Original Article

Evaluation of the psychometric properties of the Short Grit Scale (Grit-S) for Iranian dental students

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Abstract

Background & Objective: Non-cognitive and personality variables, such as grit, have been shown to play an important role in medical science education. In order to facilitate studies in this field, it is necessary to have a reliable and valid instrument. The purpose of this study was to evaluate the factor structure and psychometric properties of the short Grit Scale (Grit-S) for Iranian dental students.

Material & Methods: For this psychometric study, the short Grit-S was administered to a sample of dental students (n = 226) during the first semester of the academic year 2022-2023 at the School of Dentistry of Zanjan University of Medical Sciences. First, the questionnaire was translated, and then the psychometric properties of the Short Grit-S were evaluated. Descriptive statistics and Exploratory Factor Analysis (EFA) were performed using SPSS 26, while Confirmatory Factor Analysis (CFA) was conducted through AMOS 24.

Results: The results of this study provide evidence for the validity and reliability of the Short Grit-S as a measure of grit among Iranian dental students. The internal consistency coefficient (Cronbach's alpha), split-half reliability, and test-retest were 0.80, 0.82, and 0.84, respectively. The Short Grit-S was found to be a valid and reliable instrument with good factorial validity, internal consistency, convergence, and criterion validity. The Short Grit-S was found to be useful for finding out how persistent Iranian dental students were in their efforts (Eigenvalue 3.53; variance explained 50.44) and how interested they were in learning (Eigenvalue 1.16; variance explained 16.55). The two-factor model with 7 items (item 2 was omitted) was found to be the best factor structure for the Persian version of the Short Grit-S.

Conclusion: In conclusion, the study found that the Persian version of the Short Grit-S with 7 items was a reliable and valid instrument for measuring grit among Iranian dental students.

Keywords: students, dental, psychometrics, surveys, questionnaires

Introduction

Studies on education and learning have revealed that five major cognitive and non-cognitive elements, including attention, mental constructs, grit, learning strategies, and social skills, play a significant role in predicting educational success (1). In recent years, there has been a growing recognition of the importance of non-cognitive abilities in promoting learning. Research has shown that non-cognitive abilities, such as grit, are more important than intelligence in achieving success, regardless of an individual's abilities and skills (2). Universities serve as a scientific base for the training of competent human resources, which is the main mission of educational systems worldwide (3). Human resources are a country's most valuable asset and play a crucial role in its cultural, economic, and social development (4). Personal traits such as perseverance and grit are essential for success and require further investigation (5).

Duckworth et al. (6) introduced the grit theory in 2007, which outlines the characteristics of successful individuals and factors that contribute to their success. Grit is defined as the ability to persist in the face of adversity and remain focused and determined to achieve long-term goals. It encompasses a set of skills that enable learners to pursue their long-term aspirations despite

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short-term obstacles, overcome challenges, learn from failures, maintain focus on their goals, and move forward towards achieving them (7, 8).

Grit is composed of two subscales: perseverance of effort and consistency of interest. Perseverance of effort refers to the efforts made towards achieving goals and is measured by the extent to which required tasks have been completed. Consistency of interest, on the other hand, refers to an individual's inclination to pursue their important goals (9). Achievement motivation is another variable that predicts grit (10). It is defined as an individual's motivation to succeed and expect positive outcomes (11). It increases interest and motivation to achieve preset goals and enhances perseverance and commitment (12). According to Duckworth et al. (6), individuals with higher levels of grit tend to achieve higher academic and educational success, and grit is a stronger predictor of success than intelligence. Similarly, Hosseini et al. (12) found that grit was a more effective personality trait than intelligence in academic progress and advancement. Thus, grit is a new educational perspective that calls for further attention from authorities.

Academic optimism is a variable that can predict grit, as education and training are essential components of every individual's life (13). Academic optimism, a new concept defined by Tschannen-Morgan et al. (5), comprises three components: students' sense of identity towards school, students' trust in teachers, and students' perception of safety and identification with school.

