Psychometric Properties of the Grit-S in Chinese Nurses

Changjiu He¹, Dongmei Wu*¹, Lu Yang², Lei Yang³ and Yuchuan Yue*¹

¹The Clinical Hospital of Chengdu Brain Science Institute, MOE Key Laboratory for Neuroinformation, University of Electronic Science and Technology of China, Chengdu, China, ²Department of Nursing, The Sixth People's Hospital of Chengdu, Chengdu, China, ³School of Nursing, Chengdu Medical College, Chengdu, China

Grit, as a positive psychological trait, could affect the stability of nursing workforce and nurses’ physical and mental health continuously. The Short Grit Scale (Grit-S) with fewer items than the original Grit Scale was widely used to measure individual trait-level grit. However, the psychological properties of Grit-S among Chinese nurses have not been verified. A self-designed sociodemographic questionnaire was used to investigate 709 Chinese nurses in the study, and Grit-S, Big Five Inventory-44, Brief Self-Control Scale, 10-item Connor-Davidson resilience scale, and Task Performance Scale were adopted to collect information of grit, personality, self-control, resilience, and work performance. The confirmatory factor analysis, Pearson correlation analysis, hierarchical regression analysis, and multi-group confirmatory factor analysis were conducted to verify the psychometric properties of the Grit-S. The results demonstrated that the Grit-S had sound validity and reliability among Chinese nurse samples and had good measurement invariance across nurses in general hospitals and psychiatric hospitals. The results of this study provide confidence in using the grit measurement among Chinese nurse in the future.

Keywords: grit, scale validation, psychometric properties, nurses, China

INTRODUCTION

The attention to positive psychology has led to increased interest in its important concepts, and grit is one of them. Individuals with high grit level can maintain their interest and efforts and move forward, regardless of setbacks or difficulties. When exploring why some individuals with similar intelligence quotient are more successful, Duckworth et al. (2007) proposed that trait-level grit may be the key to success and constructed two aspects of grit: maintaining efforts and interest in goals (Duckworth et al., 2007).

Subsequently, the relationship between grit and personal performance or success has been widely studied, covering a wide range of fields, such as education (Christopoulou et al., 2018; Wei et al., 2019), military (Maddi et al., 2012, 2017), management (Schimschal and Lomas, 2019), economy (Dugan et al., 2019), sports (Meyer et al., 2017; Cormier et al., 2019), and so on. These strands of research have verified that grit could positively predict personal achievements.
Moreover, the studies on the relationship between grit and other psychological indicators and healthcare indicators have sprung up over the past few years. Previous studies have found that grit could negatively predict stress, anxiety and depression (Zhang et al., 2018a; Datu et al., 2019; Coleman, 2020), reduce suicidal ideation (Kleiman et al., 2013), and be an important protective factor for adolescent Internet addiction (Borzikowsky and Bernhardt, 2018; Kim et al., 2021). By contrast, grit could positively promote health management skills and health-related quality of life (Traino et al., 2019), improve individual wellbeing (Arya and Lal, 2018; Schimschal et al., 2021) and life satisfaction (Li et al., 2018a).

Considering the two elements of grit: Consistency of interest and perseverance of effort, it is easy to connect it with career and career achievements which are full of challenges, setbacks, difficulties, and require long-term persistence. There is no doubt that healthcare profession, especially nursing, is one of them. Nurses account for more than half of the staff in hospitals (Gutsan et al., 2018) and they are also numerous in the field of primary healthcare (Wolff-Baker and Ordonha, 2019). Women still account for the vast majority of nurses in the world (Gutsan et al., 2018). However, nurses have been facing numerous and complex difficulties, especially in hospitals and psychiatric wards, where nurses often confront the uncertain physiological and psychological needs of various patients, complex interpersonal communication problems, insufficient understanding and support of managers, and heavy workload, as well as individual life responsibilities, family problems, and financial needs, especially in the international context of the current global shortage of nurses' human resources (Zhang et al., 2018b). Therefore, how to reduce nurses’ job burnout and enable nurses to maintain their nursing jobs has become an important proposition around the world.

Studies have shown that grit is a powerful personality trait, which could predict the burnout of healthcare students (Jumat et al., 2020). In the study of nursing staff, it was found that the grit of long-term goals was conducive to long-term work in nursing posts and was negatively correlated with burnout (Seguin, 2019). Moreover, when training the next generation of nursing successors, it is important to consciously cultivate the trait-level grit of nursing students. Previous studies have shown that grit not only helped to improve the adaptability to clinical practice (Baek and Cho, 2020), but also positively predicted the clinical and academic performance of nursing students after controlling for their study years and other demographic factors (Terry and Peck, 2020). In addition, in the field of disaster nursing, the grit of nurses has also been found significant to maintain emergency preparedness, which was also the deep reason for nurses to complete their tasks well in disaster (Tyer-Viola, 2019).

