed a weak correlation between grit and the number of resits.

When we compared the 3 scores in relation to the GPA scores, we found significant differences in the Grit-S scale and both subscales (Table 5). In all 3 scores, the score obtained by those students with a GPA in the 80% and 90% bands was always significantly higher than the score obtained by those students with a GPA in the 60% band. Moreover, the Spearman ρ coefficient showed a moderate correlation between GPA and Grit-S scale and Perseverance of Effort subscale.

DISCUSSION

The present study aimed to investigate the relationship between chiropractic students' academic performance and grit. The results of this research showed that there is a moderate correlation between GPA and Grit scores; the grittier students performed better academically than did the less gritty students. The students who obtained a GPA in the 80% and 90% bands obtained significantly higher grit scores compared to those who obtained a GPA in the 60% band. Similarly, the students who had no resits had higher grit scores compared to those who had 4 or more resits. None of the other variables studied showed any significant contribution to the students' academic performance.

Traditionally, academic achievement has been typically associated with intelligence. Some authors have concluded that personality has no real significance in educational settings. More recently, several authors have described a relationship between personality traits and academic performance. For instance, in a longitudinal study, Chamorro-Premuzic et al¹¹ described a direct correlation between conscientiousness and high academic performance, whereas neuroticism may impair it, as seen from 2 university samples. Working with e-learners, Siddiquei et al¹² not only described similar results, but they also expanded the positive correlation to include openness and agreeableness traits.

Table 2 - General Results of the Grit-S Questionnaire: Means and Standard Deviations for Overall Results and Individual Items

	Avg ± SD	α	r_{it}
Grit-S	3.44 ± 0.60	.703	
Consistency of interest	3.14 ± 0.80	.711	
1. New ideas and projects sometimes distract me from previous ones.	2.72 ± 0.93		.424
3. I have been obsessed with a certain idea or project for a short time but later lost interest.	3.27 ± 1.12		.488
5. I often set a goal but later choose to pursue a different one.	3.38 ± 1.08		.524
6. I have difficulty maintaining my focus on projects that take more than a few months to complete.	3.19 ± 1.23		.565
Perseverance of effort	3.74 ± 0.71	.668	
2. Setbacks don't discourage me.	3.22 ± 1.10		.150
4. I am a hard worker.	3.92 ± 1.02		.495
7. I finish whatever I begin.	3.82 ± 0.96		.599
8. I am diligent.	4.00 ± 0.90		.653

α , Cronbach's coefficient α ; r_{it} , correlation of an item with scores of the 3 other items in each subscale.

Table 3 - Results of the Grit S Scale and Consistency of Interest and Perseverance of Effort Subscales and GPA and Number of Resits for Sex, Age, Cohort, or Studies Groups

	Grit-S	Consistency of Interest	Perseverance of Effort	GPA	Resits
Gender^a					
Female	3.52 ± 0.62	3.25 ± 0.83	3.79 ± 0.73	71.33 ± 10.16	1.15 ± 0.7270
Male	3.34 ± 0.56	3.01 ± 0.75	3.67 ± 0.68	69.20 ± 8.90	1.52 ± 0.8586
<i>p</i>	.1080	.1056	.2350	.2315	.3154
Age^b					
<25	3.41 ± 0.64	3.17 ± 0.76	3.66 ± 0.79	70.19 ± 7.40	1.22 ± 0.78
25– 29	3.37 ± 0.70	2.98 ± 1.02	3.76 ± 0.70	66.19 ± 12.84	1.62 ± 0.83
≥30	3.52 ± 0.47	3.20 ± 0.74	3.84 ± 0.56	73.14 ± 9.93	1.29 ± 0.80
<i>p</i>	.5919	.5731	.8110	.1612	.5425
Previous studies^b					
High School	3.50 ± 0.58	3.19 ± 0.76	3.80 ± 0.69	70.00 ± 9.52	1.34 ± 0.81
Bachelor	3.35 ± 0.53	3.06 ± 0.81	3.64 ± 0.66	70.33 ± 8.90	1.63 ± 0.83
Master/PhD	3.63 ± 0.40	3.28 ± 0.84	3.97 ± 0.56	77.50 ± 7.07	0.38 ± 0.26
Other	3.07 ± 1.02	2.89 ± 1.21	3.25 ± 1.06	65.71 ± 13.97	0.86 ± 0.73
<i>p</i>	.1977	.6978	.2618	.1225	.2581
Cohort^b					
Year 2	3.21 ± 0.64	2.88 ± 0.85	3.54 ± 0.70	67.92 ± 10.62	1.08 ± 0.81
Year 3	3.55 ± 0.60	3.36 ± 0.83	3.74 ± 0.68	70.50 ± 9.45	0.80 ± 0.66
Year 4	3.40 ± 0.67	3.22 ± 0.72	3.58 ± 0.88	66.67 ± 10.07	1.79 ± 0.83
Year 5	3.53 ± 0.48	3.10 ± 0.82	3.97 ± 0.48	73.10 ± 8.06	1.48 ± 0.79
Graduates	3.55 ± 0.58	3.23 ± 0.77	3.87 ± 0.75	75.38 ± 7.76	1.31 ± 0.85
<i>p</i>	.2263	.3338	.1687	.0163	.2396