The Short Grit Scale (Grit-S) consists of two subscales: perseverance of effort and consistency of interest, each with four items, for a total of eight items. Duckworth et al. (14, 15) have reported that these two subscales have different predictive values and an internal consistency of 0.80 for consistency of interest and 0.71 for perseverance of effort. Although the psychometric properties of the Short Grit-S have been investigated in several countries, such as the US, China, Oman, South Africa, and Spain (16–18), there has been no study on this instrument in Persian-language samples. Given all the above, this study aims to assess the factor structure and psychometric properties of the Short Grit-S for Iranian dental students.

Material & Methods

Design and setting(s)

This psychometric study was carried out in the first semester of the 2022-2023 academic year at the Faculty of dentistry, Zanjan university of medical sciences, Zanjan, Iran. The study focused on psychometrics and aimed to collect data on several psychological factors associated with dental students to gain a better understanding of their academic experience.

Participants and sampling

The statistical population for this study was comprised of all dental students who were enrolled in the Faculty of Dentistry, Zanjan University of Medical Sciences, between September 2022 and June 2023 (N = 226; girls = 110; mage = 22.70, SD = 0.92). The sampling period spanned over six months, and the method of sampling used was a census, with tools implemented for all students. Prior to participation, all subjects signed a written consent form. The study utilized various measures, including Short Grit-S, Academic Resilience Scale-6 (ARS-6), Work and Social Adjustment Scale (WSAS), Maslach Burnout Inventory-Student Survey (MBI-SS), Positive and Negative Affect Schedule-NA, and Satisfaction with Life Scale (SWLS).

The study's inclusion criteria consisted of dental students who attended the School of Dentistry at Zanjan University of Medical Sciences in the first semester of the 2022–2023 academic year and expressed a willingness to participate. Exclusion criteria included incomplete questionnaires and instances where students provided different answers to questions with identical content (i.e., random answering).

Tools/Instruments

Short Grit-S: The Short Grit-S scale comprises eight items, with four items representing the CI subscale and four items representing the PE subscale (15). The items are scored on a 5-point Likert scale, with 1 indicating "not at all like me" and 5 indicating "very much like me." Previous studies (16) have demonstrated a two-factor solution and confirmed that Cronbach's coefficients were satisfactory for both Omani and U.S. university students (Cronbach's $\alpha = 0.79$ and 0.76, respectively).

Academic Resilience Scale-6 (ARS-6): The ARS-6 is a brief instrument designed to measure students' overall academic resilience level. For this study, we retained all six items of ARS-6 that were originally developed by Martin and Marsh (2006). Confirming the content aspect of the construct validity by experts and students, we included the six items of ARS in the final study. Students completed the scale on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A higher score on the scale indicated a greater degree of overall academic resilience (19).

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Work and social adjustment scale (WSAS): The WSAS was utilized to evaluate dysfunction and impairment domains in various areas, including work, home management, social and private leisure activities, and relationships with others. The score range of this scale is 0–40 (20). In the study conducted by Mundt et al., the Cronbach's α estimate of internal scale consistency was found to range from 0.70 to 0.94, while the test-retest correlation was 0.73 (20).

Maslach Burnout Inventory-Student Survey (MBI-SS): The MBI-SS contains 15 items that are grouped into three subscales: exhaustion (five items), cynicism (four items), and professional efficacy (six items). All items were scored on a seven-point frequency rating scale ranging from 0 (never) to 6 (always). In an Iranian study, Cronbach's alpha and a two-week test-retest coefficient showed that the MBI-SS was reliable (21).

Positive and Negative Affect Schedule: The Positive and Negative Affect Schedule (PANAS) is a 20-item scale that evaluates an individual's positive and negative trait affect using a 5-point scale. The scale consists of two subscales: Positive Affect (PA) and Negative Affect (NA). The original validation (22) demonstrated two clearly differentiated factors (PA and NA) and good psychometric properties. In the Diaz-Garcia study (23), Cronbach's alpha was excellent for the PANAS-P (α = 0.91) and good for the PANAS-N (α = 0.87). In this study, only the negative affect items were utilized.