However, the understanding of grit may be different in different cultural backgrounds (Datu et al., 2017; Datu and Mcnerney, 2017). Although the psychometric properties of Short Grit Scale (Grit-S) have been validated among Chinese adolescents (Li et al., 2018b), whether the two-factor structured grit is suitable for Chinese nurses remains to be verified. In addition, compared with nurses in general hospitals, psychiatric nurses have more opportunities to be exposed to psychological-related knowledge and skills training, which may affect their understanding of grit. Therefore, the measurement invariance (MI) across nurses in general hospitals and psychiatric hospitals needs to be studied.

### MATERIALS AND METHODS

#### Participants

Seven hundred and fifty-six nurses who met the criteria were recruited through online advertising and responses from 709 of whom were valid. The response rate was 93.7%. The inclusive criteria were as: (a) registered nurses in the people's Republic of China; (b) at least 1 year working experience in clinical nursing or clinical nursing management; (c) no previous or current diagnosis of mental illness or drug or alcohol dependence; and (d) informed and agreed to participate in the study voluntarily. The exclusion criteria included as: (a) retired nursing staff; (b) nurses on leave during the investigation. The participants gave their informed consent and voluntarily participated in the study. The participants’ characteristics are shown in Table 1.

#### Measures

All tests were conducted in Mandarin Chinese.

### Sociodemographic Characteristics Data

A self-designed questionnaire was used to collect sociodemographic information, including age, gender, marital status, length of nursing work, nursing degree, nursing title, and employed hospitals’ type.

| TABLE 1 | Sociodemographic characteristics description. |
|---------|-----------------------------------------------|
| Nurses (N = 709) | |
| Age, mean years and SD (P25, P50, P75) | 31.74 ± 7.38 (27, 30, 35) |
| Length of nursing work, mean years, and SD (P25, P50, P75) | 10.67 ± 8.12 (5, 8, 14) |
| Gender, % (N) of female | 90.7% (643) |
| Marital status | |
| Unmarried | 27.9% (198) |
| Married | 68.1% (483) |
| Divorced | 3.7% (26) |
| Widowed | 0.3% (2) |
| Nursing degree | |
| Technical secondary school degree | 5.2% (37) |
| College degree | 38.1% (270) |
| Bachelor degree | 56.1% (398) |
| Graduate degree | 0.6% (4) |
| Nurse title | |
| None | 23.0% (163) |
| Primary | 51.6% (386) |
| Intermediate | 24.0% (170) |
| Vice senior | 1.4% (10) |
| Employed hospital | |
| General hospital | 53.3% (378) |
| Psychiatric hospital | 46.7% (331) |

SD, standard deviation; P25, 25 percentile; P50, 50 percentile; and P75, 75 percentile.
Short Grit Scale
The self-report scale, consisting of two subscales (Consistency of Interest and Perseverance of Effort), was developed and validated by Duckworth and Quinn (2009). A total of eight items were included in the scale, using the 5-point Likert scale (from 1 “not like me at all” to 5 “very much like me”). The higher the factor score, the stronger the corresponding factor. The Chinese version of the Grit-S has good reliability and validity (Li et al., 2018a). The Cronbach’s α of the total scale ranged from 0.69 to 0.72 and that of subscales was from 0.58 to 0.71 in the Chinese population (Wang, 2016). The Grit-S was used to assess the grit of all participants in this study and the Cronbach’s α of the total scale and subscales was from 0.68 to 0.75.

Big Five Inventory-44
The BFI is widely used in personality measurement all over the world (John et al., 1991, 2008; Li et al., 2015). It includes five personality domains: extraversion, agreeableness, conscientiousness, neuroticism, and openness, with a total of 44 items (16 reversed items). It is a 5-point Likert scale, and the item answers range from “strongly disagree” to “strongly agree.” The average score is used to evaluate a certain domain. The higher the average score is, the more obvious the personality of the domain is. The BFI has been proved to have acceptable validity in Chinese population with root mean square error approximation (RMSEA)=0.072–0.099; Zhou, 2010), and the internal consistencies for all personality traits were acceptable (from 0.75 to 0.91; Guo et al., 2021). It is widely used to measure the personality characteristics of nurses in China (Xia et al., 2013; Yu et al., 2019). In this study, BFI-44 was used to measure participants’ personality and to test the convergent validity and criterion-related validity of the Grit-S.