^a Groups were compared using *t* test.^b Groups were compared using ANOVA.**Table 4 - Results of Grit-S and Subscales Classified According to the Number of Resits**

No. of Resits	Grit-S	Consistency of Interest	Perseverance of Effort
0	3.63 ± 0.52*	3.36 ± 0.71	3.91 ± 0.63*
1	3.35 ± 0.50	3.07 ± 0.97	3.62 ± 0.58
2	3.35 ± 0.62	3.08 ± 0.74	3.63 ± 0.66
3	3.34 ± 0.35	2.81 ± 0.61	3.88 ± 0.86
4 or more	3.09 ± 0.76	2.80 ± 0.87	3.38 ± 0.84
Spearman correlation			
rho (<i>p</i>)	-.328	-.287	-.234
<i>p</i>	<.001	.002	.014
ANOVA			
Sums of squares	4.927	5.968	4.837
<i>df</i>	4, 103	4, 103	4, 103
Mean square	1.232	1.492	1.209
<i>F</i>	3.797	2.434	2.557
<i>p</i>	.006	.052	.043

All results are presented as the average ± standard deviation. Degrees of freedom (*df*) are present as between groups/within groups. ANOVA-Bonferroni (*p* < 0.05) are indicated as follows:

* vs 4 or more resits.

Table 5 - Results of Grit-S and Subscales Classified According to Their GPA Bands

GPA Bands	Grit-S	Consistency of Interest	Perseverance of Effort
50–59	3.18 ± 0.83	3.15 ± 0.88	3.2 ± 0.94**
60–69	2.95 ± 0.75*, **	2.57 ± 0.95**	3.33 ± 0.92**
70–79	3.39 ± 0.47**	3.11 ± 0.74	3.67 ± 0.58**
80–100	3.81 ± 0.43	3.5 ± 0.59	4.12 ± 0.51
Spearman correlation			
rho (<i>p</i>)	.480	0.317	.381
<i>p</i>	<.01	<.01	<.01
ANOVA			
Sums of squares	9.398	10.445	9.558
<i>df</i>	4	4	4
Mean square	2.350	2.611	2.389
<i>F</i>	8.337	4.579	5.585
<i>p</i>	<.01	<.01	<.01

All results are presented as the average ± standard deviation. Degrees of freedom (*df*) are presented as between groups/within groups. ANOVA-Bonferroni (*p* < 0.05) are indicated as follows:

* vs 70–79.

** vs 80–100.

Some studies have explored the relationship between academic performance and grit. When validating the Grit-S questionnaire, the authors in 1 study explored grit in 279 high school students. They found a positive correlation between grit and GPA and a negative correlation between grit and the hours spent watching television.⁸ Moreover, the same authors described that grit could be a better predictor of academic success than IQ in adolescents.¹³

To our knowledge, this is the first study describing the Grit score of chiropractic students. We also studied the relationship between the grittiness of the students and their academic performance, both with their GPA and the number of resits. When we compared the Grit-S score of those students who failed 0 to 3 exams, there were no significant differences. However, our results show a significant difference between those students who failed no exam and those who had to take 4 or more resits. Students who fail a small number of exams at the end of the regular academic year are usually capable of passing the failed exams during the resit period after the summer break. This result suggests that Grit-S scores may not be useful to predict the number of failed examinations but may discriminate between students who are passing all or most of their exams and those who are at risk of failing such a number of exams that they may compromise their progression into the next academic course.