Satisfaction with Life Scale (SWLS): The SWLS is a scale that assesses the global cognitive appraisal of satisfaction with one's life. Each item is scored on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The scale scores range from 5 to 35, with higher scores indicating greater life satisfaction (24). The results of the Iranian SWLS demonstrated that a single-factor model provides a good fit to the data. The Cronbach's alpha coefficient for the Iranian SWLS was found to be 0.887 (25).

Data collection methods

To ensure accurate translation, two psychologists fluent in both English and Persian translated the Short Grit-S into Persian. The translated questionnaire was then back-translated into English by a linguist fluent in English to confirm complete agreement between the original English version and the translated Persian version of the scale. After revision and editing, the final Persian version was confirmed (26, 27).

After obtaining written informed consent from the students and assuring them about the confidentiality of their information, the questionnaire was administered anonymously to the participants through an online platform. Mahalanobis distance was used to detect outliers, and the data were then checked for the accuracy of responses. Any items with incomplete or random answers were excluded from the analysis.

To determine the exact number of factors, the parallel analysis and scree plot were used to evaluate the primary factor structure. Geomin rotation was applied for the exploratory factor analysis since it was expected that the Short Grit-S items would have significant correlations with each other. The following criteria were used to assess the items:

(I) The factor loading of items on the main factor had to be > 0.40.

(II) Factor loading on other factors should not exceed 0.30.

(III) Factor stability was confirmed when at least half of the items had a factor loading > 0.60.

These strict criteria were implemented to achieve a strong factor structure. Any items that did not meet the above-mentioned criteria or had low initial communality with other items (< 0.20) were excluded from the questionnaire.

To validate the factor structure obtained in the previous step, a confirmatory factor analysis (principal component analysis) was performed. To assess the multivariate normality of the data, Mardia's coefficients of multivariate skewness and kurtosis were used. Each model was analyzed using the following fit indices (with a 90% confidence interval, if possible):

(I) Chi-square (values should not be significant)

(II) Comparative Fit Index and Tucker-Lewis Index (TLI) (values should be close to 0.95 or higher)

(III) Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) (values should be close to 0.08 or lower) (28).

To evaluate the reliability of the scale, the following three methods were employed:

(I) The internal consistency of the items was estimated using Cronbach's alpha.

(II) The stability of responses over time was analyzed using the test-retest reliability method with a 4-week interval.

(III) Split-half reliability assessment.

In the second step, the validity of the scale was calculated using the convergent validity and divergent validity methods. To assess the convergent validity of the scale, the correlation between the total scale and subscale scores was compared with those of the academic

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resilience scale and the satisfaction with life scale. To assess the divergent validity of the scale, comparisons were made with the Maslach Burnout Inventory-Student Survey, Work and Social Adjustment Scale, and Positive and Negative Affect Schedule.

Data analysis

For descriptive statistics and Exploratory Factor Analysis (EFA), SPSS 26 was used, while AMOS 24 was used for CFA. The sample adequacy was assessed using the Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity. Additionally, each item was compared between males and females to identify any significant systematic differences and to ensure the absence of significant differences.

The level of statistical significance for detecting a systematic difference between males and females was set at $p < 0.01$ and $r^2 > 0.01$.

Results

As indicated in Table 1, the sample comprised an almost equal number of males and females ($p = 0.690$). Significant differences were observed among the participants concerning their living status ($p = 0.000$), marital status ($p = 0.042$), and age groups ($p = 0.000$). Students residing in a dormitory, single students, and those aged between 18 and 25 had a significantly higher frequency.