 Brief Self-Control Scale
The scale, which is used to assess individual self-control, was developed by Tangney et al. in 2004. The brief version (13 items) had high correlation (r=0.92–0.93) with the total version (36 items). The items were rated on a 5-point scale, with responses ranging from “not at all like me” to “very much like me”(Tangney et al., 2004). The higher the score of Brief Self-Control Scale (BSCS), the stronger the individual self-control. The Cronbach’s α of BSCS was 0.862, and Cronbach’s α of each dimension ranged from 0.606 to 0.761 in Chinese population (Tan and Guo, 2008). In this study, BSCS was used to assess individual self-control and to test the convergent validity and criterion-related validity of the Grit-S.

10-Item Connor-Davidson Resilience Scale
The 10-Item Connor-Davidson Resilience Scale (CD-RISC-10) is a unidimensional dimension scale to measure resilience, which was revised from the CD-RISC (Connor and Davidson, 2003; Campbell-Sills and Stein, 2007). It comprises of 10 items, each rated on a 5-point scale (0–4). The higher the score, the better the individual’s resilience.

The Cronbach’s α was 0.85 and the factor loading was from 0.44 to 0.74 which indicated good reliability and construct validity in the original study (Campbell-Sills and Stein, 2007). The CD-RISC-10 also showed excellent psychometric properties with favorable internal consistency, structure, and criterion-related validity in Chinese samples (Wang et al., 2010; Cheng et al., 2020). And 48.641% of the total variance was explained in the sample of Chinese nurse students, the Cronbach’s α was 0.851 (Ye et al., 2016). In this study, CD-RISC-10 was used to assess individual resilience and to test the convergent validity and criterion-related validity of the Grit-S.

Task Performance Scale
Task Performance Scale (TPS), which measures individual task performance, was from Williams and Anderson (1991) (Bachrach et al., 2007). The seven-point scale has five items (e.g., “adequately completes assigned duties.”), and each response ranges from highly disagree to highly agree. Task performance is represented by the average score. The higher the score, the better the task performance. The Cronbach’s α of the scale was 0.79 in 304 Chinese and American graduate students (Bachrach et al., 2007). In this study, TPS was used to evaluate participants’ task performance and to test the criterion-related validity of the Grit-S.

Procedure
The study was ethically approved by the Ethics Committee of Chengdu fourth Hospital and the registration number of the Chinese Clinical Trial Registry is ChiCTR1900020715. Participants were recruited through online advertising. Before investigation, written informed consents were obtained. All questionnaires were self-rated, and participants filled separately. According to the unified guidelines, the investigators clarified the unclear and ambiguous items proposed by the participants during the field investigation. And 111 nurses completed the retest after 3 months.

Data Analyses
The following data analyses were used to verify the psychometric characteristics of Grit-S in Chinese nurses including structural validity, reliability, convergent validity, criterion-related validity, and measurement invariance across nurses working in general hospital and psychiatric hospital.

Confirmatory factor analysis (CFA) and Chi-square test were used to verify the structural validity of Grit-S. CFA which is widely used to test the hypothetical relationship between ordinal variables (such as Likert-type items; Flora and Curran, 2004) was performed with IBM SPSS AMOS 23.0. In this study, CFA was used to verify the structural validity with maximum likelihood estimation method. Moreover, Chi-square test was used to compare the two models (unidimensional model and two-dimensional model).

The reliability which was analyzed by SPSS 25.0 was shown by internal consistency using Cronbach’s α (Schweizer, 2011) and the test-retest reliability after 3 months. The convergent validity was assessed by two-tailed Pearson correlations between both factors of grit with self-control, resilience, and personality. In order to verify the criterion validity, hierarchical regression
analysis was used to explore the influence of age, gender, length of nursing work, personality, and grit on task performance. In addition, compared with nurses in general hospitals, psychiatric nurses may have different education, training, and work experience, which may affect their understanding of grit. Therefore, it is necessary to test the measurement invariance across general hospital nurses and psychiatric hospital nurses by the multi-group confirmatory factor analysis (MGCFA) which was conducted by lavaan package of R 4.0.5.

RESULTS

Confirmatory Factor Analysis
According to the previous study, the following indices and their criteria were adopted to evaluate the model fitting (Hu and Bentler, 1999), including comparative fit index (CFI) with value greater than 0.95, Tucker-Lewis Index (TLI) with value greater than 0.95, RMSEA with value less than 0.06, and standardized root mean square residual (SRMR) with value less than 0.08. To select the optimal model, two-dimensional model and unidimensional model were compared by chi-square test (see Table 2). And the results supported the former (Figure 1).