The result of the comparison between GPA and Grit-S scores gives a more defined picture. Students who obtained a GPA in the 60% band showed a significant difference compared with other students who obtained higher marks. In addition, Spearman's ρ showed a moderate positive correlation (0.500). Students who obtained a GPA in the 60% band may be passing most of their assessments but failing some of them, whereas students in the 80% or 90% bands are usually passing all of their exams. These results suggest that Grit-S may be useful for differentiating students who may perform well from those who are at risk of obtaining lower marks.

A small number of studies have described the grittiness of healthcare students¹⁴ and professionals. The grit scores of chiropractic students obtained in this study (3.4 ± 0.6) were higher than those of the general population of the same age (3.2 ± 0.7).⁸ Chiropractic students demonstrated lower grit scores compared to other healthcare professionals, such as undergraduate (3.7 ± 0.5)² and graduate pharmacy students (3.8 ± 0.5),⁴ emergency physicians (3.7 ± 0.6),¹⁵ and general surgical residents (3.78 , SD undefined).¹⁶ However, none of these results showed any significant difference compared to scores obtained by chiropractic students. Medical schools usually have the highest admission standards. On the other hand, graduate programs require students who have already shown commitment to achieving a long-term objective. These factors may explain why the Grit-S scores in this group are higher than those of the general population.

Perseverance of Effort and Consistency of Interest Subscales

The Grit-S questionnaire includes 2 subscales for Perseverance of Effort and Consistency of Interest. There

is some debate regarding whether all scales are equally useful to predict academic success. In our study, the students scored better in the Perseverance of Effort than in the Consistency of Interest subscales. This finding is aligned with previous studies.^{2,8} However, when we analyzed the correlation between Grit-S subscale scores and the academic performance, our results did not fully align with either of the previous findings. Our results show a moderate positive correlation between the Perseverance of Efforts score and the GPA. This positive correlation is lower when we analyze the Consistency of Interest score and GPA. In all cases, there was a significant difference between the students who obtained a GPA in the 80% and 90% bands.

In 2007 Duckworth et al¹ found that both subscales predicted success equally well. Pate et al² showed that there was a significant difference in the Consistency of Interest scale between those students who did not fail any exams and those who failed 1 or more exams. In the same study, they found that there was a significant difference between students with a GPA below or above 3.0.² In a recent meta-analysis, Credé¹⁷ found that the Perseverance of Effort subscale exhibited much stronger relationships with all academic performance criteria than did the Consistency of Effort subscale or the overall Grit-S score.

The correlation between Grit-S or its subscales and the number of resits resulted in less clear results. In all cases, we were able to detect a negative correlation between the 3 scores and the number of resits. However, the only significant difference that we found was between those students who did not fail any exams and those who failed 4 or more exams when we analyze Grit-S and Perseverance of Effort scores only. Our results suggest that the global Grit-S scale seems to be the best tool to differentiate students according to their performance. The use of the subscales does not seem to add any additional information.

Gender, Age, Previous Studies, and Cohort

We found that women not only had higher grit scores than did men, but that they also had higher GPAs and fewer resit exams, although the difference was not significant. Our finding is aligned with previous research that found that females tend to perform better academically than males.¹⁸ Some investigations have shown that there is either no gender difference⁸ or females have higher grit scores.^{19,20}

We also analyzed other demographic data in the search for academic performance predictors. There was a significant difference in GPA between students in the 5th cohort and recent graduates compared to students in the 2nd cohort. This fact may be explained because the students with the lowest academic performance were not allowed to progress to later years in the program of study. Also, not surprisingly, students who had finished a master's or doctorate program showed higher GPA grades, as those students were already trained in higher education.

Application of the Grit Scores

Traditionally, college admission procedures have relied heavily on candidates' previous academic success.

Chiropractic programs have international applicants, and each country has its own schooling and grading system, which makes it difficult to compare candidates. It is questionable whether previous academic success alone will predict success in a chiropractic program of studies, so it may be beneficial to investigate candidates' personality traits, such as grit, in a way that can be measured. The addition of Grit-S could be useful in admission procedures as colleges could better plan early academic support programs.²¹

By investigating students' grit scores, it may be possible to identify students who could be at risk of underachieving or dropping out. Once these less gritty students are identified, it may be important to plan effective student support. There is no clear evidence of whether grit can be improved via interventions.¹⁷ Some studies have demonstrated that the mean level of grit increases with age. However, this increase is only significant between groups whose age difference is 20 years or more.^{1,8} Several authors have proposed strategies to develop a growth mind-set that can help students increase their chances of reaching long-term goals by internalizing the motivation to persist.²² These interventions are based on the incremental theory of intelligence, with the belief that intelligence and human attributes can be improved. These interventions aim to target students' beliefs about school and learning.²³⁻²⁵ They have been shown to improve students' academic performance,²⁵ and it has been proposed that they could be most beneficial for underachieving students.²³ However, there is still some controversy over whether grit can be improved by intervention.²⁶