Table 1. Demographic characteristics of participants

Variable category		Sample Number(%)	χ^2	p-value
		226 (100)		
Gender	Male	116 (51.3)	0.195	0.690
	Female	110 (48.7)		
Living status	Dormitory	110 (48.7)	20.75	0.000
	With family	44 (19.5)		
	Alone	72 (31.8)		
Marital status	Single	191 (84.5)	4.11	0.042
	Married	35 (15.5)		
Age (yrs.)	18-25	177 (78.3)	498.11	0.000
	26-32	36 (15.9)		
	33-39	10 (4.4)		
	40-46	2 (0.8)		
	47 and higher	1 (0.4)		

Note: Chi-square tests were conducted to examine the association between demographic variables and their respective categories.
Abbreviations: Number (%), sample size and percentages; χ^2, Chi-square statistic; p, probability-value.

As presented in Table 2, the mean scores of items were mostly in the range of the terminal third (scores ranging from 1 to 4). The skewness and kurtosis of the items were within the normal range. The corrected coefficients (r) were all high, except for the second item, which displayed a weak correlation. The alpha coefficient increased by 2% when item 2 was excluded.

As mentioned earlier, three methods were used to evaluate the reliability and validity of the Short Grit-S. First, Cronbach's alpha was calculated, yielding a value of 0.80. Next, a split-half reliability assessment was conducted, with a coefficient of 0.82 obtained. Finally, a test-retest reliability assessment was performed, and the coefficient was found to be 0.84.

Table 3 illustrates the convergent and divergent validity of the Short Grit-S. The correlation coefficient of grit with its convergent variables, namely resilience and satisfaction with life, was found to be 0.50 and 0.33, respectively, and both were significant at the 0.001 level. On the other hand, grit exhibited an inverse correlation with divergent variables such as work and social adjustment, negative affect, and burnout. This finding suggests that individuals with higher levels of grit have fewer issues with work and social adjustment, are less likely to experience negative affect, and experience burnout less frequently.

Table 3 also presents the Cronbach's alpha coefficients for all convergent and divergent validity constructs. As demonstrated, all convergent and divergent validity constructs had optimal reliability.

The Kaiser-Meyer-Olkin index was found to be 0.803, indicating the adequacy of the data for factor analysis. Furthermore, Bartlett's Test of Sphericity revealed that the data correlation matrix in the study population was not zero, thus validating the exploration of factors ($X^2 = 668.652$, degree of freedom = 21, $p = 0.000$). The Oblimin rotation was then applied for the principal item analysis.

Values greater than 0.40 were deemed acceptable. Consequently, item 2 was excluded due to its low factor loading (0.059). Additionally, at least 50% of the item loadings had to be greater than 0.60, a criterion that was met in the present study. The pattern coefficients for items 1 to 8, keeping item 2, were found to be 0.53, 0.63, 0.84, 0.67, 0.57, and 0.86, respectively. After rotation, two factors were extracted with values greater than 1 in the scree plot. Factor 1 (perseverance) had an eigenvalue of 3.53 and an explanatory variance of 50.44, while the second factor (interest) had an eigenvalue of 1.16 and an explanatory variance of 16.55. The total explanatory variance was 66.99 for both factors, which was acceptable. Table 4 demonstrates the exploratory factor structure of the Short Grit-S. The correlation between the two extracted factors was 0.342.

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Table 2. Statistics related to each item of the Short Grit Scale (Grit-S)

Item	Mean	Std. deviation	Skewness	Kurtosis	Corrected coefficient	Cronbach's alpha value in case of item omission
New ideas and projects sometimes distract me from previous ones.	2.96	0.91	0.02	0.02	0.28	0.80
Setbacks don't discourage me.	3.11	1.07	-0.08	-0.62	0.16	0.83
I have been obsessed with a certain idea or project for a short time but later lost interest.	3.10	1.08	-0.21	-0.74	0.61	0.75
I am a hard worker.	3.76	0.88	-0.53	-0.02	0.60	0.76
I often set a goal but later choose to pursue a different one.	3.27	1.12	-0.30	-0.77	0.64	0.75
I have difficulty maintaining my focus on projects that take more than a few months to complete.	3.26	1.04	-0.29	-0.41	0.58	0.76
I finish whatever I begin.	3.70	0.87	-0.87	0.74	0.63	0.76
I am diligent.	3.76	0.90	-0.64	0.40	0.60	0.76

Note: Cronbach's alpha value represents the reliability coefficient. Corrected coefficient indicates the Cronbach's alpha value after the removal of each item. Kurtosis and skewness measure the shape of the distribution. Std. deviation represents the standard deviation of responses. Mean signifies the average response to each item.
Abbreviations: Std. deviation, standard deviation.