Internal Consistency and Test-Retest Reliability
The internal consistency of the scale was evaluated by Cronbach’s α. By calculating Cronbach’s α of all 709 nurse samples, the Cronbach’s α for score of consistency of interest was 0.723, for score of perseverance of effort was 0.682, and for total Grit-S was 0.751. According to the CFA results of this study, the factor load of item 2 was not satisfactory. Cronbach’s α of EFF factor after trying to delete item 2 increased to 0.772 and that of Grit-S also increased to 0.772.

To examine test-retest stability, 111 nurse samples (90 female; M_age = 31.60, SD = 6.603) were retested with Grit-S after 3 months. The score correlation coefficient of consistency of interest before and after was 0.805 and that of perseverance of effort and total Grit-S was 0.702 and 0.885, respectively. All test-retest reliability coefficients were acceptable.

Convergent Validity and Criterion-Related Validity
Table 3 shows the bivariate correlation between the Grit-S factor scores and the scores of self-control, resilience, and personality. The total score of Grit-S and its two factors had a significant positive correlation with self-control and resilience, respectively, and was highly positively correlated with conscientiousness. But in the factor neuroticism of personality, they had a strong negative correlation. These results suggested that the Grit-S was highly correlated with concept-related structure and had acceptable convergent validity.

The results from regressing age, gender, length of nursing work, personality, and grit on task performance are presented in Table 4. In the first step, age, gender, length of nursing work, and personality factors were used as independent variables and task performance as dependent variables for regression analysis. The results showed that length of nursing work (β = 0.258, p = 0.048), agreeableness (β = 0.200, p < 0.001), conscientiousness (β = 0.241, p < 0.001), and openness (β = 0.134, p = 0.001) were related to task performance of nurse. In the second step, when entering two factors of grit (consistency of interest and perseverance of effort) into the model, age (β = −0.294, p = 0.021), length of nursing work (β = 0.305, p = 0.016), agreeableness (β = 0.155, p < 0.001), conscientiousness (β = 0.140, p = 0.002), openness (β = 0.097, p = 0.012), and perseverance of effort (β = 0.261, p < 0.001) were related to task performance of nursing. However, there was no statistical correlation between consistency of interest and task performance in the nurse sample.

Measurement Invariance
Multi-group confirmatory factor analysis was conducted to test the MI across nurses working in different hospitals (general hospital and psychiatric hospital). The comparison of models tested in MGCFA was shown in Table 5. The higher-level test of MI could be executed only after the lower-level test passes (p < 0.05). It passed four tests in turn in this study: configural invariance, metric invariance, scalar invariance, and strict invariance and all values of p were not less than 0.05. The results showed that Grit-S had good measurement invariance among nurses in general hospitals and psychiatric hospitals.

DISCUSSION

The Grit-S was developed from the original Grit Scale (Duckworth et al., 2007; 12-items version) and maintained the same two-factor structure. Compared with the original version, Grit-S has fewer items (eight-items version) and still maintains good reliability and validity, and it is widely used and translated into multilingual versions, such as Polish version (Wyszyńska et al., 2017), Spanish version (Arco-Tirado et al., 2018), and Czech version

| Table 2 | Model indices and comparison of Grit-S. |
|---|---|---|---|---|---|---|---|
| Model | χ² | df | TLI | CFI | RMSEA | SRMR | Δχ²أف | df | TLI | CFI | RMSEA | SRMR | Δχ²أًَأًَأًَأً | df | TLI | CFI | RMSEA | SRMR | Δχ²أًَأًَأًَأً |
| Two-dimensional | 61.132 | 19 | 0.953 | 0.968 | 0.056 | 0.0340 | 298.892*** | 360.024 | 20 | 0.643 | 0.745 | 0.155 | 0.0919 | 360.024 | 20 | 0.643 | 0.745 | 0.155 | 0.0919 | 298.892*** |
| Unidimensional | 360.024 | 20 | 0.643 | 0.745 | 0.155 | 0.0919 | 298.892*** |

df, degree of freedom; TLI, Tucker-Lewis Index; CFI, comparative fit index; RMSEA, root mean square error approximation; and SRMR, standardized root mean square residual.

***p < 0.001 (two tailed).
Li et al. (2018b) translated it into Chinese and evaluated its psychometric properties among Chinese adolescents. Following previous studies, this study expanded the applicable population of Grit-S and verified the validity of construct and the acceptable reliability in the Chinese nurse sample.

The convergent validity and criterion-related validity also were proved, as shown in Tables 3 and 4. It is worth noting that this study found that perseverance of effort was related to task performance in sample of nurses. However, the relationship between consistency of interest and task performance has not been found. The work performance might be more affected by the perseverance of effort facet of grit than the consistency of interest facet. A meta-analysis based on 66,807 participants showed that perseverance of effort could explain the variance in academic performance even after controlling for some variables (Credé et al., 2017). Moreover, good measurement invariance across nurses in general hospitals and psychiatric hospitals was found.