Strengths and Limitations

The questionnaire was well accepted by participants, and the response rate was high (87%), especially considering that it was delivered electronically and involved participants who are not currently involved with the college. Moreover, the Grit-S questionnaire showed good internal consistency (Cronbach's $\alpha = 0.703$). The Consistency of Interest subscale also showed good internal consistency, but the Perseverance of Effort showed a Cronbach's α value slightly below 0.7. We analyzed the correlation of the different items, and question 2 ("Setbacks don't discourage me") showed a low correlation with the rest of the items in the subscale.

This study had a relatively small sample size, although it covered nearly the whole student body of the college and recent graduates. The questionnaire was delivered in its original English form and the validated Spanish translation. The BCC is an international school, with students of more than 20 different nationalities. Only 20% of our students are either Spanish or English native speakers. This may have caused some misunderstanding of the questions, especially in the reversed items. We tried to avoid confusing participants, and we did not assess other personality traits that may contribute to academic success. A recent study identified up to 105 variables that may influence academic achievement.²⁴

This was a retrospective study. Most of the studies in this field are retrospective.¹⁻⁴ Some of the more complex research also includes prospective studies.^{1,3} Grit level is a fairly constant personality trait, and it seems unlikely that the scores could be affected by the retrospective nature of this study. To our knowledge, no previous study has reported any reporting bias for grit scores.

To preserve anonymity, we used self-reported GPAs to maximize the response rate. Our preliminary test suggests that many students would not respond to a nonanonymous questionnaire. The high response rate indicates that we were able to minimize selective response bias. However, the self-reporting GPA and number of resits are prone to reporting bias. Kuncel et al¹⁰ suggest that self-reported GPA should be used with caution. According to the results of their meta-analysis, college students with good grades tend to report GPA accurately, but those with lower marks tend to show an upward bias.¹⁰ We cannot rule out the misrepresentation of lower GPAs in our study, but the questionnaires were anonymous; none of the participants could obtain any benefit, so the bias described by Kuncel¹⁰ should not apply in our study.

CONCLUSION

To our knowledge, this is the first study to explore the relationship between chiropractic students' grit and academic performance. The results of this study showed that the grittier students performed better academically than did the less gritty students. The students with a higher grit score had a better final mark, and they were less likely to fail exams. The other variables studied did not contribute to the students' academic performance. The results presented here suggest that the simple 8-question Grit-S questionnaire may be a useful tool for identifying students who may be at risk of underperforming. This knowledge may be helpful in developing a strategy for supporting less grittier students. These findings support the previous literature on how grittiness correlates with academic performance. We propose that Grit-S might also be used to increase students' self-awareness of their noncognitive strengths and weaknesses.

ACKNOWLEDGMENTS

We thank Zarak Bartley for language review.

FUNDING AND CONFLICTS OF INTEREST

This study received no funding. The authors declare no conflicts of interest.

About the Authors

Elina Pulkkinen is in private practice (Hyve Tampere, Saapastie 2, 33950 Pirkkala, Finland; elina9@gmail.com). Pablo Perez de la Ossa is the head of research at the Barcelona College of Chiropractic (Carrer dels Caponata 15, 08034

Barcelona, Spain; pablo.perez@bcc.edu.eu). Address correspondence to Elina Pulkkinen, Hyve Tampere, Saapastie 2, 33950 Pirkkala, Finland; elina9@gmail.com. This article was received April 10, 2019; revised September 2, 2019, and December 20, 2019; and accepted February 6, 2020.

Author Contributions

Concept development: EAP. Design: EAP. Supervision: PP. Data collection/processing: EAP. Analysis/interpretation: EAP, PP. Literature search: EAP. Writing: EAP. Critical review: PP.