Table 3. Convergent and divergent validity of the Short Grit Scale (Grit-S)

	Grit	Resilience	Satisfaction with life	Social adjustment	Negative affect	Burnout	Mean	Std. deviation	Cronbach's alpha
Grit	-	0.50	0.33	-0.23	-0.42	-0.55	26.95	5.08	0.80
Resilience		-	0.16*	-0.20	-0.41	-0.46	21.26	4.50	0.84
Satisfaction with life			-	0.10 ^{n}	-0.24	-0.32	16.53	4.09	0.82
Social adjustment				-	0.12	0.16*	14.47	3.58	0.89
Negative affect					-	0.42	23.59	7.29	0.72
Burnout						-	52.26	14.87	0.87

*Indicates 0.05 coefficients, and n indicates non-significant coefficients.
Note: All correlation coefficients are significant at 0.001 level.
Abbreviations: Std. deviation, standard deviation.

Table 4. Exploratory factor structure of the Short Grit Scale (Grit-S)

Item	Content	First factor	Second factor
4	I am a hard worker.	0.92	
7	I finish whatever I begin.	0.58	
8	I am diligent.	0.93	
1	New ideas and projects sometimes distract me from previous ones.		0.77
3	I have been obsessed with a certain idea or project for a short time but later lost interest.		0.68
5	I often set a goal but later choose to pursue a different one.		0.70
6	I have difficulty maintaining my focus on projects that take more than a few months to complete.		0.66
Eigenvalue		3.53	1.16
Percentage of explanatory variance		50.44	16.55

Notes: The loadings indicate the strength of the relationship between each item and its respective factor. Eigenvalue represents the eigenvalue associated with each factor. Percentage of explanatory variance indicates the proportion of variance explained by each factor.

Table 5 shows the within-item correlation matrix for all items in the grit scale. As can be seen, while item 2 exhibited a weak and mostly insignificant correlation with other items, the inter-item correlation coefficients for all other items were mostly weak, moderate, and significant.

During exploratory factor analysis, item 2 had a low eigenvalue and showed weak correlation with both convergent and divergent factors. As a result, two models were tested: one with all scale items, and the other with item 2 omitted and the covariance freed.

According to the primary model, item 2 had a coefficient of less than 0.20 as a principal factor, which was consistent with the results obtained from the exploratory factor analysis. In the presence of item 2 in the analysis, the fit indices of the primary model were somewhat acceptable. However, by omitting item 2, all fit indices increased (Figure 1).

In the final model, the correction index suggested that the covariance of item 7 with items 5 and 6 should be freed by 0.27 and 0.20, respectively. This suggestion was confirmed both statistically and theoretically. By freeing the covariances and omitting item 2, a model with more appropriate fit indices was obtained (Figure 2).

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Table 5. Within-item correlation matrix for the Short Grit Scale (Grit-S)

Item	1	2	3	4	5	6	7	8
1	-	0.05 [n]	0.28	0.11	0.28	0.26	0.23	0.10[$]
2		-	0.06 [n]	0.14[*]	0.11	0.15[*]	0.19[*]	0.10[$]
3			-	0.39	0.62	0.51	0.43	0.42
4				-	0.40	0.35	0.52	0.83
5					-	0.54	0.49	0.40
6						-	0.43	0.37
7							-	0.55
8								-

* Indicates a statistically significant correlation. [$] indicates a non-significant correlation.
Note: All correlation coefficients are significant at 0.001 level.