Although the two-dimensional structure (consistency of interest and perseverance of effort) of grit was significant, item 2 (setbacks do not discourage me) was noteworthy because its low standardized factor loading (0.25) on perseverance of effort. In the study of Duckworth and Quinn in 2009, it was found that the standardized factor loading of this item was 0.37, which was not ideal. The same results have appeared in Polish version (standardized factor loading = 0.33; Wyszyńska et al., 2017), Spanish version (standardized factor loading = 0.27; Arco-Tirado et al., 2018), and Chinese version (standardized factor loading = 0.25).

(Schmidt et al., 2021).
TABLE 4 | Hierarchical regression analysis of the impact of age, gender, length of nursing work, personality, and grit on task performance.

|                  | Step 1          |                  | Step 2          |
|------------------|-----------------|-----------------|-----------------|
|                  | β               | t               | p               | β               | t               | p               |
| Age              | −0.238          | −1.824          | 0.069           | −0.294          | −2.317          | 0.021*          |
| Gender           | 0.059           | 1.727           | 0.085           | 0.055           | 1.655           | 0.098           |
| Length of nursing work | 0.258          | 1.984           | 0.048*          | 0.305           | 2.408           | 0.016          |
| Extraversion     | −0.005          | −0.121          | 0.903           | −0.038          | −0.960          | 0.338           |
| Agreeableness    | 0.200           | 4.926           | <0.001***       | 0.155           | 3.861           | <0.001***       |
| Conscientiousness| 0.241           | 5.565           | <0.001***       | 0.140           | 3.099           | 0.002**         |
| Neuroticism      | −0.001          | −0.026          | 0.979           | −0.005          | −0.107          | 0.914           |
| Openness         | 0.134           | 3.448           | 0.001**         | 0.097           | 2.533           | 0.012*          |
| Consistency of interest | 0.020       | 0.515           | 0.607           | 0.261           | 6.267           | <0.001***       |
| Perseverance of effort |          | 0.209           | 0.046           | 23.133***       | 23.905***       |
| R²               |                | 0.209           |                | 0.255           |                |
| ΔR²              |                | 3.6527          | 6              | 0.046           |                |
| F                |                | 23.133***       |                | 23.905***       |                |

*p < 0.05; **p < 0.01; ***p < 0.001 (two tailed).

TABLE 5 | The indices of model fit of Grit-S analyzed by MGCFA.

| Model     | χ²   | df | Δχ²  | Δdf | AIC  | BIC  | p    |
|-----------|------|----|------|-----|------|------|------|
| Configural| 81.240 | 38 | 3.6527 | 6   | 13,033| 13,261| 0.72 |
| Metric    | 84.893 | 44 | 12.7810 | 6   | 13,024| 13,225| 0.05 |
| Scalar    | 97.674 | 50 | 12.8798 | 8   | 13,025| 13,198| 0.68 |
| Strict    | 103.650 | 58 | 13,015| 13,152| 0.72 |

MGCFA, multi-group confirmatory factor analysis; df, degree of freedom; AIC, Akaike information criterion; and BIC, Bayesian information criterion.

loading = 0.34; Li et al., 2018b). This study also found that after removing item 2, the internal consistency of the factor (perseverance of effort) and the total Grit-S were improved, which increased from 0.682 and 0.751 to 0.772, respectively. Item 2 (setbacks do not discourage me) was not ideal in different cultural background. It might be caused by the expression difference. Specifically, the expression of “setbacks do not discourage me” might be inconsistent with daily expression in different cultural backgrounds, or it was not easy to be used by individuals in daily life. Whether item 2 (setbacks do not discourage me) belongs to the concept of grit or how to revise its expression needs further research.

More and more studies showed that grit played an important role in the cultivation of nurses (Halperin and Regev, 2021), the maintenance of nurses’ physical and mental health, the improvement of academic performance (Oducardo, 2021), and the stability of nursing staff (Jeong et al., 2019). Adopting a widely used, simple and effective scale to measure nurses’ grit could not only improve the overall understanding of the concept, but also provide the possibility for the comparison of grit in different occupations. The professional dilemma faced by psychiatric nurses has always been worthy of attention. In addition, they will be exposed to more psychological training than nurses in general hospitals. This contradiction might interfere psychiatric nurses’ understanding of grit, which is also related to measurement accuracy of grit in nurse population. This study verified that Grit-S had excellent measurement invariance in psychiatric nurses and general hospital nurses and suggested that Grit-S could be an appropriate tool to measure the grit among Chinese nurses in the future.