© 2021 Association of Chiropractic Colleges

REFERENCES

1. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol.* 2007;92(6):1087–1101.
2. Pate AN, Payakachat N, Kristopher Harrell T, Pate KA, Caldwell DJ, Franks AM. Measurement of grit and correlation to student pharmacist academic performance. *Am J Pharm Educ.* 2017;81(6):105.
3. Eskreis-Winkler L, Shulman EP, Beal SA, Duckworth AL. The grit effect: predicting retention in the military, the workplace, school and marriage. *Front Psychol.* 2014;5:36.
4. Palisoc AJL, Matsumoto RR, Ho J, Perry PJ, Tang TT, Ip EJ. Relationship between grit with academic performance and attainment of postgraduate training in pharmacy students. *Am J Pharm Educ.* 2017;81(4):67.
5. Lucas GM, Gratch J, Cheng L, Marsella S. When the going gets tough: grit predicts costly perseverance. *J Res Pers.* 2015;59:15–22.
6. Wang S, Zhou M, Chen T, et al. Grit and the brain: spontaneous activity of the dorsomedial prefrontal cortex mediates the relationship between the trait grit and academic performance. *Soc Cogn Affect Neurosci.* 2017;12(3):452–460.
7. Rimfeld K, Kovas Y, Dale PS, Plomin R. True grit and genetics: predicting academic achievement from personality. *J Pers Soc Psychol.* 2016;111(5):780–789.
8. Duckworth AL, Quinn PD. Development and validation of the short Grit Scale (Grit-S). *J Pers Assess.* 2009;91(2):166–174.
9. Arco-Tirado JL, Fernández-Martín FD, Hoyle RH. Development and validation of a Spanish version of the Grit-S Scale. *Front Psychol.* 2018;9:96.
10. Kuncel NR, Credé M, Thomas LL. The validity of self-reported grade point averages, class ranks, and test scores: a meta-analysis and review of the literature. *Rev Educ Res.* 2005;75(1):63–82.
11. Chamorro-Premuzic T, Furnham A. Personality predicts academic performance: evidence from two longitudinal university samples. *J Res Pers.* 2003;37(4):319–338.
12. Siddiquei NL, Khalid R. The relationship between personality traits, learning styles and academic performance of e-learners. 2018;10(3):249–263.
13. Duckworth AL, Seligman MEP. Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychol Sci.* 2005;16(12):939–944.
14. Stoffel JM, Cain J. Review of grit and resilience literature within health professions education. *Am J Pharm Educ.* 2018;82(2):124–134.
15. Wong ML, Anderson J, Knorr T, Joseph JW, Sanchez LD. Grit, anxiety, and stress in emergency physicians. *Am J Emerg Med.* 2018;36(6):1036–1039.
16. Burkhart RA, Tholey RM, Guinto D, Yeo CJ, Chojnacki KA. Grit: a marker of residents at risk for attrition? *Surgery.* 2014;155(6):1014–1022.
17. Credé M, Tynan MC, Harms PD. Much ado about grit: a meta-analytic synthesis of the grit literature. *J Pers Soc Psychol.* 2017;113(3):492–511.
18. Voyer D, Voyer SD. Gender differences in scholastic achievement: a meta-analysis. *Psychol Bull.* 2014;140(4):1174–1204.
19. Christensen R, Knezek G. Comparative measures of grit, tenacity and perseverance. *Int J Learn Teach Educ Res.* 2014;8(1):16–30.
20. Bazalais P, Lemay DJ, Doleck T. How does grit impact college students' academic achievement in science? *Eur J Sci Math Educ.* 2016;4(1):33–43.
21. Green BN, Johnson CD, McCarthy K. Predicting academic success in the first year of chiropractic college. *J Manipulative Physiol Ther.* 2003;26(1):40–46.
22. Hochanadel A, Finamore D. Fixed and growth mindset in education and how grit helps students persist in the face of adversity. *J Int Educ Res.* 2015;2015;11(1):47–45.
23. Burnette JL, O'Boyle EH, VanEpps EM, Pollack JM, Finkel EJ. Mind-sets matter: a meta-analytic review of implicit theories and self-regulation. *Psychol Bull.* 2013;139(3):655–701.
24. Schneider M, Preckel F. Variables associated with achievement in higher education: a systematic review of meta-analyses. *Psychol Bull.* 2017;143(6):565–600.
25. Paunesku D, Walton GM, Romero C, Smith EN, Yeager DS, Dweck CS. Mind-set interventions are a scalable treatment for academic underachievement. *Psychol Sci.* 2015;26(6):784–793.
26. Duckworth AL, Quinn PD, Seligman MEP. Positive predictors of teacher effectiveness. *J Posit Psychol.* 2009;4(6):540–547.