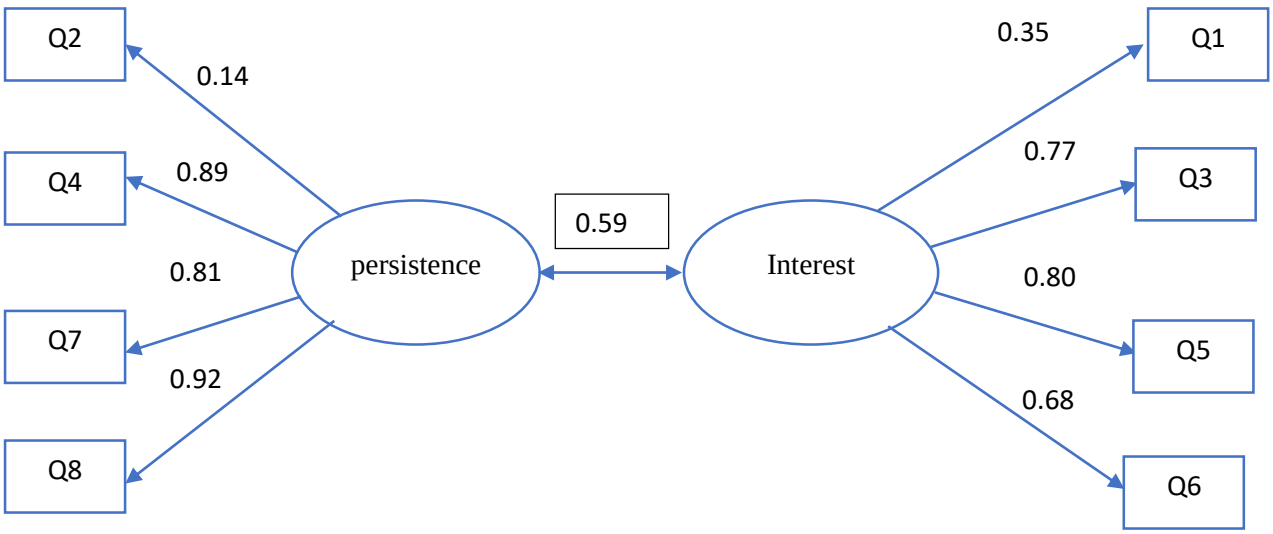

Figure 1. Primary confirmatory factor analysis model for the Short Grit Scale (Grit-S)