The limitations of this study are as follows. First, the measurement bias comes from the self-report questionnaire, that is, the inaccurate report of participants. Second, the measurement invariance test was conducted only across nurses in psychiatric hospitals and general hospitals. In measuring invariance, more nursing subspecialties should be involved in the future. Finally, the Chinese version of Grit-S used in this study did not undergo the back-translation process.

CONCLUSION

Grit is an essential trait for the challenging profession of nursing. This study demonstrated the Grit-S is a sound scale in measuring grit among Chinese nurses. In addition, through the measurement invariance test, it was suggested that different sub-professional nurses might have the consistent understanding of grit. This study is a fair foundation for the study on nurse grit in the future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.
ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Chengdu Fourth Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CH, DW, and YY were involved in all aspects of the study from design, analysis, interpretation of data, and preparation of the manuscript. LuY and LeY were involved with the interpretation of data and preparation of the manuscript. All authors contributed to the article and approved the submitted version.

REFERENCES

Arco-Tirado, J. L., Fernández-Martín, F. D., and Hoyle, R. H. (2018). Development and validation of a Spanish version of the Grit-S Scale. Front. Psychol. 9:66. doi: 10.3389/fpsyg.2018.00096

Ayra, B., and Lal, D. S. (2018). Grit and sense of coherence as predictors of well-being. Indian J. Posit. Psychol. 9, 169–172. doi: 10.1016/j.cpps.2011.1176

Bachrach, D. G., Wang, H., Bendoly, E., and Zhang, S. (2007). Importance of organizational citizenship behaviour for overall performance evaluation: comparing the role of task interdependence in China and the USA. Manag. Organ. Rev. 3, 255–276. doi: 10.1111/j.1740-8784.2007.00071.x

Baek, K. H., and Cho, M. O. (2020). Effect of grit and resilience on clinical practice adaptation of nursing students. J. Digit. Conveng. 18, 363–371. doi: 10.1080/186.6.363

Borzikowsky, C., and Bernhardt, F. (2018). Lost in virtual gaming worlds: grit and its prognostic value for online game addiction. Am. J. Addict. 27, 433–438. doi: 10.1111/ajad.12762

Campbell-Sills, L., and Stein, M. B. (2007). Psychometric analysis and refinement of the Connor–Davidson Resilience Scale (CD-RISC): validation of a 10-item measure of resilience. J. Trauma. Stress 20, 1019–1028. doi: 10.1002/its.20721

Cheng, C., Dong, D., He, J., Zhong, X., and Yao, S. (2020). Psychometric properties of the 10-item Connor–Davidson Resilience Scale (CD-RISC:10) in Chinese undergraduates and depressive patients. J. Affect. Disorder. 261, 211–220. doi: 10.1016/j.jad.2019.10.018

Christopoulou, M., Lakoti, A., Pezirkianidis, C., Karakasidou, E., and Stalikas, A. (2018). The role of grit in education: a systematic review. Psychology 9, 2951–2971. doi: 10.4236/psych.2018.915171

Coleman, N. (2020). An examination of the correlation between grit and the expressed symptoms of depression and anxiety. dissertation thesis. Chicago: The Chicago School of Professional Psychology.

Connor, K. M., and Davidson, J. R. (2003). Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC). Depress. Anxiety 18, 76–82. doi: 10.1002/da.10113

Cormier, D. L., Dunn, J. G., and Dunn, J. C. (2019). Examining the domain specificity of grit. Pers. Individ. Dif. 139, 349–354. doi: 10.1016/j.paid.2018.11.026

Credé, M., Tynan, M. C., and Harms, P. D. (2017). Much ado about grit: a meta-analytic synthesis of the grit literature. J. Pers. Soc. Psychol. 113, 492–511. doi: 10.1037/pspp0000102

Datu, J. A. D., King, R. B., Valdez, J. P. M., and Eala, M. S. M. (2019). Grit is associated with lower depression via meaning in life among Filipino high school students. Youth Soc. 51, 865–876. doi: 10.1177/004418118760402

Datu, J. A. D., and Mclnerney, D. M. (2017). Does Culture Matter for Grit? Mapping Cross-Cultural Directions in Grit Research Programs. Charlottesville, North Carolina: Information Age Publishing.

Datu, J. A. D., Yuen, M., and Chen, G. (2017). Grit and determination: a review of literature with implications for theory and research. J. Psychol. Couns. Sch. 27, 168–176. doi: 10.1017/jrc.2016.2

Duckworth, A. L., Peterson, C., Matthews, M. D., and Kelly, D. R. (2007). Grit: perseverance and passion for long-term goals. J. Pers. Soc. Psychol. 92:1087. doi: 10.1037/0022-3514.92.6.1087

Duckworth, A. L., and Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT-S). J. Pers. Assess. 91, 166–174. doi: 10.1002/1023890802634290

Dugan, R., Hochstein, B., Rouziou, M., and Britton, B. (2019). Gritting their teeth to close the sale: the positive effect of salesperson grit on job satisfaction and performance. J. Pers. Sell. Sales Manag. 39, 81–101. doi: 10.1080/08853134.2018.1489726

Flora, D. B., and Curran, P. J. (2004). A empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. Psychol. Methods 9, 466–491. doi: 10.1037/1082-989X.9.4.466

Guo, J., Zhang, J., De Fryut, E., and Pang, W. (2021). The bright and dark personality correlates of creative potentials, creative activities, and creative achievements. Curr. Psychol. 1–12. doi: 10.1007/s12414-021-01710-x

Gusman, E., Patton, J., Willis, W. K., and Coustasse, A. (2018). “Burnout syndrome and nurse-to-patient ratio in the workplace.” in Paper Presented at the 54th Annual MBAA Conference; April 18–20; Chicago, IL, April 18–20.

Halperin, O., and Regev, O. E. (2021). Predicting academic success based on perseverance and passion for long-term goals (grit) among nursing students: is there a cultural context? Nurse Educ. Today 100:104844. doi: 10.1016/j.nedt.2021.104844

Hu, L. t., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct. Equ. Model. 6, 1–55. doi: 10.1080/705519090540118

Jeong, J. Y., Seo, Y. S., Choi, J. H., Kim, S. H., Lee, M. S., Hong, S. H., et al. (2019). The influence of grit on turnover intention of university hospital nurses: the mediating effect of job involvement. J. Korean Acad. Nurs. 49, 181–190. doi: 10.4040/jkan.2019.49.2.181

John, O. P., Donahue, E. M., and Kentle, R. L. (1991). The “Big Five Inventory: Versions 4a and 5.” Berkeley, CA: University of California, Institute for Personality and Social Research.

John, O. P., Naumann, L. P., and Soto, C. I. (2008). “Paradigm shift to the integrative big five trait taxonomy: history, measurement, and conceptual issues,” in Handbook of Personality. eds. O. P. John, R. W. Robins and L. A. Pervins (New York: The Guilford Press), 114–158.

Jumat, M. R., Chow, P. K. H., Allen, J. C., Lai, S. H., Hwang, N. C., Iqbal, J., et al. (2020). Grit protects medical students from burnout: a longitudinal study. BMC Med. Educ. 20:266. doi: 10.1186/s12909-020-02187-1

Kim, C., Kwak, K., and Kim, Y. (2021). The relationship between stress and smartphone addiction among adolescents: the mediating effect of grit. Res. Square [Preprint]. doi: 10.21203/rs.3.rs-159399/v1

Kleiman, E. M., Adams, L. M., Kashdan, T. B., and Riskind, J. H. (2013). Gratitude and grit indirectly reduce risk of suicidal ideations by enhancing meaning in life: evidence for a mediated moderation model. J. Res. Pers. 47, 539–546. doi: 10.1016/j.jrp.2013.04.007

Li, J., Fang, M., Wang, W., Sun, G., and Cheng, Z. (2018a). The influence of grit on life satisfaction: self-esteem as a mediator. Psychol. Belg. 58, 51–66. doi: 10.5334/pb.400

Li, H., Xu, J., Chen, J., and Fan, Y. (2015). A reliability meta-analysis for 44 items big five inventory: based on the reliability generalization methodology. Adv. Psychol. Sci. 23:735. doi: 10.3724/SP.J.1042.2015.00755

Li, J., Zhao, Y., Kong, F., Du, S., Yang, S., and Wang, S. (2018b). Psychometric assessment of the Short Grit Scale among Chinese adolescents. J. Psychoeduc. Assess. 36, 291–296. doi: 10.1177/0734282916674858