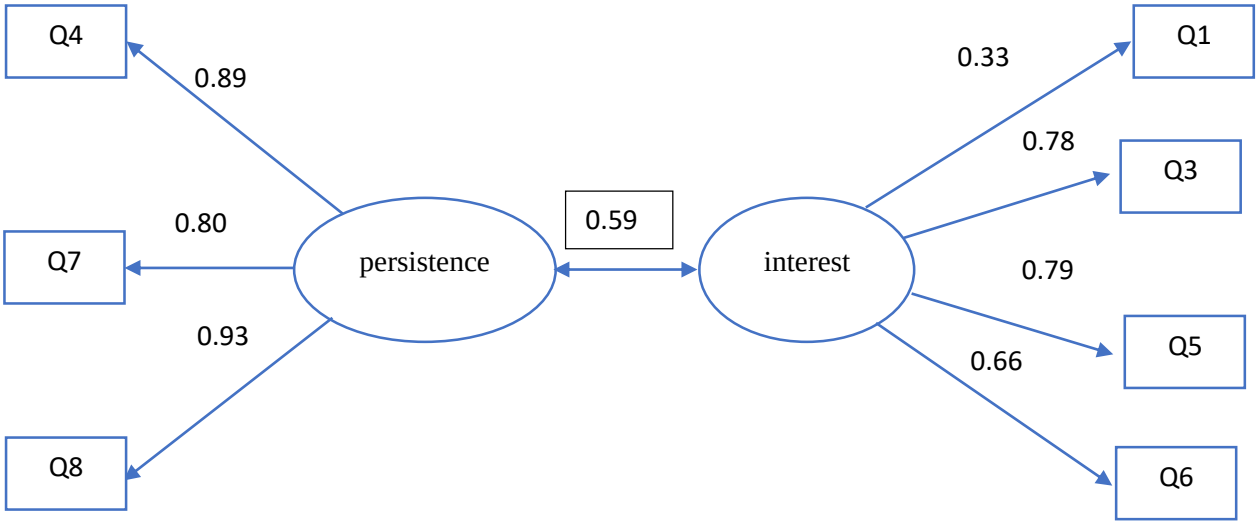

Figure 2. Final confirmatory factor analysis model for the Short Grit Scale (Grit-S)

Each model was assessed using the following fit indices, along with their 90% confidence intervals, if possible:

(I) Chi-square divided by the degree of freedom (values had to be significant and less than 2).

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(II) Goodness of Fit Index
(III) Comparative fit index and TLI (values had to be 0.90 or higher)
(IV) RMSEA (values had to be close to or less than 0.08)
(V) SRMR
These fit indices were used to evaluate the goodness of fit for each model.

The primary model had a Chi-square divided by the degree of freedom of 2.18, while the final model had a value of 1.90. The optimal value for RMSEA is less than 0.05, with values between 0.05 and 0.08 indicating moderate fit. The primary model had an RMSEA value of 0.072, while the final model had a value of 0.063, which was closer to the optimal value.

The optimal SRMR value is less than 0.05, with values closer to 0 being more favorable. The primary model had an SRMR value of 0.061, while the final model had a value of 0.047, indicating that the final model was more favorable. The goodness of fit index should be equal to or higher than 0.90, and the primary model had a goodness of fit index value of 0.955, while the final model had a value of 0.974.

Both the comparative fit index and TLI were used to evaluate the models. A value equal to or higher than 0.90 is considered acceptable for both indices. The primary model had a comparative fit index value of 0.966 and a TLI value of 0.950, while the final model had a comparative fit index value of 0.985 and a TLI value of 0.971. As shown, all values were higher for the final model. Consequently, the final model was determined to be a better fit for the data.

Discussion

The aim of this study was to evaluate the factor structure and psychometric properties of the Short Grit-S for Iranian dental students. The results showed that the Short Grit-S was a reliable and valid instrument for Iranian dental students, with a two-factor structure consisting of perseverance of effort and consistency of interest.

The construct validity of the scale was confirmed by both exploratory and confirmatory factor analyses. Additionally, the reliability of the scale was confirmed through test-retest, Cronbach's alpha, and split-half assessments. The calculated values for Cronbach's alpha, split-half, and test-retest coefficients were 0.80, 0.82, and 0.84, respectively.

Furthermore, the results indicated that the correlation coefficient of grit with its convergent variables, namely resilience and satisfaction with life, was 0.50 and 0.33, respectively. These correlations were significant at the 0.001 level, providing further evidence of the scale's construct validity.

Additionally, the results of this study showed that grit was inversely correlated with divergent variables such as work and social adjustment, negative affect, and burnout. These correlations were found to be high, indicating that the Short Grit-S was both valid and reliable for Iranian dental students.

In a study by Whipple et al., self-reported grit was evaluated in first-year students, and the results showed a positive impact on person-environment fit, which is consistent with the findings of the present study. The authors also reported that grit had a significant positive effect on the grade point average of male students but not female students. However, in the present study, no significant difference was observed between male and female students. Whipple et al. also found that perseverance of effort was more important than consistency of interest, which was also confirmed in the present study (29). Another study by Clark and Malecki (30) evaluated the psychometric properties of the grit scale for 6th to 8th grade students.

Clark and Malecki (30) found that the grit scale for 6th to 8th-grade students had a one-factor structure according to their exploratory and confirmatory factor analyses, which is in contrast to the two-factor structure found in the present study. Nevertheless, their study demonstrated high internal consistency and construct validity of the scale, which is similar to the present findings.

In another study by Verner-Filion et al. (31), only the perseverance of effort subscale of the grit scale was found to have a positive correlation with long-term progress in personal goals, changes in psychological well-being, and depression symptoms during an academic semester. In contrast, no significant difference was observed between the two subscales in the present study.

Duckworth et al. (7) showed that the 8-item grit scale was efficient, and the short version had strong psychometric properties. The confirmatory factor analysis confirmed that the short version had a better fit with the data. Furthermore, factor analysis supported its two-factor structure and showed that the two factors were independent and had adequate internal consistency, which is consistent with the findings of the present study.

A study by Kannangara et al. (32) found that females had significantly higher levels of grit than males; however, this was not observed in the present study. Interestingly, both studies found that students with higher levels of grit

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were more likely to show lower levels of perceived stress, which suggests that grit may provide a protective factor against stress.

In a study by Luo et al. (33), it was demonstrated that the Short Grit-S had good longitudinal stability over time. Additionally, the results showed that grit scores had acceptable and satisfactory internal consistency, which is consistent with the findings of the present study.

Another study by Vela et al. (34) described a two-factor structure for the Short Grit-S and showed optimal fit of the modified two-factor model. The final two-factor model with seven items was found to have good psychometric properties. These findings are consistent with the present study, which also found a two-factor structure for the Short Grit-S with good psychometric properties.

Tan et al. (35) conducted exploratory and confirmatory factor analyses for the Short Grit-S among college students in Malaysia. The exploratory factor analysis revealed two factors, and item 2 of the perseverance of effort subscale was omitted due to poor factor loading, which is similar to the present study.

Further analysis of the remaining 7 items supported the two-factor model, and the confirmatory factor analysis showed the superiority of the 2-factor model with 7 items. Additionally, the perseverance of effort and consistency of interest scores showed acceptable internal consistency, which is consistent with the findings of the present study. Overall, the results of Tan et al. (35) are similar to the present findings and support the validity and reliability of the Short Grit-S in various populations.

In summary, the present study found that the Short Grit-S with a two-factor structure and seven items had good psychometric properties in dental students, and its two-factor structure was confirmed following the omission of item 2. This omission may be due to cultural differences and variations in personal interpretation of items regarding perseverance and effort for long-term goals. Additionally, the hopefulness construct may not be the same as the grit construct for Iranian dental students, and cultural and linguistic differences can also affect the respondents' perceptions of the questions. Therefore, researchers using the grit scale should ensure that the respondents fully understand the concepts.

The present study has some limitations, including the small sample size due to the small statistical population, and the findings may only be generalized to student populations. Future studies with larger sample sizes are required to obtain more precise results, and further studies are also needed on item 2. Despite these limitations, the present study provides valuable insights into the psychometric properties of the Short Grit-S among Iranian dental students and adds to the growing body of literature on grit and its role in academic success.

Conclusion

In conclusion, the present study found that the Persian version of the Short Grit-S with 7 items was suitable for Iranian dental students. These findings provide a basis for conducting further studies in the field of grit and the educational and psychological structures related to it in Iran.

Ethical considerations

Ethical considerations were taken into account in the present study, which was extracted from a thesis approved by the Zanjan University of Medical Sciences (Ethics Code: IR.ZUMS.REC.1401.185).

Artificial intelligence utilization for article writing

No artificial intelligence was utilized in this study.

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Conflict of interest statement

The authors have no conflict of interest or financial support to disclose.

Author contributions

In terms of author contributions, S.J. was responsible for data collection, data analysis, and interpretation of the results. O.S. contributed to the study idea or design, manuscript review, editing, and interpretation of the results. K.M. contributed to the data analysis and interpretation of the results. A.N. contributed to the study idea, manuscript preparation, review, and editing.

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Data availability statement

The data that supports the findings of this study is available upon request from the corresponding author.

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