Maddi, S. R., Matthews, M. D., Kelly, D. R., Villarreal, B. J., Gundersen, K. K., and Savino, S. C. (2017). The continuing role of hardiness and grit on...
performance and retention in west point cadets. Mil. Psychol. 29, 355–358. doi: 10.1037/mil0000145
Maddi, S. R., Matthews, M. D., Kelly, D. R., Villarreal, B., and White, M. (2012). The role of hardness and grit in predicting performance and retention of USMA cadets. Mil. Psychol. 24, 19–28. doi: 10.1080/08995605.2012.639672
Meyer, B. B., Markgraf, K. M., and Gnacinski, S. L. (2017). Examining the merit of grit in women’s soccer: questions of theory, measurement, and application. J. Appl. Sport Psychol. 29, 353–366. doi: 10.1080/10413200.2016.1255277
Oducado, R. M. F. (2021). Academic performance and the role of self-directed learning, self-esteem, and grit among nursing students. SSRN [Preprint]. doi: 10.2139/ssrn.3850519
Schimschal, S. E., and Lomas, T. (2019). Gritty leaders: the impact of grit on positive leadership capacity. Psychol. Rep. 122, 1449–1470. doi: 10.1177/003329411878547
Schimschal, S. E., Visentin, D., Kornhaber, R., and Cleary, M. (2021). Grit: a concept analysis. Issues Ment. Health Nurs. 42, 495–505. doi: 10.1080/01612840.2020.1814913
Schmidt, F. T., Sudzina, F., and Botek, M. (2021). Psychometric assessment of the Short Grit Scale among Czech young adults. J. Psychoeduc. Assess. 39, 508–513. doi: 10.1177/0734282920974817
Schweizer, K. (2011). On the changing role of Cronbach’s α in the evaluation of the quality of a measure. Eur. J. Psychol. Assess. 27, 143–144. doi: 10.1027/1015-5759/a000069
Seguin, C. (2019). A survey of nurse leaders to explore the relationship between grit and measures of success and well-being. J. Nurs. Adm. 49, 125–131. doi: 10.1097/NNA.0000000000000725
Tan, S. H., and Guo, Y. Y. (2008). Revision of self-control scale for Chinese college students. Chin. J. Clin. Psychol. 16, 468–470.
Tangney, J. P., Baumeister, R. F., and Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. J. Pers. 72, 271–324. doi: 10.1111/j.0022-3500.2004.00263.x
Terry, D., and Peck, B. (2020). Academic and clinical performance among nursing students: what’s grit go to do with it? Nurse Educ. Today 88:104371. doi: 10.1016/j.nedt.2020.104371
Traino, K. A., Bakula, D. M., Sharkey, C. M., Roberts, C. M., Ruppe, N. M., Chaney, J. M., et al. (2019). The role of grit in health care professional skills and health-related quality of life in college students with chronic medical conditions. J. Pediatr. Nurs. 46, 72–77. doi: 10.1016/j.pedn.2019.02.035
Tyer-Viola, L. A. (2019). Grit: the essential trait of nurses during a disaster. J. Perinat. Neonatal Nurs. 33, 201–204. doi: 10.1097/JPN.0000000000000416
Wang, D. D. (2016). Validation of the Short Grit Scale among Chinese university students. J. Psychol. Assess. 34, 229–236. doi: 10.3390/jpysyg.2019.01.007
Wang, D. D. (2016). Validation of the Short Grit Scale among Chinese university students. J. Psychol. Assess. 34, 229–236. doi: 10.3390/jpysyg.2019.01.007
Wolff-Baker, D., and Ordona, R. B. (2019). The expanding role of nurse practitioners in home-based primary care: opportunities and challenges. J. Gerontol. Nurs. 45, 9–14. doi: 10.1097/NNA.0000000000000725
Xia, J., Wu, D. X., Zhong, X., and Nye, X. Q. (2013). Reliability and validity of Chinese Big Five Personality Inventory (CBI–PI) among nurses. China J. Health Psychol. 21, 1684–1687. doi: 10.13342/j.cnki.jhpx.2013.11.007
Ye, Z. J., Ruan, X. L., Zeng, Z., Xie, Q., Cheng, M. H., Peng, C. H., et al. (2016). Psychometric properties of 10-item Connor-Davidson Resilience Scale among nursing students. J. Nurs. 23, 9–13. doi: 10.16460/j.issn1008-9969.2016.21.009
Yu, L. Z., Zhang, Y., Jin, Y. Y., and Zhang, L. (2019). The relationship between nurses’ personality characteristics and psychological distress in intensive care: the mediating role of psychological resilience. Zhejiang Med. Educ. 18, 19–22. doi: 10.3969/j.issn.1672-0024.2019.01.007
Zhang, M. X., Mou, N. L., Tong, K. K., and Wu, A. (2018a). Investigation of the effects of purpose in life, grit, gratitude, and school belonging on mental distress among Chinese emerging adults. Int. J. Environ. Res. Public Health 15:2147. doi: 10.3390/ijerph15102147
Zhang, X., Tai, D., Pfoetsch, H., and Lin, V. W. (2018b). United States registered nurse workforce report card and shortage forecast: a revisit. Am. J. Med. Qual. 33, 229–236. doi: 10.1177/1062860617738328
Zhou, J. (2010). Construct validity of Big Five Inventory. Sci. Soc. Psychol. 25, 22–29.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2021 He, Wu, Yang, Yang and Yue. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.